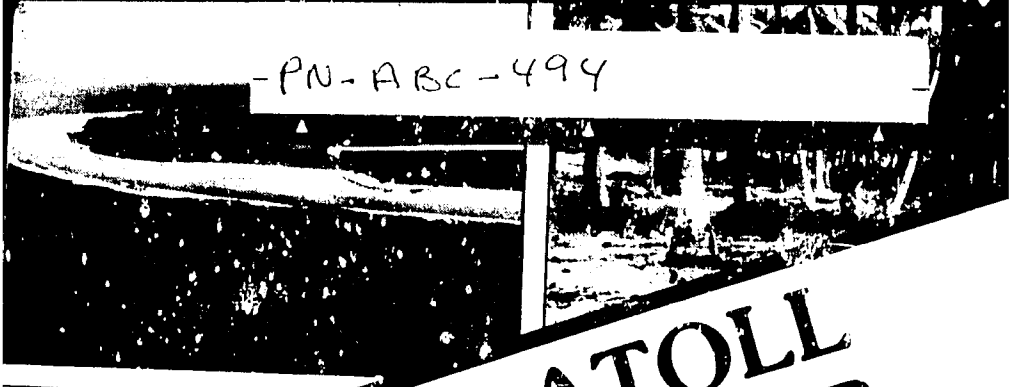

APPLIED ATOLL RESEARCH FOR DEVELOPMENT

Proceedings of the Kiribati Applied Atoll Research for Development Consultation Tarawa 27 February - 2 March 1988

APPLIED ATOLL RESEARCH FOR DEVELOPMENT

PROCEEDINGS OF THE

KIRIBATI APPLIED ATOLL RESEARCH FOR

DEVELOPMENT CONSULTATION

Tarawa, 27 February to 2 March 1989

R. R. Thaman (Editor)

financed by

The United States Agency for International Development
(Grant No. 879-0249-G-SS-9008)

in cooperation with

The Foundation for the Peoples of the South Pacific

Ministry for Natural Resource Development

The Republic of Kiribati

Bairiki, Tarawa, Kiribati

1989

Cover Design: U Singh and R.R. Thaman
Cover Photos: R.R. Thaman and J. Eade
Consultation Group Photo: M. Irata

The Ministry for Natural Resource Development acknowledges the assistance of USAID and the Foundation for the Peoples of the South (FSP) for the funding and organization of the Consultation and the publication of these proceedings.

USP Library Cataloguing in Publication Data

Kiribati Applied Atoll Research for Development Consultation (1989): Tarawa, Kiribati)
Applied atoll research for development : proceedings of the Kiribati Applied Atoll Research for Development Consultation,Tarawa, 27 February to 2 March 1989/R.R. Thaman, editor - Tarawa, Kiribati : Ministry for Natural Resource Development, The Republic of Kiribati, 1989.

xxxvi, 253 p., 1 leaf of plates; 21 cm.

Includes bibliographies.

ISBN 982-100-001-0

1. Kiribati - Economic policy - Research - Congresses
2. Coral reefs and islands - Oceania - Research - Congresses
3. Coral reef ecology - Kiribati - Congresses 4.
Environmental impact analysis - Kiribati - Congresses I.
Thaman, Randolph Robert II. Title

HD 75 .6 K57 338.99681'072

DEDICATION

To the sustainable management and development of scarce atoll resources for the benefit of future generations of atoll peoples

PARTICIPANTS AND OBSERVERS KIRIBATI APPLIED ATOLL RESEARCH CONSULTATION
Tarawa, Kiribati 27 February to 2 March, 1989

Front Row: Seluia Fakaua, Clare Baiteke, Les Clark, Jim Osborn, Hon. Taomati Iuta (Minister for Natural Resource Development), Marae Irata (Chairman), Sue Majid, Aziz Majid, Tekarei Russell, Parul Fernandes; Second Row: Being Yeeting, Bill [illegible]nan, Paul Beinfeng, Jim Woodruff, Phil Helfrich, Bob Richmond, Mike Hamnett, John Morrison, Anote Tong, Siaosi Moengangongi, Kirabuke Teiaua. Back Row: Dave Wyler, Sam Edwards, Jim Eade, Randy Thaman, John Finlay, Iosefatu Reti, Tukabu Teroroko, Nakibae Tabokai, Garry Preston, G.S. Sandhu, Robati Corcoran. Not Pictured: Shigero Iwakiri, Ata Teaotai, Rui Williams, Kaburoro Ruaia, Baraniko Baaro, Temakei Tebano.

ACKNOWLEDGEMENTS

The editor would like to thank sincerely the following persons and agencies for their help, both in facilitating the success of the Kiribati Applied Atoll Research for Development Consultation and for their help in preparing and editing various stages of the Proceedings.

Thanks is firstly due to the Ministry for Natural Resource Development of Kiribati, in particular the Minister, the Honourable Taomati I. Iuta and the Acting Secretary and Chairman of the Consultation, Marae Irata, for their hospitality and friendship, their insight in initiating the Consultation, and for their help and guidance before and during the Consultation. Thanks are also due to USAID for funding the Consultation, and in particular to Dr. James Osborn and Les Clark, both for their interest in and understanding of resource development problems peculiar to atoll societies and the need for strong applied atoll research programmes to address problems in atoll resource development, and for their active involvement and positive contributions to the Consultation itself; to David Wyler, Parul Fernandes and the staff of the Foundation for the Peoples of the South Pacific for their excellent logistical support and organization of the consultation; to Roniti Teiwaki and Anote Tong of the USP Extension Centre and the ARDU for the use of their computer facilities, without which it would have been impossible to effectively run the Consultation; to the women of Aia Maea Ainen Kiribati (AMAK), the Kiribati National Womens Organization, for their hospitality and making their maneaba (meeting house) available as the Consultation venue; to the overseas and Kiribati participants for providing their informative Working Papers, their contributions to and involvement in the Consultation, their help in editing and rewriting preliminary drafts of the proceedings, their work on the production of the Working Group Papers, their enthusiasm for sharing their expertise and experiences, and their commitment to the establishment of a strong applied atoll research consultative network; to the Chairman, Marae Irata, the Vice Chairman, Dr. James Osborn, the Chairman and Vice-Chairman of the Steering Committee, Iosefatu Reti and Anote Tong, the other members of the Steering Committee, Jim Eade and Tukabu Teroroko, and the Rapporteurs for the Working Groups, Jim Eade, Garry Preston, Tukabu Teroroko, and Mike Hamnett for their valuable

contributions in guiding and structuring the Consultation and providing written materials and Working Group Papers for discussion and approval by the Consultation; to Jim Osborn, Les Clark, Dave Wyler, and Bob Gillette for their work on the drafts of the Proceedings; and finally to the people of Kiribati for their hospitality and assistance, in particular the staff of the Ministry for Natural Resource Development and the USP Centre, the staff of the Otintai Hotel, where most of the Overseas participants stayed, to the representatives from the Kiribati Visitors Bureau, Iaram Tabureka and Molly Mamara who helped to organize the Tarawa Atoll Resource Orientation Fieldtrip, and to the Chief, elders, and people of Eita Village for their traditional welcome, their hospitality and for allowing the participants to tour their village and garden lands.

Finally, thanks are also given to Iliana Nasedra, Keresi Tabete, Maggi Morrison, Raymond Houng Lee, Sharon Bing, and Uday Singh for their assistance in typing, proof-reading, layout and printing the Proceedings.

R.R. Thaman
Suva, Fiji
April 24, 1989

PREFACE

PERSONAL LETTER FROM THE MINISTER FOR NATURAL RESOURCE DEVELOPMENT TO THE PARTICIPANTS OF THE KIRIBATI APPLIED ATOLL RESEARCH FOR DEVELOPMENT CONSULTATION

Tarawa, Kiribati

It is my great honour and a pleasure for me to welcome you, on behalf of the Government and people of Kiribati, to the Kiribati Applied Atoll Research for Development Consultation. We, of the Ministry of Natural Resource Development, strongly believe that, if successful, the results of this consultation, could provide the blueprint for a far more effective mode of development, on a sustainable basis, of our scarce and widely scattered atoll resources. Such a mode of development would allow for the development and management functions of government to be increasingly based on sound research conducted by appropriate agencies or institutions in close association with the government. We strongly believe that scarce resources . . . natural, financial, and human . . . can be applied most effectively to the development effort, only if the necessary applied research is conducted before new programmes and conservation strategies are initiated.

Time, money and resources have been squandered throughout the developing world on poorly thought-out and poorly-researched projects and development strategies, often with little or no benefit, and in extreme cases, with very negative effects on the resources and local communities concerned. In Kiribati, for example, thousands of dollars and other scarce resources have been expended on coconut replanting schemes, the objective being to replace traditional palm varieties with high-yielding improved cultivars which would increase production to keep abreast with rapid population growth. The result, some ten years later, is that large acreages of palms, producing very little in the harsh atoll environment, have replaced the traditional cultivars and other useful trees that had successfully serviced the cash and subsistence needs of generations of I-Kiribati. Similarly, the well-known Tilapia fish was introduced into our fish ponds and landlocked lagoons by well-meaning "developers" to increase the protein supply. The result was that this highly competitive fish, which rarely grows longer than six inches in Kiribati, has replaced the culturally, commercially and nutritionally important milkfish,

which grows to considerable size in our atoll environment. Efforts to eradicate the tilapia and to re-establish milkfish culture have been unsuccessful. If only applied research on the the performance of the new coconut varieties and on the ecology of tilapia had been conducted in Kiribati, before these projects were operationalized, such negative development could have been avoided.

We believe that one of the most systematic ways of minimising the chance of such negative development, is to insure that we have a strong applied atoll research for development programme, upon which appropriate programmes for the conservation and management of scarce natural resources could be based. We believe that such a programme would address our real development needs, both at the national level, in terms of maximising sustainable cash incomes and foreign exchange, as well as at the village and household levels, where development, per se, really takes place. Such research could range from sophisticated surveys of the extent and economic development potential of pelagic mineral and fisheries resources; the potential for repopulation or improvement, through species enrichment or introduction, of our reefs and lagoons; biological control of the taro beetle and coconut pests; or the effect of prolonged drought, like we have experienced over the past year, at the national or island level, to village-level studies of shellfish or finfish resource sustainability and management; the use and improvement of local plant species; groundwater quality monitoring and conservation; land reclamation and coastal erosion; and even food preservation.

Because of our concern to strengthen applied research in atoll development and to develop appropriate conservation strategies, the Kiribati Government welcomed the establishment, in 1983, of the Atoll Research AND Development Unit (ARDU) of The University of the South Pacific, which was to shoulder, as a regional institution, many of the responsibilities for such research, both for Kiribati and other regional countries. We are also grateful for the work in these areas conducted by other organisations and regional and international agencies. The Government, however, wishes to insure that such an extra-governmental research centre and other relevant applied atoll research is strengthened and coordinated to yield maximum benefits to Kiribati and other atoll nations.

To address this problem the Kiribati government is totally committed to the establishment of a strong atoll development research programme, preferably an Atoll Development Research Centre (ADRC), to conduct and coordinate practical developmental research on the living and non-living natural resources of atolls. It is envisioned that such a centre would incorporate, facilitate, and strengthen both the roles of the current Atoll Research Unit (ARDU) of the University of the South Pacific and other agencies working in the area of applied atoll and oceanic research, as well as those roles which the Agricultural and Fisheries Departments have previously been responsible for in addition to their day-to-day developmental and administrative responsibilities. However, as suggested above, although there are bodies in the region currently responsible, at least in part, for such activities, it would seem appropriate to increasingly focus such development in the atolls and, thus, show greater committment to smaller less fortunate countries.

To develop such a "centre" and associated extra-governmental research capabilities, however, requires both finance and scientific expertise. This is why the Kiribati Government believed that the time was right, given the increasing interest that aid donors, research institutions and island and metropolitan governments and regional organisations have shown in funding and conducting applied atoll and oceanic resource development research, to hold, with the support of the United States Agency for International Development (USAID) and the Foundation for the Peoples of the South Pacific (FSP), this Applied Atoll Research for Development Consultation to "actively assist" it in the creation of such a "centre" and to more clearly identify the nature of its activities.

The parties and institutions involved in the Consultation include relevant ministries and agencies in Kiribati plus selected organizations and agencies that have either already shown an interest or that could potentially contribute to the development and operation of an Atoll Development Research Centre (ADRC). As participants, you are now faced with the task of identifying and prioritising areas for research, management, conservation and training related to the use of Kiribati's resources, in light of the economic, social and ecological realities of an isolated, natural-resource-poor atoll nation. It must be stressed, however, that because other atoll nations and societies are faced with similar research in development and conservation problems and needs, that

the Kiribati Government, is also open to any solutions that might be regional or international, rather than national, in order to achieve economies of scale in research, particularly if such a combined effort would make funding of given projects of an Atoll Development Research Centre (ADRC) more viable.

In short, it is the purpose of the Kiribati Applied Atoll Research for Development Consultation, from 27 February to 2 March, 1989, to have all of you actively assist the government in the creation of an effective ADRC and to explore avenues for collaborative atoll research in development. Billions of dollars of aid have been given freely each year to communities in the larger continental areas of Asia, Africa and South America, often to communities far smaller than the 60,000 people of Kiribati, often with limited visible results in terms of human development and the sustainable management of scarce natural resources. The Government and people of Kiribati sincerely believe that investment in applied developmental research for atolls is a good investment, an investment that can help countless communities of atoll dwellers on countless atolls, not only in the Pacific, but also in the Indian Ocean, achieve a sustainable balance between cash and subsistence production in the resource-poor isolated atoll environment.

Finally, let me take this opportunity to thank you all for having the interest and taking the time to participate in this Kiribati Applied Atoll Research and Development Consultation. I wish also to formally thank the United States Agency for International Development (USAID) for generously providing funds for this consultation and the Foundation for the Peoples of the South Pacific (FSP), the organizing agency for the consultation. In my capacity as Minister of Natural Resource Development, I wish to formally extend to you all, the hospitality of the Kiribati people and to wish you an enjoyable and productive stay. I hope that, after your stay, and after you have a chance to view, however briefly, our atolls, their resources, and the way our people have developed them, you will understand how serious the Government and people of Kiribati must be about the need for applied research for sustainable development, management, and protection of our scarce atoll resources. I sincerely hope that we can all work together to realize the goals of the consultation, namely to actively assist the Kiribati Government in the establishment of an effective Atoll in Development Research Centre (ADRC) and to identify and prioritize specific research areas

and conservation strategies within the funding and research capabilites of appropriate institutions or agencies. Not only do we feel that this consultation is an exciting and innovative activity, which will allow us to rationalise, sytematise, and optimise our development activities, we also see the development of a strong research base for natural resource development as the very basis for the survival of our atoll communities.

We thank you for sharing our concern and wish to thank you in advance for helping us, in whatever way you can, to foster such development.

Te mauri, te raoi, ao te tabemoa to you all during your stay in Kiribati and in your future endeavours.

Taomati T. Iuta
Minister for Natural Resource Development
27 February 1989

TABLE OF CONTENTS

KIRIBATI APPLIED ATOLL RESEARCH
FOR DEVELOPMENT CONSULTATION
27 February to 2 March, 1989
Tarawa, Kiribati

LIST OF ACRONYMS AND ABBREVIATIONS

ADAP	Agricultural Development for the American Pacific
AIDAB	Australian International Development Assistance Bureau
AMAK	Aia Maea Ainen Kiribati (Kiribati Women's Federation)
ARDU	Atoll Research and Development Unit (of USP)
CAA	Center for Applied Aquaculture (of OI)
CAC	Coastal Aquaculture Centre (of ICLARM)
CAN	Coastal Aquaculture Network (of ICLARM)
CCOP/SOPAC	Committee for the Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (or Coordinating Committee for Offshore Prospecting in the South Pacific)
CRC	Coastal Resources Center (of URI)
CRM	Coastal Resources Management Programs (of URI)
CTAHR	College of Tropical Agriculture and Human Resources (of UH)
CTSA	Center for Tropical and Subtropical Aquaculture (of OI)
EIA	Environmental Impact Assessment
ESCAP	Economic and Social Commission for Southeast Asia and the Pacific
FFA	Forum Fisheries Agency
FSP	Foundation for the Peoples of the South Pacific
HIMB	Hawaii Institute of Marine Biology
HNEI	Hawaii Natural Energy Institute (of UH)
IADP	Integrated Atoll Development Project (of UNDP)
ICLARM	International Centre for Living Aquatic Resources Management
IMR	Institute of Marine Resources (of USP)
INR	Institute of Natural Resources (of USP)
IPS	Institute of Pacific Studies (of USP)
IRD	Institute of Rural Development (of USP)
IRETA	Institute for Research, Extension, and Training in Agriculture (of USP)

KU	Kagoshima University
ODA	Overseas Development Administration (of the U.K.)
OI	Oceanic Institute
ORMP	Ocean Resources Management Programme (of USP)
OTEC	Ocean Thermal Energy Conversion
NRI	Natural Resources Institute (of ODA)
PICHTR	Pacific International Center for High Technology Research
PIMRIS	Pacific Islands Marine Resources Information System
RAB	Regional Advisory Board (of IRETA)
SOA	School of Agriculture (of USP)
SOH	School of Humanities (of USP)
SPAS	School of Pure and Applied Science (of USP)
SPC	South Pacific Commission
SPRAD	South Pacific Regional Agricultural Development Project
SPREP	South Pacific Regional Environment Programme (of SPC)
SSED	School of Social and Economic Development (of USP)
TIM	School of Travel Industry Management (of UH)
UH	University of Hawaii
UOG	University of Guam
UNDP	United Nations Development Programme
URI	University of Rhode Island
USAID	United States Agency for International Development
USP	University of the South Pacific
UVW	University of Victoria, Wellington
WRRC	Water Resources Research Center (of UH)

KIRIBATI APPLIED ATOLL RESEARCH FOR DEVELOPMENT CONSULTATION

27 February - 2 March 1989

LIST OF PARTICIPANTS

(Detailed information and contact addresses and phone, telex, and fax numbers for each participant, if available, can be found in Appendix I)

A. OVERSEAS PARTICIPANTS

1.	James Osborn	U.S. Agency for International Development (USAID)
2.	Les Clark	U.S. Agency for International Development (USAID)
3.	Philip Helfrich	University of Hawaii (UH)
4.	Michael Hamnett	University of Hawaii (UH)
5.	James Woodruff	University of Hawaii (UH)
6.	Robert Richmond	University of Guam (UOG)
7.	Paul Bienfeng	Oceanic Institute (OI)
8.	William Branan	University of Rhode Island (URI)
9.	Shigero Iwakiri	Kagoshima University (KU)
10.	Jim Eade	Committee for Co-ordination of Joint Offshore Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC)
11.	Garry Preston	South Pacific Commission (SPC)
12.	Iosefatu Reti	SPC/South Pacific Regional Environment Programme (SPREP)
13.	John Morrison	University of the South Pacific (USP)
14.	George Moengangongo	USP Institute of Rural Development (IRD)
15.	Roniti Teiwaki	USP Kiribati Extension Centre
16.	Anote Tong	USP Atoll Research and Development Unit (ARDU)
17.	John Finlay	USP ARDU and IRETA
18.	Goeff Hubgood	UNDP IADP
19.	Susan Majid	Australian International Development Assistance Bureau (AIDAB)
20.	Aziz Majid	AIDAB

B. LOCAL PARTICIPANTS

1.	Hon. Taomati Iuta	Minister for Natural Resource Development
2.	Marae Irata	Acting Secretary for Natural Resource Development
3.	Ata Teaotai	Secretary to the Cabinet
4.	Rui Williams	Chief Agricultural Officer
5.	Tukabu Tereroko	Acting Chief Fisheries Officer
6.	Kaburoro Ruaia	Assistant Secretary for Foreign Affairs
7.	Nakibae Tabokai	For Secretary for Education
8.	Baraniko Baaro	Secretary for Finance
9.	Robati Corcoran	Clerk to Tarawa Urban Council
10.	Seluia Fakaua	Clerk to Betio Town Council
11.	Clare Baiteke	ARDU Committee Member
12.	Tekarei Russell	ARDU Committee Member

C. OBSERVERS AND SPECIAL GUESTS

1.	Being Yeeting	Fisheries Division
2.	Kirabuke Teiaua	Division of Agriculture
3.	Sam Edwards	Division of Agriculture
4.	G.S. Sandhu	Division of Agriculture
5.	Temakei Tebano	Marine Biologist
6.	Murdo McInnes	Te Mautari Ltd. (Kiribati National Fishing Company)

D. APOLOGIES

1.	John Munro	International Centre for Living Aquatic Resources Management (ICLARM)
2.	Philip Muller	Forum Fisheries Agency (FFA)
3.	Josefa Osborne	University of the South Pacific (USP)
4.	Malcolm Hazelman	USP Institute for Research, Extension and Training in Agriculture (IRETA)
5.	Nora Berwick	U.S. Agency for International Development (USAID)

6.	Roger Lawrence	Victoria University, Wellington (VUW)
7.	Bernie Galgo	UNDP IADP
8.	Jeff Liew	United Nations DevelopmentProgramme (UNDP) Integrated Atoll Development Programme (IADP)
9.	Enari Bauro	Secretary for Home Affairs

E. SECRETARIAT

1.	David Wyler	Foundation for the Peoples of the South Pacific (FSP)
2.	Parul Fernandes	Foundation for the Peoples of the South Pacific (FSP)
3.	Randy Thaman	Foundation for the Peoples of the South Pacific (FSP)

PROGRAMME TIMETABLE

KIRIBATI APPLIED ATOLL RESEARCH FOR DEVELOPMENT CONSULTATION

Saturday 25 February	Participants Arrive
6:00 P.M.	Cocktail Party, Otintai Hotel
Sunday 26 February	
3:00 P.M.	Tarawa Atoll Resource Orientation Fieldtrip: Tenaya to Betio (Departs from Otintai Hotel)
Monday 27 February	
9:00 A.M.	Introduction of Minister for Natural Resource Development by Chairman
9:05 A.M.	Opening Address by the Honourable Minister of Natural Resource Development, Taomati I. Iuta
9:20 A.M.	Introduction of U.S.A.I.D. Representative by Chairman
9:25 A.M.	Address by the U.S.A.I.D. Representative
9:40 A.M	Introduction of the University of the South Pacific Representative by Chairman
9:45 A.M	Address by the University of the South Pacific Representative
9:55 A.M.	Administrative Announcements by the Foundation for the Peoples of the South Pacific (FSP) Consultation Coordinator Mrs. Parul Fernandez

Monday 27 February	SESSION I: INTRODUCTORY SESSION
2:00 P.M.	Opening remarks to the plenary session by the Chairman
2:10 P.M.	Election of Technical Members of the Consultation (Vice-Chairman, Rapporteur, and Steering Committee)
2:25 P.M.	Presentation of the Government of Kiribati's interest in the development of a strong ongoing applied atoll reseach centre and programme by the Chairman
2:35 P.M.	Discussion related to the interests of the Kiribati Government and the objectives of the Consultation
2:45 P.M.	Presentations by participating agencies of their interests, capabilities, and possible involvement in the development of a strong applied atoll research centre and programme in Kiribati
3:30 P.M	Coffee
3:45 P.M.	Continuation of presentations by participating agencies

Tuesday 28 February	SESSION II: SCOPE OF PROJECT
9:00 A.M.	Introduction and definition of objectives of session by Chairman followed by discussion
9:10 A.M.	Identification of areas of activity and concern in open ocean/pelagic and nearshore or lagoonal marine resource

research and development: NON-LIVING RESOURCES (mineral resources, physical oceanography, environmental chemistry/pollution monitoring, meterology, climatology)

9:50 A.M. Identification of areas of activity and concern in open ocean/pelagic and nearshore or lagoonal marine resource research and development: LIVING RESOURCES (fish, seaweed, coral distribution; extent, utilisation status/potential in pelagic, reefslope, reef and lagoonal areas)

10:30 A.M. Coffee

10:45 A.M. Identification of areas of activity and concern in terrestrial resource research and development (land use potential; soil, water, energy, plant, and animal resources; agricultural resources, systems and potential; pest and disease situation; etc.)

11:25 A.M. Identification of areas of activity related to the conservation of natural resources and environmental management

12:30 P.M Lunch

2:00 P.M. Identification of functions and organisation of an applied atoll research centre/network, including the balance of research, information dissemination, development, and training

3:30 P.M. Coffee

3:45 P.M. Discussion on Tarawa as the base for an

	applied atoll development research centre and the nature of its geographical terms of reference
4:15 P.M.	Discussion on the nature of regional and/or international cooperation in the establishment and activities of a strong applied atoll development programme
4:45 P.M.	Summation of Session II by Chairman and general discussion

---

Wednesday 1 March

8:30 A.M.	To be decided by Steering Committee based on progress and findings of previous sessions

---

Thursday 2 March

8:30 A.M.	To be decided by Steering Committee based on progress and findings of previous sessions
2:00 P.M.	Summing up of consultation and identification of resolutions/ recommendations
5:00 P.M.	Closing Address by Minister of Natural Resource Development
6:00 P.M.	Reception and Kiribati Cultural Display, Otintai Hotel
Friday 3 March	Participants begin to depart

EXECUTIVE SUMMARY

Atolls, as a unique class of habitats, have very limited developmental potential owing to scarcity of terrestrial resources, high and increasing population densities, and geographic isolation and fragmentation. The natural resources of the atoll nation of Kiribati, for example, are either extremely limited and fragile, in the case of terrestrial, lagoonal and near-shore resources, or extremely vast and difficult to utilize in the case of its oceanic marine resources within its extended exclusive economic zone (EEZ). There is, consequently, a pressing need for improved understanding and management of these resources to serve the commercial and subsistence needs of current and future generations of i-Kiribati (Kiribati people). There is, however, a critical lack of practical and systematic knowledge on the living and non-living natural resources of atolls, and on the impact that different development alternatives might have on their sustainable development and management. Pre-developmental applied research on atoll resource development, management and conservation is needed; without it the future of atoll societies is extremely problematic.

With this problem in mind, the Government of Kiribati has long believed that it is imperative that: 1) a strong Atoll Development Research Centre (ADRC) to conduct developmental research on the living and non-living natural resources of atolls be established; 2) a centre for data collection and dissemination for atoll resources and development be created; and 3) a pool of technical advisors on economic utilization of atoll natural resources be identified. Because of this concern, the Kiribati Government welcomed and facilitated the establishment, in 1983, of the Atoll Research and Development Unit (ARDU) of The University of the South Pacific, which was to shoulder, as a regional institution, many of the responsibilities for such research, both for Kiribati and other regional countries. Unfortunately, the ARDU has been unable to meet the expectations of Kiribati and other regional atoll nations.

Consequently, to explore seriously the feasibility and desirability of the creation of a strong applied research capability or "centre", the Government of Kiribati, with funding from the United States Agency for International Development (USAID) and organizational support from the Foundation for the Peoples of the South Pacific (FSP), hosted the "Kiribati Applied Atoll Research for

Development Consultation" in Kiribati from 27 February to 2 March, 1989.

Participants in the Consultation included representatives from relevant ministries and agencies in Kiribati, from the existing University of the South Pacific Atoll Research and Development Unit (ARDU), and from relevant overseas organizations which could participate in the development of a strong applied atoll research for development capability and the operation of an Atoll Development Research Centre.

The major objectives of the Consultation were to assist the Government of Kiribati in:

1. The identification and prioritization of subjects for applied atoll resource research, with particular focus on living and non-living marine resources, agricultural and terrestrial resources, and conservation and management of the environment, including the prioritization of activities.

2. The identification and development of management strategies for achieving the appropriate balance between the functions of research, development, and training.

3. Assuming that the location of such a centre would be Tarawa, the administrative centre of Kiribati, the identification of the extent to which the centre should be involved in developmental research on other islands and oceanic areas within the region.

4. The identification of the potential roles of government and non-government organizations and institutions in the establishment of a centre and the implementation of its work programme.

A number of findings became clear, inter alia:

1. There is a critical need for applied atoll research as a basis for the sustainable development of scarce terrestrial and nearshore fisheries resources and highly scattered and fragmented living and non-living oceanic resources of atoll nations such as Kiribati.

2. It would be preferable, in terms of funding opportunitie and achieving economies of scale through cooperative research, t develop a regional or international atoll research capability, rathe than a national facility.

3. The Government of Kiribati has resolved to seek and support a strengthened applied atoll research capability.

4. The current USP Atoll Research and Development Unit (ARDU), given its current organization and funding, is unable to satisfy the current applied atoll research needs of both Kiribati and other member atoll countries of the USP.

5. Kiribati, as the world's largest atoll nation, and because of its central location among other atoll nations, as the site of the current USP ARDU, and as the initiator of the Consultation, is an appropriate site for a strong applied atoll research facility.

6. There is considerable capability for, and interest in, conducting applied atoll research on the part of the participating institutions and certain non-participating organizations, which could contribute significantly to the development of a strong applied atoll research programme.

7. A strong applied atoll development research and information dissemination network, which could initially be based on the institutions and agencies participating in, and contacts established during the Consultation, is needed.

8. Given the very limited terrestrial atoll resources, including land, soil, and plant and agricultural resources, and due to very high population densities, particulary in areas such as urban Tarawa, there is a critical need to evaluate these scarce resources and develop appropriate development strategies. The more specific priorities are studies of the nature, utility, propagation and the promotion of important indigenous and exotic plant resources and cultivars; agricultural system analysis and improvement, including studies of plant and soil improvement, pest control and plant quarantine and traditional agricultural knowledge and technology; and studies of appropriate agricultural and resource-use strategies for high density urban atoll settlements.

9. A strong programme of marine resource research is needed to identify and develop the options available to the Government of Kiribati for marine resource management and development. Against a background of increasing urbanisation and pressure on marine resources and the marine environment in Tarawa, and the related need to improve the relative well-being of communities in outer islands and other atoll communities, the priorities of applied atoll research on marine resources are: a) research on the management and enhancement of stocks in Tarawa lagoon and elsewhere which are threatened by depletion from overfishing, b) research on aquaculture, at a variety of levels, as a means of enhancing natural populations of selected marine resources and providing bait for the local tuna industry and food fish for local consumption and export, with a particularly high priority on milkfish culture; c) research on the development of unexploited or underexploited resources which might provide additional sources of subsistence protein, as well as employment and income generating opportunities; and, d) research on the protection of marine resources and the marine environment from pollution and other interference resulting from land-based activities, including, for example, causeway construction.

10. The priority research subjects for the development of non-living and/or energy resources in the atoll environment are mineral resources, particularly studies of sand, gravel, and cement-making resources for construction purposes; water quality and management; and renewable energy resources, including solar energy, fuelwood resources, and OTEC. Long term priorities would include studies of seabed mineral deposits. Baseline studies of the physical coastal environment and the effects of development work, such as causeway development, were also considered priority areas of research.

11. Because atoll resources are so limited, it is imperative that if development is to result in a sustained increase in the standard of living of the people, those resources be managed effectively and thoughtfully. Such management should involve the establishment of appropriate conservation strategies, including conservation area establishment and the protection of endangered species, and effective environmental impact assessment legislation and procedures, all of which must be seen as an integral part of sustainable development, rather than an obstacle to growth.

12. There is a need for in-depth studies, involving local people as major, fully-paid researchers and scientists, to be conducted on the social and economic importance of atoll resources. Particular emphasis should be placed on traditional resource-use knowledge and technologies and the subsistence importance of those resources, in an attempt to ensure: a) that such relevant knowledge is not lost, and b) that it can be used as a basis for a more appropriate sustainable self-reliant model of modern development.

13. Traditional resource- and land-use knowlege of atoll societies should be integrated into the curricula of formal education systems, possibly through the involvement of older knowledgeable members of the community in the formal education system. This would constitute an attempt to make education more immediately practical, given the long-term needs and realities of isolated, resource-poor atoll communities.

Resolutions related to these findings were:

1. That there are critical applied research needs of Kiribati, and other atoll countries, which require a strong applied atoll research facility and programme.

2. That the USP Atoll Research and Development Unit (ARDU) is, at present, the logical body to fulfill such a need, although to this point in time, it has been unable to satisfy this need.

3. That the Government of Kiribati requests USP to urgently review its commitments to the (ARDU) and to look for ways to enhance its performance, including solicitation of the active involvement of other regional and non-regional institutions and a range of donor agencies.

4. That a network of institutions and agencies involved in the Consultation be established which could serve, initially, as a body to advise Kiribati and other atoll nations on atoll research matters and to facilitate the free flow of information on applied atoll research for development, with a provision for including other relevant institutions not represented at the Consultation to further strengthen such a network.

5. That the needs of applied atoll research for development and for environmental and resource management identified by the four Working Groups be considered of some urgency as a basis for sustainable development of scarce atoll resources: there would be no attempt to order the priorities set by the Working Groups, with this being left for consideration by the Kiribati Government and potential cooperating and financing institutions. It was suggested that, where there seemed to be major obvious utility of a given type of research or project, where considerable expertise existed, and where funding might be immediately available, an attempt should be made to identify specific research projects for which aid funding should be immediately solicited.

6. That, with respect to marine resources, there seemed to be three urgent subjects for research in terms of the economic and social realities of atoll states. These are: a) studies of milkfish aquaculture and aquacultural improvement, b) ecological, population, and sustainable-use studies of Tarawa Lagoon, and c) studies of the ecology of the bivalve species (Anadara maculosa) and its possible introduction into atoll environments where it is not currently present.

I. INTRODUCTION

The natural resources of the atoll nation of Kiribati are either extremely limited, in the case of terrestrial, lagoonal and near-shore resources, or extremely vast and difficult to utilize in the case of its oceanic marine resources within its extended exclusive economic zone (EEZ). There is, consequently, a pressing need for improved development and management, on a long-term basis, of these resources to serve the commercial and subsistence needs of current and future generations of I-Kiribati (Kiribati people). To do so most effectively, there is an urgent need for practical developmental research on the living and non-living natural resources of atolls and on the impact that different development alternatives might have on the management of these resources on a sustainable basis by the people of Kiribati. Without such pre-developmental applied research, resource development, management and conservation is problematic.

1.1 Proposal for an Atoll Development Research Centre

As stressed by the Minister for Natural Resource Development in his opening address and in his detailed statement in the form of a personal letter to the participants (Appendix III), and by the Acting Secretary for Natural Resource Development in his opening address as Chairman of the Consultation (Appendix V), to address this problem, the Government of Kiribati believes that it is imperative that: 1) a strong "Centre for Practical Development

organizational support from the Foundation for the Peoples of the South Pacific (FSP), hosted a "Kiribati Applied Atoll Research for Development Consultation" in Kiribati from 27 February to 2 March, 1989. This report constitutes the Proceedings of that Consultation.

The parties and institutions which participated in the Consultation included representatives from relevant ministries and agencies in Kiribati, and from selected overseas organizations and agencies which could potentially contribute to the development and operation of an Atoll Development Research Centre (ADRC)(Brief and detailed lists of the participants, with affiliations and addresses can be found in the introductory section and Appendix I, respectively).

1.3 Major Objectives of Consultation

The major objectives of the Consultation, in relation to the establishment and operation of an Atoll Development Research Centre or a strong applied research capability, were to assist the Government of Kiribati in:

1. The identification and prioritization of areas for applied atoll resource research activity, with particular focus on living and non-living marine resources, agricultural and terrestrial resources, and conservation and management of the environment, including the identification and prioritization of activities or specific projects which might be undertaken within each area of activity.

2. The identification of development or management strategies for achieving the appropriate balance between the functions of research, development, and training.

3. Assuming that the location of such a centre would be Tarawa, the administrative centre of Kiribati, the identification of the extent to which the centre should be actively involved in developmental research on other islands and oceanic areas within the region.

4. The identification of the potential roles of government and non-government organizations and institutions in the establishment of a centre and the implementation of its work programme.

1.4 General Background on the Resources of Kiribati

The 33 islands of the independent Republic of Kiribati span the equator and cover some 5 million sq. km. of the Pacific Ocean. The country consists of three groups: the Line Islands to the east, Kiribati (formerly the Gilbert Islands) to the west and the Phoenix Islands in between. Although the 17 islands of the Kiribati Group proper (the traditional name was Tungaru), which includes the nearby phospate island of Banaba (Ocean Island) to the east, constitute only 278.4 sq. km. (33.8%) of the total claimed land area of 822.8 sq. km., they include some 56,397 people (96.4%) of the total population.

The mean annual rainfall is highly variable, both within the three groups and from year to year. It ranges from about 1,000 mm. near the equator, including 1,500 mm. at Tarawa to 3,000 mm. in the northernmost islands, and from 700 mm. at Kiritimati (Christmas Island) to more than 4,000 mm. at Teraina (Washington Island) in the Line Islands. The natural vegetation and crops are, consequently, much more luxuriant on islands like Butaritari and Makin in northern Kiribati proper and Teraina in the Line Group, which are outside the equatorial dry belt. Banaba, central and southern Kiribati proper, the Phoenix Islands, and Kiritimati are all subject to severe droughts, lasting many months, during which time the annual rainfall can be as low as 200 mm. Such droughts cause water shortages, affect water quality and adversely affect the growth of all plants, most importantly, coconut palms, breadfruit, giant swamp taro (te babai), and other food plants, and severely limit the production of the sole cash crop, copra. During the time of the Consultation, Kiribati was experiencing an extended drought, over a year in duration, which had severely affected plant growth and freshwater resources.

The atoll soils of Kiribati are possibly among the most infertile in the world, being comprised largely of highly alkaline coral debris, sand and silt-sized particles of limestone. Activity of soil micro-organisms is limited, soil water-holding capacity is very low because of coarse texture, and ground water is often saline. These factors make conventional agriculture, as practiced on other larger Pacific islands, very problematic in Kiribati.

Most of Kiribati's islands have protected lagoons with significant sand and subsistence fisheries resources. Some islands, however, like Tamana and Arorae, are table reef islets with no lagoons. All islands have some fringing reef and reef slope resources, all of which are of critical subsistence importance, as well as being of limited, primarily local commercial importance, particularly in the case of the deep-water snapper resource.

Kiribati's EEZ of over 5 million km^2 has considerable potential for pelagic fisheries development, and, to a lesser extent, for the harvesting of deepwater corals. There is also potential for mineral resource development in the long-term, based on the occurrence of polymetallic manganese nodules and cobalt-rich crusts. In both cases, however, Kiribati lacks the technology, capital, and, in some cases, the knowledge of the nature of these resources, needed for exploitation, and must depend on outside assistance to negotiate the most appropriate aid-funded, joint-venture or leasing arrangements to exploit these resources.

1.5 Socio-Economic Situation

The extremely limited land area suitable for agriculture, settlements, and commercial, intitutional and infrastructural development, and a limited terrestrial and near-shore natural resource base, coupled with unequal population distribution, makes modern development along Western lines problematic. This unequal population distribution leads to some of the highest population densities in the world, especially in highly-urbanized south Tarawa, where it has been estimated that population densities by 1993 will be approximately 4,705 per sq. km., approaching that of Hong Kong. Such densities place excessive localized pressure on land, freshwater, and marine resources, which will only increase, given current high birthrates, thus underlining the need for improved knowledge and management of these resources.

Although the people of Kiribati are generally well-nourished and healthy, there are some increasingly serious nutritional disorders and health problems, which are related to changes in resource use systems, increasing population densities, and urbanization. These include iron deficiency anaemia, infant malnutrition, vitamin A and vitamin B deficiency in all age groups, dental disease, particularly in

school-age children, and increases in non-communicable diseases such as diabetes, hypertension, cardiovascular disease, and hyperuricaemia. In almost all cases, these nutritional disorders seem to be related to either poor weaning diets or excessive dietary dependence on rice, white flour, sugar, tea, and alcohol and the abandonement of traditional agriculture, food, and beverage systems.

In terms of other health problems and causes of mortality, diarrhoeal diseases, influenza, perinatal complications, skin diseases, and a number of other infectious diseases remain among the major health problems, and, in many cases, are related to poor management of scarce water resources, poor nutrition, isolation from healthcare facilities, overcrowding, and poor environmental hygiene.

Because of lack of resources and extreme isolation from major world markets, the future economic wellbeing of Kiribati will depend on the protection and management of the existing subsistence economy and its terrestrial and marine resource bases (which have provided most of the people's needs for generations), while, at the same time, maximising the potential for cash-productive activities.

Although increasing food dependency, the deterioration of foreign exchange reserves, the promotion of export and cash-generating activities, and aid are the most commonly discussed economic problems, and although most development plans stress the need to maximize self-sufficiency, very little attention is given to the protection and maintenance of subsistence resources and traditional resource-use technologies that have served the Kiribati people for generations. These technologies, which are based on existing natural and cultural resources (e.g., knowledge of the terrestrial and marine environment and traditional agricultural, fishing, medicinal technologies), and the wide range of products they produce constitute a resource, the replacement of which, if it were possible, would lock the country of Kiribati even tighter into the vicious circle of dependency on an international economic system over which it has very little control.

Since the cessation of phosphate mining on Banaba in 1979, the only locally-produced exports from Kiribati have been copra, fish, and handicrafts which accounted for only Australian $3,326,000 in 1981. Imports, however (including $6,300,000 for food, beverages,

tobacco, and animal and vegetable oils and fats), amounted to $19,912,000, leading to an enormous trade imbalance. The value of food imports alone of $4,960,000 is almost 150% the value of all locally-produced exports. If beverages, tobacco, and animal and vegetable oils and fats are included, this value increases to almost 200%.

This serious trade imbalance and rapidly increasing food dependency is particularly alarming, given the limited land area, soils and terrestrial flora, which is among the poorest in the world, and the severely limited potential for export-oriented agricultural and industrial development, apart from copra, the processing and export of fisheries resources from a vast exclusive economic zone (EEZ) and its many lagoons and atolls, and the licencing of foreign fishing vessels fishing within the EEZ. Aid and remittances from I-Kiribati residing or working overseas as seamen and contract workers in the Nauru phosphate industry are the only other significant sources of foreign exchange.

Household incomes are very low compared to those in most other Pacific Island groups. Few people, especially in the rural outer-islands, have formal wage employment, and depend almost exclusively on meagre resources from copra and remittances. Although national income figures suggest an increase in personal income of about 6% per year, the retail price index, which is dominated by foodstuffs, is increasing at about 9% per year.

In short, the situation in terms of cash availability for the purchase of imported food, other consumer goods, and capital goods is critical and deteriorating, and will most certainly deteriorate further with current inflationary pressures and the slow phasing out of overseas employment in the phosphate mining industry of Nauru. This, again, underlines the need to balance efforts to increase cash earning and export-oriented activities with the protection of important subsistence activities and the protection and proper management of the existing and potential subsistence and commercial resource base (For a more detailed account of the resources and social and economic background, including references, see Working Paper 1 in Appendix VI, which was provided to all participants prior to the Consultation).

1.6 The Need for a Strong Applied Atoll Research Capability and the Prioritization of Research Areas and Resource Management Strategies

As stressed above, the purpose of the Consultation was to explore the possibilities of establishing a strong applied atoll research capability, preferably a major Applied Atoll Development Research Centre (ADRC), and to identify and to prioritize areas for research, management and training related to the use of Kiribati's resources, in light of the economic, social and ecological realities of an isolated and fragmented, natural-resource-poor atoll nation.

More specifically, the Government of Kiribati is strongly committed to the establishment of an Atoll Development Research Centre (ADRC) and the development of a strong capacity for applied atoll development research, as a critical precondition for the wise development and management of its scarce atoll resources on a sustainable long-term basis. To best achieve this aim, there is a need to: 1) identify and prioritize those resources which could be developed and/or managed; 2) identify the scope and nature of activities or functions in which an ADRC should be involved; 3) identify those activities or functions, which can be carried out best by the people and Government of Kiribati themselves; and 4) identify those activities which can be best carried out by the most appropriate external agencies or institutions. It was the purpose of the Kiribati Applied Atoll Research for Development Consultation, from 27 February to 2 March, 1989 to "actively assist" the government in achieving these objectives.

1.7 Organization of Proceedings

In addition to this introduction these Proceedings include the following components:

1. A Lists of the main acronyms used during the Consultation;

2. Brief and detailed lists of participants with contact information;

3. The Consultation programme timetable;

4. Summaries and written versions (when available) of opening addresses to the Consultation;

5. Details on the Technical Members of the Consultation;

6. Summaries of the oral presentations by overseas participants/institutions and discussion arising out of those presentations;

7. Copies of the all Working Papers submitted by overseas participants;

8. Summaries of oral presentations by Kiribati participants/agencies and discussion arising out of those presentations;

9. Working Papers prepared by four Working Groups on the rationale for, and the prioritization of applied atoll research on a) non-living resources and energy, b) agricultural, urban and terrestrial resources, and c) marine resources; and d) the rationale for the need for, and prioritization of activities in the general area of natural resource conservation and management;

10. Summaries of discussion and responses to presentations of the Working Groups and prioritization of areas for applied research;

11. Summaries of statements of capabilities and potential involvement of participating institutions in an applied atoll research centre/network;

12. Summaries of discussions related to the establishment of an effective Atoll Development Research Centre (ADRC);

13. Summary and Resolutions Arising out of the Consultation;

14. Closing Addresses by Minister, Chairman and Overseas Participants;

15. Seven Appendices containing: i) a detailed list of

participants with addresses and other contact information, II) the Itinerary for the Tarawa Atoll Resource Orientation Fieldtrip, III) the formal Opening Address/Personal Letter from the Minister for Resource Development, IV and V) addresses by the Chairman delivered to the opening of the plenary session of the Consultation, VI) the sixteen Working Papers (1-16) prepared for the Consultation by the participants/participating institutions; and VII) a description of the proposed ativities of the Pacific Islands Marine Resources Information System (PIMRIS).

2 FORMAL OPENING OF THE CONSULTATION

2.1 Address by the Minister of Natural Resource Development

The Honourable Taomati I. Iuta, Minister of Natural Resource Development, stressed that he has been actively involved in the initiation and planning for the Consultation because of his continuing concern for the strenthening of applied atoll research for development in Kiribati, beginning with his involvement in discussions which led to the establishment of the USP Atoll Research Unit (now the Atoll Research and Development Unit or ADRU) in 1979. He said that, although his opening statement would address the major issues of, and rationale for the Consultation, in an effort to streamline the proceedings, he had decided to distribute his more detailed formal address to all participants in the form of a "personal letter" which could be read, at their leisure, before the Consultation (The letter is found in Appendix III).

In terms of the rationale for the Consultation, he stressed that his current concern arises out of the inability of the ARDU and other organizations, with capabilities in the areas of applied atoll research and development, to adequately address the applied research requirements of Kiribati and that his remarks would be his personal views, as a concerned participant in the Consultation, rather than constituting an official government position.

He congratulated the USP for organizing and facilitating the Consultation, USAID for financial support, and the participants for their interest and excellent contributions which have considerably enhanced our understanding of the capabilities in various areas of applied atoll research. He grouped the participants into three general categories: 1) those who have the proven ability and have expressed the willingness to help Kiribati and other atoll countries to solve their problems in applied research; 2) those who have the capability and interst in helping, but who are afraid of trodding on the toes of others already working, or with interests in a given area of research; and 3) the Kiribati Government and the people of Kiribati, who neither have the financial resources nor the expertise to conduct much of the kind of research needed, but who do have considerable time tested practical or empirical knowledge of atoll resources which must be seen as being of considerable importance in the sustainable long-term development of Kiribati.

In relation to the USP ARDU, he felt that the reasons for the inability of the unit were three-fold: 1) the failure of the USP to support wholeheartedly the ARDU and to provide the guidance and monitoring needed to make the unit viable; 2) neglect on the part of the Government Kiribati to support the ARDU and to involve it in its ongoing projects; and 3) internal operational problems within the unit itself which did not allow it to address its stated research priorities. Thus, has arisen the current concern for establishing a strong and effective applied atoll research capbility.

In terms of the priorities of research, he stressed that there are many areas that were highlighted in his formal statement issued to the participants in the form of a personal letter yesterday and in the background paper sent to all particiants (Working Paper 1), which he said he would not repeat. Some that he highlighted, included possibilities of improved technologies for simplifying the tasks of rural people, such as the development of a mechanical pandanus fruit pounder to produce pandanus flour, a painstaking and time-consuming process for women; reforestation to restock endangered species of cultural and economic importance to the people of Kiribati; solar energy development; solar salt production; and, in particular, research on the sustained development and management of our vast marine and oceanic resources.

He stressed that the main interest lies in applied, rather-than basic research. He said, for example, that simple descriptive studies of traditional agricultural sytems are not what is really needed, but rather scientific analysis of the commercial and subsistence importance of such systems, so that informed decisions can be made as to the best avenues for their development such as the substitution of more productive crops for the traditionally important, but hard-to-grow, giant swamp taro (te babai).

He also stressed the need for coordination of such programmes to eliminate wasteful duplication of effort, and asked why there were three groups with similar objectives, the ARDU, the UNDP Integrated Atoll Development Programme (IADP), and the SPC Integrated Atoll Development Programme, working side-by-side, but with only limited coordination? He asked why these programmes had not been managed properly from the implementation stage. This, he stressed, could be the role of an Atoll Development Research Centre (ADRC). He stressed that there was also the need for funding and

the identification of the responsibilities and priorities of such a centre or network, which would hopefully be addressed during the remaining sessions of this Consultation.

He stressed that these were some of the issues which must be addressed by the Consultation, and that he hoped that the remaining sessions would be able to deal successfully with them and come up with some useful ideas and strategies for helping Kiribati and other atoll countries deal with their problems in developing effective applied atoll research for development programmes.

2.2 Address by the United States Agency for International Development (USAID) Representative

Dr. James Osborn, the USAID representative and Assistant Director of its Regional Development Office for the South Pacific, stressed the considerable pleasure and satisfaction of USAID in funding this Consultation, its admirable purpose being to explore the need for a strong applied atoll research programme that would benefit both Kiribati and other atoll nations and societies. He also remarked on the increasing interest in small island nations on the part of the U.S. government, and, in particular, the importance of ecologically sustainable development. He then highlighted the need for the meeting to prioritize research needs, to identify agencies and institutions which could play a meaningful role in the development and implementation of a strong applied atoll research for development network, and appropriate development strategies of value to Kiribati, other Pacific nations, and atoll communities throughout the world.

He thanked the Ministry for Natural Resource Development of the Government of Kiribati for initiating the Consultation and its role in its organisation and the Foundation for the Peoples of the South Pacific for the excellent organisation and arrangements. He gave particular thanks to both the I-Kiribati and overseas participants for showing the interest and making the effort to come to Kiribati to take part in the Consultation and to the Honourable Taomati I. Iuta, Minister for Natural Resource Development, for opening the Consultation. He finally wished the meeting success in its deliberations, and hoped, as both a representative of USAID and as a geographer, by training, that the meeting would help in

promoting environmentally sustainable and economic growth-oriented development in the ecologically fragile and resource-poor island states of the Pacific Ocean.

2.3 Address by the University of the South Pacific Representative

Professor John Morrison, the official representative of the Vice-Chancellor of the University of the South Pacific, thanked the Government of Kiribati for inviting the University of the South Pacific to participate in this important and timely meeting. He conveyed the apologies and best wishes of the Vice-Chancellor, Mr. Geoffrey Caston, who was, at the time of the Consultation, involved in the extensive activities associated with the beginning of the USP 1989 academic year which commenced, in Fiji, on the same day as the Consultation.

He stressed his personal pleasure in Mr. Caston's inability to attend, as it gave him an opportunity to return to Kiribati and to renew old aquaintances and to remind himself of the particular problems faced by atoll countries in striving for greater development.

He stressed that the University of the South Pacific, as most people well know, is supported by eleven member regional countries. Of these, six . . . Kiribati, Tuvalu, Tokelau, Nauru, Niue and the Cook Islands . . . are comprised completely or dominantly of atolls or small limestone islands, while virtually all of the University's other member countries have some atolls. He stressed that the development of atoll countries and societies is, therefore, of major concern to the University.

He stressed that the main function of the University is the teaching of degree and diploma programmes, with a recent increase in postgraduate teaching. In this respect, he was pleased to note the recent increase in the number and quality of graduates from Kiribati. He said that Kiribati has much to be proud of and was confident that these graduates would make a major contribution to the development of the country.

He stressed, however, that the University of the South Pacific is more than just a teaching institution, and that it has a major

pool of highly trained staff, over 60% of whom come from the regional countries that support the University, and many of whom have research interests and skills that have been applied, and will continue to be applied to addressing problems relating to the development of regional countries. It was also stressed that many of these activities are carried out in collaboration with other regional and non-regional institutions.

He said that one of the initiatives taken to involve this pool of expertise was the establishment, in 1979, of the Atoll Research Unit (ARU) based in Tarawa, which later became the Atoll Research and Development Unit (ARDU) in 1983. He said that it was fair to state that, in spite of initial flourish and enthusiasm, the overall output of the Unit had been disappointing to both the atoll countries supporting the USP, including Kiribati, and to the University itself. He said that there were a number of reasons for this which he would not elaborate on at that stage of the Consultation.

Rather, he emphasised the importance of this present Consultation, and congratulated the Government of Kiribati for taking the initiative in its organization. He stressed that the Consultation was timely and of vital importance, not only to Kiribati but also to other atoll countries.

He said that the USP was fully supportive of this initiative and hoped that the Consultation would lead to an innovative, coherent and integrated research programme that would enable the Government of Kiribati to meet at least some of the development aspirations of its people. He stressed that his colleagues, Mr. Moengangongo, Mr. Finlay, Mr. Feiwaki, Mr. Tong and himself were here to listen, learn, interact, and contribute in whatever way they could to assist the Consultation in its work.

In conclusion, he again thanked the Government of Kiribati for inviting the University of the South Pacific to participate, and said that the USP looked forward to interaction with the participants from the Government of Kiribati and the other institutions represented and was confident that, by the end of the Consultation, a research programme could be identified that would meet many of the goals intended by those who initiated and implemented this Consultation.

3. INTRODUCTORY PLENARY SESSION

3.1 Opening Address for Plenary Session by Chairman

The plenary session was opened by the Chairman, Marae Irata, the Acting Secretary for Natural Resource Development, who explained, and presented a brief paper on the general background and objectives of the Consultation (see insert below), and opened a technical session to elect the technical members of the Consultation.

OPENING STATEMENT OF CHAIRMAN FOR PLENARY SESSION

Marae M. Irata
Acting Secretary for Natural Resource Development
Republic of Kiribati

In my capacity as the Secretary for Natural Resource Development and the Chairman, I wish to welcome you to the plenary working sessions of the Kiribati Applied Atoll Research for Development Consultation and to use this opportunity to briefly explain and to dispense with some of the technical and administrative aspects of the meeting so we can get to business in the most effective way.

You have all received the original programme and the more detailed programme which was included in your consultation materials. We will essentially follow this programme for the first two days, although flexibility will prevail to accomodate important issues which seem to warrant additional attention. The detailed programme for the last two days will be finalised by the Steering Committee based on the progress made during the first two days.

The first action we must take is to elect the technical members of the Consultation. These will consist of a Vice-Chairman; a Rapporteur; and a Steering Committee, consisting to two I-Kiribati and two non-I-Kiribati members.

The Rapporteur will be responsible for preparing the record of proceedings of the consultation, which will be circulated daily for verification and amendments, and for the production of the finalised proceedings, findings, and recommendations of the consultation. The Rapporteur will have a mandate to co-opt other members of the

consultation to help him in this task.

The Steering Committee, which will include both the Chairman and the Rapporteur as ex-officio members, will serve both as a drafting committee to assist the Rapporteur and as an advisory body to the Chairman in terms of ensuring that the objectives of the meeting are realised and in planning or modifying the following day's sessions based on results of preceeding sessions.

Once we dispense with these formalities, we will hopefully have a good technical team, which will facilitate the success of the meeting for all of us. Before, we actually elect these people, let me again say thank you for joining us in this Atoll Applied Research for Development Consultation which we feel is critical to the sustainable development of our scarce natural and cultural resources.

3.2 Election of Technical Members

Dr. James Osborn, the USAID representative was elected Vice-Chairman.

Dr. R. R. Thaman, the FSP Consultant to the Ministry for Natural Resource Development, was elected Rapporteur.

Mr. Iosefatu Reti, Coordinator of SPREP, was elected Chairman of the Steering Committee, with Mr. Anote Tong, Acting Director of the USP Atoll Research and Development Unit, elected to the post of Vice-Chairman of the Steering Committee.

Dr. James Eade, the Deputy Director of CCOP/SOPAC, was elected as the second non-I-Kiribati member and Mr. Tukabu Teroroko elected as the second I-Kiribati member of the Steering Committe. The Chairman and Rapporteur were approved as ex-officio members of the Steering Committee.

Because of the role of the Ministry for Natural Resource Development as initiator of the Consultation, it was accepted that Mr. Marae Irata, the Acting Secretary for Natural Resource Development, serve as Chairman for the Consultation.

4. PRESENTATIONS BY OVERSEAS PARTICIPATING ORGANIZATIONS

4.1 Introduction by Chairman

After a brief introduction and submission of a paper (see insert below) by the Chairman on the main objectives of the Consultation and the exchanges of presentations by both overseas and I-Kiribati participants, the participating organizations were called on to make brief presentations, based on their formal Working Papers, related to

---

OPENING OF SESSION ON THE PRESENTATION OF THE INTEREST OF THE KIRIBATI GOVERNMENT AND THE INTEREST, CAPABILITIES AND POSSIBLE INVOLVEMENT OF PARTICIPATING AGENCIES IN THE DEVELOPMENT OF A STRONG APPLIED ATOLL RESEARCH CENTRE AND PROGRAMME IN KIRIBATI

Marae M. Irata
Acting Secretary for Natural Resource Development
Government of Kiribati

As suggested by the very "title" of this meeting, it is designed to be a consultation, an exchange of ideas, the main objective being to assist the Government and the people of Kiribati to rationalise and develop a strong and relevant applied atoll research for development programme. You have received the original background paper which stated the more specific objectives of the Kiribati Applied Atoll Research for Development Consultation as being to actively assist the Government of Kiribati in the:

1. Creation of a centre for practical developmental research in living and non-living natural resources on atolls;

2. Creation of a centre for data collection for atolls; and

3. Creation of a pool of technical advisors on economic utilization of atoll natural resources.

Subsequent to that communication, most of you should have also received an expanded background paper prepared by our ESP Consultant entitled "Research for Atoll Resource Development and Management: Priorities and Capabilities for Applied Research in Kiribati" and, this morning, we heard the Honourable Minister of Natural Resource Development's Opening Address, both of which clearly highlight, in my mind, both the need for strengthened applied atoll research, as well as the commitment of the Government of Kiribati to making it a reality. We had hoped that the Atoll Research Unit of the University of the South Pacific (USP) would have been able to fill this need. Although we are grateful for USP's efforts in this direction, we feel we must act now to make a strengthened and well-coordinated applied atoll research programme in development a reality. We can wait no longer, as good research must provide the basis for the survival of both our culture and our scarce and fragile resources in a very rapidly modernising and increasingly commercialised world.

I will say no more at this juncture, as that would only use up valuable time that could be used in consultation, the real purpose for which we are here . . . consultation to help Kiribati, and hopefully other atoll nations and communities as well, to rationalise and strengthen their applied research for development. I hope our objectives are clear, and I hope that we can all work together to identify the most appropriate models for realizing such objectives and to identify the most appropriate agencies to address research needs related to specific resources.

If, however, our concern and objectives remain unclear, the following session, before the participating agencies present their interests, capabilities, and possible involvement in the development of a strong applied atoll research centre and programme, will give us an opportunity to elaborate on any specific objectives, concerns or other issues related to the consultation.

---

the research capabilities of their institutions and their interests in helping to establish a strong applied atoll research capability in Kiribati and the Pacific region. The following are brief summaries of those presentations. The complete papers are included in Working Papers I to 16 in Appendix V.

4.2 The University of Hawaii (UH) (Working Paper 5)

Professor Philip Helfrich of the University of Hawaii stressed the long research tradition that the UH has had in the Pacific and the diversity of schools and institutes which deal with both living and non-living natural resources and the more social science-related areas of development. He stressed the vast experience that UH has had, particularly in the areas of marine biological sciences, physical oceanographys, and atoll studies, which could be of value to the development of an atoll research programme. He particularly highlighted the time-depth studies that have been conducted on the natural history of Eneweta k Atoll, the former nuclear U.S. testing site in the Marshall Islands, which was based on some 1,100 scientist-visits over a thirty year period. He also highlighted the work conducted over the years on Kiritimati (Christmas Island) and other islands in the Line and Phoenix islands, as well as the work done on ciguatera fish poisoning, a problem in most Pacific island countries.

Dr Michael Hamnett of the Center for Development Studies of UH highlighted the work in the more development-, and social science-related areas, in particular the work of the College of Tropical Agriculture and Human Resources and other agriculturally oriented activities. He described their cooperative programmes with the USP, the University of Guam, and other organizations and the work being done in the areas of agricultural economics and marketing, critical concerns in the area of resource development. He also stressed the importance of the Water Resources Research Centre which had recently conducted research on water resources and water conservation in the Marshall Islands. He described the work of the Center for Development Studies which draws on personnel from throughout the University for involvement and consultation in development-oriented projects.

Dr. Jim Woodruff of the Hawaii Natural Energy Institute commented on the work that had been done on natural energy research including photovoltaics, wind power, and OTEC (Ocean Thermal Energy Conversion), in terms of their appropriateness for Pacific Island countries, and highlighted the role of the Pacific International Center for High Technology Research, which is responsible for high technology development, including OTEC, and

reponsible for facilitating the transfer of technology to developing countries. It was also stressed that the State of Hawaii might purchase Palmyra Atoll from its current private owners, and that, if this does happen, Hawaii would become a much closer neighbour of Kiribati, thus creating new possibilities for collaborative research.

In discussions related to the UH presentation, Prof. Helfrich stressed that there were many areas where UH could help Kiribati with their development related research needs, and particularly stressed the attractiveness of work on Kiritimati and Canton Islands which have or, in the case of Canton, could have reliable transportation links with Hawaii. Kiritimati, for example, is only two and a half hours from Honolulu. It was also stressed that human and financial resources do exist which could be directed to research in Kiribati, but as a state institution, UH has primary reponsibility to the state legislature.

4.3 University of Guam (UOG) (Working Paper 10)

Dr. Robert Richmond, the Director of the Marine Laboratory of the University of Guam, stressed that, although they are a small university, UOG does have a body of highly qualified researchers in certain areas of great importance to atoll countries. It was stressed that it was the policy of UOG to conduct work only in areas where they had established expertise and the ability to produce high quality results. Areas of ongoing research interest include studies of groundwater resources, small-scale fisheries development programmes, beche-de-mer reproduction and reseeding, and the monitoring of the effects of sedimentation and pesticide and fertilizer runoff on reef and coastal ecosystems.

He highlighted their collaborative research with the UH and some of the community colleges in Micronesia. He also stressed the emphasis they have placed on the determination of the cultural appropriateness of resource development projects and UOG's considerable focus on small-scale village level development research which will benefit people at the community level. Stress was also placed on the importance that UOG placed on a regional approach to achieving economies of scale in solving problems common to most small-island states of the Pacific.

UOG additionally has an agricultural experiment station with expertise in tropical agriculture, and collaborates with the Guam Department of Commerce in the operation of a large aquacultural/hatchery facility.

4.4 Oceanic Institute (OI) (Working Paper 7)

Dr. Paul Bienfang stressed that the OI, as a private institute located in Hawaii, is almost exclusively concerned with applied aquacultural research which is commercially viable or of practical developmental importance. He highlighted OI's participation in the USDA Center for Tropical and Subtropical Aquaculture and the USDA-ARS Tropical Aquaculture Research Unit and the soon-to-open Center for Applied Aquaculture. He highlighted their marine shrimp aquacultural programme, marine shrimp being the main fisheries import into the US, costing some 1.7 billion dollars per year in foreign exchange.

Their programmes include the development of nutritious and cost-effective aquaculture feeds, based in part on locally available feed substrates and other technologies that can be transferred into the commercial sector. Work on stock enhancement of coastal fisheries resources, which tend to be overfished, is another area of research involvement which builds on the in-hand ability to produce large numbers of finfish fry via their aquacultural technology. Considerable work is also being done on aquacultural instrumentation. Other areas of involvement include mahimahi and mullet aquaculture and water quality management of aquacultural areas.

It was stressed that market research has been a prerequisite to developing new programmes, thus stressing the market-driven nature of their applied research activities. The innovative work on hormone therapy on mullet and milkfish to enhance reproductive and maturation capacities of these very important food fish, where fry production is often a limiting factor in economic viability of aquaculture, was also highlighted. The OI has also been involved in technology transfer of such aquacultural techniques to the Philippines, Taiwan and Indonesia.

He also described some of the capabilities of OI in the areas of pond management and water quality control, aquacultural feed production, and increasing spawning and maturation rates, which would seem to be particularly applicable to the atoll countries of the Pacific.

Mrs. Tekarei Russell of AMAK remarked on the appropriateness of such research, because mullet seemed to be an increasingly over-exploited species in Kiribati, and a species which also had considerable cultural significance. She also mentioned the problems created by the introduction of tilapia. In response, Dr. Bienfeng described experiments that have been done to eliminate tilapia and to process them into feed stock for the aquacultural production of other species.

4.5 Kagoshima University (KU) (Working Paper 3)

Professor Shigero Iwakiri of KU stressed the wide range of expertise that Kagoshima University had in the area of marine science research and training, including 19 Professorial Chairs, three research and training vessels, and one research laboratory, in a wide range of areas of interest to Pacific Island countries. He stressed that KU had undertaken five scientific field surveys in the Pacific in the past seven years.

Areas of research interest of importance to atoll countries include land use and conservation of terrestrial ecosystems in rural areas, primary production and aquatic resource utilization in tropical waters, oceanic structure and change in the tropical Pacific, lagoon water circulation systems, utilization and promotion of underutilized atoll lagoon resources, and the socio-economic importance of lagoon resources and lagoon tenure systems.

In response to a question, it was stressed that their programmes are, like those of many other institutions, subject to the interests of the Japanese academic agency concerned.

4.6 The Committee for Co-ordination of Joint Prospecting fo Mineral Resources in South Pacific Offshore Area (CCOP/SOPAC) (Working Paper 13)

Jim Eade highlighted some of the programme activities of thi regional organization which belongs to and is run by the membe governments, which consists of a combination of individual country projects of which there are over 100 at present plus a number o regional projects. The focus of the work is on non-living resources in offshore, nearshore, and coastal areas, in coastal development studies, and in marine renewable energy resources, especially wave energy and OTEC. He highlighted the cooperative efforts with other institutions that CCOP/SOPAC is involved in to maximise the benefits to the region. He highlighted the importance of the Annual Meeting where the member countries outline their priorities for the following year's programme, which dictates CCOP/SOPAC's ongoing activities.

Kiribati has 8 country projects. These projects include: the evaluation of lagoonal phosphate deposits, of which there seem to be some localized deposits of some local utility but doubtful commercial viability; studies of the distribution of manganese nodules in the EEZ of Kiribati, where there seem to be promising results in the Line Islands area; reconnaissance surveys for precious corals, which indicate there may be significant deepwater coral (Coralium) resources, also in the Line Islands; studies of coastal erosion and coastal resource potential for causeway and tourism development; and mapping of coastal resources and the seabed within the Kiribati EEZ. Finally, CCOP/SOPAC runs data management and training programmes for member country nationals. These include the annual certificate course in Earth Science, workshops and specialized training programmes on a one-to-one basis, such as the use of computer for analysing the types of data generated by CCOP/SOPAC programmes.

It was stressed in discussion, that CCOP/SOPAC does not do market surveys once deposits or information on deposits exists, but tries to involve private companies and to interest them in developing these deposits in the best interests of the regional countries. Moreover, the "coordinating" aspect of CCOP/SOPAC must be stressed in terms of advising regional countries on appropriate training and research opportunities, and how to conduct negotiations

with mining companies. It was stressed that CCOP/SOPAC's main job was to let ~ional countries know the status of their non-living resources so that they can make, with the help of CCOP/SOPAC, the best developmental decisions of these resources.

4.7 South Pacific Commission (SPC) (Working Paper 4)

Mr. Garry Preston stressed that the SPC, which is based in New Caledonia, was a technical support agency involved in a wide range of discrete research projects, rather than a funding agency . Its membership is the widest of all Pacific regional organizations, because it includes both independent countries and the non-independent French and American territories.

Specific areas of activity include agriculture, with particular emphasis on technologies suitable for atoll countries; an ongoing plant protection programme, a major fisheries programme which is described in detail in working paper 4; the South Pacific Regional Environment Programme (SPREP); a rural technology programme which, among other activities, includes energy studies; a nutrition and health programme, including strong epidemiological and educational components, as well as a dental health programme; a statistical reporting programme; a demography programme which collects and analyses population information and statistics on migration for member countries; and a Community Education Training Centre and Media Development Unit in Fiji.

One of the most recent projects is the integrated atoll development programme. Although the SPC collaborates with the UNDP Integrated Atoll Development Programme in the area of agricultural development, their programme is a separate entity, which will focus on particular atoll communities, with the first project in Kiribati proposed for North Tarawa, subject to continuing discussions with the Kiribati Government. These projects are developed in close association with the local community and include components of fishing, agriculture, and health, with a strong emphasis on self-help.

In response to queries, Mr. Iosefatu Reti, outlined the nature of the integrated village-based atoll development project, which began in Mitiaro in the Cook Islands. He stressed that these were cooperative projects between the SPC, the government and the

communities involved, and that an important component of these projects has been the conduct of environmental impact assessment prior to implementation.

Concern was expressed by the Minister that although there has been some favourable reaction to the SPC and UNDP cooperatively run projects, there was concern with the coordination of a number of similar projects, including those run by Save the Children Fund and The Foundation for the Peoples of the South Pacific, which seem to have considerable overlap and often compete for scarce aid funds.

It was stressed by Mr. Reti, that the SPC projects, e.g., the North Tarawa project, are organised in response to requests from governments.

4.8 South Pacific Regional Environment Programme (SPREP) (Working Paper 2)

Mr. Reti, the Coordinator of SPREP, described the role of SPREP in helping countries of the region to foster environmentally sound development. It was stressed that SPREP has a small secretariat to coordinate activities, but most of the actual research work and educational programmes, most of which is in reponse to requests from individual governments, are sub-contracted to Universities and other appropriate institutions.

Some SPREP priority areas of activity include the monitoring and control of coastal pollution, including studies of Tarawa Lagoon in Kiribati; protected area development and endangered species protection, including a major inland water quality and pesticide monitoring and control project; natural resource management and environmental planning, under which SPREP helps in environmental development plans and the preparation of environmental impact assessment statements; and environmental education, with several regional workshops having been held on curriculum development and environmental impact assessment. An area of most recent interest is the focus on the effects of the greenhouse effect and global sealevel rise on Pacific countries, and the identification of positive action that Pacific countries can take to address this problem.

Areas of particular focus in Kiribati, include the work of SPREP in the development of an environmental science curriculum for schools, the previously mentioned pollution monitoring in Tarawa Lagoon, the visit of an ORSTOM scientist to study the effects of mining on Ocean Island (Banaba), which was stripmined of its phosphate over a period of 60 years before mining ceased; the involvement in integrated atoll development work; and training in a wide range of areas or for specific projects, including the development of environmental management plans and the preparation of environmental impact statements. It was stressed that a wide range of activities were possible, on request by regional governments, and that all SPREP programmes conducted in regional countries are considered to be joint programmes, which attempt to involve, as much as possible, local expertise and involvement.

The Minister highlighted the particular interest of the Kiribati Government in the problem of coastal erosion and the need to build seawalls or take other ameliorative action. Mr. Reti remarked that this was an excellent area for cooperative interaction between SPREP and CCOP/SOPAC, with CCOP/SOPAC conducting basic research and SPREP coordinating the EIS and monitoring programmes, with the actual implementation of given programmes lying in the hands of particular government departments or private agencies, such as public works departments.

It was remarked that Kiribati had not yet ratified the SPREP Convention, and that it was hoped that in the near future that the Convention would be ratified by most regional countries. The Minister remarked that, although Kiribati was fully in support of the objectives of the SPREP Convention, that it had been unable to sign the treaty because of differences over the delineation of the limits of the EEZ and the failure to designate Kiribati as an archipelagic state, and that until this disagreement was resolved, Kiribati was unlikely to ratify the convention.

4.9 The University of Rhode Island (URI) (Working Papers 14 and 15)

Dr. William Branan stressed the oceanic nature of the state of Rhode Island (URI) and the wide range of programmes of URI involvement in marine resource development and coastal management.

He highlighted the contribution of the International Center for Marine Resources Development and the International Coastal Resources Management Programmes (CRMP). He stressed that the emphasis is on the formulation, implementation and testing of coastal resource management programmes in Ecuador, Sri Lanka, the Philippines, and Thailand. Particular areas of interest include near-shore fisheries, water quality, tourism amenities, and protection of critical habitats.

He highlighted URI's involvement with coastal management in Phuket, Thailand, a province greatly pressured by tourism development, far in advance of the ability to upgrade infrastructure to protect and manage coastal resources. The Phuket demonstration project and other demonstration sites, which comprise a full range of coastal problems and resource conflicts, will lead ultimately to the development of national coastal resources management policies. CRMP depends primarily on local expertise and emphasises the implementation of coastal resources management (CRM), rather than additional studies. URI uses consultants over long periods of time to foster deeper familiarization with the practical problems associated with implementation-orientated programmes.

4.10 The University of the South Pacific (USP) (Working Paper 8)

Professor John Morrison outlined the role of USP as a regional institution with 11 member countries, campuses in Fiji and Western Samoa, extension centres in ten countries. There are four schools coordinating the teaching of diploma and degree programmes at the undergraduate and postgraduate levels, plus a number of specialised research units. He highlighted the work that the USP was conducting in the area of agricultural and soil sciences, water balance studies, food and nutrition systems, coastal and atoll agroforestry, marine ecology, environmental management, and studies related to climatic change and the greenhouse effect. The large involvement in marine pollution studies, which includes a major training component was highlighted, as were the studies of lagoon water quality monitoring, in particular studies of the Tarawa Lagoon.

Other areas of focus are the development of alternative energy resources, including solar energy, coconut-based fuels, fuelwood resources, and energy utilization studies, and studies of natural

products, in particular medicinal plants. He indicated that the work related to climatic change, was not so much in the area of basic research, but more focussed on the effects of such change on island countries, and the types of action which could be taken to address the effects of such change.

Stress was also placed on the role of USP as a major teaching institution, which had also established some nine non-teaching research or development units, one of which was the Atoll Research and Development Unit (ARDU) based on Tarawa. It was stressed that, after their establishment, such units were expected to become largely self-funding. It was also hoped that individual member governments would, through either their recurrent budgets or through bilateral aid sources, contribute to the viability of such units.

It was suggested that the reason that the ARDU had not been able to conduct its activities at the desired level was basically, that once the original funding negotiated by the Kiribati government ceased, the unit was not able to generate sufficient funds to maintain a desired level of operation.

The importance of the role of USP in the Pacific Island Marine Resource Information System (PIMRIS), a regional information system for fisheries and marine resources, which is being developed by the Forum Fisheries Agency in Honiara, the University of the South Pacific in Suva, and the South Pacific Commission in Noumea, was stressed. The system is designed to serve the information needs of the 22 island member countries of the SPC region. Detailed information on PIMRIS is contained in Appendix VII.

In discussion, the severe limitations placed on atoll communities, due to scarcity of freshwater were highlighted and suggestions made regarding the possibility of desalination and water conservation technologies for agricultural and tourism development. Prof. Morrison agreed with the importance of water resource studies and development, and reported that the UN Department for Technical Cooperation Pacific Islands Water Resources Development Project, based at the USP Institute of Natural Resources, is currently working in these areas and has a major project in Kiribati.

4.11 USP Atoll Research and Development Unit (ARDU) (Working Paper 9)

Mr. Anote Tong gave some background to the establishment of the Atoll Research Unit in 1979, with the focus being on marine resource development, and its later upgrading to an Atoll Research and Development Unit (ARDU), with broadened terms of reference to include agricultural resources and social aspects of atoll development, including small business development. He stressed that the inability of the ARDU to achieve its stated goals seemed to be mainly a problem of resources. Without going any further into the details regarding the failure of the unit, he urged the meeting to perhaps focus more on the role such a unit could play and how best that role could be promoted.

In discussion, the AMAK representative Mrs. Tekarei Russell suggested that, given the fact that the ARDU was supposed to cater not only to the needs of Kiribati, but also to other atoll countries such as Tokelau and Tuvalu, USP should have given greater priority to the unit given the serious developmental problems experienced by atoll countries. It was suggested that in USP's efforts to decentralise its activities, that maybe not enough attention had been given to the ARDU, particularly in terms of letting it sit out on its own and not providing sufficient monitoring of and support to its activities. It was stressed by John Morrison that most non-teaching units had similar levels of funding, but that units like IRETA (the Institute for Research, Extension and Training in Agriculture) had been able to attract substantial external funding for their activities.

The Minister stated that the original function of the ARDU, was to conduct meaningful research in the areas of atoll agriculture and fisheries, etc., with the results then being passed on to government departments for implementation. He questioned why this hadn't happened? It was suggested by Anote Tong, that the reason that this division of labour had not been successful was that government bodies, who often had greater funds, also conducted their own research, with little interaction with the ARDU. Mr. John Finlay, ARDU's agricultural researcher remarked that during his tenure, there had been only minimal cooperative efforts between ARDU and Kiribati agricultural personnel.

Mr. John Finlay briefly described the teaching activites of the USP School of Agriculture located at Alafua, Western Samoa and the activities of the School's outreach arm, the Institute for Research, Extension and Training in Agriculture (IRETA). Some of the general areas of activity included intensification and improvement of agricultural systems; local livestock feed development and production; soil management and chemical analysis; genetic testing, planting material improvement and multiplication programmes; agricultural engineering and appropriate technology improvement; plant pathology; atoll agriculture; youth and women in agriculture; and training and research on coconut husbandry, in relation to coconut replanting schemes. He highlighted the Information Outreach Programmes, in particular, its Agricultural Information Network and Regional Agricultural Liaison Officers, with associated publishing activities, media programmes, etc.

Mr. Finlay stressed that, based on his observations over two years in Kiribati at the ARDU, for a viable atoll research effort to be maintained, a number of conditions must be met. These included:

1. Political committment beyond lip service to the importance of atoll research;

2. Organisational support and coordination from relevant government and non-government ministries and agencies that play important roles;

3. Adequate financial and manpower support from several disciplines and at all levels;

4. Guidance from influential and knowledgeable groups or bodies to ensure that programmes undertaken are relevant to atoll needs and that they include adequate attention to the early inclusion of needs analysis, learning about traditional knowledge, and communication and extension phases as well.

The Chairman asked whether the responsibility for soliciting, initiating new proposals, or allocating funds was based primarily with the central university or with the units themselves. In answer to this question, it was suggested that although the University is to make formal approaches to funding agencies, the individual units can initiate approaches to funding sources for given programmes or

projects. In some cases, this has been particularly difficult f smaller units with only limited staff, who may not have the time expertise to conduct both research and to undertake the process of proposal preparation and soliciating funds.

In terms of the nature of the types of projects that ar funded, in the case of IRETA, a Regional Advisory Board (RAB) w established to get feedback and to advise IRETA on the needs of th region in terms of its activities on both the regional and nation levels. The RAB, however, seems to have had very little punch a the regional level, unlike other organisations such as the Forum Fisheries Agency or COOPSOPAC, because it does not have similar government-approved mandate.

4.12 USP Institute of Rural Development (IRD) (Working Paper 11)

Mr. George Moenganyongo, the Director of the Institute of Rural Development (IRD) and a member of RAB, firstly stressed that the decentralization of USP's activities has created problems of integration and communication which may be one of the reasons for the inability of some units to effectively perform their mandated functions.

He again stressed that, although the Regional Advisory Board (RAB) was an excellent idea in terms of prioritizing research directions for IRETA, it had been somewhat ineffective because it does not have a governmental mandate to carry out any activities, other than advisory. In relation to the priorities of IRETA, he said that Dr. Malcolm Hazelman, who was unable to attend the meeting, wanted to stress that one of the priority interests of IRETA was to conduct research on traditional atoll agricultural systems and their possible improvement.

It was stressed that, unlike some of the other USP bodies, such as IRETA or the Institute of Social and Administrative Studies (ISAS), that are attached or associated with particular schools which they can draw upon for expertise, the IRD and ARDU are left somewhat out on their own. In relation to their ongoing activities, it was stated that current recommendations indicated that the emphasis of IRD would be more on training rather than on research, in an attempt to emphasise the human factor in resource development, as

a critical, often neglected factor, which along with good applied research can contribute to more meaningful development of small island communities. He stressed that IRD activities are very multidisciplinary in nature, and, thus, being coordinated under the umbrella of RAB, with its almost exclusive focus on agriculture, is somewhat inappropriate.

In response to the stated interest of IRETA in studies of traditional agricultural systems, the AMAK representative, stressed the need to look at aspects of traditional agricultural technology which could increase food availability throughout the year, both through traditional means of inducing out-of-season fruiting and the promotion and maintenance of diversity of important supplementary crops which have suffered and are declining in importance due to official overemphasis on non-traditional commercial agricultural production. It was also stressed that the preservation of traditional agricultural and food systems was a major environmental management and conservation concern of the SPREP Action Plan.

Clare Batteke and the Minister stressed the need for studies of plants such as te babai and the soil factors which influence cultivation of te babai in the southern and northern islands of Kiribati, but that this type of research must be done in a very sensitive way because many people commonly protect traditional agricultural information for the exclusive use of their extended families and their ancestors.

The AMAK representative, Tekarei Russell, suggested, in response to the problem of people often hiding traditional agricultural knowledge, that Universities, as recognized institutions of formal education must go out to the islands and include such studies as a priority in formal education, which could be integrated into the curriculum, possibly through involving knowledgeable older people in the education process. Such attempts at making education more relevant must, however, not just be cursory and "arm-chair" activities in nature, but should entail spending some time in the field. It was stressed that only through in-depth observation can these types of information, which are based on millennia of traditional applied research be tapped for application to modern development and educational purposes.

John Marrison stated that USP stressed the importance of traditional science and shared the concern for lack of any substantial data on it. To begin to address this need, USP will be hosting a major conference on traditional science in the Pacific islands in 1990. Bob Richmond of Guam, stressed, along the same lines, that because much traditional knowledge, is not freely given, that there are great dangers in giving large grants to outside researchers on short-term contracts, because they will often be unable to get useful information, or even worse, might collect false data because there is insufficient time to verify results through observation or through the use of reputable (paid) local researchers or informants. He noted the importance of including local people in such research and to pay them a wage commensurate with their critical role in important research. Phil Helfrich supported strongly the sentiment that there is a need for researchers to learn from traditional scientists and the appropriateness of depending on traditional data sources, citing an example of an excellent study of fisheries in Palau, Words of the Lagoon by Robert Johannes, based on information from local informants, which contains more valuable information than most marine biology texts.

4.13 United States Agency for International Development (USAID)

Dr. James Osborn remarked on the complexity of USAID activities which currently assist ten Pacific island countries. It was also stressed that, although funds available to the Pacific have been considerably increased over previous levels, these funds are still limited, as are staff. There is, however, a very significant committment, in terms of the increasing strength of USAID staff in the fields of agricultural, fisheries, health, and environmental development. Among the main goals of the USAID programme in the South Pacific is the improvement of incomes in rural areas, with the health and nutritional status of Pacific peoples and the protection of scarce environmental resources as secondary factors in the sustainability of rural income levels.

USAID is particularly interested in the problem of the protection and sustainability of scarce atoll resources. This interest is evidenced by USAID's willingness to fund this Consultation. Three levels or avenues of funding are available in the region from USAID: 1) support for regional organisations when their programmes

have immediate applicability, including those of many of the institutions participating in the Consultation; 2) small targeted assistance at the local level, often through NGOs and organizations such as Peace Corps, Foundation for the Peoples of the South Pacific, and Save the Children Fund; and 3) activities within sectors such as health, agriculture, fisheries, and small business development, which are being developed to contribute to rural income generation in selected countries. A specific ongoing activity is the SPRAD cooperative project between the USP, UH and Cornell University in agricultural development, extension, research, and training.

He noted that, with USAID's strengthened technical staff, there should be increasing opportunity for consultation with Pacific countries to determine their real aid and research priorities. This Consultation was one of the first major formal steps in this direction.

Mr. Les Clark described USAID's present programmes of assitance for marine resource development, and outlined USAID's plans for further assistance to this sector.

4.14 Representations From Other Organizations

Representatives from organizations unable to attend due to unavailability of air transport or other committments included Dr. Jeff Drew, Regional Project Coordinator and Chief Technical Advisor of the United Nations Development Programme Office of Project Services (UNDP/OPS) Integrated Atoll Development Project (IADP); Dr. Seumanutafa Malcolm Hazelman, Associate Director for Extension and Training of the University of the South Pacific (USP) Institute for Research, Extension and Training in Agriculture (IRETA); and Dr. John E. Munro, Senior Scientist and Director (South Pacific) of the International Center for Living Aquatic Resources Management (ICLARM) South Pacific Office, all of whom sent their apologies to the Chairman. Their Working Papers 6, 12, and 16 are included in Appendix V.

5. PRESENTATIONS BY KIRIBATI PARTICIPATING ORGANIZATIONS AND PARTICIPANTS

5.1 Te Mautari

In a special presentation requested by the Chairman, the General Manager of the Kiribati national fishing company Te Mautari, Mr. Murdo McInnes, stressed that although Te Mautari is a government operation, it is run as a commercial operation, which is "the only way to catch fish". He stressed, however, that the company is heavily aid-funded in many ways in terms of the provision of fishing boats, and in this aspect, stressed that aid must work fast, if aided projects are to become economically feasible. For example, it took over five years to receive two new pole-and-line vessels under the Lome Convention. This had a considerable negative effect on the commercial viability of the operation.

Some other variables affecting the success of Te Mautari are the need for training of excellent natural seamen in the technology of modern fishing; the need to fish all year and to take the fleet into Fiji waters during the off-season in Kiribati; and the fact that the baitfish rearing operation at Temaiku has not been particularly successful because they do not produce fry which attract fish as well as collected wild fish. They see the improvement of the milkfish production and the identification of the reason that artificially produced baitfish are not as effective as the mixed-species wild baitfish as major priorities. A question was also asked with regard to research into the natural availability and production of baitfish.

Mr. McInnes argued that the maximum number of pole-and-line vessels should probably be no more that six to eight, or else there would be negative effects on the sustainability of baitfish resources which are basically obtained from four lagoons (Tarawa, Abiang, Abemama, and Butaritari) in which bait stocks seem to be declining. He, thus, stressed the importance of milkfish aquaculture to the future operation and expansion of the fishing industry.

From an economic standpoint, it was mentioned that, although Te Mautari would be willing to pay an economic price of $2.50 per kg, the government currently provides baitfish from Temaiku at $1.60 per kilo. He stated, however, that if he were running the baitfish aquacultural operation on a commercial basis, he would sell

them for over $6.00 per kg. The SPC representative said that some studies have shown that the best catches have been realized when mixed wild baitfish and milkfish are used. In answer to a question as to the overall economic viability of Te Mautari, it was indicated that catches are improving and that the operation seemed to be increasingly economically viable.

5.2 Agricultural Sector

Sam Edwards, a tree crops agronomist whose expertise lies in the area of coconut replanting, stressed that the coconut replanting schemes in the past have been less than successful because of overoptimistic estimates of how many acres could be planted, which put pressure on the ability to obtain sufficient high-quality seed nuts. Other problems included inappropriate spacing, which was too close in the past.

Current efforts, based on research over the past few years, have been to show farmers that benefits can be obtained by rehabilitating palms planted under the previous replanting scheme, as well as encouraging farmers to continue replanting using improved varieties. Rui Williams, the Chief Agricultural Officer, supported Sam Edwards in stressing the emphasis placed on coconuts and efforts to rehabilitate existing replanted areas, particularly through the application of fertilizers, as well as putting some emphasis on vegetable production. One of the main vehicles for implementing the programme is the use of demonstration plots.

Means of fertilization included injection of trees with trace elements. The Chairman asked a question related to the possibility of fertilizer pollution of groundwater resources. It was suggested that the trunk injection of nutrients in no way affected groundwater, and that the frequent low-level applications of potassium around the bases of trees provided for efficient nutrient uptake, with very little evidence of pollution of groundwater.

In discussion, it was indicated that in previous replanting schemes, the government had advised farmers to clear all plants and trees from the land, regardless of traditional utility, although farmers are now encouraged to protect and conserve valuable trees.

It was suggested that such practices had led to widespread deforestation and loss of valuable subsistence products.

In response to a question regarding the economic viability of fertilizer use, the cost to the farmer would be $150 per acre, with returns of $300 ($150 profit), which does not include labour costs.

Dr. Sandhu reported on research on the taro beetle (Papuana sp.), which has caused considerable damage to te babai, an important ceremonial and staple crop, as well as to bananas. He stressed that control was based on the behavior of the beetle because of the danger to groundwater resources when employing pesticide. Strategies that suit the atoll environment include the use of non-chemical approaches. Currently recommended are the maintenance of high water levels (deepening pits) and good pit husbandry, clearing waste organic material which serve as breeding sites, as well as some other methods such as covering plants with nylon mesh or the application of kerosene to the water in the pits.

In relation to vegetable production, there are only 5 insects considered to cause significant damage. Current control measures include physical control measures such as traps made of locally available empty tins, with some experimental work being done to test the value of relatively safe pesticides in case there is a need for them in the future. Some work is also done with pest control on coconuts and cantaloupe, with biological control being considered for the recently introduced white fly in South Tarawa.

Because there are relatively few pests in Kiribati, there is considerable emphasis on quarantine and restriction of the movement of plant materials, both into and within Kiribati. The use of poison baits to control rats on three islands is also part of the regular pest control programme.

In response to a question on the importance of coconuts, Mr. Rui Williams stressed that coconuts were the only commercial crop currently available to the people of Kiribati who live in outer islands. Additionally, the coconut is a major food crop, a source of shelter, medicines, fuel, as well as serving countless other cultural and ecological functions. It was also stressed that 79% of all export income in 1985 came from copra production, whereas only 17% came from fish exports.

Although traditional planting technologies, used in the past by I-Kiribati planters, seemed to have been well-suited to the atoll environment, the over 6000 acres of coconuts planted in the outer islands over the past 20 years, using spacings and planting technologies suggested from overseas, have been mostly a failure. Another problem seems to have been the lack of high quality planting materials, sufficient for the large acreages required, whereas traditional gardeners were probably able to more carefully select good planting material from mother trees. Other problems are nutritional and social, in terms of people not being willing to cut down coconuts, even if they are senile. Whereas a wealthy farmer will clear old coconuts and replant, a poor farmer may not, possibly because he is not driven by the economic incentive of payments to clear and replant. One of the reasons for the focus on fertilizer-based rehabilitation programmes is that farmers can get some return within a year, whereas they may have to wait much longer to reap the benefits from a replanting scheme.

John Finlay stressed the fact that IRHO at Sarautoa in Santo, Vanuatu, one of the best coconut research organizations in the world, has offered expertise to other Pacific countries, although because of the nature of atoll environments, there was a need to conduct specific experimentation and hybridization research in the atoll environment.

It was suggested by George Moengangongo that we must look more carefully at coconuts not only as a commercial resource, but also as a subsistence resource, and that for most subsistence purposes, the local cultivars seem to be most appropriate, and do not require costly imported inputs.

In response to a question as to whether such fertilizer rehabilitation is a process that needs to be continued year after year, it was explained that the application of trace elements by trunk injection lasted three years, whereas the direct potassium fertilization must be continued yearly.

In relation to plant and animal quarantine, the Minister questioned the rationale for restricting imports of chicken and vegetables from particular points of origin, with some points of origin, such as Australia, being favoured over others such as the U.S., at the seeming detriment to the people of Kiribati. The

Minister asked whether this was just a hangover from colonial times or whether such long-standing regulations were really needed or could be changed. A definitive answer was not forthcoming, although it seemed that, in fact, some regulations were inappropriate and were based more on traditional colonial and economic ties and not on any sound technical or pest-related basis. Mike Hamnett pointed out that the University of Hawaii has a programme in its School of Tropical Agriculture and Human Resources focussing on quarantine and problems related to it. It was also pointed out that the South Pacific Commission Plant Protection Programme in Suva would also advise countries on the appropriateness of plant quarantine regulations. It was suggested, however, that with the increasing importance of commercial aquaculture, there will be increasing regulation of the movement of aquatic resources in the future, which are not regulated as strictly at present as terrestrial plant and animal products.

In summarizing, based on current research priorities, the major areas of applied research in agriculture included:

1. The need to test hybrid coconut cultivars, which has received little emphasis in the atoll countries. This would include the capacity to conduct hybridization and screening work of cultivars of both commercial and subsistence potential in Kiribati.

2. The need to screen vegetables and other plant cultivars for resistance to high levels of salinity and prolonged drought.

3. Experiments with vegetables and technologies suitable to the production of the more difficult vegetable to grow in the atoll environment, such as Chinese cabbage, English cabbage, tomatoes, and watermelons.

4. Control of the taro beetle, short-term vegetable pests, some minor coconut pests, rat control, and quarantine regulations to restrict the spread of those pathogens which do exist in Kiribati or elsewhere.

5. The need for the development of the capability to produce high quality planting material of coconuts and other selected plants, and to facilitate the introduction of improved genetic material.

5.3 Fisheries Sector

Mr. Tukabu Teroroko, the Chief Fisheries Officer, reported that the fisheries programmes are directed towards providing a food resource, export income, and employment. Programmes include milkfish culture for food and baitfish, seaweed production, transplantation of the important bivalve known locally as te bun (Anadara maculosa), an improved boatbuilding programme which allows fishermen to go farther more safely and to carry larger catches, gear improvement, fish preservation, and ice making. Of particular importance is the fish aggregation device (FAD) programme, which makes it easier for fishermen to get to the productive fishing grounds, a major objective being to minimize the loss of fishermen at sea, a serious problem in Kiribati. There is also a statistical programme to evaluate fisheries resources and to monitor overfishing, the major project focussing on Tarawa lagoon, plus the ongoing surveys of baitfish resources.

Other areas of potential development include giant clam culture and the possible introduction of Trochus niloticus, which has proven to be a successful export income earner in other areas of Micronesia after its introduction by the Japanese. The stocking of beche-de-mer species, and the development of artificial reefs are other areas of interest. There is also considerable interest in evaluating the potential of underexploited resources such as deepwater snapper resources.

The Chairman expressed concern over the high degree of inshore gillnetting in the lagoons in Kiribati because of its possible negative effects on all fish species. James Woodruff reported on the very serious view taken of open-sea gillnetting in Hawaii, where very stern measures are being taken to restrict such "stripmining" of the seas, including heavy fines, refusing use of harbour and maintenance facilities, etc. It was stressed that Kiribati has also taken a very strong stand against open sea gillnetting.

Bob Richmond asked the Kiribati representative whether ciguatera poisoning was a serious problem in Kiribati. It was stressed that ciguatera was a problem in some areas of Kiribati, and that studies were being conducted by Temakei Tebano in Kiribati, the results of which will soon be published in Hawaii. Phil Helfrich stressed the great gains that have been made to understand this

highly variable problem, and stressed that support should be continued in efforts to better understand it, particularly in terms of factors which control its genesis and incidence which seems to be associated with reef disturbance. In relation to such reef disturbance, Paul Bienfeng warned of the dangers of the establishment of artificial reefs, which may not really increase fisheries productivity, but rather only aggregate the fisheries resources and make it easier to overexploit them.

In relation to the widespread interest in the exploitation of deepwater snapper resources, it was suggested that the deepsea benthic snapper resource is much more fragile than people realize, and, as experience in Guam shows, could be brought to the point of non-recovery very easily through overfishing. Garry Preston suggested the surveys at the SPC have given us a good idea of the extent of these resources, so that, if so desired, they could be managed on a sustainable basis. He, however, supported the concern that, if overexploited, deepsea snapper resources could be easily destroyed.

Les Clark, asked if the concerns over the overexploitation of reef and lagoon resources and concern over the increasing scarcity of certain favoured species could possibly be elaborated on in terms of the priority of research needs.

Mr. Being Yeeting said that the Fisheries Division had, for a number of years, conducted surveys of fisheries resources and of catch-and-effort studies in artisanal fisheries throughout Kiribati. The main findings are that there are definite signs of overfishing, particularly in the Tarawa Lagoon. The artisanal surveys included catch-and-effort data and inventories of fishing equipment. All of these indicate serious overfishing. This baseline data, however, does not include good biological data on specific fisheries, and there is a need for further research. One example of the need for specific research, suggested by the Secretary to Cabinet and the Chairman, was that the government's plans to establish milkfish ponds in outer islands based on natural supply of fry, must be supported by research to determine the feasibility and possible effects of such developments on lagoon resources.

In response to a question regarding the presence of goldlipped pearl shell in Kiribati, the presence of which has been confirmed at

Kiritimati, it was reported that there is a major USAID project to improve the blacklipped pearl oyster industry in the Northern Cook Islands, the results of which should be applicable to some of the islands in Kiribati and other atoll countries.

5.4 Discussion Related to Presentation by Kiribati Participants

The Chairman mentioned the possible effects of the linking of North and South Tarawa by causeway and how this might shift the focus of resource utilization and require environmental impact assessment of the effects of such developments. Phil Helfrich mentioned that for Kiribati the development of borrow pits in association with the building of causeways such as that proposed to link north and south Tarawa, which could create enriched fisheries habitats on windward coastal reefs, might make fishing more accessible, and provide a dampening effects to storm surge. It was suggested, however, that this may intensify the incidence of ciguatera poisoning in such areas due to reef disturbance.

Nakibae Fabokae stressed that the rapid movement of people from South Tarawa was already taking place which will have considerable implications on resource use sustainability in North Tarawa. James Osborn supported the need to focus on the process of urbanization and its serious impact on resources, and argued that, if innovative strategies are not adopted to shift resource-use emphasis, major resource-use problems could ensue in the future. It was also stressed that such innovative approaches, such as well thought-out resettlement schemes, if well presented, can be attractive to aid agencies.

Iosefatu Reti, remarked that one problem is that the environmental impact assessment process is not properly understood in many areas of the Pacific and that it is often seen as being an obstruction to development instead of being seen as part of development or a way of showing the possible alternatives of development. This sentiment was strongly supported by Kaburoro Ruaia, who suggested that we must begin to take the need for environmental assessment seriously, because, although the initial costs of a given development may be greater, very considerable social and environmental costs may be far greater than the extra cost in designing a project based on sound assessment of the

environemntal risks and tradeoffs of a given project. The Secretary for Finance, from a more economic perspective, stressed the need for environmental assessment and the development of a strong applied atoll research capability to show potential aid donors that there are, in fact, great long-term benefits to be gained by addressing possible negative aspects of a project in the initial planning and implementation stages. The Secretary to Cabinet similarly stressed the economic problem of fostering environmentally conservative development, and the importance of environmental impact statements on one hand, while on the other the reluctance to conduct such assessments because of the cost. Iosefatu Reti again stressed the fact that money spent on EIA is money well spent and that it is increasingly common for donor agencies to require EIA work which could often be required of the donor countries themselves.

Nakibae Tabokai, along similar lines, stressed the critical need for good planning so that there will be a good life for people in South Tarawa, and the need for EIA and the protection of some aspects of the traditional way of life, for if the need for such planning is not taken seriously, it would be like enjoying a feast, while the fine mat you are sitting on is about to be pulled out from under you.

6. REPORTS OF WORKING GROUPS

Based on the first two days of the Consultation and, in particular, the Minister of Natural Resource Development's address on the areas of priority in applied atoll resource development in Kiribati, four working groups were established to prepare working papers for presentation, amendment and approval by the participants of the Consultation and the Kiribati Government.

6.1 Nature of Working Groups

The four working groups and their areas of concern, in terms of the prioritization of concern in applied atoll research, were as follows:

Group 1: Non-living Resources (Including mineral resources, water resources, energy development, and coastal geomorphology and engineering)

Group 2: Agricultural, Urban and Terrestrial Resources (Including agricultural, forestry and soil resources, land tenure and land use, and housing and urban development)

Group 3: Marine Living Resources (Including pelagic, deepwater benthic, lagoon, reef and nearshore fisheries resources, and aquaculture)

Group 4: Conservation and Environmental Management (Including national park and conservation area establishment, endangered species protection and management, and environmental impact assessment)

Each Working Group was asked to produce a Working Paper by Wednesday afternoon for discussion, amendment and approval by the participants in the Consultation. Each group selected a rapporteur who was responsible for submitting the Working Paper of each Group to FSP for photocopying and distribution to all participants (including observers), for discussion, amendment and approval.

6.2 Terms of Reference for Working Groups

Groups 1-3

Groups 1-3 were all expected to:

1. Provide a statement of justification for applied research in the areas of concern allotted to each group, based on past developmental experience and current and future needs assessment.

2. List areas of research which are considered to be of highest priority by the Kiribati government.

3. List other research areas which are of considerable importance, either to Kiribati or other atoll countries, or of international developmental importance.

* For Groups 1, 2 and 3, a brief rationale of the importance of the given research areas should be provided.

Group 4

Group 4 was expected to:

1. Provide a statement of justification of the need for conservation, environmental and resource management, and environmental assessment.

2. List potential areas for the development of national-level parks or conservation areas in Kiribati.

3. List potential areas or resource types which require protection or management at the community or local level.

4. List individual plant and animal species requiring protection or improved management.

A brief statement of the rationale for each area, resource, ecosytem, or species which warrants special management of conservation status should be provided.

7. WORKING GROUP PAPER 1: NON-LIVING RESOURCES

7.1 Introduction

Non-living resources in the atoll environment that are identified as priority areas for development in Kiribati include mineral, water, and energy resources. Use of mineral resources provides the opportunity to earn foreign currency, or reduce dependency on costly imported materials. The study of water resources is essential to proper management to meet growing demands in an environment where water is scarce. Baseline studies of the physical coastal environment are of considerable importance in assisting with the use and development of these resources and with the country's coastal development programme.

The priority areas identified below do not represent all areas that should be addressed to assist with development, but are those that are appropriate for an atoll applied research centre to pursue.

7.2 Priority Projects for Kiribati

7.2.1. Sand and Gravel Resource Identification and Management

Project 1: To identify sand and gravel resources needed for construction, roading, landfill etc.; to identify best areas to mine close to where the resource is required and where mining will not conflict with other developments or produce effects counterproductive to the overall use of the coastal area; prepare a management plan for the extraction of sand and gravel from lagoon and reef flat areas.

Project 2: To investigate the viability of cement manufacture in Kiribati. Such an industry would reduce dependency on imported cement and create jobs in Kiribati.

7.2.2 Black Coral Resources

Project 1: Establish distribution, quantity, and quality of black coral and investigate the potential of establishing a small local black coral industry aimed at a growing tourist market.

7.2.3 Coastal Baseline Studies of Beach, Reef Flat, Lagoon, etc. fo development planning

Project 1: Establish a pool of data on coastal sediment processes, waves, currents, tidal action, lagoon circulation, etc., as required for development planning and engineering design. Coastal activities such as reef blasting, mining, harbour development, and coastal construction, require baseline information for design, resource management, and environmental management plans.

7.2.4 Water Resources

Project 1: Establish a laboratory to monitor water quality on a regular basis. Measurements of quality of both ground and lagoon water should be made to monitor the effects other activities may have on the water resources on atolls.

Project 2: Establish a management plan for freshwater use on densely populated atolls. By monitoring water use, future requirements can be estimated and a plan developed to ensure a continuing supply of freshwater as needed.

Project 3: Establish the nature of water movement within the fresh water lens, especially in populated areas.

Project 4: Establish the potential of renewable energy technology as a byproduct of producing freshwater in the atoll environment.

7.2.5 Renewable Energy

Project 1: Investigate potential for establishing OTEC plants in Kiribati. A study is required to identify suitable sites for OTEC technology and collect the information on those sites needed to assess the potential for OTEC plants. As well as providing an electric power supply, such plants are a source of cold water which has specific uses in air-conditioning, refrigeration, aquaculture and agriculture.

Project 2: Extend the use of solar energy technology especially in water heating. Increased use of solar energy will reduce the dependence on expensive imported fuels.

Project 3: Investigate the potential of improving the availability and use of domestic fuels in Tarawa, specifically in improving firewood supply and local production of charcoal.

7.3 Discussion on Working Group Paper 1

In response to a question about the development potential of a precious coral project, the meeting was informed that certain corals which have value for making jewellery could be collected, processed, and sold by a Kiribati operation with little or no outside assistance. Some of these resources were being sought by vessels from other parts of the Pacific and, if not collected and utilised by Kiribati, may be taken by others with no benefit to Kiribati.

It was agreed that there was a real need to establish a laboratory to monitor water quality on a regular basis. However, it was stressed that careful consideration must be given in deciding where it would be based and who would control it. As there was a shortage of qualified and experienced people to run such a laboratory, training should be an important part of this project.

The meeting was informed that the work described in projects on the fresh water lens and fresh water supply to urban areas would probably be dealt with by the UN Department for Technical Cooperation Pacific Islands Water Resources Development Project, based at the USP Institute of Natural Resources, which was setting up a drilling programme in Kiribati to determine the amount of extractable water available.

Questions were raised as to whether OTEC technology was really viable today or whether it was still experimental, and whether it was too costly to set up and maintain. It was mentioned that the Japanese had set up and run an OTEC plant in Nauru several years ago, but that this had run into problems and had ceased operation. The meeting was informed that considerable research had been done in recent years and that experimental plants were operating successfully in Hawaii. It was felt that, in the light of recent

progress in developing this technology, it was an appropriate time to look at the possibility of establishing plants in Kiribati.

The idea of investigating charcoal production was supported and the meeting was informed that this project was part of a larger programme in the coconut replacement scheme. Old trees being replaced would be used, among other things, in a charcoal production experiment. The meeting was warned that if organic matter was burned and not put back into the soil, such a practice could ultimately lead to soil depletion.

The meeting raised the question of the value of a biogas project to provide domestic fuel for urban areas where there was a growing shortage of fuel. It was stressed that such projects had been tried in Kiribati and other areas of the Pacific without much success. In South Tarawa, where there was the need, it was not possible to farm enough animals to make the project work. Also whatever manure was available was required as a fertiliser. There also appeared to be strong social objections to using human waste which could possibly be overcome in time with education.

8. WORKING GROUP PAPER 2: AGRICULTURAL, URBAN AND TERRESTRIAL RESOURCES

8.1 Rationale for Applied Research on Terrestrial Resources

Given the very limited terrestrial resources, including land, soil and plant and agricultural resources, and very high population densities, particularly in urban Tarawa due to rural to urban migration, there is a critical need to evaluate these scarce resources and develop appropriate development strategies. Such research would address the need for land use intensification in densely settled areas and the need to make life in rural areas more attractive and more productive in an effort to reverse trends of rural-to-urban migration. Such research must involve both the natural and social sciences, and perhaps, most important, local people in such research because of the very close interrelationship between land use development and social factors.

The need for applied research specifically focussing on atoll terrestrial resources and the establishment of a centre to coordinate such activities is seen as particularly critical and appropriate because of the unique and very limited and fragile nature of atoll resources. More specifically atoll soils are among the poorest in the world agriculturally; water resources are extremely limited and subject to depletion; high salinity affects all life forms; drought, tropical cyclones, and other climatic problems are common; and terrestrial plant and animal resources are perhaps the poorest or most limited in the world. Despite the poverty of the resource base, it is these resources, which have served and, with some appropriate introductions, will have to serve most of the commercial and subsistence needs of the people of Kiribati and other atoll peoples.

Related to increasing population densities, scarce resources, and the inappropriate utilization of such resources, there are rapidly increasing incidences of malnutrition, nutrition-related diseases, and health problems related to urban crowding in atoll countries. Because there are very limited opportunities for income earning in rural areas and because of rapid increases in the importation costs of expensive food and other goods, there is a need for research to identify new income generating opportunities as well as strategies to maximise self-sufficiency and import substitution at the local level. Moreover, scarce resources, such as land, marine food species, and

firewood, are under pressure and are being rapidly depleted, especially in densely populated areas, thus stressing the need to identify strategies for the sustained development and management of these resources.

8.2 Areas of Research Priority

Areas of research priority fall into three basic categories: 1) studies related to the commercial and subsistence importance, endangerment status, propagation, and promotion or replanting of a wide range of socially, economically and ecologically important plant species; 2) the development of agronomic practices and strategies which will lead to the protection and increased productivity of agricultural and food systems in the atoll environment; and 3) land tenure and land use studies and experiments designed to develop appropriate strategies for high density settlements in the atoll environment. In all cases, it was stressed that such studies and strategies need to be tailored to the cultural needs of atoll societies and should include local researchers from the communities involved as fully (rather than token) paid members of research teams or projects.

The individual areas of applied research priority are listed below, without reference to the specific order of priority.

8.2.1 Coconut Cultivar Improvement, Replanting and Rehabilitation

Any improvement in the productivity of coconut palms will be of major economic and cultural significance as coconut is the most important commercial and subsistence crop in atoll countries, providing in Kiribati, for example, 79% of all cash income and providing countless subsistence products such as traditional building materials, fuel, a staple food, drinks, in the form of juice and toddy, medicines, cosmetics, etc., the replacement of which would be either impossible or very expensive. There is also a need to identify and protect cultivars which have particular subsistence utility, such as cultivars which provide strong coir for the production of sennit and other products.

8.2.2 Giant Swamp Taro (te babai) Improvement

Any improvement in the yields, based on cultivar or production system improvement, of this culturally and nutritionally important crop will contribute significantly to the cultural and nutritional wellbeing of Kiribati.

8.2.3 Breadfruit Improvement and Promotion

This very important seasonal staple tree crop is eaten almost daily when in season, and can also be preserved. Given improved cultivation techniques and the identification of salt- and drought-tolerant cultivars, increased breadfruit production could contribute greatly to nutritional improvement on atolls. Culturally acceptable technologies for its preservation would contribute to its promotion.

8.2.4 Native Fig (te bero) Improvement and Promotion

The improvement and promotion of this drought-resistent staple food crop which bears fruit continuously, could lead to considerable nutritional development and food security on drought-prone atolls. Improved less labour-intensive harvesting and preparation technologies could also contribute to the increased importance of this species.

8.2.5 Development of Optimum Agricultural Systems for High-Density Settlements

Given land shortage, increasing dependence on nutritionally inferior and expensive imported foodstuffs and associated malnutrition in densely settled atoll urban areas, the development of optimum, nutritionally-sound agricultural systems for high-density settlements is crucial to economic and nutritional development of atoll peoples.

8.2.6 Germplasm Collections, Reproduction, and Distribution of Important and/or Endangered Local Plant Species and Cultivars/Varieties

There are numerous indigenous plants, cultivars of imported food and other useful plants, which because of urbanization, commercial agricultural developement, and deforestation, are very scarce or endangered, and can only be saved and promoted by a systematic research and development or reintroduction programme.

8.2.7 Identification, Testing, and Promotion of Appropriate Vitamin-rich Food Crops

Because of the shortage of traditional leafy green vegetables and other vitamin and mineral-rich crops in the atoll environment and the increasing incidence of vitamin and mineral deficiency and other nutrition-related disorders, particularly in urban areas, the identification and testing of foodcrops for local commercial and subsistence production is seen as a priority.

8.2.8 Identification of Pandanus Cultivars and Utilization for Food, Plaited Ware, Construction, and Other Purposes

Because of the broad cultural and nutritional importance of pandanus cultivars, many of which are increasingly scarce or endangered, the systematic identification, reproduction and promotion of the planting of pandanus is seen as a priority

8.2.9 Identification of Alternative Commercial Uses and Processing Technologies for Coconut, Pandanus, and Other Plant Products

Because of the very limited cash earning opportunities on atolls, particularly in rural areas, research to identify alternative commercial uses of coconuts and other plants is seen as a priority

8.2.10 Research on Land Tenure and Land Use

Because of rural to urban migration and the nature of traditional land tenure practices, underutilized land is often unavailable to people who are interested in using it, particularly young rural people. There is, consequently, a need for land tenure and land utilization studies which could serve as a basis for land reform or land use intensification.

8.2.11 Research on Fertilizer, Mulching and Composting Systems and Soil Improvement and Conservation

Due to the extremely low natural fertility and level of organic material in atoll soils, coupled with problems of natural and physiological drought, there is a critical need to identify appropriate systems of fertilization, mulching, composting, and soil improvement which capitalize on both traditional and appropriate introduced technologies.

8.2.12 Improvement of Water Accessibilty, Irrigation, and Water Conservation

Due to the scarcity of groundwater and periodic drought on most atolls, there is a critical need to improve water accessibility, irrigation and water conservation strategies to maximise the use of scarce water resources for agricultural, domestic, and small-scale industrial purposes.

8.2.13 Data Collection on Traditional Agricultural Technology and Knowledge

Because of the ignorance of traditional agricultural knowledge, on the part of most formally trained agricultural scientists and developers, technologies and knowledge gained over thousands of years in the atoll environment, many of which have great utility in modern development, are being lost. There is, thus, a critical need to systematically gather data on such sytems before this knowledge is lost.

8.2.14 Analysis of Soils and Plant Tissues for Soil Nutrient Levels

This facility is necessary in conjunction with plant nutrition trials to determine optimum levels of organic and inorganic fertilizers. Such studies should provide the valuable capacity to improve agricultural productivity for a wide range of crops grown in nutrient-deficient atoll soils.

8.2.15 Research on the Ethnobotany and Economic Potential of Existing Atoll Plant Resources

Almost all indigenous and recently introduced plant resources are useful, in some way, to atoll societies. There is, however, little information on the distribution, endangerment status and cultural utility of atoll plants which can be made available to planners and policy makers. Such plants, consequently, receive little if any official recognition in formal development plans within agricultural, forestry, or urban and housing related sectoral development objectives, despite the fact that they have known social, economic and ecological importance which could not be replaced with foreign substitutes, or even if they could be, would be either very expensive or lead to significant cultural change, often of aspects of culture which atoll societies highly value.

8.2.16 Feasibility Studies on Atoll Reforestation and Tree Planting

Atoll societies have long suffered deforestation due to expansion of monocultural coconut plantation development, urbanization, and the long-term use of forest resources for construction, boatbuilding, fuel and other purposes. There is, thus, a need for systematic studies of the endangerment status of culturally and ecologically important plant resources, their life histories and modes of production, cultural utility, and the potential for their use in reforestation or tree planting programmes. This is seen as particularly important in the atoll environment, where all trees are integral and useful components of traditional agricultural systems, providing a wide range of construction materials, fuel, medicines,

fertilizers and mulching, flowers and perfumes and other useful products, as well as serving a wide range of ecological functions such as soil improvement, shade, coastal protection, marine habitats, and sea-bird nesting areas. The increasingly critical fuel shortages on South Tarawa and in other atoll areas, coupled with increasing energy dependency also underline the importance of appropriate tree planting programmes.

8.2.17 Small Livestock Improvement and Production Systems and Local Feed Production

Given the limited land area and limited plant resources of atolls, the potential for large livestock production, even of goats, is very limited and ecologically dangerous. The production of small scavenging animals, such as pigs and poultry, both culturally and nutritionally important to most atoll societies, seems to offer the greatest potential for developing local terrestrial protein resources, based to a great extent on locally available waste products and foodstuffs. There is a need, however, to develop production sytems and feed resources suitable for densely populated and feed-poor atoll environments.

8.2.18 Agricultural, Solid and Domestic Waste Disposal and Utilization Studies

Studies of improved disposal, utilization, or recycling of agricultural, solid, and domestic wastes are important for two reasons. Firstly, many types of waste, such as aluminium cans, coconut waste, and human waste, constitute a health problem, in terms of transmission of diseases or serving as mosquito and fly breeding sites. Secondly, in a resource poor area, there may be valuable uses for agricultural, domestic animal, human, and domestic waste and, with by-products being used for fertilizer, fuel or energy generation, for fish and aquacultural feeds, or other purposes. All such activities would yield considerable economic and social benefits.

8.2.19 Strengthening of Plant Quarantine Services and Plant Protection Programmes, with an Emphasis on Non-chemical and Biological Control Strategies

Due to the scarcity of plant resources in the atoll environment, pest infestations to crops, such as coconut and giant swamp taro (te babai), constitute perhaps a greater danger in Kiribati than in other areas with more diversified plant and animal resources. There is, thus, a continuing need to strengthen plant quarantine and plant protection capabilities and services. The plant quarantine services, both in relation to international and intranational movement of plant and animal materials, are particularly important because many islands are currently free of some major pests, such as the taro beetle (Papuana sp.).

8.2.20 Improvement of Bioaesthetic/Flowering and Fragrant Plant Resources and Systems

Aesthetic plant resources, in particular flowering and fragrant plants, are of extreme cultural importance for making garlands, coconut oils, have ceremonial and spiritual value to atoll societies, and contribute significantly to the quality of atoll life. Such plant resources are, however, being thoughtlessly eliminated in the face of modern urban and agricultural development. There is, thus, a need for these plant resources to be identified, their endangerment status defined, and strategies developed for their reproduction and re-establishment in agricultural areas, home gardens and plantings along roadsides and public places.

8.2.21 Studies of Social Constraints to the Sustained Development, Management and Protection of Scarce Atoll Resources

Numerous studies show that social factors, such as division of labour, land tenure, leadership and local politics, cultural beliefs and behaviour, traditional conservation and resource management practices, and social committments, strongly effect the success of technically feasible and socially appropriate resource development programmes. There is, thus, a need for sociological studies to determine attitudes and cultural practices which may determine the success or failure of given resource development programmes.

8.3 Discussion of Working Group Paper 2

In response to the need for reforestation and tree planting, the Minister reported that there was a "Plant a Tree Day" which tried to reverse the dangerous trends of the past which have led to widespread deforestation and neglect of trees.

In response to a suggestion that few of the Working Papers or Working Group Papers had focussed on the social obstacles to natural resource development, which are considerable, and, in some cases, may be the major consideration in the success or failure of given projects, the Minister strongly supported the need to evaluate social factors in resource development programmes where this is an important factor. The Secretary of Education, similarly, stressed the need to focus on the human factor in development in terms of preserving the beauty and less tangible aspects of culture which are so important, but which are so rarely covered in official development planning. He cited the example of the disappearance of sacred and fragrant trees species such as te uri (Guettarda speciosa) which are important in the production of garlands for important occasions and which are featured in traditional love songs and legends, as well as being important in the process of preserving traditional foodstuffs by sun drying and in composting. Iosefatu Reti of SPREP stressed that such studies of the impact of development projects on social factors were an important component of the environmental impact assessment process.

9. WORKING GROUP PAPER 3: LIVING MARINE RESOURCES

9.1 Rationale for Applied Research on Living Marine Resources

I-Kiribati have traditionally depended on a range of products from the sea for their well-being. The Government of Kiribati places a high priority on gains from marine resource management and development to improve nutrition and create employment and income-generating opportunities, especially in outer islands, in ways which protect and enhance the atoll environment. A strong programme of marine resource research is needed to identify and develop the options available to the government and people of Kiribati in order to achieve these aspirations.

9.2 General Research Priorities

Against a background of increasing urbanization and pressure on marine resources and the marine environment in Tarawa, and the related need to improve the relative well-being of communities in outer islands, the priority areas of the atoll research marine resources programme should be:

1. Research on the management and enhancement of stocks in Tarawa lagoon and elsewhere which are threatened by depletion from overfishing;

2. Research on aquaculture at a variety of levels, especially on milkfish, as a means of enhancing natural populations of selected marine resources, providing bait for the local tuna industry, and foodfish for local consumption and exp[illegible];

3. Research on the development of unexploited or underexploited resources which might provide additional sources of subsistence protein, as well as employment and income-generation opportunities;

4. Research on the protection of marine resources and the marine environment generally from pollution and other terrestrial inputs resulting from land-based activities, and from the impacts of development activities such as causeway construction.

With such priorities, a marine research programme could play a role in the improvement of the quality of life on the outer islands, thus discouraging further drift to Tarawa, as well as encouraging part of the commercial fishery in Tarawa to move offshore, thus reducing pressure on the resources of the lagoon and enhancing yields for subsistence oriented users. It could help increase, or at least preserve, the present level of catches in the Tarawa lagoon; could increase export revenues from tuna and other marine resources; and could enable the government to ensure that activities such as causeway construction, solid waste disposal, resort development, etc, protect and, where possible, enhance the marine environment.

9.3 Research Priorities for Capture Fisheries

9.3.1 Inshore Fisheries

There is an urgent need to address inshore artisanal fisheries problems, particularly as they apply to human population movements and the resultant demands placed on certain inshore fishery stocks. Overall development and management of the resources of Tarawa lagoon are seen as a priority, as one third of Kiribati's population of about 20,000 people (a figure that has doubled in the last decade) now live in South Tarawa. With this trend expected to continue, and with a desire on the part of the Kiribati Government to utilise locally produced foodstuffs, where possible, the marine resources of South Tarawa are in serious jeopardy. There is an urgent need for better management in the face of this urbanization and related health problems. Possible projects include:

Project 1: Monitoring and Assessment of Lagoon Resources

Data has been collected for 10 years on some aspects of the fishery. There is a need for trend analysis and the application of management.

Project 2: Encouragement of Offshore Artisanal Fishing Activities.

The aim here is to reduce pressure on lagoon resources and to

take advantage of the more extensive and resilient offshore stocks of pelagic and outer slope species.

Project 3: Explore Habitat Enhancement for Resource Conservation and Improved Exploitation

Possible methods to be explored include the digging of borrow pits on the ocean reef to provide a concentrating mechanism for reef fish, emplacement of octopus habitats, the deployment of fish aggregation devices for offshore species and for lagoon baitfish, and the use of "artificial reefs", perhaps in conjunction with area closures, as a means of restoring lagoon fish stocks.

Project 4: Study Resource Enhancement and Possible Harvest of Other Resources Having Potential as Subsistence or Commercially Exploitable Foods

a. Cockles, known locally as te bun (Anadara maculosa) are currently heavily gleaned by local subsistence gatherers, mostly women and children, on a daily basis. Several aspects of the te bun fishery deserve further study: 1) the management of the resource that is obviously overfished in South Tarawa, 2) the distribution of this species that does not occur in all islands of the Gilberts group, and 3) the methods needed for stock enhancement and its possible introduction into areas where it does not presently exist;

b. Sea cucumbers, a resource in high demand in Asia, but with problems relating to quality control and marketing. There needs to be a study of the distribution of the resource and alternatives for harvesting, processing, marketing and resource enhancement;

c. Trochus spp. (topshell) and Turbo marmoratus (green snail), species of considerable export potential. There is a need for the exploration of the potential for introduction and establishment of these species as has been done successfully elsewhere in the Pacific;

d. Black pearl oyster, a major export income earner in the atolls of the Cook Islands. There is a need to explore the potential for its production in Kiribati;

e. Sponges, a high-value non-perishable product. There is a need to assess the potential for a limited market for sponge products such as bath sponges;

f. Spiny lobsters,a high value luxury food item. There is a need to assess the status of stocks of spiny lobsters at Christmas Island and recommend management strategies to ensure a maximum sustained yield;

g. Milkfish, the priority marine species in Kiribati. There is a need to assess the management problems of milkfish in the fresh water environment of Washington Island.

Project 5: Assess the options for mullet fry enhancement in Tarawa Lagoon.

Project 6: Monitor changes in the incidence of ciguatera fish poisoning in Kiribati, and liaise with other organisations working in this field.

Project 7: Examine the impact of extensive causeway development on Tarawa atoll.

This has particular implications for the circulation and biological productivity of the lagoon. There is serious concern that closing off the channels between lagoon islets will have a detrimental effect on the biota that serve as the basis for the heavily exploited artisanal fishery of South Tarawa. There is also a related health problem that will most certainly be worsened by the reduced circulation of Tarawa lagoon that results from causeway construction. Some studies on lagoon circulation have been conducted, but there is a need to examine all of these and relate them to atoll lagoon circulation studies elsewhere. Based on this background material, a more detailed study of the circulation of the lagoon, with predicted changes in the light of various strategies of causeway construction, may be needed. This must be accomplished in the light of what is known about the distribution of living aquatic resources and their environmental requirements.

9.4 Research Priorities for Offshore Fisheries

The offshore tuna resources are the basis for a major export item that is essential to the economic development of Kiribati. This is a high priority sector of the Kiribati development plan. The industrial pole and line fishery is dependent on wild bait and on cultured milkfish bait for its operation. Each plays an essential role because wild bait is not available during certain seasons and phases of the moon. At these times the industry must call on the aquaculture system at Temaiku to supply the essential element for this fishery.

Project 1: Continued assessment of wild stocks of bait in the four target lagoons where they are fished.

This is required in order that better management practices can be exercised. The baitfish sampling programme will allow for the determination of key population parameters that can provide the basis for a rational management strategy to ensure optimum harvesting of this important resource. This will be an ongoing project in order to detect unanticipated fluctuations in stocks.

Project 2: Study of the use of lagoon Fish Aggregation Devices (FADs) to attract baitfish.

Experience elsewhere indicates that FADs in lagoon or shallow inshore waters may have some potential for attracting and holding concentrations of baitfish, allowing for increased harvesting efficiency and predictability. It is proposed that the bait species attracted to FADs also be monitored to provide an index of the wild bait stock availability.

Project 3: Identification and development of unexploited or underexploited inshore pelagic and benthic fish resources.

Ocean and outer-reef slope fishes are seen as having the greatest potential for expansion of capture fisheries at a variety of scales, from small artisanal to industrial. Identification and

application of techniques to increase or improve harvesting of these species, which include deep-bottom fish, tunas, and pelagic species such as kingfish, rainbow runners, big-eye scads and round scads, are priority areas requiring attention.

9.5 Research Priorities in Aquaculture

Aquaculture in Kiribati provides an important alternative to capture fisheries for providing bait for the tuna industry as well as food for local consumption and potentially for export. It also provides possibilities for the enhancement of natural populations of exploited resources. The group noted the potential for aquaculture at Christmas Island where numerous natural ponds exist, as do stocks of fry of important species such as milkfish.

Project 1: Improvement of pond production of milkfish for bait and food.

The milkfish now produced aquaculturally for bait, do not equal in performance the wild-caught bait, and must be studied to determine what dietary, behavioural or environmental factors might be manipulated to improve its quality as livebait.

Project 2: Eradication of tilapia from milkfish production ponds.

Tilapia constitute a "weed" species in milkfish pond production, and although usable for food and animal feed, make management of milkfish stocks difficult. A study of the best eradication or control method is needed.

Project 3: Culture of seaweeds.

Seaweed culture has been practised as a village-level endeavour for some time, but problems with marketing have been identified. A study is proposed to examine the marketing of Eucheuma, the principal species harvested in the past, to assess its future potential. The production of other species for human and animal food should

also be explored. Based on this study, a future plan of action f seaweed production and marketing should be developed and pursued.

Project 4: Giant clam culture.

Giant clams (Tridacna spp.) are a traditional food in Kiribat Natural stocks have been reduced, as demonstrated by an ongoin survey. There is a need for further assessment and for a stoc enhancement programme which is presently being developed i conjunction with James Cook University (Australia), ICLARM, an other concerned institutions in the region. There are still concern about this being practised as a village-level activity. To supplemen ongoing efforts, this project proposes to examine the options fo stock enhancement and controlled culture of tridacnids.

9.6 Research Priorities in Post-Harvest Development

Develo ment or improvement of seafood products has the potential to lead to better utilization of Kiribati's fishery resources. A particular area of attention should be the development of alternative fish and fishery products not requiring refrigerated storage.

Project 1: Assessment of the potential of appropriate or intermediate technology (eg., smoking, drying, pasteurising, salting, etc.) for processing of current commercial species to meet local needs and reduce imports of canned fish.

9.7 Priorities in Education and Extension Activities

There is a need to increase the awareness of young people in Kiribati of the problems of living marine resource conservation in order to meet the challenges of a growing human population impacting a limited resource.

Project 1: A programme needs to be developed and implemented in conjunction with the Ministry of Education that will increase the

knowledge and concern of the younger generation for these problems that will affect their future livelihoods.

9.8 Priorities for Improving Technical Information Access

It is difficult for those working on problems of living marine resources on atolls to obtain relevant information on topics of current interest. There is a need to acquire and circulate technical information within Kiribati and to other atoll countries to serve this need, utilizing the best mechanism and technology available.

Project 1: Participate in the information-sharing services of appropriate agencies and individuals, in particular the developing Pacific Island Marine Resources Information System (PIMRIS), to improve the availability and utilization of technical marine resources information in Kiribati.

9.9 Discussion on Working Group Paper 3

Acting Chief Fisheries Officer Mr Tukabu Teroroko made a presentation of the Marine Resources Working Groups discussions, referring to two discussion papers prepared by the group. The presentation outlined the major marine species/resources requiring research/development attention, and referred to the problems of marine resource management and stock enhancement, and the needs to divert fishing pressure from fragile lagoon resources.

Les Clark noted the difficulties in capturing the feeling of a group discussion in a rapidly-prepared paper. He felt that the priority research areas identified by the group were to improve aquacultural production, particularly for milkfish, and to improve the management of Tarawa lagoon - a problem which ranged from cockles to causeways.

Mike Hamnett agreed with the identification of milkfish as a priority research area, and noted the importance of acquiring relevant, timely research related information from other areas to avoid duplication of effort and the consequent waste of research time and money.

Garry Preston noted that some fisheries projects were already under way to answer some of the research needs identified by the working group.

The representative of the Australian High Commission noted that several Australian funded projects were under way, including baitfish research, giant clam research, funding of a postgraduate student to work on te bun, and, possibly, a reef fish assessment project.

Phil Helfrich reinforced earlier comments on the importance of information systems to research in Kiribati and elsewhere, and the need to include aspects of resource conservation in school and public education programmes. Sam Edwards pointed out that the fact that Government departments were already working in given research areas did not automatically preclude involvement in that area by an atoll research centre. Departmental research activities, he stressed, were often a good guide to the areas considered to be of highest priority by the Kiribati Government, and in many cases could be reinforced by additional research effort.

Mike Hammett raised again the importance of education in marine resource development. The Secretary for Education responded by noting the importance of maintaining traditional knowledge and skills through the formal education system, using several colourful examples to illustrate aspects of traditional knowledge that have been lost. Seluta Fakava from Tarawa Urban Council noted that there is an "informal" education system in Kiribati for students who do not qualify for high school, which focusses on vocational skills, including fishing. Some secondary schools also teach fishing as a minor part of the curriculum. She emphasised the importance and potential of fishing as an income earner for people who may not be considered to have an advanced secondary education.

Les Clark noted USAID's interest in the area of marine resources. He outlined the restructuring of USAID's Pacific programme and the importance it attached marine resource development activities, and advised that following this meeting, and after considering its conclusions and recommendations, USAID would like to explore further the concept of an atoll research programme with the Kiribati government and other interested parties.

10. WORKING GROUP PAPER 4: CONSERVATION AND ENVIRONMENTAL MANAGEMENT

10.1 Justification for the Need for Conservation, Environmental and Resource Management and Environmental Assessment

Kiribati has such limited natural resources that, if development is to result in a sustained increase in the standard of living of the people, those resources be managed effectively. In particular, there are so few indigenous plant and animal resources, that there is a need to effectively manage and improve indigenous species in such a way that they can be sustained. Conservation is defined for the purposes of this discussion as the maintenance of a sustainable yield of resource exploitation for development. Conservation must, thus, be considered part of positive development, rather than as an obstacle to development, because development itself, in the future, would be impossible if natural resources are destroyed or severely depleted.

Kiribati, like other atoll countries, is undergoing tremendous social and economic change. The growth of the population on South Tarawa, the development of commercial fishing, the construction of causeways, the introduction of new agricultural techniques and tourism development may have significant impacts on the plant, animal, and non-living resources in the Republic. Therefore, there is a need to plan development so that resources can be used on a sustained basis. Such planning can only take place if the nature of the resources and their interaction is understood, thus underlining the need for applied research on atoll resources. Moreover, there is a need to evaluate the impacts of new development initiatives to allow the government to design projects and programmes that will ensure that resource use can be sustained in the future.

Another rationale for protection of the environment is the potential that tourism development offers as an economic option for Kiribati. At least part of the appeal is the presence of a relatively pristine marine and island environment. If that environment is destroyed, the potential for tourism will be significantly diminished.

10.2 Potential Areas for the Development of National Level Parks or Conservation Areas in Kiribati

The establishment of reserve and conservation areas are methods for insuring that plant and animal species and important non-living resources are not destroyed. Many of the plant and animal species found in Kiribati and the islands, reefs and lagoons are important to the cultural, social and economic life of I-Kiribati. These resources include food and medicinal plants, marine species and animals. Some of these resources have disappeared or are extinct.

The Kiribati Government has already recognized the strategy of establishing the reserves as demonstrated by its designation of the Kiritimati island bird sanctuary. Other Island Councils in Kiribati have also designated protected areas. However, there is a need to identify marine and terrestrial resources that are currently threatened and to consider the designation of reserves or conservation areas for the preservation of endangered species.

Other strategies for resource management and conservation should also be considered. These could include environmental education and public awareness and stock and plant species enhancement.

10.3 Potential Areas or Resource Types that Require Protection or Management at the Community or Local Level

There is undoubtedly a wealth of local knowledge about species that are currently being threatened. This knowledge could be compiled in conjunction with resource surveys and other activities being carried out by divisions of the Ministry for Natural Resource Development. The South Pacific Regional Environment Programme (SPREP), the University of the South Pacific (USP), and other organizations and institutions have carried out research that has identified species that are endangered or populations that are being depleted. The establishment of reserves, or the use of other strategies for resource management and conservation, could be based on this existing knowledge. However, there may be a need to supplement this knowledge through additional studies such as that being conducted on Kiritimati.

10.4 The Need for Environmental Impact Assessment as an Integral Component of Development Projects

The Kiribati Government is currently planning several resource and infrastructure development projects. These include the construction of causeways to North Tarawa, the establishment of milkfish farms in outer islands and other projects. There have been unanticipated environmental impacts of development projects in Tarawa and on other atolls in the region.

Environmental impact assessments have provided information that has allowed governments to avoid negative environmental impacts. Environmental impact assessment procedures could assist the government in designing projects to ensure the sustainability of important resources including those that are currently being threatened. As suggested earlier during the Consultation, environmental impact assessment is increasingly considered to be an integral and required part of many development projects, and is also increasingly included as a funded component by aid agencies as part of their aid proposals and project funding.

11. DISCUSSION AND RESPONSES TO PRESENTATIONS AND PRIORITIZATION OF AREAS FOR APPLIED RESEARCH

11.1 Importance of Marine Resources Research to Kiribati

Les Clark stressed that two major priorities which seemed to have been highlighted were the emphasis on aquaculture, in particular milkfish production for support of the tuna fishing industry and for food production, and studies of the ecology and utilization of nearshore, lagoon, and reef fishery resources because of evidence of overfishing in Tarawa lagoon and the need to manage such resources.

Bob Richmond, of UOG, stressed that these areas of research were well within the capabilities of existing institutions to help in solving problems faced in aquaculture and in conducting appropriate ecological studies of the nearshore fisheries resources.

It was stressed by SPC and Australian representative that there were ongoing projects in these areas, such as milkfish aquaculture, studies of the ecology and potential of the introduction of te bun (Anadara sp.), and giant clam culture, all of which were conducted in Kiribati in collaboration with the Fisheries Department.

11.2 Need For an Information Exchange Network

It was stressed that, because often overlapping research in these areas is being conducted by various different bodies, there was a need for an information exchange network and that an Applied Atoll Research Centre could coordinate such efforts. USP stressed that this was the reason for the establishment of PIMRIS, which is designed to collect and disseminate information on Pacific island marine resources research and development.

Kirabuke Teaua, the USP Agricultural Liason Officer for Kiribati, stressed the role that the USP Agricultural Liason network plays in the dissemination of news on agricultural research in the region.

11.3 Importance of Research and Education on the Social Aspects of Natural Resource Management

UOG stressed the importance of the contributions made by the Secretary for Education as to the cultural importance and even sacredness of most natural resources and the need for education to pave the way for ecologically sustainable natural resource development, and that strategies for information dissemination, including the dissemination of the findings of this Consultation, were needed to promote the concept of environmental management and the importance of traditional ecological knowledge and cultural traditions in wise resource development.

The Secretary for Education supported this sentiment by stressing the need to achieve a balance between the very valuable traditional environmental education and ecological knowledge and resource-use systems of atoll peoples and modern, more academic or "scientific" education, teaching and knowledge within the context of the formal education system. He stressed that only, thus, can we address the reality of the conflicts between modern development and the preservation of important cultural traditions and resource management strategies which are important to the success of modern development.

The Chairman asked what avenues there might be to modify formal education systems in this manner. The Secretary for Education responded by providing an example of the problem of overemphasis on administration and financial management in formal education, with little emphasis on training related to the Kiribati cultural and natural environment, and how a few years back, increasing emphasis was placed on fishing in formal education. The result was that a number of very economically successful fishermen and their families are now seen as succesful and as "gentlemen", whereas in the past only administrators and businessmen were classified as gentlemen.

Tekarei Russell supported this statement, further stressing that the increasing emphasis on fishing had made it a respectable activity, and that there is a necessity to put stress on other areas of expertise and knowledge of importance to people, particulary women, on atolls.

11.4 Statement of Interest by USAID

Les Clark outlined plans to develop a regional project, which would be the major vehicle by which USAID would provide development assistance for marine resource development in the region. If it proceeded, this project would assist a small number of marine resource development activities over the next five years. He stressed that USAID was also interested in the further development of ideas about the need for assistance for atoll research programmes in marine resources.

It was suggested that, in time, USAID would also be considering the successor to its present programmes of assistance to agriculture through USP, Alafua. There would then be scope for considering new forms of assistance for agricultural and land resources development, possibly with an additional emphasis on environmental protection and sustainable resource use in fragile atoll ecosystems.

One of the potential activities is some support for the development of an Atoll Research Unit, with USAID wishing to continue discussions on assistance for such a programme, in light of the results of this Consultation.

The Chairman thanked USAID for this statement of interest and expressed his satisfaction with the way that the Consultation had begun to focus on some of the priorities for research that might form the work programme of an Atoll Development Research Centre (ADRC).

11.5 Statement of the Need for the Management on Non-Marine Resources

The Chairman, in summarizing the general direction of the Consultation, stated that, although the main emphasis seemed to be swinging towards marine resources, that the need for the management of other resources is also imperative, because it would not be possible to continue to import more and more agricultural products from places such as Australia, without being severly affected by deterioration in terms of trade and balance of payments problems.

In response to this, it was stated that, perhaps one of the ways of better defining the relative importance, in both commercial and subsistence terms, of marine and terrestrial resources, and the relative roles in the provision of products of economic value (both commercial and subsistence) was to conduct research in both rural and urban areas to determine the real subsistence value, in comparison to what imported substitutes would cost, of terrestrial and marine resource products. Even though the generation of such data is difficult, it is imperative that such data be gathered as a basis for sustainable resource development, which does not undermine the very valuable subsistence base of atoll societies.

The Secretary for Education and the Chief Fisheries Officer both supported the need to quantify the value of subsistence production to better understand the importance of this to Kiribati as a basis for culturally and ecologically sensitive resource management. Being Yeeting stressed that 80% of I-Kiribati fishermen are subsistence fishermen, and that they generally only sell their surplus, partly because of the lack of processing or storage facilities.

11.6 The Need for Research on Family Planning

The need for looking into the areas of family planning was also stressed because of the very high and rapidly increasing populations of atoll countries. The Minister remarked that the Government did place high priority on family planning, thus the change of the name of the Ministry to Health and Family Planning. Because of high population densities, the Government has implemented programmes for resettlement of communities in the Line and Phoenix Groups.

12 POTENTIAL AREAS OF INVOLVEMENT BASED ON APPLIED RESEARCH PRIORITIES

In an attempt to focus more clearly on the roles that various organizations and institutions could play in collaborative research and the development of a strong ADRC, the participating organizations were asked to briefly outline the possible areas of expertise or avenues of involvement in the establishment of an ADRC of their institutions, in light of the priority areas that had been identified by the four working groups and in the subsequent discussions.

12.1 South Pacific Commission

The SPC representative stressed that, as a regional institution, it had ongoing programmes and a strong committment in many areas of priority: fisheries development, including the master fisherman programme, training, fishing gear improvement, development of alternative processing and use of fisheries products, assessments of inshore and offshore fishery resources and many other areas identified in the paper prepared by the marine resources working group and in Working Paper 4. He stressed that there is considerable scope for further assistance in response to requests from the Kiribati government.

He stressed that there are many other organizations, or projects, involved in fisheries development activities, not represented at this consultation, who are conducting very relevant research and who should be involved in the coordination and implementation of various research projects, such as the South Pacific Aquacultural Development Project and the South Pacific Regional Fisheries Support Programme, located in Suva, Fiji, and the Forum Fisheries Agency (FFA), located in Honiara, Solomon Islands.

12.2 University of Guam

UOG stated that it can provide results of previous work with direct applicability to the priority areas identified by the Kiribati Government, and can provide education and training opportunities for people from Kiribati and other atoll countries at UOG, as well

as selective on-site training in Kiribati. UOG could provide consultancy services to an ADRC in areas of their expertise, such as in the area of milkfish aquaculture, marine biology, reproduction of marine organisms, water resource analysis, fisheries statistics, and island agriculture. He stressed that their expertise and experience lie with Pacific island and atoll ecosystems.

In response to UOG, the Chairman asked if UOG was willing to place staff in Kiribati as part of an atoll research network. The answer was affirmative, although whether that committment was in the form of short-term visits or longer-term projects would depend on staff availability and funding.

12.3 Oceanic Institute

OI said that they can, provided there is funding, make available their services and technologies in the areas of maturation, spawning, and larval rearing of mullet and milkfish in support of Kiribati's ongoing aquacultural activities at the Tarawa Faitfish farm. This would probably entail both training and visits by OI staff to the Tarawa operation.

12.4 University of Hawaii

UH similarly indicated that teaching and research capabilites of UH would be available to support such activities, and stressed their interest in atoll research, particulary on Kiritimati, and stressed that their research institutes and other funding and staffing arrangements gave the UH considerable flexibility in being able to became involved in relevant atoll research before outside funding became available.

The Hawaii Natural Energy Institute and the Pacific International Center for High Tecnology of UH are likewise very interested in becoming involved in the ADRC concept and indicated that there is some scope for finding matching funds to become involved in overseas project work such as that identified by the Consultation.

The UH expressed interest in continuing its involvement in atoll agricultural and water resources research, with its Center for Development Studies being very interested in becoming involved in the more social science and development-orientated aspects of the research of an ADRC, and would certainly entertain the possibility of locating a staff member at an ADRC. This, of course, despite some flexibility in doing so, would depend on availability of external funding. It was stressed that future involvement would depend very much upon requests from the Kiribati Government based on their stated priorities.

12.5 CCOP/SOPAC

CCPO/SOPAC stressed that their Kiribati programme was part of the CCOP/SOPAC work programme which was set by the Committee according to individual government priorities. It will continue to strongly support the government's attempts to strengthen its applied resource research capabilities. It stressed that it strongly supported the idea of the establishment of a strong national or regional research coordinating group which would further facilitate their activities, and would be very happy to work cooperatively on projects with other institutions.

12.6 University of the South Pacific

The significant role of IRETA in the area of atoll agricultural research was noted, as was the need for Kiribati to submit well thought-out proposals for atoll agricultural research to the RAB in order to gain greater benefit from existing funds. The existence of USP research funds, which could be used for atoll research, was also highlighted.

It was stressed that USP would be favourably disposed to cooperative research and involvement with other regional institutions and universities in the activities of the ARDU. The USP IRD also expressed the willingness to divert some of their financial resources to cooperative research with an ADRC.

12.7 Kagoshima University

KU indicated that it would continue, on request, to assist with its education and training capabilities for suitably qualified persons, its visits of its research vessels, and its capabilities in the areas of marine and oceanic studies and regional development planning, with particular concern for the management of biotic and non-living marine resources. KU would also favourably consider the possibility of locating staff at an ADRC.

12.8 University of Rhode Island

URI stated that its capabilities in coastal land use planning, the establishment of coastal and marine reserves, and other areas of environmental impact assessment could be provided to the development of an ADRC, and stressed that URI should support the capabilities of existing institutions within the region. However, where its areas of expertise were seen as relevant, URI might accept a leading role and help in the planning and proposal preparation stages of an ADRC, and might be favourably disposed to attaching staff or students to an ADRC. URI stressed that it had conducted research in the Maldives and other atoll areas and strongly supported the need to conduct applied research in atoll development.

12.9 Australian Government

The Australian Government reaffirmed its interest in atoll research, and stressed its major involvement in funding USP and the current ARDU, and supported the concept of strengthening or modifying the current unit, rather than establishing a new unit. It also stressed its support for the establishment of an effective data centre or library for atoll research to enable a freer flow of information and to make more accessible to atoll countries research that has already been conducted or to help establish links with relevant researchers or research institutions.

The existence of institutions in Australia with considerable expertise in the areas in marine resources development (e.g., James Cook University), Pacific island studies (e.g., Research School of Pacific Studies, Australian National University), and development studies (e.g., National Centre for Development Studies, ANU), in general, was stressed and that there was considerable interest in involving agencies specializing in applied research, such as the AIDAB-funded statutory authority, the Australian Centre for International Agricultural Research in the kinds of activities proposed for the ADRC. It was stressed that, under the Australian Government's bilateral aid programme, the main emphasis was on infrastructural development, rather than on natural resource development. As such, environmental studies were of interest, with some environmental studies about to be commissioned relating to the major causeway development project.

12.10 South Pacific Regional Environment Programme (SPREP)

SPREP indicated the areas where it had the expertise and mandate to assist in the implementation of the priorities as stated by the Consultation. These included the development of a regional marine turtle project, their ongoing programme to monitor marine pollution, soil improvement and management, and the assessment of sand mining.

In terms of the specific priorities addressed by Working Group 4, SPREP is very interested in undertaking a survey of protected area sites and conservation development in Kiribati and other atoll countries; water quality and waste disposal studies; the preparation

of environmental impact assessment statements and legislation; and work related to environmental health and education, on which SPREP places great priority. SPREP is also involved in the process of establishing a bird sanctuary on Kiritimati.

As primarily a coordinating body, SPREP would not usually be able to place a person full-time in Kiribati, but would encourage such placement through its involvement with regional institutions and implementing bodies. The possibility, although outside the current work programme, could be considered under future SPREP workplans.

13 MATTERS RELATING TO THE ESTABLISHMENT OF AN EFFECTIVE ADRC

The Chairman asked if it could be taken as given that, based on the findings of the Consultation and the priorities identified by the four Working Groups (with their combined force of researchers and I-Kiribati participants with expertise in specific fields in relationship to the development of atolls), there was general agreement on the identification of a number of priority areas for applied atoll research. The response was affirmative.

13.1 Reaffirmation of the Need for a Strong ARDC

The Chairman and the Minister again reaffirmed the great need and resolve of the Government of Kiribati to establish a strong ADRC to address its applied research for development needs. The members of the Consultation also strongly supported this as a priority need.

The Minister underlined the need for a strong coordinating body like an ADRC by giving the example of a number of projects to which the Government of Kiribati had given high priority, such as the rehabilitation of the honey industry of Fanning Island, but which after over a year of waiting, was still bogged down in the proposal stage in the bureaucracy. He suggested that, if there existed a strong ADRC to coordinate and facilitate such efforts, such projects would have probably already commenced.

UH also suggested that a strong host facility was needed to facilitate the work of consultants, researchers, etc. in terms of providing infrastructure, communication, organize housing, transport, in-country personnel, and other logistical support so critical to the success of major research projects, which often involved large numbers of both overseas and local researchers whose time is at a premium.

In response to the discussion, the Minister suggested that there seemed to be three ways to proceed. These were: 1) strengthening the current ARDU; 2) development of a larger facility, an "ADRC", which included other institutions; or 3) the formation of an advisory committee which meets once a year to hold consultations similar to this Consultation.

13.2 The Advisability of Strengthening the USP ARDU as the Direct Solution

It was suggested by the UOG participant that, in light of the fact that there may not be sufficient funding or support for a major new ADRC facility or capability, that the most effective way to improve such a capability would be to put strong and systematic pressure on the USP to make a greater committment to support and provide guidance and monitoring to the current ARDU.

The USP representative supported this avenue of proceeding, and stressed that the Kiribati Government itself, as a member country of the USP, must make a strong formal representation to the USP Council about their concern over the apparent neglect of the current institution by the USP and the inherent past inability of the ARDU to function in the way the Kiribati Government had hoped. It was also stressed that the Kiribati Government must, likewise, make a stronger and well-articulated committment to supporting the unit and to maximize integration of its ongoing applied atoll research activities with those of the ARDU.

UH indicated that it, likewise, favoured maintaining a strong regional facility, such as the USP ARDU, which could provide the critical mass and a solid base for researchers from a great number of institutions, which could attract funding, and which would help to increase the research capabilities of such a unit to address the stated needs of Kiribati and other atoll countries.

UOG strongly supported this sentiment and stressed the need for increased accountability on the part of both the USP (and its ARDU) and the Kiribati Government, and stressed that such a unit would not only enhance the opportunities for collaborative research, but also serve to help eliminate research duplication in an environment of scarce financial resources.

It was stressed by SPC that there might be some disadvantages to a USP-run project, as opposed to a nationally-run institution, one being that many of the regional bodies look more favourably to funding projects which are nationally based. It was pointed out that this was not necessarily always the case, and that there are of course other inherent disadvantages in government institutions compared to institutions with regional affiliation.

It was suggested by URI that there might be a non-profit body attached to such a unit responsible soley for soliciting funds to support projects of an ADRC and controlled by a board of directors. The Chairman strongly supported such an arrangement, which could possibly be attached to some bilateral or multilateral funding agency, such as USAID or an appropriate UN agency such as UNDP. The URI suggested that such an organization be recognized as the organization responsible for the financial operation of the organization, but that another organization, such as USP, be responsible for the operation of the research facility.

USP suggested that, although there is no certainty that there would be increased funding, there were many other avenues for addressing research needs by working through funding allotted to other units of the USP, but which could be vetted and conducted under the aegis of APDU.

The Acting Director of ARDU suggested that for a strengthened ARDU to be a reality, there must be more sharing of resources, both by USP and the Kiribati Government.

USAID stressed that, given the great needs as identified by the Kiribati government, there seemed indeed to be a definite need for an effective ADRC, but there are also immediate needs in applied atoll research which are of priority to the Kiribati Government. Given the first need, it was stressed that the USP seemed to be the obvious body, at present, to facilitate the active implementation of projects which are deemed to be of immediate priority. It was suggested that, as a regional institution, USP be given a second chance and be made the agency responsible for implementation of research projects identified to be of priority by governments and funding agencies.

In terms of the interest of USAID, in particular, the existence of a centre has considerable benefits as a regional focus which would justify a level of expenditure which could be directed to regional, as well as Kiribati national priorities. The fact that the activities of NGOs and other bilateral funding agencies could be located under the umbrella of such a center was also an advantage. USAID suggested that it might be able to support further efforts to strengthen and reorganise the ARDU as a regional organization and

part of USP and to continue its involvement in pursuing this issue from its base in Suva.

The Australian Government stressed that the consultation had been very productive, but that the immediate task ahead should be for USAID, USP and the Kiribati Government to get together to decide on the next steps that need to be taken to develop effective applied atoll research programmes and an atoll research centre or network.

13.3 The Potential for a Larger Regional or International ADRC

It was suggested by UH that perhaps there was a need to endorse the concept of the establishment of a larger regional or international ADRC, and that there was some scope for the Kiribati Government to consult with relevent bodies involved with similar developments and to come out with a concrete plan of action for the establishment of such a facility. The Chairman strongly supported this sentiment and suggested that he would rather that USP not necessarily be the managing agency, but rather a major partner, along with other member agencies such as the Oceanic Institute, UH, UOG, etc.

There was considerable support for such an organization, but at the present time, the general feeling was that funding for such a body would be difficult to acquire, and that for the present time, anyway, the most direct means of strengthening Kiribati's applied atoll research capabilities would be to encourage USP to strengthen its operation, in cooperation with other relevant agencies and institutions.

13.4 The Need for An Advisory Body or Atoll Research Network

The important role that an advisory body or atoll research network could play was also stressed, and it was suggested that such a network or even an advisory committee could play a very valuable role in facilitating the implementation of projects, research, and in the identification of appropriate agencies or researchers which could be most helpful in addressing a government's or a regional research unit's research and consultancy needs. It was stressed, however, that

such a network didn't necessarily have to require large sums of money to fly network members all over the world, but could be conducted through the mail, by phone, fax or through meetings of convenience. It was stressed that the Consultation, itself, had in fact served to establish such a network which could certainly continue to strengthen the applied research capability of Kiribati and other atoll societies served by the participating organizations.

14 SUMMARY OF FINDINGS

In summary, based on the deliberations of the Consultation, a number of findings became increasingly clear. These were as follows:

1. The critical need for applied atoll research as a basis for the sustainable development of scarce terrestrial and nearshore fisheries resources and highly scattered and fragmented living and non-living oceanic resources of atoll nations such as Kiribati;

2. The desirability, in terms of funding opportunities and achieving economies of scale through cooperative research, of a regional or international atoll research capability, rather than a national facility;

3. The resolve of the government of Kiribati to establish and/or to support a strengthened applied atoll research capability;

4. The inability of the current USP Atoll Research and Development Unit (ARDU), given its current organization and funding, to satisfy the current applied atoll research needs of both Kiribati and other member atoll countries of the USP;

5. The appropriateness of Kiribati, in particular Tarawa, as the world's largest atoll nation, because of its central location among other atoll nations, as the site of the current USP ARDU, and as the initiator of the Consultation, as an appropriate site for a strong applied atoll research facility;

6. The existence of considerable capability for, and interest in conducting applied atoll research on the part of the participating institutions and other non-participating organizations, which could contribute significantly to the development of a strong applied atoll research capability;

7. The need for a strong applied atoll development research and information dissemination network, which could initially be based on the institutions and agencies participating in, and contacts established during the Consultation;

8. A strong interest on the part of USAID and other funding agencies, to support applied atoll and oceanic research, and the

possible strengthening of a centre, because of its economic and political importance;

9. The priority applied research areas for the development of non-living and/or energy resources in the atoll environment as including studies of mineral resources, particularly studies of sand, gravel, and cement-making resources for construction purposes; water quality and management research; and studies of renewable energy resources, including solar energy, fuelwood resources, and OTEC. In the long term, priorities would include studies of seabed mineral deposits. Baseline studies of the physical coastal environment and the effects of development work, such as causeway development, were also considered priority areas of research.

10. Given the very limited terrestrial atoll resources, including land, soil, and plant and agricultural resources, and due to very high population densities, particularly in areas such as urban Tarawa, there is a critical need to evaluate these scarce resources and develop appropriate development strategies. Some of the more specific priority areas include studies of the nature, utility, propogation and the promotion of important indigenous and exotic plant resources and cultivars; agricultural system analysis and improvement, including studies of plant and soil improvement, pest control and plant quarantine, and traditional agricultural knowledge and technology; and studies of appropriate agricultural and resource-use strategies for high density urban atoll settlements;

11. A strong programme of marine resource research is needed to identify and develop the options available to the Government of Kiribati for marine resource management and development. Against a background of increasing urbanization and pressure on marine resources and the marine environment in Tarawa, and the related need to improve the relative well-being of communities in outer islands and other atoll communities, the priority areas of applied atoll research on marine resources seem to include: a) research on the management and enhancement of stocks in Tarawa lagoon and elsewhere which are threatened by depletion from overfishing; b) research on aquaculture, at a variety of levels, as a means of enhancing natural populations of selected marine resources and providing bait for the local tuna industry and food fish for local consumption and export, with a particularly high priority on milkfish culture; c) research on the development of unexploited or

underexploited resources which might provide additional sources of subsistence protein, as well as employment and income generating opportunities; and, d) research on the protection of marine resources and the marine environment from pollution and other terrestrial inputs resulting from land-based activities, and from the impacts of development activities such as causeway construction and gillnetting;

12. Because atoll resources are so limited, it is imperative that if development is to result in a sustained increase in the standard of living of the people, those resources be managed effectively, and that such management should include the establishment of appropriate conservation strategies, including conservation area establishment and the protection of endangered species, and effective environmental impact assessment legislation and procedures, all of which must be seen as an integral part of sustainable development, rather than as an obstacle to development;

13. There is a need for in-depth studies, involving local people as major, fully-paid researchers and scientists, to be conducted on the social and economic importance of atoll resources, with particular emphasis on traditional resource-use knowledge and technologies and the subsistence importance of those resources, in an attempt to ensure: a) that such relevant knowledge is not lost, and b) that it can be used as a basis for a more appropriate sustainable self-reliant model of modern development.

14. There is a need to integrate traditional resource- and land-use knowlege of atoll societies into the curricula of formal education systems, and to possibly involve older knowledgeable members of the community in the formal education system, in an attempt to make education more relevant, given the long-term needs and realities of isolated, resource-poor atoll communities.

15 RESOLUTIONS ARISING FROM THE CONSULTATION

The Consultation resolved:

1. That there are critical applied research needs of Kiribati, and other atoll countries, which require a strong applied atoll research facility or capability.

2. That the USP ARDU is, at present, the logical body to fulfill such a need, although to this point in time, it has not been able to satisfy this need.

3. That the Government of Kiribati requests USP to urgently review its commitments to the Atoll Research and Development Unit (ARDU) and look for ways to enhance the performance of the ARDU, including the active involvement of other regional and non-regional institutions and a range of donor agencies.

4. That a network of institutions and agencies involved in the Consultation be established which could serve, initially, as a body to advise Kiribati and other atoll nations on atoll research matters and to facilitate the free flow of information on applied atoll research for development, and that there be a provision to include other relevant institutions not represented at the Consultation to strengthen such a network.

5. That all of the areas of applied atoll research for development and for environmental and resource management identified by the four Working Groups be considered of some urgency as a basis for sustainable development of scarce atoll resources, and that there would be no attempt to order the priorities stated by each of the four working groups, with this being left for consideration and prioritization by the Kiribati Government. It was suggested that, where there seemed to be obvious major utility of a given type of research or project, where considerable expertise existed, and where funding might be immediately available, an attempt should be made to identify specific priority areas and to identify specific research projects for which aid funding should be immediately solicited.

6. That in the area of marine resources there seemed to be three specific areas, due to the urgency of such research in terms of the

economic and social realities of atoll states, which warranted particular priority. These areas were: 1) studies of milkfish aquaculture and aquacultural improvement; 2) ecological, population, and sustainable-use studies of Tarawa Lagoon; and 3) studies of the ecology of the bivalve species (Anadara maculosa) and its possible introduction into atoll environments where it is not currently present.

16. SUMMARY OF CLOSING SESSION

16.1 Closing Address by the Minister for Natural Resource Developement

The Minister said that he was delighted that, throughout the Consultation, he had felt not as a guest listening in, but rather as very much an active participant in the Consultation. He thanked the participants for their educative, informative, constructive and frank contributions to the Consultation. He thanked USP for their assistance in discussing sensitive aspects of the running of the Atoll Research and Development Unit, apologized for the need for frankness, and congratulated USP for the way it had dealt with this.

He commented on the lively and very worthwhile nature of the four-day deliberations of the Consultation and how stimulating, personally, it had been in terms of helping the Ministry and the people of Kiribati gain a clearer idea of the opportunities and capabilities that existed for improving the applied atoll research capabilities of Kiribati and other atoll nations.

In conclusion, he again thanked all of the participants, wished them a safe journey to their respective homelands, and expressed the need for resolve to maintain and strengthen the relationships established during the Consultation between the participating institutions, the government of Kiribati and other atoll countries, so that the the benefits of applied atoll research to atoll societies can be maximised.

16.2 Concluding Remarks by the Chairman

The Chairman thanked the Minister for his closing address and for the central role he had played in making the Consutation a success. He again thanked the representatives of USAID both for funding and their constructive role in the Consultation; the Foundation for the Peoples of the South Pacific for their excellent organization of the meeting; the members of AMAK for their hospitality and excellent morning and afternoon teas; the Chairman and members of the Steering Committee for their important role in making the meeting a success; and finally the Rapporteur for his work in recording the deliberations of the Consultation. He then

thanked all of the participants for their excellent contributions and frankness, and expressed his desire that this be only the beginning of such positive interchanges and the establishment of a communication network that could strengthen capabilities and cooperation in the field of applied atoll research, with the ultimate aim being to benefit atoll societies.

He then reminded the participants of the end-of-Consultation reception and Kiribati dancing which would commence immediately, and wished them all a pleasant evening and a safe trip home.

16.3 Vote of Thanks from the Participants

Professor John Morrison of USP, on behalf of the overseas participants, thanked USAID for their initiative and financial support that had made the Consultation possible, and the Foundation for the Peoples of the South Pacific for their excellent work in organizing the Consultation. He remarked on how all participants had appreciated the well-managed travel arrangements and local organization, and, in particular, wished to thank Dave Wyler and Parul Fernandez for dealing with the many logistical problems that had been raised during the Consultation. He also thanked the ladies of AMAK who were responsible for the morning and afternoon coffee breaks, the variety of local snacks being one of the features of the meeting.

Thanks were also given to the I-Kiribati paticipants, whose willing participation in discussions, ability to explain local problems, and genuine concern for national development was particularly stimulating and useful to the outside participants. In particular, he thanked the Minister for Natural Resource Development, the Honourable Taomati I. Iuta for making available so much of his time, his experience and knowledge of Kiribati, and his forthright comments on proposals, and stressed how, through his willingness to be involved in all aspects of the Consultation, had been an example to us all.

In conclusion, he thanked the Chairman, the Acting Secretary for Natural Resource Development, Marae M. Irata, for his enthusiastic and committed guidance and participation in the Consultation and his tolerance in dealing with the many topics raised by the participants.

LIST OF APPENDICES

9. Applied Atoll Research and the USP Atoll Research and Development Unit: Problems and Prospect.
   A. Tong

10. The University of Guam Marine Laboratory.
    R. Richmond

11. The USP Institute of Rural Development.
    G. Moengangongo

12. The USP School of Agriculture and Institute for Research, Extension and Training in Agriculture (IRETA): Atoll Agricultural Activities and Role in Atoll Research for Development.
    M. Hazelman

13. CCOP/SOPAC: Ongoing Activities and Capabilities with Particular Focus on Kiribati.
    J. Eade

14. The University of Rhode Island's Experience in Transferring Implementable Coastal Resources Management.
    W.V. Branan

15. The University of Rhode Island's International Coastal Resources Management Project.
    W.V. Branan

16. Annual Report for 1988: Coastal Aquaculture Centre, Guadalcanal, Solomon Islands.
    J.L. Munro

VI. Proposed activities of the Pacific Islands Marine Resources Information System (PIMRIS).

Appendix 1. Detailed List of Participants Kiribati Atoll Applied Research for Development Consultation, 27 February to 2 March, 1989.

A. OVERSEAS

FIJI

James Osborn
Deputy Director
USAID
American Embassy
P.O. Box 218
Suva, FIJI

Phone: (679) 311-399
Fax: (679) 300-075
Telex: 2647 FJ USAID

Les Clark
Fisheries Advisor
USAID
(as above)

John Morrison
Professor of Chemistry
School of Pure & Applied Sciences
University of the South Pacific
P.O. Box 1168
Suva, FIJI

Phone: (679) 301-639
Fax: (679) 300-380
Telex: 2276 FJ

Jim Eade
Deputy Director
CCOP/SOPAC Techsec
c/o Mineral Resources Department
Private Bag
Suva, FIJI

Phone: (679) 381-377
Fax: (679) 384-810
Telex: 2330 FJ SOPACPRO

GUAM

Robert Richmond
Director
Marine Laboratory
University of Guam
UOG Station
Mangilao, GUAM 96923

Phone: (671) 734-2421
Fax: (671) 734-3118
Telex: 721-6275

JAPAN

Shigero Iwakiri
Dean, Faculty of Fisheries
Kagoshima University
Shimoorata
Kagoshima, 890 JAPAN

Phone:
Fax:
Telex:

NEW CALEDONIA

Iosefatu Reti
Coordinator
SPREP
South Pacific Commission
B.P. D5
Noumea Cedex, NEW CALEDONIA

Phone: (687) 262-000
Fax: (687) 263-818
Telex: 3139 NM SOPACOM

Garry Preston
Senior Inshore Fisheries Scientist
Inshore Fisheries Research Project
South Pacific Commission
(as above)

TONGA

George Moengangongo
Director
Institute of Rural Development
University of the South Pacific
Private Bag 30
Nukualofa, TONGA

Phone: (676) 21-955/21-540
Fax: (676) 23-829
Telex: 66222 CW ADM TS

USA

Paul Bienfeng
Vice President
Oceanic Institute
P.O. Box 25280
Honolulu, HI 96825, USA

Phone: (808) 259-7951
Fax: (808) 259-5971
Telex: 723-8450

Michael Hamnett
Coordinator
Centre for Development Studies
Social Science Research Institute
University of Hawaii
2424 Maile Way
Porteus Hall Room 719
Honolulu, HI 96822, USA

Phone: (808) 948-7749/948-8930
Fax: (808) 942-5710
Telex: 27430050

Philip Helfrich
Director
Hawaii Institute of Marine
Biology
University of Hawaii
Coconut Island
P.O. Box 1346
Kaneohe, HI 96744, USA

Phone:(808) 247-6631/948-6715
Fax: (808) 955-6950
Telex: 7430050

James Woodruff
Project Coordinator,
Hawaii Natural Energy Institute
of the University of Hawaii
and the Pacific International Center
for High Technology Research
1245 Young St. Suite 206
Honolulu, HI 96814, USA

Phone: (808) 536-0711
Fax: (808) 537-4517
Telex:

William Branan
Technical CoordEnator
University of Rhode Island
National Environment Board
60/2 Soi Prachasampan 4
Rama 6 Rd
Bangkok, THAILAND 10400

Phone:
Fax:
Telex: 84315

AUSTRALIA

Susan Majid
2nd Secretary Development
Australian International
Development Assistance
Bureau (AIDAB)
G.P.O. Box 887
Canberra 2601, Australia

Phone: (61) 764-000
Fax: 487521
Telex:

Aziz Majid
Administrative Officer
AIDAB
(as above)

Phone: (61) 764-000
Fax: 487521
Telex:

B. KIRIBATI

Hon. Taomati Iuta
Minister for Natural Resource
Development
P.O. Box 64
Bairiki
Tarawa, KIRIBATI

Phone: (686) 21-099
Fax: (686) 21-099
Telex: 77039 KI MINNRD

Marae Irata
Acting Secretary
Ministry for Natural Resource
Development
P.O. Box 64
Bairiki
Tarawa, KIRIBATI

Phone: (686) 21-099
Fax: (686) 21-120
Telex: 77039 KI MINNRD

Ata Teaotai
Secretary to the Cabinet
Bairiki
Tarawa, KIRIBATI

Phone:
Fax:
Telex:

Nakibae Tabokai
Secretary for Education
Ministry of Education
P.O. Box 263
Bikenibeu
Tarawa, KIRIBATI
Phone: 28-132

Baraniko Baaro
Secretary for Finance and
Economic Planning
Phone: 21-216

Kaburoro Ruaia
Secretary for Foreign Affairs
Phone:

Tiaaniko Baaro
Secretary for Home Affairs
Phone:

Sam Edwards
Tree Crops Agronomist (ODA)
Division of Agriculture
Ministry for Natural Resource
Development
P.O. Box 267
Bikenibeu
Tarawa, KIRIBATI
Phone: (686) 28-108
Fax: (686) 21-120
Telex: 77046 KI

G.S. Sandhu
Entomologist (CTTC)
Division of Agriculture
(as above)

Kirabuke Tetaia
Agriculture Liason Officer
Division of Agriculture
(as above)

Tukabu Teroroko
Chief Fisheries Officer
Fisheries Division
Ministry for Natural Resource
Development
P.O. Box 276
Phone: (686) 28-252
Fax: (686) 21-120
Telex: 77046 KI

Tamaea
Tarawa, KIRIBATI

Being Yeeting
Fisheries Officer (Research)
Fisheries Division
(as above)

Roniti Teiwaki
Director
USP Centre
Tarawa, KIRIBATI

Anote Tong
Acting Director
Atoll Research and Development Unit
P.O. Box 206
Bikenibeu
Tarawa, KIRIBATI
Phone: (686) 28-029

John Finlay
IRETA Fellow in Atoll Agriculture
Atoll Research and Development Unit
(as above)

Seluta Takaeia (Mrs)
Betio Town Council
P.O. Box 477
Betio
Tarawa, KIRIBATI
Phone: (686) 26-278

Robati Corcoran
Tarawa Urban Council
P.O. Box 42
Teaoraereke
Tarawa, KIRIBATI
Phone: (686) 21-294

Clare Baiteke (Mrs)
Committee Member ARDU
Catholic Church
Justice Peace & Development
P.O. Box 79
Tarawa, KIRIBATI
Phone: (686) 21-279

Tekarei Russell (Mrs)
Committee Member ARDU
Kiribati Women's Federation (AMAK)
Bikenibeu
Tarawa, KIRIBATI
Phone: (686) 28-115

Temakei Tebano
Department of Marine Biology
James Cook University of North Queensland
Townsville Q4811, AUSTRALIA
Phone: (07) 81-4280

Murdo McInnes
General Manager
Te Mautari Ltd.
Betio
Tarawa, Kiribati
Phone:

C. SECRETARIAT

David Wyler
Regional Director
Foundation for the Peoples of the South Pacific (FSP)
P.O. Box 14447
Suva, FIJI
Phone: (679) 300-392
Fax: (679) 302-212
Telex: 2526 FJ

Parul Fernandes
Country Director
FSP
P.O. Box 43
Bairiki
Tarawa, KIRIBATI
Phone: (686) 28-101
Fax: (686) 21-010
Telex: 76177024

Randy Thaman
FSP Consultant
School of Social & Economic
Development
University of the South Pacific
P.O. Box 1168
Suva, FIJI

Phone: (679) 313-900
Fax: (679) 300-380
Telex: 2276 FJ

Appendix II. Intinerary for Kiribati Applied Atoll Research Consultation Tarawa Atoll resource orientation fieldtrip 26 February, 1989.

KIRIBATI APPLIED ATOLL RESEARCH CONSULTATION
TARAWA ATOLL RESOURCE ORIENTATION FIELDTRIP
26 FEBRUARY, 1989

ITINERARY

Objectives of Fieldtrip

The main objectives of the fieldtrip are twofold, firstly to give overseas participants a chance to get out and to see South Tarawa, the administrative and population centre of Kiribati, and secondly for those people, who have not been to Kiribati or on an atoll before, to view, firsthand, before the consultation begins, our atoll environment and resources, and our efforts, both traditional and modern, to develop these resources. In this way, it is hoped that the consultation will be more meaningful and productive. Additionally, it will give the participants another chance to mix socially and to discuss the objectives of the consultation and mutual research interests outside of the formal sessions.

Fieldtrip Itinerary

3:00 Leave Otintai Hotel with representatives from the Kiribati Visitors Bureau, Iaram Tabureka and Molly Mamara

3:15 Arrive Tanea to briefly visit the USP Atoll Research Unit (ARU), to view and discuss facilities and agricultural experiments with John Finlay and to discuss the potential development of the area, which had been formally earmarked for development as a defence force installation and is a potentitial site for a causeway connecting highly urbanized south Tarawa to rural North Tarawa

3:30 Stop at Bonriki village and Airport area to discusss problems related to land tenure and noise

3:40 Visit Temaiku milkfish and batfish pond and land reclamation project, with brief explanation by Chief Fisheries Officer Tukabu Teirotoko; view Tarawa Lagoon reef flat area, important for reef gleaning for food species such as te bun (Anadara spp.), one of the most important sources of protein in Kiribati

3:55 Stop Ananau Causeway area to view unsuccessful coconut replanting scheme

4:00 Brief visit to vegetable garden developments in the Temaiku area to see attempts at producing temperate and other vegetables and view surrounding agricultural areas

4:10 Visit Temaiku seawall and outer ocean coast to view fringing reef and coastal erosion and derise coconut groves and twin-topped coconut

4:20 Stop along lagoon area in Bikenibeu to discuss solid waste management problems and tourism development

4:25 View coconut replanting scheme at Bangantebure

4:30 View hydroponic gardening at the Moroni High School

4:35 Traditional welcoming ceremony by Chief and village elders and drinking of ceremonial green coconuts in maneaba (village meeting house) and walk through Eita Village to view multistory tree cropping, endangered tree species, te autoa and te nimarebureibu (Heritiera littoralis and Hernandia nymphaeaefolia) and te babai (giant swamp taro) pit cultivation; walk along oceanside beach to view coastal land use and back through plantation lands, to lagoon coast

5:15 Stop on Stewart Causeway to view reef islets and dying off of coconut palms on Scout Island and adjacent island

5:20 Visit the Ambo area with land purchase by outer island I-Kiribati and the Ambo fishponds which the government is trying to develop

5:25	Visit Nanikai, low-income labour housing area, a previous municipal waste disposal site
5:30	Stop on the recently completed Dai Nippon Bairiki-Betio Causeway and Fishing Channel
5:40	View World War II gun emplacement at the Betio end of Causeway
5:45	Walk through high-density Labour Line housing area in Betio, one of the most densely settled areas in the world, which is expected to reach a density equal to Singapore by 1990
5:55	Drive through the industrial areas of Tarawa and to the main wharf and jetty, base of interisland shipping and Te Mautari Ltd. fishing company, as well as the site of the new Japanese-aided ice plant and the obscured U.S. Marine Memorial
6:05	Drive past Command bunker of Admiral Shibasaki; the Marine Training Centre where I-Kiribati merchant seamen are trained to international standards (remittances being one of the main sources of foreign exchange); the main business centre of Betio; the Japanese airstrip
6:15	Refreshment (no host) at the Betio Hotel
7:00	Return to Otintai Hotel

Note: Bring a hat, sunscreen (if required), cameras, film, notebooks, swimming suit, shoes, beer/drink money, sleeping bags!, if required.

Appendix III. List of Working Papers prepared for the Kiribati Atoll Applied Research for Development Consultation 27 February to 2 March, 1989, Tarawa, Kiribati.

1. Research for Atoll Resource Development and Management: Priorities and Capabilities for Applied Research in Kiribati.
   R.R. Thaman

2. Work Programme Elements and Activities of the South Pacific Regional Environment Programme (SPREP).
   I. Reti

3. Kagoshima University: Fields of Study, Areas of Expertise and Research Capabilities and Interests.
   S. Iwakiri

4. South Pacific Commission (SPC) Fisheries Programmes and Their Relevance to Kiribati and the Atoll Research and Development Unit.
   G. Preston

5. Potential Resources for Atoll Development Research at the University of Hawaii.
   M. Hamnett

6. Research Proposals and Institutional Arrangements to Enhance Sustainable Atoll Development.
   J. Liew

7. Collaborative Activities: The Oceanic Institute and the Republic of Kiribati.
   F. Bienfeng

8. Applied Research for Atoll Development: Expertise Available and Activities Carried Out by the University of the South Pacific.
   R.J. Morrison

9. Applied Atoll Research and the USP Atoll Research and Development Unit: Problems and Prospects.
   A. Tong

10. The University of Guam Marine Laboratory.
R. Richmond

11. The USP Institute of Rural Development.
G. Moengangongo

12. The USP School of Agriculture and Institute for Research, Extension and Training in Agriculture (IRETA): Atoll Agricultural Activities and Role in Atoll Research for Development.
M. Hazelman

13. CCOP/SOPAC: Ongoing Activities and Capabilities with Particular Focus on Kiribati.
J. Eade

14. The University of Rhode Island's Experience in Transferring Implementable Coastal Resources Management.
W.V. Branan

15. The University of Rhode Island's International Coastal Resources Management Project.
W.V. Branan

16. Annual Report for 1988: Coastal Aquaculture Centre, Guadalcanal, Solomon Islands.
J.L. Munro

WORKING PAPER 1
RESEARCH FOR ATOLL RESOURCE DEVELOPMENT AND MANAGEMENT: PRIORITIES AND CAPABILITIES FOR APPLIED RESEARCH IN KIRIBATI

R. R. Thaman[1]

1. INTRODUCTION

1.1 The Need for Applied Research on Atoll Resources

The natural resources of the atoll nation of Kiribati are either extremely limited, in the case of terrestrial, lagoonal and near-shore resources, or extremely vast and difficult to utilize in the case of its oceanic marine resources within its extended exclusive economic zone (EEZ). There is, consequently, a pressing need for improved development and management, on a long-term basis, of these resources to serve the commercial and subsistence needs of current and future generations of I-Kiribati. To do so most effectively, there is a need for "practical developmental research" on the "living and non-living natural resources of atolls" (Ministry of Resource Development, 1988). Such research might include: 1) generation of data on the extent, nature and current use or development and conservation status of its natural resources; 2) evaluation of current and potential development or management strategies (both traditional/local and modern/imported); and 3) assessment of the impact that different development or management alternatives might have on its resources or the management of these resources on a sustainable basis by the people of Kiribati. Without the data from such research, resource development, management and conservation is problematic.

---

[1]. Reader in Geography, School of Social and Economic Development (SSED), The University of the South Pacific (USP), Suva, Fiji and Consultant to the Foundation for the Peoples of the South Pacific (FSP) Regional Programme, Suva, Fiji.

1.2 Proposal for an Atoll Development Research Centre

To address this problem the Kiribati government proposes to: 1) establish a strong "Centre for Practical Developmental Research on the Living and Non-living Natural Resources of Atolls"; 2) "create a centre for data collection for atolls"; and 3) "create a pool of Technical Advisors on Economic Utilization of Atoll Natural Resources".

1.3 The Kiribati Applied Atoll Research for Development Consultation

To "actively assist" it in the creation of such a "centre" and to more clearly identify the nature of its activities, the Government of Kiribati, with the support of the United States Agency for International Development (USAID) and the Foundation for the Peoples of the South Pacific (FSP), will hold a "Kiribati Applied Atoll Research for Development Consultation" in Kiribati from 27 February to 2 March, 1989.

The parties and institutions which have been tentatively identified for involvement in the Consultation include relevant ministries and agencies in Kiribati plus selected organizations and agencies which could potentially contribute to the development and operation of an Atoll Development Research Centre (ADRC). Included in the tentative list of outside participants in the consultation are high-level representatives from the International Centre for Living Aquatic Resources Management (ICLARM); the South Pacific Regional Environment Programme (SPREP); the South Pacific Commission (SPC); the Committee for the Coordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (CCOP/SOPAC); the Forum Fisheries Agency (FFA); the Oceanic Institute, Hawaii; the UNDP Integrated Atoll Project Section; the Atoll Research and Development Unit (ARDU), Institute of Rural Development (IRD), Institute for Research, Extension and Training in Agriculture (IRETA), and the Vice-Chancellor of the University of the South Pacific; the Faculty of Fisheries, Kagoshima University, Japan; and relevant institutes and sections of the University of Hawaii, University of Guam, and the University of Rhode Island.

1.4 Major Objectives of the Consultation

The major objectives of the "consultation" will be:

1. The identification and prioritization of areas for resource research activity, such as marine resources, agricultural resources, and conservation of the environment, including the the identification and prioritization of activities which might be undertaken within each area of activity.

2. The identification of development or management strategies for achieving the appropriate balance between the functions of research, development and training;

3. Assuming that the location of such a centre would be Tarawa, the administrative centre of Kiribati, the identification of the extent to which the centre should be actively involved in developmental research on other islands and oceanic areas within the region.

4. The identification of the potential roles of government and non-government organizations and institutions in the establishment of a centre and the implementation of its work programme.

2. GENERAL BACKGROUND ON RESOURCES

2.1 Land and Ocean Area

The 33 islands of the independent republic of Kiribati span the equator and cover some 5 million sq. km. of the Pacific Ocean. The country consists of three groups: the Line Islands to the east, Kiribati (formerly the Gilbert Islands) to the west and the Phoenix Islands in between. Although the 17 islands of the Kiribati Group proper (the traditional name was Tungaru), which includes the nearby phospate island of Banaba (Ocean Island) to the east, constitute only 278.4 sq. km. (33.8%) of the total claimed land area of 822.8 sq. km., they include some 56,397 people (96.4%) of the total population.

2.2 Climate

The mean annual rainfall is highly variable both within the three groups and from year to year, ranging from about 1,000 mm. near the equator, including 1,500 mm. at Tarawa to 3,000 mm. in the northernmost Islands, and from 700 mm. at Kiritimati (Christmas Island) to more than 4,000 mm. at Teraina (Washington Island) in the Line Islands. The natural vegetation and crops are, consequently, much more luxuriant on islands like Butaritari and Makin in northern Kiribati proper and Teraina in the Line Group, which are outside the equatorial dry belt.

The climatic problem most detrimental to crop production is drought. Banaba, central and southern Kiribati proper, the Phoenix Islands, the Kiritimati are all subject to severe droughts lasting many months, during which time the annual rainfall can be as low as 200 mm. Such droughts cause water shortages, affect water quality and adversely affect the growth of all plants, most importantly, coconut palms, breadfruit, giant swamp taro (te babai), and other food plants, and severly limit the production of the sole cash crop, copra.

2.2 Soils

The atoll soils of Kiribati are possibly among the most infertile in the world. These young shallow soils directly overlay the island reef platforms, and because of their immaturity, are similar to the original coral-limestone parent material. They are comprised largely of coral debris, sand and silt-sized particles of limestone, with a chemical composition of calcium carbonate and a small proportion of magnesium carbonate. They are typically highly alkaline, and other exchangeable cations, especially potassium, and deficient in iron, manganese, and zinc which, if present, are made unavailable to plants due to the high pH levels caused by the limestone. Activity of soil micro-organisms is limited, soil water-holding capacity is very low because of coarse texture, and ground water is often saline. These factors together make conventional agriculture, as practiced on other larger Pacific islands, very problematic in Kiribati.

2.3 Lagoonal and Reef Resources

Most of Kiribati's islands have protected lagoons with significant sand and subsistence fisheries resources. Some islands, however, like Tamana and Arorae, are table reef islets with no lagoons. All islands have some fringing reef and reef slope resources, all of which are of critical subsistence importance, as well as being of limited, primarily local commercial importance, particularly in the case of the deep-water snapper resource.

2.4 Oceanic Pelagic Resources

Kiribati's EEZ of over 5 million sq km has considerable potential for pelagic fisheries development, and, to a lesser extent, for the harvesting of deepwater corals. There is also potential for mineral resource development in terms of the occurrence of polymetallic manganese nodules and cobalt-rich crusts. In both cases, however, Kiribati lacks the technology, capital, and, in some cases, the knowledge of the nature of these resources, and must depend on outside assistance to negotiate the most appropriate aid-funded, joint-venture or leasing arrangements to exploit these resources.

3. SOCIO-ECONOMIC SITUATION

3.1 Population Pressure on Resources

As suggested above, the extremely limited land area suitable for agriculture, settlements, and commercial, intitutional and infrastructural development, and a limited terrestrial and near-shore natural resource base, coupled with unequal population distribution, makes modern development along western lines problematic. This unequal population distribution leads to some of the highest population densities in the world, especially in highly-urbanized south Tarawa, where it has been estimated that population densities by 1933 will be approximately 4,705 per sq. km., approaching that of Hong Kong. Such densities place excessive localized pressure on land, freshwater, and marine resources, which will only increase, given current high birthrates, thus underlining the need for improved knowledge and management of these resources.

3.2 Nutrition and Health Status

The state of health and nutrition in a country is probably one of the most important indicators of societal wellbeing and development. Although the people of Kiribati are generally well-nourished and healthy, there are some increasingly serious nutritional problems and health disorders, which are related to changes in resource use systems, increasing population densities, and urbanization.

Time-depth studies beginning over 30 years ago showed that, with the exception of vitamin B deficiency (especially vitamin B2 or riboflavin), there was little evidence of nutritional disorders (malnutrition) or nutrition-related non-communicable disease in Kiribati where people subsisted on a traditional diet of unrefined local food.

Studies by Holmes (1953) in the early 1950s on rapidly urbanizing Tarawa and the "rural" island of Maiana (where significant amounts of imported food were already being consumed), showed some iron deficiency anaemia among pregnant women and infants between 0 and 4 years of age and some "general poor nutrition". There were also some cases of adult malnutrition, mainly vitamin B-complex deficiencies, vitamin A deficiencies, and some vitamin C deficiencies. In almost all cases, these nutritional disorders were related to either poor weaning diets or excessive

such as diabetes, hypertension, cardio-vascular disease, hyperuricaemia, and certain forms of cancer (neoplastic diseases). Studies of the Micronesian people of the highly-urbanized phosphate-rich equatorial island of Nauru, have recorded among the highest prevalence of diabetes in the world, as well as very high prevalences of obesity, hypertension (high blood pressure), hyperuricaemia (often manifested as acute or chronic arthritis) and gout, diseases of the digestive system, cirrhosis of the liver, and cancer. All ranked high in, or were contributory to the major causes of death in Nauru. A Study by Paget et al. (1984) shows that similar trends are prevalent in Kiribati, and are closely related to a abandonement of traditional foodstuffs and an increasingly urbanized lifestyle.

In terms of other health problems and causes of mortality, diarrhoeal diseases, influenza, perinatal complications, skin diseases, and a number of other infectious diseases remain among the major health problems and, in many cases, are related to poor management of scarce water resources, poor nutrition, overcrowding and poor environmental hygiene.

3.3 The Kiribati Economy

Because of lack of resources and extreme isolation from major world markets, the future economic wellbeing of Kiribati will depend on the protection and management of the existing subsistence economy and its resource bases (which have provided most of the people's needs for generations), while, at the same time, maximising the potential for cash-productive activities.

3.3.1 Importance of the Subsistence Economy and Subsistence Resources

Although increasing food dependency, the deterioration of foreign exchange reserves, the promotion of export and cash-generating, and aid are the most commonly discussed economic problems, and although most development plans stress the need to maximize self-sufficiency, very little attention is given to the protection and maintenance of subsistence resources and traditional resource-use technologies that have served the Kiribati people for generations. These technologies, which are based on existing natural

and cultural resources (e.g., knowledge of the terrestrial and marine environment and traditional agricultural, fishing, medicinal technologies), and the wide range of products they produce, constitute a resource, the replacement of which, if it were possible, would lock the country of Kiribati even tighter into the vicious circle of dependency on an international economic system over which it has very little control. Table 1 is a list of ecological and cultural functions that the terrestrial and marine resources of Kiribati have served and continue to serve. As can be seen from this list, the replacement with imported substitutes of these ecological function and cultural uses of existing environmental resources, if they were available, would further worsen the economic situation in Kiribati, and would constitue underdevelopment and a cultural and ecological loss, rather than development of existing resources.

3.3.2 The Cash Economy

Since the cessation of phosphate mining on Banaba in 1979, the only locally-produced exports from Kiribati have been copra, fish and handicrafts which accounted for only (Aus)$3,326,000 Australian in 1981. Imports, however (including $6,300,000 for food, beverages, tobacco and animal and vegetable oils and fats), amounted to $19,912,000, leading to an enormous trade imbalance. The value of food imports alone of $4,960,000 is almost 150% the value of all locally-produced exports. If beverages, tobacco and animal and vegetable oils and fats are included, this value increases to almost 200%.

This serious trade imbalance and rapidly increasing food dependency is particularly alarming, given the limited land area, soils and terrestrial flora, which are among the poorest in the world, and the severely limited potential for export-oriented agricultural and industrial development, apart from copra and the processing and export of fisheries resources from its vast exclusive economic zone and its many lagoons and fish ponds. Aid and remittances from I-Kiribati residing or working overseas as seamen and contract workers in the Nauru phosphate industry are the only other significant sources of foreign exchange.

Household incomes are very low compared to those in most other Pacific Island groups. Few people, especially in the rural

Table 1. Ecological and cultural functions and uses of natural resources in Kiribati and other Pacific island countries, based on fieldwork in Papua New Guinea, Solomon Islands, Fiji, Tonga, Western Samoa, Kiribati and Nauru.

ECOLOGICAL

Shade	Soil Improvement	Animal/Plant Habitats
Erosion Control	Frost Protection	Flood/Runoff Control
Wind Protection	Water Quality Control	Pest/Disease Control
Wild Animal Food		Pollution Control

CULTURAL/ECONOMIC

Timber (commercial)	Broom	Prop or Nurse Plants
Timber (subsistence)	Parcelling/Wrapping	Staple Foods
Fuelwood	Abrasive	Supplementary Foods
Boatbuilding	Illumination	Wild/Snack/Emergency Foods
Sails	Insulation	
Tools	Decoration	Spices/Sauces
Weapons Hunting	Body Ornamentation	Teas/Coffee
Containers	Cordage/Lashing	Non-alcoholic Beverages
Woodcarving	Glues/Adhesives	Alcoholic Beverages
Handicrafts	Caulking	Stimulants
Fishing Equipment	Fibre/Fabric	Narcotics
Floats	Dyes	Masticants
Toys	Plaited Ware	Meat Tenderizer
Switch for Children/ Discipline	Hats	Preservatives
	Mats	Medicines
Brush/Paint Brush	Baskets	Aphrodisiacs
Musical Instruments	Commercial Export Products	Fertility Control
Cages/Roosts		Abortifacients
Tannin	Ritual Exchange	Scents/Perfumes
Rubber	Poisons	Recreation
Oils	Insect Repellents	Magico-religious
Toothbrush	Deodorants	Totems
Toilet Paper	Embalming Corpses	Subjects of Mythology
Fire Making	Lovemaking Sites	Secret Meeting Sites

Source: Adapted from Thaman and Clarke, 1987.

outer-islands, have formal wage employment, and depend almost exclusively on meagre incomes from copra and remittances. Minimum wage levels are similarly very low. In early 1976, the minimum wage was 39 cents an hour and 30 cents an hour for persons under 18 years of age, with some government wage earners getting 67 cents an hour. Although national income figures suggest an increase in personal income of about 6% per year, the retail price index, which is dominated by food-stuffs, is increasing at abo. 9% per year (Carter, 1984:230-240).

In short, the situation in terms of cash availability for the purchase of imported food, other consumer goods and capital goods is critical and deteriorating and will most certainly deteriorate further with current inflationary pressures and the slow phasing out of overseas employment in the phosphate mining industry of Nauru. This, again, underlines the need to balance efforts to increase cash earning and export-oriented activities with the protection of important subsistence activities and the protection and proper management of the existing and potential subsistence and commercial resource base.

4. THE NEED TO IDENTIFY AND PRIORITIZE AREAS FOR RESEARCH ON RESOURCES AND THEIR MANAGEMENT

As stressed above, the purpose of the Consultation is to identify and prioritize areas for research, management and training related to the use of Kiribati's resources, in light of the economic, social and ecological realities of an isolated, natural-resource-poor atoll nation. The lists provided in Appendices I and II are attempts to identify specific resources and potential resource management strategies which could be considered for prioritization for activities of an Atoll Development Research Centre, and to which relevant organizations and institutions could respond in terms of their interests and or capabilites in providing assistance.

Appendix I breaks the "General Areas" of focus into: 1) "Terrestrial Resources", including land mineral, soil, water, energy, plant, animal and agricultural resources; 2) "Lagoonal and Nearshore Marine Resources", including lagoonal, fringing reef and reef slope resources; and 3) Oceanic/Pelagic Resources, including fisheries and

mineral resources. Within these categories, stress is placed on determining the extent, nature and distribution, the quality and productivity and the current and potential utilization, including the identification of appropriate conservation and management strategies for each "resource".

Appendix II attempts to identify potential strategies for the development and management of resources within the resource areas identified in Appendix I, which could be prioritized for attention by the ADRC and participants in the consultation. Suggested strategies include: 1) resource enhancement (e.g., reforestation, reafforestation, fishfarming, land reclamation, agricultural rendensification, etc.); 2) environmental legislation (e.g., anti-pollution or plant and animal wildlife protection legislation); 3) restrictive utilization-conservation strategies (e.g., water, energy, and soil conservation, protection of endangered species, seasonal or restricted exploitation of marine fish and bird species, etc.); establishment of protected areas (e.g., national terrestrial and marine parks or conservation areas, village- or island-level microparks, subsistence agricultural reserves, etc.); 4) joint-venture development and management of resources-technology transfer; and 5) leasing of exploitation-exploration rights.

Although, only tentative, and obviously incomplete lists which could be amended before and during the consultation, it is hoped that Appendices I and II will provide a starting point (and checklist) for the identification and prioritization of areas for the focus of the envisioned ADRC and the Kiribati Applied Atoll Research for Development Consultation.

5. CONCLUSION

In conclusion, the Government of Kiribati believes that the establishment of an Atoll Development Research Centre (ADRC) and the development of the capacity for applied atoll development research is a critical precondition for the wise development and management of its scarce atoll resources on a sustainable long-term basis. To best achieve this aim, there is a need to: 1) identify and prioritize those resources which could be developed and/or managed; 2) identify the scope and nature of activities or functions in which the ADRC should be involved; 3) identify those activities or

functions, which can be carried out best by the people and Government of Kiribati themselves; and 4) identify those activites which can be best carried out by the most appropriate external agencies or institutions. It is the purpose of the Kiribati Applied Atoll Research for Development Consultation, from 27 February to 2 March, 1989, to "actively assist" the government in the creation of an effective ADRD. It is hoped that this background paper will provide some initial focus for the deliberations of the consultation.

6. SELECTED REFERENCES

Barrau, J. 1961. Subsistence Agriculture in Polynesia and Micronesia. Bulletin 223. Bernice P. Bishop Museum Bulletin, Honolulu.

Carter, J.(ed.). 1984. Pacific Islands Yearbook (15th edition). Pacific Publications, Sydney.

Catala, R. L. A. 1957. Report on the Gilbert Islands: Some Aspects of Human Ecology. Atoll Research Bulletin No. 59.

Central Planning Department (Kiribati). 1983. National Development Plan 1983-1986. Central Planning Department, Bairiki, Tarawa.

Coyne, T.(Badcock, J. and Taylor, R., eds.). 1984. The Effect of Urbanization and Western Diet on the Health of Pacific Island Populations. Technical Paper No.186. South Pacific Commission, Noumea. 1984.

Fairbairn, I.J. 1971. Pacific Islands Economies. Journal of the Polynesian Society 80(1): 74-118.

Fosberg, F. R. and Sachet, M.-H. 1987. Gilbert Island Flora, Checklist. Atoll Research Bulletin. (In press).

Fosberg, F. R., Sachet, M.-H., and Oliver, R. 1979. A Geographical List of the Micronesian Dicotyledonae. Micronesica 15(1-2):41-295.

Klee, G.A. Oceania. 1980. In Klee, G.A. (ed.), World Systems of Traditional Resource Management. Edward Arnold, London. Pp. 245-281.

Luomala, K. 1953. Ethnobotany of the Gilbert Islands. Bulletin 213. Bernice P. Bishop Museum, Honolulu.

McGee, T.G. 1975. Food Dependency in the Pacific: A Preliminary Statement. Working Paper No. 2. Research School of Pacific Studies, Australian National University, Canberra.

Massal, E. and Barrau, J. 1956. Food Plants of the South Sea Islands. Technical Paper No. 94. South Pacific Commission, Noumea.

Overy, R., Polumin, I. and Wimblett, D. W. G. 1982. Some Plants of Kiribati: An Illustrated List. National Library and Archives, Tarawa.

Pargeter, K.A., Taylor, R., King, H., and Zimmet, P. 1984. Kiribati: A Dietary Survey. South Pacific Commission, Noumea.

Parkinson, S.V. 1982. Nutrition in the South Pacific - Past and Present. Journal of Food and Nutrition 39(3):121-125.

Small, C. A. 1972. Atoll Agriculture. Department of Agriculture, Tarawa.

Thaman, R.R. 1979. Food Scarcity Food Dependency and Nutritional Deterioration in Small Pacific Island Communities. In Moran, W., Hosking, P. and Aitken, G.(eds.), Proceedings of the Tenth NZ. Geographical Conference and 49 ANZAAS Congress. New Zealand Geographical Society Conference Series No.10. Pp.191-197.

_____. 1982a. The Foods that Came First. Alafua Agricultural Bulletin 7(3):105-116.

_____. 1982b. Deterioration of Traditional Food Systems, Increasing Malnutrition and Food Dependency in the Pacific Islands. Journal of Food and Nutrition 39(3):109-121.

_____ 1983. Food for Urbanizing Polynesian Peoples. Proceedings of the Nutrition Society of New Zealand 8:26-37.

———. 1985. Pacific Islands Health and Nutrition: Trends and Areas for Action. In Development and Change: Issue Papers. Pacific Islands Conference, Rarotonga, Cook Islands, August 1985. Pacific Islands Development Programme, East-West Centre, Honolulu. Pp. III-A.1-27.

———. 1986. Trees, Conflict Resolution, and Peace: The Preservation of Trees as a Precondition for Environmental and Social Stability. In Maas, I. and Stewart, R.A.C.(eds.), Toward a World of Peace: People Create Alternatives. The University of the South Pacific, Suva. Pp. 379-396.

———. 1987a. Urban Agroforestry: The Pacific Islands and Beyond. Unasylva 39(155):2-13.

———. 1987b. Plants of Kiribati: A Listing and Analysis of Vernacular Names. Atoll Research Bulletin 296:1-42 (complete).

Thaman, R.R. and Clarke, W.C. 1987. Pacific Island Agrosilviculture: Systems for Cultural and Ecological Stability. Canopy International (In 3 parts) Part 1, 13 (1):6-7; Part 2, 13 (2):8-10; Part 3, 13(3):6-9.

Ward, R.G. 1980b. Agricultural Options for the Pacific Islands. In Shand, R.T. (ed.), The Island States of the Pacific and Indian Oceans: Anatomy of Development. Monograph No. 23. Development Studies Centre, Australian National Unviversity, Canberra. Pp. 23-40.

Watters, R.F. and Banibati, K. 1977. Abemama Island Report: Economic and Social Response in the Gilbert and Ellice Islands. The Ministry of Local Government and Rural Development, Bairiki, Tarawa, Kiribati.

Wilmott, J.V. 1968. Gilbert and Ellice Island Colony: Report on a Visit by a Nutritionist. South Pacific Health Service, Suva.

Yen, D.E. 1980a. Food Crops. In Ward, R.G. and Proctor, A.(eds.), South Pacific Agriculture Choices and Constraints: South Pacific Agricultural Survey 1979. Asian Development Bank in Association with Australian National University Press, Canberra. Pp.197-234.

___ 1980b. Pacific Production Systems. In Ward, R.G. and Proctor, A.(eds.), South Pacific Agriculture Choices and Constraints: South Pacific Agricultural Survey 1979. Asian Development Bank in Association with Australian National University Press, Canberra. Pp.73-106.

Appendix 1. Potential areas, sub-areas and specific topics for resource development and management research in Kiribati.

General Area	Sub-Areas	Specific Topics
Terrestrial Resources	Land Resources Area	
		Distribution
		Tenure Status
		Carrying Capacity
		Current Utilization
		Potential Utilization/Improvement
		- Identification of conservation strategies
		- Identification of appropriate development
	Mineral Res ·ces	Extent/Distribution
		- Sand and Aggregate Resources
		- Phosphate Deposits
		Current Utilization
		Potential Utilization/Improvement
		- Identification of conservation strategies
		- Identification of appropriate development
	Soil Resources	Extent/Distribution
		Structure
		Fertility
		Drainage
		Current Utilization
		Potential Utilization/Improvement
		- Identification of conservation strategies
		- Identification of appropriate development
	Water Resources	Extent/Distribution
		- Surface water
		- Groundwater
		Water Quality
		Current Utilization
		Potential Utilization/Improvement

- Identification of conservation strategies
- Identification of appropriate development

Energy Resources Extent/Distribution
-Fuelwood
-Sunlight
-Wind
-OTEC
Current Utilization
Potential Utilization-Improvement
- Identification of conservation strategies
- Identification of appropriate development

Plant Resources Extent/Distribution
Inventory/Indentification
Abundance/Endangerment Status
Current Utilization
Potential Utilization-Improvement
- Identification of conservation strategies
- Identification of appropriate development

Animal Resources Distribution
Inventory/Indentification
Abundance/Endangerment Status
Current Utilization
Potential Utilization/Improvement
- Identification of conservation strategies
- Identification of appropriate development

Agricultural Resources Extent/Distribution
- Plantation agriculture
- Rural subsistence agriculture
- Urban subsistance agriculture

Inventory/Indentification
- Food species and cultivars
- Medicinal species and cultivars
- Fragrant and sacred plants
- Other plant species of subsistence

importance
- Animal Species/Strains
- Traditional Knowledge

Abundance/Endangerment Status
Current Utilization
- Appropriate traditional technologies
- Appropriate existing introduced technologies
- Analysis of local food resource use

Potential Utilization/Improvement
- Identification of conservation strategies
- Identification of appropriate development

agoonal and Nearshore Marine Resources

Lagoon Resources/Extent/Distribution
Water Quality
- turbidity
- contaminants/degree of pollution

Productivity
- Shellfish
  Crustacea
- Finfish
- Other marine animal food species
- Plant species

Sand/Aggregate Resources
Lagoonal Phosphate Resources
Current Utilization
Potential Utilization/Improvement
- Identification of conservation strategies
- Identification of appropriate development

Fringing Reef

Extent/Distribution
Resources/Water Quality
- turbidity
- contaminants/degree of pollution

Productivity
- Shellfish
- Crustacea
- Finfish
- Other marine animal food species
- Plant species

Baitfish availability

Sand/Aggregate Resources
Current Utilization
Potential Utilization Improvement
- Identification of conservation strategies
- Identification of appropriate development

Reef Slope Resources

Extent/Distribution
Water Quality
- turbidity
- contaminants/degree of pollution

Productivity
- Shellfish
- Crustacea
- Finfish
- Other marine animal food species
- Plant species

Baitfish Availability
Black Coral Availability
Current Utilization
Potential Utilization/Improvement
- Identification of conservation strategies
- Identification of appropriate development

Oceanic/Pelagic Marine Resources

Pelagic Fisheries/Extent/Distribution
Resources/Productivity
- Shellfish
- Crustacea
- Finfish
- Other marine animal food species
- Plant species
- Deepwater pink coral

Current Utilization
Potential Utilization/Improvement
- Identification of conservation strategies
- Identification of appropriate development

Oceanic Mineral

Extent/Distribution
Resources- Polymetallic manganese nodules
- Cobalt-rich crusts

Economic Potential
Mineability

Current Utilization

Potential Utilization Improvement

- Identification of conservation strategies
- Identification of appropriate development

Appendix II. Potential strategies for the management of specified natural resources in Kiribati, the development of which could depend on assistance from appropriate local and outside organizations in the areas of research and training

General Area	Specific Areas	Potential Strategies
Terrestrial Resources	Land Resources	National Parks
		Local microparks
		Reclamation
		Coastal erosion control
	Mineral Resources	Rotational utilization
		Restricted exploitation
	Soil Resources	Soil conservation
		Soil improvement
	Water Resources	Water conservation
		Water quality improvement
		Water catchment system improvement
	Energy Resources	Fuelwood development
		Wood stove development
		Solar energy development
	Plant Resources	Protection of endangered species
		Reforestation
		Conservation areas/Restricted zones
		National parks
		Microparks
	Animal Resources	Protection of endangered species
		Reaffaunation
		Conservation areas/Restricted zones
		National parks
		Microparks
	Agricultural Resources	Germ plasm collections
		Plant multiplication and distribution

		areas/stations Reintensification of diversified multistory mixed cropping Agricultural reserves
Lagoonal and Nearshore or reserves		Lagoon ResourcesProtected areas/Lagoon parks Protection of endangered species Fishing regulations laws Anti pollution legislation
	Fringing Reef/	Protected areas Reef parks or reserves Reef SlopeProtection of endangered species ResourcesFishing regulations laws Anti-pollution legislation Technology transfer
Oceanic/Pelagic Marine Resources		Pelagic Fisheries Joint-venture development Resources Maximization of rental of fishing rights Patrolling EEZ areas Technology transfer
	Oceanic Mineral	Joint-venture development ResourcesEasing of exploration rights

WORKING PAPER 2
WORK PROGRAMME ELEMENTS AND ACTIVITIES OF THE SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME (SPREP)

I. Reti

1. BACKGROUND

The South Pacific Regional Environment Programme (SPREP) is housed and executed by the South Pacific Commission (SPC) based in Noumea, New Caledonia. SPREP receives directions from its Co-ordinating Group comprising the South Pacific Bureau for Economic Cooperation (SPEC)(recently renamed the South Pacific Forum Secretariat), the United Nations Environment Programme (UNEP), the Economic and Social Commission for Asia and the Pacific (ESCAP), and the SPC.

SPREP is contributed to by all 22 member states and territories of the South Pacific Commission and is by far the largest Regional Seas Programme in area (29 million km^2), although its total land area is only about 551,000 km^2 of which Papua New Guinea makes up 84 per cent.

The preparation phase for SPREP began in about 1974 with the appointment by SPC of a Regional Ecology Adviser. In 1980, country reports and reviews of important environmental topics in each of the island countries were prepared, thus providing for the Programme an indication of government priorities and the state of the environment in the region. These reports and reviews led to the adoption of the "SPREP Action Plan" by the Conference on the Human Environment in the South Pacific in 1982, ten years after the Stockholm Conference on the Human Environment.

The SPREP Action Plan has as its principal objective, "helping the countries of the South Pacific to maintain and improve their shared environment and to enhance their capacity to provide a present and future resource base to support the needs and maintain the quality of life of the people". Hence the SPREP Action Plan serves as a regional conservation strategy and provides a framework for environmentally sound planning and management suited to the

South Pacific region.

2. SPREP PRINCIPLES

Implementation of the SPREP Action Plan proceeds according to three principles, that it:

1) be undertaken by local people and organizations;

2) include an on-the-job training component and training courses should be conducted in-country or on a sub-regional basis; and

3) be open-ended with an emphasis on follow-up.

The intent of the first two principles is to build upon existing island expertise and institutions. When it becomes necessary to draw upon specialists from outside the region, local counterparts are identified. The emphasis on follow-up in the third principle, however, aims to overcome local dependency on developed country expertise and technology and is therefore an important consideration in the implementation of the Action Plan. It is assumed that SPREP projects will continue until the government and project team jointly consider that the need from which the project arose has been appropriately satisfied and that adequate on-the-job training has occurred to impart an appropriate degree of self-efficiency.

3. SPREP WORK PROGRAMME ELEMENTS

The work programmes of SPREP are approved by biennial meetings of member governments and administrations. Project proposals are received by the Secretariat from member governments and regional institutions and are submitted to Intergovernmental Meetings on the Work Programme for adoption and implementation under the SPREP Work Programme.

The Second Intergovernmental Meeting on the SPREP Work Programme (27 June to 1 July 1988) approved the 1989-90 Work Programme which contains the following elements:

(i) Monitoring, Research and Control of Pollution in Coastal and Open Waters of the SPREP Convention Area (SPREP POL)

Projects undertaken under this category include studies of pollutants and sources of pollution in coastal waters and lagoonal areas of Pacific island countries. Studies are under way at Laucala Bay/Suva Harbour, Fiji; Port Vila harbour and Erakor Lagoon, Vanuatu; Tarawa Lagoon, Kiribati; Fanga'uta Lagoon, Tonga; and Morovo Lagoon, Solomon Islands. Other related studies are under way in the coastal areas of French Polynesia and Guam.

(ii) Protected Area Management, Species Conservation, Historic Site Protection and Exotic Organisms

Under this category, special attention is given to the high degree of biological diversity in the region and very high levels of species endemism which contributes towards the large number of endangered species of flora and fauna in the region. An interesting and important activity under this category is the project for the coordination and integration of regional marine turtle management initiatives which will focus on the promotion of field activities, the development of supporting legislation and public education programmes, and the development of regional arrangements for marine turtle management.

(iii) Inland Water Quality, Pesticides and Pollution Control

Projects included in this category are those concerned with the assessment of hazards due to wastes originating from agriculture, forestry, industry, domestic activities, and mining sources. The projects implemented under this category are aimed at reducing deleterious impacts on inland water-ways, estuaries, lagoons and the terrestial environment.

(iv) Natural Resource Management and Environmental Planning and Administration

Projects considered under this group fall within three main sections: National Conservation Strategies, Coastal Zone Management

and Traditional Resource Knowledge. The preparation of National Conservation Strategies for several member countries over the next few years will be a major undertaking under this category.

(v) Environment Education, Training and Information

The large number of projects under this category reflected increased awareness by governments, institutions and non-government organizations of the need for expansion of environmental education, information and training activities. The 52 projects in this group represented a balanced spread between regional, sub-regional and in-country projects together with a broad geographical scope.

(vi) Impacts of Climate Change and Sea Level Rise on Pacific Island States of the SPREP Region

This project was developed in response to the general consensus in the scientific community that changes will occur in climate and sea levels over the next century which could have profound impact on the island countries of the South Pacific. Other indirect impacts could also occur such as significant changes in weather patterns leading to disruption of agriculture and other sectors. The SPREP project will include baseline studies for determining the long-term trends and effects of climate change on ecological and socio-economic systems and assistance to governments in the identification of response options and in the implementation of suitable options.

(For a complete list of activities on the 1989-90 SPREP Work Programme see Appendix 1).

4. AREAS OF SPREP INTEREST IN A KIRIBATI APPLIED ATOLL RESEARCH FOR DEVELOPMENT PROJECT

The areas of research and/or development activities undertaken by SPREP have been discussed in very general terms in the foregoing section. Under each category is a number of regional, sub-regional and national initiatives to be implemented within the framework of the SPREP Work Programme during the 1989-90 biennium.

Presently SPREP is providing assistance in two important areas to Kiribati: the development of an environmental school curriculum and the monitoring of pollution in the Tarawa lagoons. A third area of assistance in which SPREP is presently seeking outside support is in the eradication of feral cats on Christmas Island.

Apart from these projects, SPREP has interest in and/or ability to assist in the following areas, should they be considered of priority by the Kiribati government:

(i) Training

* Through its series of Coastal Resource Management and Planning Training Courses, SPREP could provide assistance in the training of local people in the preparation of appropriate management plans for critical areas or islands.

* Provide training and assistance in undertaking Environmental Impact Assessment of major development projects identified for the Atoll Research for Development Project.

(ii) Field Survey Type Research

* Resource surveys/inventories for:
  (a) site specific projects including EIA.
  (b) island level management planning, e.g., coastal management plans.

(iii) Development of Natural Resource Management Plans

* Country level - National Conservation Strategies.
* Island level - natural resource (or coastal) management plans.
* Specific sites for protection.

(iv) Marine Pollution

* Marine pollution related research and monitoring in other parts of the country (Note Tarawa is already included in current monitoring programme).

(v) Sea Level Rises/Climate Change

* Research, planning or policy projects related to the effects of climatic changes and sea level rises.

It is not possible to determine with any degree of certainty at this stage what SPREP can offer until some indication of the type of projects to be proposed for the Atoll Development Project is made known. It should be remembered, however, that any development project, in order to be sustainable, must not have a negative impact on the people, the resources and the environment upon which it depends. In this respect, it would appear that an important contribution by an environmental organisation like SPREP to any development proposal/project would be the training and assistance in conducting environmental impact assessment for such proposals/projects.

5. PROCEDURES FOR OBTAINING SPREP ASSISTANCE

SPREP undertakes activities in response to specific requests for assistance from its member governments or in order to expand the programme to meet other objectives of the Action Plan. Requests for assistance are submitted to the Secretariat for approval by Intergovernmental Meetings on the SPREP Work Programme. Under special and urgent circumstances, requests received during the interim period between Intergovernmental Meetings are accepted if submitted through the official SPC contact point (usually Foreign Affairs) in that country.

SPREP is not a funding agency, although from time to time, depending on the level of contribution received from its member governments and the success of the Secretariat's efforts in raising funds from other sources for programme activities, it might be in a position to provide modest financial support to national initiatives to protect important and vital resources or sites. The competition for this limited source of support, however, is often very intense and new proposals however important and well-meaning might have to be deferred in consideration of other long outstanding requests.

It is important to note here that every project assisted by SPREP on the request of a member country is considered a joint

project with that country. It is important therefore that in preparing requests or project proposals to SPREP, the "in-kind" contribution (usually staff time, services and facilities) provided by the government concerned should be clearly stated in the requests/proposals. Technical assistance is usually provided by the Secretariat staff in the first instance but could be obtained from other sources within the region if SPREP staff are not available. As much as possible the expertise available in-country will be used but it has been noted that in many Pacific island countries, expertise in the environmental sciences is sadly lacking.

APPENDIX 1
1989-90 SPREP WORK PROGRAMME
PROJECT PROPOSALS

Project No.	Title	Area	Status
NR 3	Pacific Resource and Environmental Data System	REG	Cont.
NR 9	Pukapuka Traditional Resource Management Knowledge	CKIS	Out
NR 12	Feral Cat Eradication	KB	Out
NR 13	Baseline Studies of Nearshore Areas	PAL	Out
NR 14	Environmental Impacts of Destructive Fishing in Truk	FSM	Out
NR 15	Terrestrial Ecosystem Mapping	W.SAM.	Out
NR 17	Survey of Dugong Status	SOL	Out
NR 19	Traditional Porpoise Harvest	SOL	Cont.
NR 21	Traditional Resource Knowledge	TOK	Cont.
NR 26	Traditional Environmental Knowledge	SOL	New
NR 27	Study of Mangrove Fish Communities in S.W. Lagoons	N.CAL.	New
NR 28	Guidelines for Harvesting Renewable Coastal Resources	MAR	New
NR 29	Environmental Management of Forestry	PNG	New
NR 30	Survey of Exotic Weed Problems in Micronesia	SUBREG	New
NR 31	Traditional Resource Management Yam Cultivation, Pohnpei	FSM	New
PA 7	Study and Protection of Cagou	N.CAL.	Cont.
PA 8	Management Planning Garrick Memorial National Park	FJ	Cont.
PA 9	Survey of Historic Sites and Buildings	FJ	Out
PA 13	Potential Protected Area Sites	VAN	New
PA 14	Protected Area on Customary Lands	SOL	New
PA 15	Survey of Potential Protected Areas	MAR	New

PA 16I	Inventory of Endangered Species	MAR	New
PA 17	Survey of Wildlife Status	SOL	New
PA 18	Assessment of Estuarine Crocodiles	VAN	New
PA 19	Survey of Mt. SilisiliNational Park	W.SAM.	New
PA 20	Survey of Lake Lanotoo National Park	W.SAM.	New
PA 21	Lake Lanotoo Development Scheme	W.SAM.	New
PA 22	Reconstruction of Vailima Botanical Garden	W.SAM.	New
PA 23	Turtle Conservation	FSM	New
PA 24	Turtle Hatchery, Yap Outer Islands	FSM	New
PA 25	Integrated Development Plan, Waikatakata Catchment	FJ	New
PA 26	Cook Islands National Park	CKIS	New
CM 2	Oceanography	REG	Cont.
CM 5	Sea Level Rise	REG	Cont.
CM 8	Effects of Hydroclimatic Variations on Planktonic Life in West Pacific	REG	New
CM 9	Sedimentology in New Caledonia Lagoons	N.CAL.	New
CM 10	Variability of Salinity and Temperaturein S.W. Pacific Waters	SUBREG	New
CM 11	Current Circulation Model	N.CAL.	New
CM 12	Lagoon Environment Monitoring System	SOL	New
CM 13	Reef Reserve Effects on Fish and Invertebrate Populations	SOL	New
CM 14	Zooplankton and Larval Fish Survey, Kolonia	FSM	New
CM 15	Monitoring of Mangrove Crab Populations, Pohnpei	FSM	New
CM 16	Biological Assessment of Patches and Inner Reefs	FSM	New
CM 17	Rehabilitation of Reef-dredged Sites	FP	New
CM 18	Nutrient trapping by Mangroves	GUAM	New
WQ 6	Monitoring Coastal Water of French Polynesia	FP	Cont.

WQ 7	Pacific Lagoonal Study	SUBREG	Cont.
WQ 8	Water Quality Monitoring	MAR	Out
WQ 9	Assessment and Monitoring of Drinking Water	VAN	Out
WQ 10	Survey of Mercury Levels in Fish and Water	FSM	New
WQ 11	River Input into Pacific Waters	SUBREG	New
WQ 12	Slow Sand Filter Demonstration Project	A.SAM.	New
WQ 13	Monitoring Lagoon Water Quality Pohnpei	FSM	New
WQ 14	Training in Water Quality Monitoring	FSM	New
WM 1	Bio-indicator use to Monitor	REG	Out
WM 2	Occupational and Environmental Hazards of Pesticide Use	REG	Cont.
WM 4	Heavy Metal and Organochlorine Monitoring in PNG Coastal Waters	PNG	Cont.
WM 5	Monitoring PNG rivers for Heavy Metals from Mining	PNG	Cont.
WM 6	Oil Pollution Survey, Vuda Point	FJ	Cont.
WM 10	Radioactivity on Guam	GM	Cont.
WM 11	Pesticide in the South Pacific	REG	Cont.
WM 12	Pesticide Monitoring	MAR	New
WM 13	Port Oil Spill Response Plan	FSM	New
WM 14	Training in Environmental Management of Fish Processing and Cannery Plants	FSM	New
WM 15	Alternative for Bulky Waste Disposal	A.SAM.	New
WM 16	Waste Oil Disposal	A.SAM.	New
WM 17	Assessment of Alternative Solid Waste Disposal Methods	MAR	New
WM 18	Environmental Impact of Solid Waste and Land Fill	PAL	New
EE 1	UPNG Environmental Science Programme,Fieldwork	PNG	Cont.
EE 5	Undergraduate Agroforestry Research and Training	SUBREG	Cont.
EE 9	National Environmental Symbol Promotion	W.SAM.	Out

EE 10	Upgrading Mobile Education Unit	FJ	Out
EE 11	Environmental Education Case Studies	REG	Cont.
EE 14	P.L.E.S.	REG	Cont.
EE 17	Support to S.P.A.C.H.L.E.E.	SUBREG	Cont.
EE 18	Environmental Education Kits	REG	Cont.
EE 19	Video-Environmental Issues in the South Pacific	REG	New
EE 20	Fieldwork - Environmentally Focussed Courses in Geography at USP	SUBREG	New
EE 21	Support to Fiji Nature Club	FJ	New
EE 22	Public Education Material - Solid Waste Management and Sanitation	PAL	New
EE 23	Environmental Seminars/ Education Week Series	REG	New
EE 24	Curriculum Development Support	REG	New
EE 25	Water Quality Education Campaign	WF	New
EE 26	Audio-visuals - Plants and Animals of Samoa	W.SAM.	New
EE 27	Education Material - Parks and Reserves	W.SAM.	New
EE 28	Field trips for Micronesian Teachers and Students Studying Environmental Science	SUBREG	New
EE 29	Training Micronesian Teachers to use their Environment with Conservation Values	SUBREG	New
EE 30	Conservation Posters in Vernacular Language of Micronesia	SUBREG	New
EE 31	Fieldwork - Environmental Science	SUBREG	New
EE 32	Radio Programming for Conservation Education	SUBREG	New
EE 33	Marine Conservation Education in Micronesia	SUBREG	New
EE 35	Litter Consciousness Campaign	CKIS	New
EE 36	Coastal Zone Illustrative Advertisements	CKIS	New
EE 37	Environmental Interpretation/ Media	CKIS	New

EE 38	South Pacific Journal of Natural Science		
EE 39	Coastal Zone Kits (ICOD)	REG	New
EE 40	Education on solid waste disposal	REG	New
EE 41	Pacific Wildlife readers	FJ	New
EE 42	Nature Awareness Series	SUBREG	New
		SUBREG	New

Project No.	Title	Area	Status
EI 1	Environmental Newsletter	REG	Cont.
EI 2	Environmental Bibliographies	REG	Cont.
EI 3	Coral Reef Newsletter	REG	Cont.
EI 4	Audio-visual Material Production	REG	Cont.
EI 7	Vanuatu Environmental Bibliography	VAN	Cont.
EI 8	Environmental Health Information System	A.SAM.	New
EI 9	Medicinal Plants Publication	REG	New
EP 1	National Conservation Strategy	FJ	Out
EP 4	National Environmental Strategy Development	W.SAM.	Out
EP 6	National Conservation Strategy Publication	SOL	Out
EP 7	National and State Coastal Management Plans	FSM	Cont.
EP 8	Coastal Management Plans Majuro and Kwajalein	MAR	Out
EP 9	Northern Cook Islands Archipelagic Conservation Strategy	CKIS	Out
EP 10	Coastal Management Planning S.W. Viti Levu	FJ O	Out
EP 14	Vanuatu Environmental Staff Secondment to SPREP	VAN	New
EP 15	SPREP/IUCN NCS Programme	REG	New
EP 16	Environment Assessment of Mineral Development	SOL	New
EP 17	Legislation for National Parks and Reserves	MAR	New
EP 18	Environment Conservation Strategy	TUV	New
EP 19	Conservation Strategy for		

	New Ireland	PNG	New
EP 20	Feasibility Study of Declaring PNG Territorial Waters a Nuclear Free Zone	PNG	New
EP 21	Afulilo Hydro Scheme Env. Assessment	W.SAM.	New
WT 1	Environment Impact Assessment, Training Course	REG	Cont.
WT 3	Coastal Resource Management and Protected Area Training Course	REG	Cont.
WT 11	Regional Workshop on Transport, Handling and Storage of Hazardous Materials	REG	Cont.
WT 12	Protected Area Scholarships	REG	Cont.
WT 16	Environmental Media Workshop	REG	Cont.
WT 17	Environmental Education Workshop	VAN	New
WT 18	Post-graduate Training in Environmental Science	REG	New
WT 19	Joint Meeting of the Parties to the Apia and SPREP Conventions	REG	New
WT 20	Vanuatu EIA Training Course	VAN	New
WT 21	Training Course: Sand Mining and Coral Dredging Site Selection	FSM	New
WT 22	Workshop on Prevention of Stream Siltation	FSM	New
WT 23	Pesticide Management Training	A.SAM.	New
WT 24	Groundwater Training	A.SAM.	New
WT 25	Fourth South Pacific Nature Conservation and Protected Areas Conference	REG	New
WT 26	Solomon Is. Training in Env. Planning	SOI	New
WT 27	Hazardous Waste Management, Transfer,Disposal Workshop	REG	New

WORKING PAPER 3
KAGOSHIMA UNIVERSITY: FIELDS OF STUDY, AREAS OF EXPERTISE AND RESEARCH CAPABILITIES AND INTERESTS

Prof. Shigero Iwakiri
Dean, Faculty of Fisheries
Kagoshima University

I. KU GENERAL INFORMATION

Kagoshima University, situated in the southernmost prefecture of the main islands of Japan, was established in 1949 as a national university. With rapidly expanding institutes and facilities, it has developed into a fully-fledged university with a College of Liberal Arts and eight other faculties: Law and Letters, Education, Science, Medicine, Dentistry, Engineering, Agriculture and Fisheries. It offers, in several fields, graduate as well as undergraduate courses: a doctoral course in the Faculty of Medicine and in the Faculty of Dentistry, and a masters course in the Faculties of Law and Letters, Science, Engineering, Agriculture and Fisheries respectively. United Graduate School, which offers a final three-year Doctoral Course in Agricultural Sciences including Fisheries Sciences was established in 1988. The Research Centre for the South Pacific is an inter-faculty research centre of the university.

The Faculty of Fisheries has nineteen (19) chairs, three (3) research and training ships, and one (1) research laboratory as follows:

I.1 Chairs

KU has professorial chairs in Physical Oceanography, Engineering Oceanography, Marine Botany and Environmental Science, Marine Biology, Fish Resources, Aquacultural Physiology, Marine Resources Biochemistry, Marine Resources Nutrition, Chemistry, Microbiology, Food Chemistry, Food Preservation Science, Food Analysis and Quality Control, Fishing Gear Science, Fishing Technology, Fishing Vessel Navigation, Fishing Vessel Seamanship, International Marine Policy, Fisheries Business Economics and Fisheries Environmental Sociology.

1.2 Research and Training Ships

KU's research and training vessels and their specifications are shown below:

Ships	Gross (t)	Engine	H.P.	Length (m)	Width (m)	Depth (m)
Kagoshima-Maru	1,292.75	Diesel	2,200	62.70	12.60	5.45
Keiten-Maru	860.25	Diesel	2,000	57.04	11.00	6.90
Nansei-Maru	82.97	Diesel	400	22.00	5.70	2.55

2. AREAS OF RESEARCH UNDERTAKEN BY THE KU

During the last seven years, KU has conducted 5 scientific field surveys in Oceania. This programme has been supported by a special research grant from the Japanese Ministry of Education, Science and Culture. The KU training ship, Kagoshima-Maru, participated in these surveys.

- Fiji in 1981;
- Fiji and the Solomon Islands in 1982;
- Papua New Guinea in 1983;
- Ponape and Truck in 1985; and
- Palau and Yap in 1986.

The outline of research activities are as follows.

Subject I: Land Use and Conservation of Terrestrial Ecosystems in Rural Areas (Includes Botany and Agricultural Sciences).

Subject II: Primary Production and Aquatic Resource Utilization in Tropical Waters (Includes Marine and Fisheries Sciences).

Subject III: Hereditary Analysis and Survey for Public Health.

Subject IV: Socio-Economic Development in Rural Areas.

Subject V: Oceanic Structure and Its Fluctuation in the Western Tropical Pacific

Full-time and on-campus researchers have also conducted scientific studies in Guam, Fiji, Papua New Guinea, Solomon Islands, Vanuatu, Tonga, Tahiti, Thailand, Malaysia, Indonesia, Philippines and Madagascar.

3. AREAS OF INTEREST FOR RESEARCH PROJECTS

The subjects of research projects which would be of interest to the Faculty of Fisheries at KU and to collaborating Agricultural Scientists include:

3.1 Subject I: The role of circulation and water exchange systems in lagoon ecosystems

Purpose: Nutrients are essential to reef and lagoon foodwebs. From the oceanographic point of view, the amounts of nutrients and their change in time are dependent on the circulation and water exchange systems. The purpose of this study is to determine the supply of nutrients entrained in the tidal current and the role of upwelling as a source of nutrients.

Main items of the study include:

a. Measurements of water temperature, salinity and nutrients at different tidal stages in and out of the lagoon.

b. Measurements of current velocities at several mooring stations both inside and outside of the lagoon.

c. Analysis of wind data, to examine the relationship between circulation patterns and wind fields.

3.2 Subject II: Studies on the assessment and possible promotion of the utilization of marine biological resources around atolls in the Republic of Kiribati and its adjacent oceanic areas

Purpose: The marine biological resources around atolls, such as fish, algae and molluscs, will be investigated quantitatively and qualitatively. Present fishing of this area will be evaluated, as will the suitability of the area for sustainable utilization. A survey and exploitation of unused biological resources will be carried out. For several kinds of biological resources, we will evaluate possible methods for the augmentation of their productivity by means of our technology on mariculture.

Main items of the study, which will focus on Study Areas I (lagoon and barrier reef), II (outer reef slope), and III (offshore region) include:

a. Field and literature surveys on biological resources, such as fish, algae and molluscs for Study Areas I-III.

b. Evaluation of the suitability of present fishing practices in Study Areas I-III.

c. Exploitation of unused biological resources and an evaluation of suitable fishing methods in Study Areas I-III.

d. Selection of species and planning of their mariculture on a commercial basis.

3.3 Subject III. Study on Social Ecology and Regional Planning for Lagoon Areas in the South Pacific

Purpose: Tropical lagoons are an important source of protein supply and sea communication for rural inhabitants under the customary rules of lagoonal communities. Furthermore, the ecosystem including the lagoon itself and the barrier reef and mangrove areas, possesses great potential for extensive aquaculture of finfish, shellfish and marine plants. Various aspects of study will be integrated to ascertain a model of effective utilization of lagoon resources with a view to achieving more equitable regional economic development.

Main items of study include;

a. Ecology and assessment of available

b. Customary tenure system and res lagoon as a fishing ground.

c. Socio-economic structure and activi

d. Various models of regional plan and aquaculture modes.

WORKING PAPER 4
SOUTH PACIFIC COMMISSION (SPC) FISHERIES PROGRAMMES AND THEIR RELEVANCE TO KIRIBATI AND THE ATOLL RESEARCH AND DEVELOPMENT UNIT (ARDU)

Garry Preston

---

1. INTRODUCTION

The South Pacific Commission is an international technical assistance agency serving the countries and territories of the Pacific Islands region. The Commission employs about 65 professional staff and has an annual budget of about US $9.2 million. Of these, 27 (41%) of the staff and $1.65 million (18%) are directly employed in fisheries-related activities.

The fisheries programme is made up of the following divisions:

Coastal Fisheries Programme

- -Deep Sea Fisheries Development Project
- -Fisheries Training Project
- -Fish Handling and Processing Project
- -Inshore Fisheries Research Project

Tuna and Billfish Assessment Programme

- -Fisheries Statistics Project
- -Tuna and Billfish Research Project
- -Regional Tuna Tagging Project

Regional Purse-seining project.

The following paragraphs describe work undertaken by each project in Kiribati and note aspects that are of direct relevance to this consultation.

2. DEEP SEA FISHERIES DEVELOPMENT PROJECT (DSFDP)

The DSFDP employs a team of roving Master Fishermen who spend periods of 3-12 months on assignment in SPC member countries, assisting with a wide range of fisheries development activities. SPC Master Fishermen have been assigned to Kiribati on several occasions. Details of the assignments are given in Table 1.

As well as in-country assignments, Kiribati nationals have undertaken in-service training with SPC Master Fishermen. An officer of the Fisheries Division spent about 6 weeks on attachment to an SPC Master Fisherman in Fiji in 1985.

Table 1. Deep sea fisheries development project assignments to Kiribati.

Dates	Location	Principal Objectives of Assignment
April-November 1980	Tarawa, Maiana and Kuria	Identify and provide preliminary assessment of deep-bottom fish resources of outer reef slope; provide practical deep-bottom fishing training to local fishermen and government demonstration team; evaluate economic viability of deep-bottom fishing in Kiribati.
April-September 1984	Tarawa, Abaiang, Abemama, Arorae, and Tamana	To conduct further surveys of deep-bottom fish stocks at Tarawa; to carry out preliminary resource assessments at the other islands; to assess the feasibility of fishing this resource using canoes and other locally available fishing craft.
October-December 1984	Christmas Island	Survey deep-bottom fishing grounds and fish stocks; train a government demonstration team in deep-bottom fishing techniques; assess the feasibility of developing an export-based fishery.

January 1989 - present	Tarawa	Development of small-scale surface longline system for use by local tuna fishermen (Note: this is considered a regional project, rather than a strictly national assignment, because of its application to other countries of the region).

3. FISHERIES TRAINING PROJECT (FTP)

The Fisheries Training Project helps SPC member countries satisfy their training needs by assisting in the development of long-term manpower and training plans by matching training requirements to available training opportunities, and by providing information on training courses and sources of funding in general. Both the Kiribati Government and Te Mautari have used the services of the FTP in developing their own in-service training plans.

The FTP also arranges attachments and short specialised training programmes where training requirements cannot be met by available courses. A specialised attachment for a Fisheries Division seaweed technician was arranged to various institutions in Australia in 1988. Kiribati participants in SPC courses, or intended courses in recent years are listed in Tables 2 and 3.

Table 2: Kiribati participants in SPC fisheries training courses.

Year	Course	Location	Number of I-Kiribati Participants
1980	Nelson Polytechnic	New Zealand	2
1982	Nelson Polytechnic	New Zealand	1
1983	Nelson Polytechnic	New Zealand	2
1984	Nelson Polytechnic	New Zealand	1

1985	Nelson Polytechnic	New Zealand	1
1987	Nelson Polytechnic	New Zealand	1
1988	Nelson Polytechnic	New Zealand	1
1985	Fisheries Refrigeration	Cook Islands	2
1986	Fisheries Refrigeration	Cook Islands	1
1987	Fisheries Refrigeration	Papua New Guinea	1
1986	Fish Catching Methods and Extension Skills	Fiji	1
1988	Stage 1 Fisheries Extension	Fiji	1

Table 3. Courses that the FTP has conducted or will conduct either in Kiribati or at Kiribati's request are as follows.

Year	Course Title or Subject	Number of I-Kiribati Participants
1987	FAD construction and deployment course (international)	4
1988	Joint Kiribati/Tuvalu Extension course	6
1989	Extension skills	10-12

4. FISH HANDLING AND PROCESSING PROJECT (FHPP)

The FHPP provides expert advice and training in post-harvest fisheries by offering assistance in fish handling and processing by promoting the use of suitable processing, packaging and marketing techniques. The SPC Fish Handling and Processing Officer visited Kiribati in February 1988 to advise Te Mautari Ltd on its plans for diversification of product base. This proposal was intended to tie in with the Outer Island Commercial Fisheries Trial where fish harvested, frozen and stored at two of Kiribati's atolls, are

transported to South Tarawa on an approximately monthly basis. During the assignment a visit to Butaritari, one of the outer islands chosen for the trial, was made to evaluate the site. Detailed recommendations were made on the proposed procedures, equipment, materials and training for staff. Further input from the FHPP is being discussed for 1989 in relation to the export of marine produce from Christmas Island.

5.INSHORE FISHERIES RESEARCH PROJECT (IFRP)

The IFRP assists member governments to collect and make use of fisheries data in order to improve the rational utilization and management of inshore marine resources. The Project is only recently established and has not yet operated in Kiribati, although a proposal to assist with a survey of pearl shell resources at Christmas Island is presently being considered.

The IFRP is nevertheless involved, or planning to become involved in the near future, in a wide range of activities that are of relevance to marine resource research and development in Kiribati, and to the work of the Atoll Research and Development Unit. These include: survey and assessment of marine fish and invertebrate resources; collection and interpretation of fisheries statistics for assessment and management purposes; monitoring of ciguatera occurrence; application of remote sensing technology and techniques to marine resource assessment; adaptation of visual survey techniques to commercially important fin-fish species; analysis of deep-bottom fish catch-and-effort and biological data, region-wide; training in mathematical stock assessment techniques; establishment of specialist working groups on technical subjects; and the dissemination of information on the biology and management of Pacific Island living marine resources.

6. FISHERIES STATISTICS PROJECT (FSP)

The main activity of the FSP is to maintain a database which contains catch, effort, and biological information on the national and international tuna and billfish fisheries of the Pacific Islands region. The database is maintained through the cooperation of Pacific Island and other countries, whose fishing boats provide records of fishing

activities in the Pacific Islands. The data is provided in raw form by Kiribati and other countries, and is entered onto the Commission's main computer in Noumea. Data summaries are provided to the Kiribati government on a regular basis, and these are of major importance in negotiating access fees with foreign fishing interests, and in monitoring industrial fishing activities in general.

Other FSP activities include: maintaining in-country databases for tuna fisheries (including Kiribati); developing national fisheries statistics systems; and training of fisheries officers.

7. TUNA AND BILLFISH RESEARCH PROJECT (TBRP)

The TBRP makes use of information in the regional tuna database at SPC, and other data, to monitor the levels of exploitation of, and fishery-induced changes in, stocks of commercially important tuna and billfish species, and to study their life history and behaviour with the aim of improving our understanding of those aspects of tuna biology relevant to their capture and management. Specific areas of study relevant to Kiribati and the ARDU include: mechanisms of attraction of fish aggregation devices (FADs); tuna migration and its variation; association of tuna concentrations with sea surface temperatures and other oceanographic features; and the effects of disturbances to global ocean current patterns on tuna distribution.

8. REGIONAL TUNA TAGGING PROJECT (RTTP)

This is a major new activity which will commence in 1989, tentatively in May. Tagging will be carried out from a variety of vessels, including both industrial vessels and small artisanal fishing craft. The pilot project which established the feasibility of tagging from tuna-fishing skiffs was carried out in Kiribati in 1986, and it is highly likely that at least one more tagging exercise will take place in Kiribati. One of the important aims of the project is to study the interaction between surface (pole-and-line and purse-seine) and midwater (longline) fisheries for tuna, particularly yellowfin, and between artisanal and industrial tuna fleets. In some cases, estimates of skipjack stock size derived by the earlier Skipjack Survey and Assessment Project (SSAP) will be upgraded. This is a research

topic of considerable significance to Kiribati, which has tuna fisheries that fall into all these categories and that may ultimately be competing for the same resource.

9. REGIONAL PURSE-SEINE TRIAL FISHING PROJECT (RPSP)

This new project proposes the development of localised purse-seine fisheries in areas or countries currently outside the main purse-seine fishing grounds, using small to medium-scale boats operating in a limited range. After an initial mission to determine the level of interest in the project in 1988, a full-scale technical and economic feasibility study will be conducted in 1989. Kiribati has expressed strong interests in being included in the first study area or sub-region. This possibility, and the implications of the Project for Kiribati, will be investigated during the feasibility study.

10. CONSULTANCIES AND SPECIALIST SERVICES

The SPC periodically engages consultants to undertake specialist work beyond the scope of the normal SPC work programme. In 1987, a consultancy was commissioned to assess the abundance of deep water shrimps around Tarawa and the feasibility of a commercial harvesting activity based on this resource. The Fisheries Division plans to follow up this work and extend it to Christmas Island, where the exporting infrastructure is better developed than in Tarawa.

11. SUMMARY

The South Pacific Commission has been intimately involved in living marine resource research and development in Kiribati, and expects to continue this involvement in future. Many of our activities are relevant to the work of the ARDU, and we expect to be able to cooperate fully with this institution, whatever its new form. The services of the Commission will be available, via the Kiribati government, to the ARDU should they be required. The Fisheries Programme, and in particular the Inshore Fisheries Research Project, looks forward to a fruitful and mutually beneficial involvement in ARDU.

WORKING PAPER 5
POTENTIAL RESOURCES FOR ATOLL DEVELOPMENT RESEARCH AT THE UNIVERSITY OF HAWAII

M. Hamnett

1. INTRODUCTION

The University of Hawaii (UH) is the largest educational and research institution in the State of Hawaii and the Pacific Islands. It was established in 1907 as a land grant college of agriculture and mechanic arts. It now offers undergraduate degrees in 89 fields and advanced degrees in 62 fields, has a research and teaching faculty of over 2,100, and supports over 200 international programs. The University has recently established a School of Hawaiian, Asian, and Pacific Studies that will work with other university programs to increase UH's role in Asia and the Pacific Islands.

The faculty and staff of the University of Hawaii feel privileged to be asked to participate in the initial discussions about atoll development research in the Republic of Kiribati. Several University programs have expressed interest in providing support for research on sustainable resource development and environmental management in Kiribati through a coordinated effort. This paper briefly describes the resources available in University of Hawaii research and training programs that may be relevant to the resource development needs of the Republic of Kiribati. It focuses primarily on the College of Tropical Agriculture and Human Resources, the Hawaii Institute of Marine Biology, the Water Resources Research Center, the Hawaii Natural Energy Institute, and the Center for Development Studies of the Social Science Research Institute. It identifies other University of Hawaii programs that could make a contribution to atoll development research. It also notes several collaborative activities with institutions represented at the Kiribati Atoll Applied Research for Development Consultations.

2. COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

The College of Tropical Agriculture and Human Resources (CTAHR) has over 25 years of experience in providing research, training and technical assistance aimed at sustainable agricultural development in the Pacific Islands and Asia. CATHR is currently participating in six major agricultural development and technical assistance activities and is ranked seventh among US universities in total volume of international development programs.

The College is heavily committed to international training and instruction. CATHR provides professional training in agricultural technology and science, agricultural and resource economics, human nutrition and food science, family and leadership development, home management and community resources development. Recent activities include training in farming systems and sustainable resource development, tropical fruit and nut production (e.g. taro, papaya, pineapple, guava and macadamia nut), design of drip irrigation systems, integrated pest management, plant protection and quarantine, production and management of fast growing trees, and the biology and management of freshwater prawns. The College also has technical programs focusing on tissue culture, biological pest control and enzyme production.

CTAHR is involved in extensive scientific collaboration and exchange programs with Pacific and Asian institutions. Projects include soil management work in Indonesia, vegetable production research on Guam, taro breeding in Western Samoa, taro production in Cook Islands and taro processing in American Samoa. The College is the coordinator of two institutional and human resource development efforts, the South Pacific Agriculture Development Project (SPRAD) and the Agricultural Development for the American Pacific (ADAP). SPRAD is a training, research, outreach support effort with the University of the South Pacific's South Pacific School of Agriculture at Alafua. This program, which is supported by USAID, serves Cook Islands, Fiji, Kiribati, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Western Samoa. Under the auspices of this project, collaborative research involving USP and the Government of Kiribati was undertaken on breeding more salt-tolerant varieties of babai (Cyrtosperma chamissonis). ADAP is a collaborative effort involving the five land-grant institutions in the

American affiliated Pacific islands. Its goal is to accelerate agricultural development and promote the maintenance of the region's fragile ecosystems.

The CATHR Department of Agronomy and Soil Sciences could assist in the areas of soil survey and classification, soil fertility and conservation. The department has a major emphasis on resource management and conservation. Crop production expertise is available for the selection and cultivation of salt-tolerant cultivars such as Cyrtosperma chamissonis, Alocasia macrorrhiza, and Colocasia esculenta.

The Department of Agriculture and Resource Economics has staff capabilities in economic analysis, small enterprise management, and the marketing and export of Pacific island agricultural products. One of the senior faculty is internationally recognized in aquaculture and fisheries economics.

The Departments of Agricultural Engineering, Entomology and Plant Pathology, and Animal Science provide expertise in waste management, agricultural systems analysis, animal nutrition, feed production and analysis, poultry, goat and swine production, animal reproduction in tropical and subtropical environments, and animal and plant quarantine.

The College maintains laboratories for basic soil chemistry, biochemical analysis, tissue culture, and nutrition related research. CTAHR operates a diagnostic center that conducts soil analysis and disease diagnosis for faculty and community clients. It also manages 15 off-campus research facilities in different environmental zones in support of research on crops [illegible] throughout the world.

3. HAWAII INSTITUTE OF MARINE BIOLOGY

The Hawaii Institute of Marine Biology (HIMB), established in 1921, has acquired an international reputation for studies in tropical marine biology. The Institute is best known for research on coral ecosystems ecology, aquaculture, marine pollution, marine toxins (ciguatera), fisheries management and development, animal behavior, plankton studies, and biogeo-chemical processes. Education and training have been, and will continue to be, important components of

the HIMB program. Numerous courses, seminars, workshops and training sessions have been conducted by HIMB, with many of the professional marine biologists working in the Pacific islands today having received training at the Institute.

HIMB staff have been involved in a range of research and training activities in the Northwest Hawaiian Islands, Johnston Island, the northern Line Islands, French Polynesia, Tonga, Western and American Samoa, Cook Islands, Belau, Guam, Federated States of Micronesia, Wake Island, Tuvalu, Papua New Guinea, Okinawa, New Caledonia, as well as in the Phoenix and Gilberts groups in Kiribati. The Institute's longer range studies have included research on: pollution in Kaneohe Bay in Hawaii; aquaculture pond dynamics in Hawaii, Asia and Central America; the ecology and behavior of reef and pelagic fish with important resource management implications; biogeochemical processes of lagoons and enclosed bays; ecological and physiological studies of corals and associated organisms in coral ecosystems.

For a period of thirty years, HIMB operated a marine laboratory on Enewetak Atoll in the Marshall Islands under contract with the US Department of Energy. This experience was invaluable to the Institute staff, and it resulted in what is recognized as the most thoroughly studied tropical marine ecosystem in the world. A summary of the knowledge gained about atoll environments was recently published in a two volume treatise titled The Natural History of Enewetak Atoll.

HIMB's headquarters facility is located on Coconut Island in Kaneohe Bay on the island of Oahu with direct access to a range of marine habitats. It includes a modern well-equipped laboratory complex, offices, classrooms, a sea water system, ponds, tanks, two research and support vessels (10-15 meters), a fleet of smaller boats, a marine railway, and support shops. The Institute also operates the Mariculture Research and Training Center at Hakipuu on Kaneohe Bay. The center consists of 12 acres in dirt ponds, access to both fresh and salt water, a hatchery, classrooms, offices, water analysis laboratory, and living quarters. Additional laboratories are maintained on the main campus of the University in Honolulu.

The Institute currently has collaborative agreements with the University of Guam, the University of the South Pacific, as well as

with universities in the Philippines, Taiwan, Thailand, Japan and Australia. HIMB also works closely with the recently established Center for Tropical and Subtropical Aquaculture, a joint venture involving the University of Hawaii and the Oceanic Institute. Organizationally, HIMB is within the recently established School of Ocean and Earth Science along with the Department of Oceanography, the Department of Ocean Engineering, the Sea Grant Program, the Hawaii Institute of Geophysics, the Hawaii Undersea Research Laboratory, the Joint Institute for Marine and Atmospheric Research, and the Waikiki Aquarium.

4. WATER RESOURCES RESEARCH CENTER

The Water Resources Research Center provides research and technical assistance in water resource development and management. WRRC has four major divisions: hydrology, engineering, water quality and ecology, and water law and economics. Programs within the four divisions include research on hydrologic cycles, supply and demand for water, water quality, conservation and water use efficiency, water resource development, as well as socio-economic, legal, biological, and ecological problems associated with water.

Center staff are currently involved in projects focusing on Atoll Groundwater Development and Monitoring, the Need and Effectiveness of Centralized Water Management in the Republic of Belau, Hydrogeography on Pohnpei, Waste Disposal Practices and Ground Water Impact in Truk and Belau, and Macroeconomic Impacts on Water Resources Systems of the Northern Marianas. Recent projects include an analysis of Pacific islands rainfall deficiencies on agriculture, ground water assessments of Bikini Atoll and Laura islet on Majuro, and a review of groundwater resources in Micronesia.

The Center maintains research facilities for four laboratories (Environmental Virology, Water Bacteriology, Water Quality, and Soil Hydrology), a water-reuse experimental field site, two deep research wells, an evapotranspiration-solar radiation transect, and a stream gauge station. WRRC also maintains a close working relationship with the Water and Energy Research Institute at the University of Guam as well as other water research institutes in the Pacific region.

5. HAWAII NATURAL ENERGY INSTITUTE

The Hawaii Natural Energy Institute (HNEI) conducts research and development on renewable energy resources found in Hawaii and the Pacific region. These resources include solar radiation, geothermal heat and fluids, warm surface and cold deep ocean water, wind, biomass, and other indigenous energy options. The heavy reliance of the Pacific region on petroleum and the costs associated with imported petroleum has made research and development in alternative forms of energy crucial to the region's future.

HNEI works closely with other university programs, the Hawaii State Government, the Pacific International Center for High Technology Research, the U.S. Federal Government, private industry, utility authorities, as well as institutions in other countries on renewable energy activities. The Institute provides public information on renewable energy technologies, supports energy-related instructional and training programs, publishes technical reports, and conducts workshops and conferences. Under HNEI's leadership, faculty from throughout the University conduct research on energy, ocean resources, and related topics.

HNEI's recent projects include research on windpower applications, energy storage, solar photovoltaics, transportation alternatives, environmental and socio-economic energy issues, and energy systems integration. The Institute makes extensive use of the Natural Energy Laboratory of Hawaii, the Kahu Wind Energy Storage Test Facility, the Pulse Research Center, the Marine Materials Laboratory, as well as research laboratories on the University's main Manoa Campus.

6. THE CENTER FOR DEVELOPMENT STUDIES

The Center for Development Studies is an initiative of the Social Science Research Institute and provides a focus for research, technical assistance, and training aimed at development problems in the Pacific region. The Center maintains a working knowledge of the ongoing research, technical assistance and training relevant to development in the Pacific region. In keeping with the educational role of the University of Hawaii, activities are designed to enhance

the professional capacity of individuals and organizations which use Center expertise.

The Center has developed a training program for development planners from the Pacific region and produced training materials on private sector development, regional development planning, and policy implementation and program evaluation and monitoring. Center staff are currently involved in an assessment of the policy and planning implications of global climate change and sea level rise in the Pacific islands, future trends analysis, telecommunications needs and resources in the Pacific, and science and technology policy. Center staff provide consulting services to the US Agency for International Development, the US Peace Corps, the Pacific Basin Development Council, and the State Department of Business and Economic Development. Such services include technical assistance in coastal zone management, hazardous waste management and planning, development policy planning, and program evaluation. Center staff also have research experience in social impact analysis, studies of traditional marine exploitation, indigenous land tenure systems, economic development in the Pacific Islands, migration, and social change.

7. OTHER RELEVANT PROGRAMS

Several other University of Hawaii programs may offer resources that could contribute to the development of resource development and management capability in the Republic of Kiribati. The Sea Grant College Program develops and administers a multidisciplinary institutional program related to the marine environment and its living and nonliving resources. Sea Grant works with HIMB and other marine programs to provide research and extension services in Hawaii and the Pacific region. The Hawaii Institute of Geophysics conducts oceanographic, geological, geochemical and planetary science research in the broad field of earth science. The Institute maintains two research vessels and a ship operation facility in addition to various specialized laboratories. The School of Travel Industry Management (TIM) provides research and training services to state, territorial, and national governments as well as the private sector. TIM is currently involved in a regional study of tourism development in the Pacific Islands and has assisted

the governments of Kiribati and other Pacific governments in developing tourism development plans.

Several other Hawaii-based research organizations with which the University has cooperative programs may also offer resources. The National Marine Fisheries Service conducts and supports studies of tuna migration and other aspects of fisheries development. The Pacific International Center for High Technology Research (PICHTR) is currently involved in research on ocean thermal energy conversion (OTEC) and will be examining the feasibility of OTEC development in the Pacific Islands. The East-West Center conducts research on resource systems, environment and policy, population, culture and communications, and Pacific Islands development in conjunction with several University of Hawaii programs described above.

The University of Hawaii is grateful for the opportunity to participate in these consultations. University faculty and staff would welcome future opportunities to assist with the development of atoll research capabilities in the Republic of Kiribati and to collaborate with other institutions and organizations in the region.

WORKING PAPER 6
RESEARCH PROPOSALS AND INSTITUTIONAL ARRANGEMENTS TO ENHANCE SUSTAINABLE ATOLL DEVELOPMENT

Jeff Liew [1]

1. INTRODUCTION

The UNDP Office of Project Services (OPS) Integrated Atoll Development Project is a regional project aimed at promoting self-sustained development at the atoll level in order to increase self-reliance to the greatest extent possible. The project covers the Cook Islands, Federated States of Micronesia, Kiribati, Marshall Islands, Tokelau and Tuvalu in the Pacific and Maldives in the Indian Ocean.

The project is presently in its second phase of implementation. The first phase of the project (1985 to 1988) was a pilot phase involving the implementation of an integrated development project in a selected atoll in each of the four original participating countries of Kiribati, Maldives, Marshall Islands and Tokelau. The primary objective was to demonstrate and evolve development planning and implementing methodologies and technologies to enhance sustainable development. Each project included activities in food production, marine resources development, renewable energy, income generation, water supply and sanitation, transportation, community skills improvement and local institution building.

The success of the first phase of the project led to the expansion of the project into its present second phase (1989 to 1990) which hopes to transfer the experience gained from project implementation in each of the four original countries to national counterparts, so that the government and local institutions are able to undertake similar activities in other atolls. At the same time, the project also plans to initiate and/or strengthen similar development processes in the new participating countries of the Cook Islands, Federated States of Micronesia, and Tuvalu.

---

[1]. Regional Project Coordinator and Chief Technical Advisor of the UNDP/OPS Integrated Atoll Development Project (RAS/88/014).

The project, therefore, had a unique opportunity to view, at very close range, the needs and the aspirations of atoll communities and to share with atoll peoples the many constraints they face.

This paper draws heavily from the accumulated experience of this project and, in particular, from the first-hand experience of our project staff who have been living and working on the project sites for the past three years.

2. APPLICABILITY OF RESEARCH

It is strongly argued that in order for any research activity to be of relevance it must be people centred, action oriented and within the institutional and resource capability of the country to put it to use.

3. RESEARCH PROPOSALS

It is strongly recommended that the first research initiative should be directed at taking stock and documenting past, ongoing, and planned (imminent) research efforts.

The following, in no order of priority, are fields of research which will have immediate impact on the lives of the atoll people:

3.1 Agriculture

1. Integrated Pit Cultivation

Look into ways of integrating other crops into the babai pit cultivation system in order to intensify food production and to take advantage of the availability of organic matter and moisture present in the pits. It is also argued that since the babai pit is already an established cultivation system, the integration of new crops into the system may make it easier to introduce new crops to the farmers. Experiments on terracing the walls of the pits and the selection of plants with varying root depths and moisture requirements for planting on each terrace level may prove viable.

2. Vanilla Trials

With the drop in world copra prices and the immense cultural and land tenure problems associated with replanting programmes, an alternative crop of commercial potential must be found. Vanilla, at first investigation, may prove to be a possible commercial crop for some atolls. It is a hardy plant grown on compost, the curing process is simple and does not require high capital input, does not require large areas of land, the cured beans are not readily perishable, and the product is of very high value. As far as is known, there has been no previous concerted work done on vanilla under atoll conditions.

3. Fruit Trees

A programme to identify fruit tree species likely to thrive in the atoll environment. The research and development programme to include (a) the identification of species; (b) the acquisition, propagation and distribution of the trees; and (c) the training of local agricultural staff in propagation and agronomic techniques.

4. Local Seed and Planting Material Production

One of the most important factors preventing sustained food production (especially vegetables) is the lack of seeds and other forms of planting materials at the atoll level. Research should be conducted to develop simple methods of local planting material production and storage.

Marine Resources

1. Customary/Traditional Fishing and Regulation Practices

Many atolls (e.g. Tamana) have enacted local by-laws or still practice traditional taboos related to the exploitation of marine resources. Some of these restrictions may lack scientific backing (particularly those related to migratory species of fish) and their continued practice may prevent the further development of their marine resources. It is

proposed that a study be undertaken to determine the scientific basis (or otherwise) of current customary and promulgated regulations on fishing and to advise (involving a major extension programme) the community, and both the traditional and modern leadership to modify these regulations.

2. Development Potential for Reef Islands

Compared to classical atolls with islets strung around a central lagoon, reef-islands (like Tamana, Beru, Nikunau and Arorae) do not have a lagoon. Their potential for development is, therefore, very limited and made extremely difficult. They are often also equally worse off in terms of their land resources. Special attention must be given to develop suitable projects and options for these island types.

3. Flyingfish Stock Assessment of Tamana

This is a good example of a research project which embodies the elements noted in 1 and 2 above. On Tamana, a local by-law allows only the use of coconut leaf torches for flyingfish catching, forbiding the use of the more efficient pressure lantern. This rigorous control of flyingfish underlies the importance of this fish as a basic resource. Because Tamana is a reef island, there are few other available lagoonal fish resources. Investigation of the possible depletion of flyingfish stocks is, therefore, of importance.

4. PROGRAMME STRUCTURE

It is essential that any research project be formulated within a well-defined programme of development. It is proposed that all efforts be taken to make the proposed programme truly "applied" by planning all research projects within a development context. The research component will be an integral part of a larger development project. Its linkages and inputs to the achievements of the wider development objectives are to be clearly defined. Only in such an

integrated framework will there be a direct link between research and its application.

In addition, the research component can be financed as part of the development package. This will overcome one of the fundamental problems faced by researchers - the lack of timely funding. It is urged that potential donor agencies also take this comprehensive view to development oriented research. Such an approach will have obvious programme coordination and management implications. Hence, it is equally important that the management structure for the proposed research programme has the capability and resources to effectively coordinate among on going research projects, to liaise with development projects and to work closely with donor agencies.

5. REGIONALITY

Because of the unique resource-related problems experienced by atolls, these problems require special focus and attention. Atoll countries on their own usually cannot afford or lack the technical capability to carry out research to seek solutions to these problems.

Many atoll research activities will have applicability to other atoll countries experiencing similar problems. There is, therefore, a need to effectively disseminate such information to other atoll countries. The proposed research programme should have this mandate. The feasibility of developing a capability to act as a clearing house for atoll research would be a logical complement.

6. INSTITUTIONAL ARRANGEMENTS

Current atoll research and development activities (including this project) are of short-term duration, primarily because of the short-term commitment of funding by donor agencies. This is not conducive to developing meaningful research programmes. There is, therefore, a need to develop a longer-term, if not permanent, programme to focus specifically on atoll development.

Any atoll research programme in Kiribati should work closely with the ARDU. While it may be premature to talk about the exact nature of that relationship, it is important that the following factors be taken into consideration during the ensuing deliberation:

a. the present management capability at ARDU;

b. the need to maintain a balance between a Kiribati research content and other research of regional importance;

c. means of coordinating and rationalising multi-donor inputs; and

d. its potential as a truly regional institution.

The UNDP/OPS Integrated Atoll Development Project (IADP) would strongly support initiatives to further strengthen the research mandate of ARDU and would also recommend that socio-economic research be given equal importance in the overall work programme of the institution.

WORKING PAPER 7
COLLABORATIVE ACTIVITIES THE OCEANIC INSTITUTE AND THE REPUBLIC OF KIRIBATI

Paul Bienfeng

1. OCEANIC INSTITUTE

The Oceanic Institute (OI) is an applied aquatic research center located at Makapuu Point on the windward coast of the island of Oahu, Hawaii. Established in 1960, OI is a nonprofit, private organization whose mission is research on practical technologies for aquaculture production and applied oceanography. OI's coastal location provides access to abundant, pristine seawater and Hawaii's climate supports a nearly year-round growing season for its research.

OI houses administrative offices for the Center for Tropical and Subtropical Aquaculture, one of the five USDA regional aquaculture centres in the nation. It is also the site of the USDA's Agricultural Research Service Tropical Aquaculture Research Unit, the first of its kind in the nation. In 1988, OI was awarded a $6.2 million federal appropriation to construct a Center for Applied Aquaculture.

2. OPERATING PHILOSOPHY

Ultimately, the thrust of OI's activities is commercial application of aquaculture and its support industries. OI's operating philosophy is that industry needs establish the research hierarchy; priorities and institutional resources are allocated accordingly. Research programs are structured to encompass rigorous scientific development and practical commercial application. With all the research programs, OI's approach is to network with related national and international research organizations and technical advisory groups. This helps confirm the program's technical perspective and mode of application.

3. CURRENT RESEARCH PROGRAMS

Current research programs at OI are: finfish, shrimp, feeds, stock enhancement, marine instrumentation, mahimahi culture, oceanography and Asian Interchange. These are discussed briefly below together with descriptions of the CTSA and the new aquaculture centre. The finfish programme, since it is pertinent to Kiribati, is discussed separately.

3.1 Shrimp

The goal is accelerated development of the domestic marine shrimp industry to help reduce a fisheries trade deficit annually greater than $1.5 billion. Research has indicated that shrimp farming must be intensive in order to achieve profitability. Specific activities target intensification, disease prevention and control, seed production, economics, marketing, training and facility designs.

3.2 Feeds

This program is oriented to aquaculture support services and interfaces with all OI research programs because of its attention to both larval and growout feeds. Considerable work has been done in formulating and processing diets, many made from local feed stuff or by- and waste products. The program is experienced in biochemical analysis and testing of a variety of diets, most recently, a test of U.S. commercial shrimp feeds. At present, the program has three components: larval and juvenile nutrition of tropical carnivore finfish, shrimp growout feeds, and transfer of agriculture technology to aquaculture.

3.3 Stock Enhancement

OI's stock enhancement program responds to the problem of depleted coastal fish populations, especially those important to recreational fisheries. Essentially, it represents using hatchery operations to supplement the recruitment potential lost through overfishing. Target species have been chosen and current work is

focusing on refining culture technology and juvenile tagging as a means of evaluating release programs. Socio-economic and cost-benefit effects will be closely monitored as well.

3.4 Marine Instrumentation

The task of this research program is to identify current and future needs for instrumentation in aquaculture and selected fisheries. This will also encompass demonstration of automated systems within selected production sectors defined by species. The first demonstration will be conducted with marine shrimp in an intensive growout system.

3.5 Mahimahi Culture

This program seeks to advance rearing technology in support of commercial culture of mahimahi. The project began by delineating the market scenario (e.g., volume, price and form targets) to define the context within which production from aquaculture will be commercially-feasible. An economic model and culture handbook will be developed together with refined culture methods.

3.6 Oceanography

Currently, the major project of the oceanography program is APPRISE, a multi-year, multi-disciplinary fisheries-oceanography program. Other activities include water quality control and environmental studies conducted for the state and private sector, including research on effluent discharge.

3.7 Asian Interchange Program

This program establishes an information network and involves an exchange of Asian and American scientists. The first year targets acquisition of practical knowledge for culture of temperate-water species of marine shrimp.

4. CENTER FOR TROPICAL AND SUBTROPICAL AQUACULTURE (CTSA)

The CTSA is jointly administered by the Oceanic Institute and the University of Hawaii. It is a programmatic center that funds and administers research, development and demonstration projects. Unlike the other regional centers whose activities are tailored to particular locales, the CTSA supports research and demonstration projects targeting aquaculture of tropical and subtropical species. The working committees include representatives from Hawaii, Guam, Pohnpei, Palau, American Samoa, the Commonwealth of the Northern Marianas, and the Republic of the Marshall Islands. Current projects include production of prawn and shrimp seed for commercial producers in Guam and the Western Pacific; characterization of effluent discharge; registration of new drugs and therapeutics for hatchery diseases; training and demonstration of giant clam culture in the Pacific Islands; and establishing an aquaculture workstation.

5. CENTER FOR APPLIED AQUACULTURE (CAA)

OI received a congressional appropriation of $6.2 million to construct a world-class aquaculture research, demonstration and training facility, the Center for Applied Aquaculture. The State has made an initial contribution of $1 million toward the $8 million match required by the federal government. The Center will greatly enhance OI's ability to support industry development in the state and the Pacific Basin. The past year has been spent planning the Center's function and use in conjunction with the State of Hawaii and the University of Hawaii. Site visits have been made to major marine research institutions to ensure that the new center will be the finest of its kind. Preliminary designs have been drawn up and construction is expected to begin in April, 1990, with completion targeted for October, 1991.

6. FINFISH PROGRAM

The primary focus of the Finfish Program has been a USAID-funded project, "Studies on the Maturation and Spawning of Milkfish". Its goal is the development of a complete technological resource base to transfer to milkfish farmers and researchers in

lesser developed countries. Milkfish represents an important source of animal protein in Southeast Asia, where its culture in ponds remains a long-standing custom. Fry availability has been a limiting factor for the milkfish industry in these countries. The primary objectives are to develop techniques to control reproduction of milkfish in captivity, evaluate these with other species and develop suitable hatchery procedures.

The current project has accomplished a great deal since its inception in 1984. The specific activities and accomplishments are described in detail in the program's most recent progress report, which is available here. We have developed an effective chronic hormone therapy to influence maturation in milkfish. When combined with manipulation of photoperiod, females can be induced to mature out of season. We have also been able to induce spawning with an acute hormone therapy, leading to a high number of fertilized eggs without loss of valuable broodstock. Additionally, we have been able to achieve natural spawning of milkfish in dirt ponds. These techniques are being or have been tested at field stations in the Philippines, Taiwan and Indonesia.

For later stages of culture, hatchery techniques for mass culture of milkfish larvae have been developed. These include evaluating temperature and salinity conditions on larval growth and survival, and techniques to control larval production in large outdoor impoundments.

7. MEMORANDUM OF AGREEMENT: REPUBLIC OF KIRIBATI AND OI

In 1988, OI and the Republic of Kiribati signed a Memorandum of Agreement (MOA) based on their mutual interest in milkfish culture. The Republic of Kiribati has established expertise, facilities and personnel for developing the aquaculture resources of Kiribati. Kiribati has expressed a commitment to milkfish production and interest in OI's spawning technology. The MOA supports collaborative activities in research and development, training and extension, production of milkfish, transfer of developed technology and information exchange.

The Republic of Kiribati presently has an 80-ha milkfish farm targeting both food and baitfish production. Unfortunately, the farm is operating at a loss of A$76,000 annually. A number of factors other than fry availability may need to be resolved, including pond management, feeds, handling and transport procedures, and relationship of market demand to production.

We believe Kiribati has potential for milkfish culture and that a cooperative effort can resolve whatever constraints exist. OI offers the critical mass of capability that is needed to resolve constraining issues. The Institute's experience in the commercial setting is extensive.

We have worked closely with commercial farmers on resolving shrimp seed constraints, improving pond management, and increasing production. Related work includes studies of the environmental impact of effluent discharge from aquaculture facilities. Aquaculture producers believe farm effluent is relatively benign and have requested assistance with this problem. The information gathered will be used to improve and better define current regulations and permitting processes which pose difficulties to aquaculturists.

Another project involves demonstration, training and technology transfer for Indonesian milkfish farmers. The methods developed in OI's finfish research are being applied in Indonesian farms in an effort to increase fry supply, which is the primary constraint to milkfish production in this country.

8. COOPERATIVE ACTIVITY

The MOA provides an opportunity for initiating activities directed to resolving constraints to aquaculture in the Republic of Kiribati, particularly those limiting milkfish production. We see a number of potential areas in which OI has experience and can provide collaborative assistance.

Pond management, including reconstruction, maintenance, predator control, and balanced pond ecology, is an important factor in successful aquaculture. OI has substantial experience in design and construction of aquacultural systems. Growout and nursery feeds and fertilizers to maintain phytoplankton concentration are also

critical elements to success. It is our experience that, in many cases, feeds can be formulated from locally-available materials and be produced on-site. For example, tilapia may be used as a base for fish hydrolozates or made into organic fertilizer to support the food web in nursery ponds.

Fry availability must be better defined, for example, a study to determine how many fry enter through sluice gates is needed. Before considering a hatchery, it is important to know more precisely the current type and amount of supply. Once pond management and appropriate feed strategies are in place and the current seed supply is better defined, production-specific factors can be addressed.

We would consider market demand and development very important. OI has conducted extensive studies on the market and production economics of shrimp and mahimahi and cost-benefit analyses of stock enhancement activities. Our work indicates the market should determine the quantity and form of production and thus the amount of seed required. This in turn leads to an evaluation of supply, i.e., whether wild fry alone can support that production, if mortality is reduced, or whether a hatchery operation is needed.

If wild fry cannot support the production required, a feasibility study may be needed to determine cost, size and output of fry needed. Design for a turnkey hatchery, if required, would follow the feasibility study. OI's finfish capabilities encompass hatchery technology and management. Training in larval-rearing techniques, handling and transport of fry is available on-site and at OI.

9. CONCLUSION

The existing MOA has defined the mutual objectives of the Republic of Kiribati and OI. OI has the critical mass of expertise to bring to bear on current aquaculture constraints in the Republic of Kiribati, especially those relating to milkfish culture. We suggest a planning study to initiate necessary activities, i.e., we will require support to jointly develop an implementation plan.

To initiate collaborative activity, a letter expressing strong interest should be directed to USAID in Fiji. The letter should

request a buy-in for $25,000 or a mission contract to begin the initiation phase.

WORKING PAPER 8
APPLIED RESEARCH FOR ATOLL DEVELOPMENT: EXPERTISE AVAILABLE AND ACTIVITIES CARRIED OUT BY THE UNIVERSITY OF THE SOUTH PACIFIC (USP)

R.J. Morrison[1]

1. BACKGROUND INFORMATION ON USP

The University of the South Pacific was established on the recommendation of a Higher Education Mission to the South Pacific which reported in May 1966. Legislation was introduced in Fiji in June 1967 to establish a regional University of the South Pacific at Laucala Bay, Suva and an interim Council set up. The first students were admitted in February 1968 and the granting of a Royal Charter and Statutes took place on 10 February, 1970. The University was established in accordance with the wishes of and to serve the needs of the Governments of the Cook Islands, Fiji, Kiribati, Nauru, Niue, Solomon Islands Tokelau, Tonga, Tuvalu, Vanuatu, Western Samoa.

The University originally had three Schools. A fourth was added in 1975. Some rearrangement took place with renaming of Schools in 1985. The four schools now operating are: School of Agriculture (SOA) (based at the Alafua Campus, Western Samoa), School of Humanities (SOH), School of Pure and Applied Sciences (SPAS), and the School of Social and Economic Development (SSED). The Schools, together with Extension Services are responsible for the normal teaching programmes of the University. In 1988 these programmes catered for approximately 2130 on-campus students and 4,400 extension students.

Following a comprehensive review of academic policy in 1975, the University recognised that it was more than a teaching institution and that its role and potential had not been adequately realized in the region. In an attempt to address these issues a

---

1. Prepared in consultation with R. Briscoe, W.C. Clarke, P.D. Nunn, W.G.L. Aalbersberg, M. Hazelman, P. Sivan, J. Seeto, C.R. Lloyd, R.R. Thaman, A. Savu and E. Williams.

number of action-oriented Institutes were established in order to facilitate the application and use of skills, equipment and other resources of the University in appropriate tasks for regional development. The Institutes presently in operation are: Institute of Education (IOE), Institute of Marine Resources (IMR), Institute of Natural Resources (INR), Institute of Pacific Studies (IPS), Institute of Research, Extension and Training in Agriculture (IRETA) (located in Western Samoa), Institute of Rural Development (IRD) (located in Tonga), Institute of Social and Administrative Studies (ISAS), and two associated units, the Pacific Languages Unit (PLU) (located in Vanuatu) and the Atoll Research and Development Unit (ARDU) (located in Kiribati).

The University Grants Committee recommended in 1984 (and reaffirmed in 1987-88) that the Institutes and Units should move towards full self-funding. This was accepted by the University Council and the Regional Ministers of Finance. As a result these sections now receive only a fraction of their total operating costs from the USP recurrent budget, the remainder (less than 50% for most sections) has to be earned by contract consultancy work, organisation of short training courses or externally funded research projects.

2. ATOLL RESEARCH AND DEVELOPMENT UNIT

Realising that 6 of the supporting countries consisted wholly or substantially of atolls, and that atolls occur in every supporting country, USP established an Atoll Research Unit in 1979 (began operations in 1980) with assistance from the governments of Kiribati (allocation of buildings) and United Kingdom (cash grant). For several years the activities of the Atoll Research Unit were concerned with marine resources, and it operated under the administrative direction of the Institute of Marine Resources. Some of these initial activities included: lagoon circulation studies, shoreline processes and coastal erosion, corals of Tarawa, hydrogen sulphide in fish ponds, tuna baitfish population research, aquaculture development, marine reference collection, and biological studies of marine birds nesting on Christmas (Kiritimati) Island.

Later the Unit expanded its activities to include other aspects of atoll life - soil classification, social factors of lagoon use and

shore colonisation, collection of terrestrial plants, atoll information, economic aspects of atoll development - and in 1983 the Unit was separated from the Institute of Marine Resources and renamed the Atoll Research and Development Unit with the Director being directly responsible to the Vice-Chancellor.

While there was a lot of activity in the early 1980's, there has been a marked downturn in activities since about 1984. This may be due, in part, to the UGC decision mentioned earlier on the funding of non-teaching sections of USP, in part to the isolation of the Unit and the difficulty in negotiating externally funded projects and, in part, to lack of clear definition of research priorities and committed support by appropriate regional governments.

3. RESEARCH AND DEVELOPMENT ACTIVITIES RELEVANT TO ATOLLS UNDERTAKEN BY USP

3.1 Agriculture, Food and Nutrition

IRETA has maintained one staff member in Tarawa since 1987 (Mr John Finlay); he has been based at the ARDU and the ociated projects include:

(a) Determination of the usefulness of composts with added fertilizer to crops on coral sand soils. Methods of producing compost and its effect on crop growth relative to inorganic fertilizer.

(b) Growth-bag media trials - growth media, with and without fertilizer, enclosed in polythene bags are being evaluated for vegetable production.

(c) Fertilizer application methods for coconuts (potassium and trace elements).

(d) Comparison of nitrogen fertilizer sources for use on coral soils (isobutylene diurea, urea, calcium nitrate and ammonium sulphate in single and split applications).

(e) Soil moisture conservation for vegetable production on atolls, including comparisons of Agrosoke, a polymer which

increases soil water holding capacity and plastic cover to reduce water loss.

(f) Trickle irrigation for sweet potato production on atolls.

(g) Development of improved Cystosperma taro production systems.

(h) Rapid multiplication systems for Pandanus spp. propagation.

(i) Introduction and testing of potentially useful food crops to atolls, e.g., citrus, pepper and Colocasia taro.

IRETA SOA is also collaborating with the FAO/UNDP Root Crops Development Project, the EEC Coconut Improvement Project, ADB Tree Crops Project and EEC projects on taro beetle control, sweet potato breeding, vegetable and cereal production. These, together with normal training and extension activities, will be of benefit to atoll countries.

Other agriculture activities include soil resource evaluation and classification work on atolls (SPAS/INR), water balance studies (SPAS/INR/SSED), Kiribati agroforestry and general urban agroforestry in the Pacific Islands (SSED).

Food and nutrition activities completed or in progress include:

(a) Family food production and nutrition in Kiribati (SSED).

(b) Mixed home gardening in the Pacific Islands (SSED).

(c) Food scarcity, food dependence and nutritional deterioration in small island communities including the consequences of the decline of traditional food systems in the Pacific Islands (SSED).

(d) Preparation of Pacific Island Food Composition Tables (INR/SPAS in collaboration with SPC).

3.2 Marine Science

Work relating to the marine resources of atolls (apart from those projects listed earlier for ARDU) has been carried out by staff of IMR, SPAS, SSED, the Library and the Ocean Resources Management Programme (ORMP). Activities include :

(a) Pacific Islands Marine Information System (PIMRIS) has been established to provide marine resource information to regional governments and agencies (Library/SPC FFA CCOP/SOPAC).

(b) Bioaccumulation of heavy metals and micro-organisms in edible bivalves - an important health problem in coastal areas (SPAS INR IMR).

(c) Marine pollution with particular reference to lagoons and other coastal waters (INR IMR/SPAS). A specific study in Tarawa lagoon was begun in 1987 in collaboration with ARDU and Kiribati Department of Health.

(d) Physiological effects of marine pollutants on commercially important Pacific Island species (bivalves and reef fish) (SPAS IMR INR).

(e) Mapping of coastal resources using remote sensing techniques (INR ESCAP Regional Remote Sensing Unit).

(f) Ecology of Anadara sp. (te bun)

(g) Inter-tidal ecological studies (IMR INR SPAS)

(h) Studies in crown of thorns starfish (Acanthaster planci) and its impact in reefs (IMR/SPAS).

(i) Post harvest management of marine products (IMR/SPAS).

(j) Work on I-Kiribati fish names (IMR).

(k) EEZ and ocean policy in the South Pacific (ORMP SSED).

(l) Studies on marine natural products (SPAS IMR INR).

IMR has submitted a number of projects to the EEC for funding under Lome III. Activities proposed which are of interest to atoll countries are :

(a) Fish poisoning toxic dinoflagellate survey.

(b) Te bun (Anadara spp.) transplanting and culture.

(c) Penaeid saltwater prawn surveys.

3.3 Economic Development

Studies in the general area of social and economic development which have relevance to atoll countries include:

(a) Enterprise support - provision of specific recommendations to governments on how best to support and encourage small businesses and local entrepreneurs (SSED).

(b) The viability of small economies of atoll countries in the face of population growth (SSED).

(c) Solar energy equipment for storage of medicines and food products (INR).

(d) Use of coconut oil as a diesel substitute (INR).

(e) Land tenure in atoll countries (IPS).

(f) Kiribati fishing industry (Uentabo Neemia, an I-Kiribati staff member of IPS) - PhD studies at Macquarie University).

3.4 General Atoll Environment

A range of projects has been completed or is in progress which can be combined under this title:

(a) Urban intensification in South Tarawa: household response (SSED).

(b) The geomorphology of atolls in relation to uplift and subsidence in the Pacific Basin (SSED).

(c) Nauru vegetation and soils study and the impact of mining (SSED/INR).

(d) Plant names in Nauru and Kiribati (SSED), plus atoll plant reference collection (INR).

(e) Energy needs and forest resources in small islands (SSED/INR).

(f) Water resources development (INR/UNDTCD).

(g) Impact of agricultural intensification on the atoll environment (SPAS/SSED/IRETA/INR).

(h) Natural products chemistry and the use of plants in traditional medicine, e.g., study on Scaevola taccada (te mao) because of its use as a contraceptive. Many other uses of plant products are possible (SPAS/INR).

(i) Climate change, sea-level rise ('greenhouse effect') and the impact on atolls (SSED/SPAS/IMR/INR).

4. AREAS OF INTEREST AND EXPERTISE AVAILABLE AT USP FOR A POSSIBLE KIRIBATI ATOLL RESEARCH FOR DEVELOPMENT PROJECT

USP has a large number of highly trained staff, many of whom have expertise that could be available for use in a Kiribati Atoll Research for Development Project. Many have expressed interest in

collaborating with such a project provided satisfactory working arrangements can be established. The areas of expertise where interest has been shown include:

4.1 Agriculture

(a) traditional crop production improvements (IRETA/SOA/IRD/SSED).

(b) soil resources evaluation (SPAS/INR/IRETA).

(c) introduction of new crops/cropping systems (IRETA/SOA).

4.2 Marine Science

(a) marine biology (IMR/SPAS).

(b) marine pollution (INR/IMR/SPAS).

(c) marine chemistry including marine natural products development (SPAS/IMR/INR).

(d) coastal mapping (INR/ESCAP).

(e) geomorphology/shore processes (SSED).

4.3 Energy

(a) solar energy use (INR/SPAS).

(b) cooking fuel sources (INR/SSED/IRD).

(c) wood stove efficiency improvement (Extension Services/IRD).

(d) alternative fuels (INR/SPAS/IRD).

4.4 Environment

(a) water resources development (INR/UNDTCD/IRD).

(b) plant resources - evaluation and new uses (SSED/SPAS/INR).

(c) climate change impact studies (SSED/SPAS/INR/IMR).

(d) impact of urbanisation (SSED/IRD).

4.5 Economic Development

(a) assistance to small businesses (SSED/IRD).

(b) studies on small island economies (IPS/SSED).

4.6 Information

(a) USP Library can provide literature searches on a wide range of topics relating to atolls and atoll societies.

5. CONCLUSION

USP was established to serve the countries that support it. While the main activity is the training of graduates and diplomates the resources of the University can provide more to the region. In spite of the recent staffing difficulties and increased student enrolments which have led to a marked increase in basic teaching/administrative loads for most staff, many of the staff wish to have a wider involvement in regional development. The Kiribati Atoll Applied Research for Development Project may provide an ideal opportunity to channel some of the available expertise into addressing the problems of the smallest regional countries where efficient natural resources management is vital for national development.

WORKPAPER 9
APPLIED ATOLL RESEARCH AND THE USP ATOLL RESEARCH AND DEVELOPMENT UNIT: PROBLEMS AND PROSPECTS

A. Tong

1. BACKGROUND

The concept of an applied research programme to cater for the special requirements of atoll island countries was mooted as early as 1979. It arose out of concern by the smaller atoll countries that unless arrangements were made to meet their special requirements, it was likely that their priorities would become subsumed within the regional programmes. Following the establishment of the various institutes within the University of the South Pacific, the Kiribati Government in 1979 initiated discussions with the University which resulted in the establishment of an Atoll Research Unit which was duly established under the umbrella of the Institute of Marine Resources (IMR). Thus the initial focus of the Unit's programme was entirely on marine (living resources) research in line with IMR's mandate. Other research activities such as atoll agriculture were also undertaken by the University under the auspices of other institutes such as the Institute for Research, Extension and Training in Agriculture (IRETA), based in Western Samoa.

In 1983 a review of the Unit was undertaken which resulted in the decision by Council to redesignate the Unit as the Atoll Research and Development Unit (ARDU) with the broader mandate to cover the marine, agricultural and social aspects of atoll research and development. Following internal consultations within the University in 1986 arrangements were made to have atoll agricultural research carried out by IRETA undertaken by staff based in the Unit at Tanaea rather than in Western Samoa as had been the case in the past. In terms of geographical coverage the Unit theoretically covers the atoll countries of the University region which has generally been regarded as those countries which comprise mainly islands of coral atoll formation with substantially similar environmental and resource situations, thus including Cook Islands, Kiribati, Tokelau, Tonga and Tuvalu.

Other research on atolls not carried out directly by the Unit may be done in collaboration with other institutes of the University as well as with other Universities. With respect to such collaborative efforts, arrangements exist for apportioning costs between the organisations involved to ensure that the cost of equipment and services provided by the Unit are covered, thus ensuring that it remains self sustaining as far as possible. This principle applies equally to all other institutes of the University. It has also been this very principle which has generated competition for limited funds among institutes of the University. With the resources available to it the Unit has carried out the projects listed in Attachment I.

2. PRESENT CONSULTATIONS

The present consultations which have been initiated by the Kiribati Government have undoubtedly been motivated by the lack of a more substantial response by the Unit and the University at large to their research requirements. Without going into detail, it should be pointed out that this has been due to the lack of resources available to the Unit in the past. What seems now more important to address is the question of the future arrangements particularly in terms of the implications on the Unit of these consultations. With the promise of substantial input from USAID provided through the Kiribati Government towards Atoll Research and Development for Kiribati the following are two of the options available:

a. The Kiribati Government could use the funds to establish its own national centre and programme for atoll research and development; or

b. The Kiribati Government (and indeed any other country) could channel the funds to the Unit to carry out directly, or in collaboration with other research institutions, a research programme formulated by Kiribati.

If option (a) is adopted it would mean that the Kiribati Government would be establishing a National Research Centre for its own requirements using the financial resources provided initially by USAID and other bilateral aid sources, but may in the long term need to draw on its own resources. Regional aid sources are most unlikely to be available to support a national centre. Such a centre

would become involved in much if not all of what the Atoll Research and Development Unit was intended to carry out for Kiribati, and will most probably become redundant. If that results in the closure of the Unit, the University will need to consider how the requirements of the other atoll countries are to be met.

Under option (b) the Unit will have the resources required to carry out the research requirements determined by the Kiribati Government and at the same time retain its regional character. The execution of such projects may require collaboration with the other institutes of the University of the South Pacific or other research organisations according to their fields of specialisation and ability to contribute positively to the project.

It is also pertinent to point out that under the current arrangements, research organisations and individuals wishing to undertake research activities at all related to atolls are offered access to facilities and services available at the Unit, provided they are willing to meet the cost of such facilities. However if it is envisaged that there would be increased use of the Unit then there would certainly be a need for the commitment of additional resources to upgrade existing facilities including buildings and equipment as well as manpower resources. If it maintains its regional character the necessary resources may be secured from regional aid funds.

3. FUTURE PROGRAMME

In these consultations emphasis is being placed on practical research for development, with self-sufficiency, conservation and rational management of resources including the environment being the key issues. This essentially defines the more realistic development objectives of Kiribati and indeed other atoll countries which are very much determined by their geographical situation. Without going into rhetoric over the problems associated with atoll islands it is more relevant here to address the particular situation of Kiribati, which will to a large degree also apply to other atoll island countries.

For the purposes of defining a future programme of research for Kiribati it is important to have clear ideas over what the

country defines as important development objectives. Such an approach acknowledges the integral nature of the lifestyle of atoll communities dictated by their resource situation and should largely determine the approach to research. Whilst it is undoubtedly necessary to establish the data base to determine the extent and state of the resource to be managed, it is equally necessary to investigate the social parameters likely to have an impact on the successful management of the resources and to recognise the interrelationships involved in the management and utilisation of the different resources be they marine, terrestrial or social.

The priorities for research in Kiribati should be determined by its resource situation. It will also be a factor of the relative importance given to the different development objectives. For example if sufficiency of food supply in the rural sector is considered critical then attention may need to be focussed on both increasing productivity (this may apply more to terrestrial resources) and rational management of factors affecting the sustained production of such resources (this will apply more to marine resources). Thus it may require the institution of management strategies necessary to avoid over exploitation of lagoon resources. However before any management programme could be formulated, research will be necessary to establish basic information about the resource and other factors which will have an effect on its exploitation.

On the basis of the foregoing conceptual background and the broad categorisation based both on the type of resource and its use, suggestions for future research are set out in Attachment II. This list incorporates inputs from divisions of Government, individuals and research organisations which have been involved in atoll research on what they perceive as the requirements for Kiribati not only in areas directly related to resource use and management but also those which may fall within the purview of other ministries.

Another very important element of research is the training opportunity it offers but which in the past has not always benefitted regional personnel. In formulating future research projects more deliberate thought should be given to incorporating training components for local personnel either through secondment from departments of Government or through other arrangements. Such an arrangement would provide another alternative to training of key

personnel in Government while at the same time ensuring that as much of the skills learned through the research remain within the country.

4. CONCLUSION

To conclude, it is important to focus the attention of these consultations on the key issues which need to be addressed. It is necessary to determine whether the interests of Kiribati are best served by applying the funds likely to be available from USAID to establish a national atoll research centre with all its implications, or to maintain the existing regional arrangement but with the injection of additional resources from USAID and hopefully from other regional aid sources. There may be other options but whatever option is taken it will be necessary for this meeting to consider the future programme for atoll research in Kiribati and perhaps the likely contributions of the organisations present at these consultations.

ATTACHMENT 1
PAST RESEARCH ACTIVITIES

HYDRODYNAMIC

1. Lagoon Circulation Study

   Reports: (i) "Drouge Trajectories, Data Report.: G.W. Groves (in publ.)

   (ii) "Linear Prediction Model for Circulation in Tarawa Lagoon" G.W. Groves (in publ.)

2. Shore Process Study

   Reports: (i) "Coastal Erosion in Kiribati." R. Howorth (1982) IMR tech. report no.1, CCOP/SOPAC sponsored.

   (ii) "ARU Shore Process Study, Progress Report". G.W. Groves (1982). IMR report, in publ.

3. Water Quality Testing

Report: "Report on Water Testing Visit to Nikunau Island Kiribati," J. Brodie (1983), INR tech. report.

4. Causeway Studies

Report: "Flow Through Tarawa Channels" G.W. Groves and B. Ye Ting (1982). IMR report.

5. Sea Level Observations

6. Hydrogen Sulphide Studies in Ground Waters.

Report: "Monitoring and Control of H. S. in Different Freshwater Habitats on Tarawa, Republic of Kiribati." T. Frevert (in prep.)

7. Related Reports

Reports: (i) "High Waves at M'akin in December 1979." G.W. Groves (1980), IMR report.

(ii) "Arorae Earthquakes. "G.W. Groves (1980), IMR report.

(iii)"Wind, Waves and Currents in the Tropical Pacific."G.W.Groves (1979) IMR/SEAGRANT publ. Proceedings of the Seminar/Workshop on Utilization and Management of Marine Ecosystems of the Tropical Islands, Nov. 24-30, 1979, USP.

TRADITIONAL FISHERIES

. Fishing Craft

Report: (i) "Canoes of Kiribati." L.P. Zann, IMR report no. 6.

(ii) "Subsistence Fishing in the Atolls of Tuvalu and Kiribati. L.P. Zann. For 4th Int. Coral Symp., Manila.

(iii)"Man and Atolls: Traditional Patterns of Utilization and Conservation in Kiribati and Tuvalu." L.P. Zann. Transcription of Pacific Conf. seminar (1983) IMR report.

2. Traditional Fish Names

ECOLOGY

1. Environmental Surveys of Tarawa

Reports: (i) "The Intertidal Fauna of Southern Tarawa Lagoon, Republic of Kiribati. L.Bolton (1982), IMR report.

(ii) "Marine Life on the Ocean Reef, Tarawa, Kiribati, "L.Bolton (1982), IMR report.

(iii) "Species List of Marine Plants and Invertebrates of the Gilbert Group Islands, Kiribati. L. Bolton (1982), IMR report.

(iv) "The Marine Ecology of Betio Island, Tarawa Atoll, Republic of Kiribati." L.P. Zann (1982), IMR report CCOP/SOPAC sponsored consultancy.

2. Te Bun Studies

Reports: (i) "Shellfish Harvesting in Tarawa Atoll Lagoon, Kiribati." L. Bolton (1982), ARU reports.

(ii) "Short Report on the Introduction of Te Bun to Tabiteuea North" L. Bolton (1982), ARU manuscript.

(iii) Masters Thesis on Te Bun Biology, L. Bolton (inprep.)

3. Coral Studies

Reports: (i) The Corals of Tarawa Ocean Reef, Kiribati." L. Bolton (1982). IMR report.

(ii) "Tarawa Atoll: Coral Assemblages and the Impact of L.P. Zann (in publ.)

4. Beche-de-Mer Studies

Report: "Beche-de-Mer in the Deeper Waters of Tarawa Atoll" H. Silver (1982). IMR report.

5. Euchema Studies
Report: (in prep.)

BIOLOGICAL COLLECTIONS

1. Coral Collection

2. Herbarium

3. Fish Specimen Collection

4. Algal Collection

5. Other Collections

SOCIAL FACTORS

1. Tarawa Social Factors and Bibliography

Report: "Social Factors of Shore Colonization and Lagoon Usage, South Tarawa, Kiribati." Ginette and Keith Sullivan (1982) IMR report.

CIGUATERA FISH POISONING

1. Fish Toxicity

   Report: "Examination of Algal and Fish Samples from Atoll Research Unit, Kiribati." J. Sceto and S. Dei Singh (1982), IMR report.

2. Monitoring of Gambierdiscus toxicus

3. Collection of Moray Viscera

4. Collection and Dissemination of Reference Material

   Report: "Summary of the Recent Training Course on Fish Poisoning." D. McCarthy (1983), IMR report.

TUNA BAITFISH BIOLOGY

1. Biology and Population Dynamics of Tuna Baitfish

   Report: "Tuna Baitfish: Biology of Tarawa Populations. Research Proposal." D. McCarthy and S. Munch-Peterson. (1983).

2. Collection of Reference Material

MISCELLANEOUS REPORTS

1. Research Prospects

   Report: "Opportunities for Scientific Research on Kiritimati Island." G.W. Groves. (1983), IMR report.

OTHER ARDU RELATED ACTIVITIES

1. Soil Classification

2. Drip Irrigation and Nutrient Film

3. Aroid Research and Breeding

4. Taro Beatle Research

ATTACHMENT II
RESEARCH PROPOSALS

AGRICULTURAL

1. Traditional agricultural techniques

2. Land tenure system

3. Traditional agricultural systems: Social and cultural role and impact on and of introduced systems

4. Continuation of ongoing projects carried out by J. Finlay

MARINE RESOURCES & ENVIRONMENT

1. Artisanal Surveys and Landings Record Data

2. Experimental Gill Net Trials in Tarawa Lagoon

3. Examination of the Anandara maculosa Stocks in Tarawa Lagoon

4. Research Programme into Bait-fish Populations in Kiribati

5. A comparison of the Effectiveness of Different Fishing Craft in Tarawa Lagoon

6. Assessment of Albula vulpes Stocks in South Tarawa

7. Data Collection on Abemama and Butaritari in Relation to the Outer Island Trial Commercial Fisheries

8. Fish Aggregating Devices Monitoring

9. Data Collection on Kiritimati

10. Study of the effect of Causeway Construction on (a) Sediment Movement in the Lagoon and (b) Fish stocks in the Lagoon

11. Effect of Reef Blasting on Levels of Ciguatoxin in Lagoon and Ocean Side Reef Fishes.

WORKING PAPER 10
THE UNIVERSITY OF GUAM MARINE LABORATORY

R. H. Richmond

UNDERGRADUATE OPPORTUNITIES

The Marine Laboratory offers numerous undergraduate research assistantships each semester, enabling interested students to gain practical experience in tropical marine sciences. Opportunities also exist for independent study programs which allow students to pursue a particular area of interest.

2. THE GRADUATE PROGRAM

The University of Guam offers a graduate program of study leading to the Masters of Science in Biology with specialization in tropical marine biology. The MS degree requires a total of 30 semester credits of course work and thesis research. The program is designed for careers in marine (especially coral reef) ecology, environmental protection, aquaculture, fisheries, marine zoology, microbiology, and botany. It also prepares students for future entry into Ph.D. programs. The program provides a balance between laboratory, field, and theoretical studies and emphasizes the use of modern equipment and research techniques.

3. FACILITIES

The University of Guam Marine Laboratory is a multi-disciplinary research facility. A 38-foot research vessel, two smaller outboard motor crafts, as well as inflatables allow access to the diverse coral reef habitats which surround the island. The Marine Lab maintains a flowing seawater system with numerous tanks for the culture and maintenance of marine organisms. A shop technical services wing at the laboratory, and three marine technicians provide technical support for research projects. Field and laboratory equipment include a current meter, an underwater color video system, oxygen and specific ion meters and probes, Gilson

respirometers, a lyophilizer, a chloride titrator, microbomb calorimeter, light meters, ashing ovens, refrigerated centrifuge, an environmental chamber, a CHNS analyzer, electrophoresis equipment, histological equipment and supplies, and chromatographic equipment and supplies. The Lab has 11 IBM and IBM compatible computers, several of which have the capacity to run larger statistical and data base packages. Both plotters and a digitizer are also available.

4. THE UNIVERSITY

The University of Guam is a public Land Grant institution established as the only U.S. university in the Western Pacific. It serves as the primary institution of higher learning for a region of the Pacific almost as large as the continental U.S. The campus is located on a bluff overlooking the ocean about 6 miles from Agana, the capital of Guam. Total enrollment is approximately 2500 students, presently including 8-15 students in the Graduate Program in Biology.

5. THE LADIAN AQUACULTURE FACILITY

The University of Guam Marine Laboratory collaborates with the Department of Commerce and the College of Agriculture and Life Sciences in maintaining the Ladian Aquaculture Facility. This facility includes large indoor and outdoor fiberglass tanks, concrete raceways and "ponds," which can be used with either sea water or brackish water. An algae culture system provides food for raising a diversity of vertebrates and invertebrates. Projects presently underway include Macrobrachium, pinnacids, rabbitfish, and sea cucumbers.

6. GUAM

Guam is a U.S. territory (pop. 115,000) with an elected local government. The 205 square mile island is situated at 130°N, 143°E in the western Pacific with New Guinea as the nearest large land mass. Air temperature ranges from 78°-93°F. Water sports, diving, fishing and beachcombing are favorite pastimes on the island. The economy is highly dependent upon tourism and military expenditures. Guam is within the U.S. domestic mails system. There are good

telephone connections to the U.S. mainland and other countries. Modern hospitals and medical facilities are available.

7. THE REEFS AND ENVIRONMENT

Guam is surrounded by thriving, diverse coral reefs and therefore provides excellent opportunities for the study of tropical marine biology. About 300 species of scleractinian corals, 220 species of marine plants, 1050 species of molluscs, and 800 species of coral reef fish indicate that Guam is within one of the richest biogeographic provinces yet studied. The lab is unique among U.S. marine laboratories with modern laboratory facilities and equipment situated less than 100 yards from a biologically rich coral reef, with other reef habitats within easy access by land and small boats.

8. FINANCIAL SUPPORT

Undergraduate and Graduate student financial support is available through research assistantships on grants or contracts awarded to faculty of the program.

9. THE FACULTY

Steven S. Amesbury, Ph.D., University of Hawaii; Ichthyology, population biology.

Charles E. Birkeland, Ph.D., University of Washington; Community ecology, species interactions.

Stephen G. Nelson, Ph.D., University of California-Davis; Aquaculture, coral reef ecology.

Valerie J. Paul, Ph.D., Scripps Institute of Oceanography; Marine chemical ecology, natural products chemistry.

Richard H. Randall, M.S., University of Guam; Coral taxonomy and ecology, island geology.

Robert H. Richmond, Ph.D., State University of New York at Stony Brook; Coral physiology and larval ecology.

Barry D. Smith, M.S., University of Guam; Marine Extension Agent, University of Hawaii-University of Guam Sea Grant Program.

Christopher S. Lobban, Ph.D., Simon Fraser University; Phycology, Algal Physiology.

Ernest A. Matson, Ph.D., University of Connecticut; Marine microbiology, (Coordinator, Graduate program in Biology).

Roy T. Tsuda, Ph.D., University of Wisconsin, Algal taxonomy and ecology.

MARINE LABORATORY
ANNUAL REPORT FISCAL YEAR 1987

CONTINUING PROJECTS

Marine Assessment of the Obyan-Naftan Reef Area, Saipan. COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS ($11,419)

Chemical Defenses in Tropical Marine Algae Herbivore Deterrence and its Relationship to Variation in the Production of Secondary Metabolites. NATIONAL SCIENCE FOUNDATION ($92,559).

Historic Inventory of Marine Mammals in Micronesia. SOUTH PACIFIC REGIONAL ENVIRONMENTAL PROGRAMME ($4,000)

Marine Assessment of Northern Tanapag Lagoon and Barrier Reef, Saipan. COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS ($10,611).

Survey of Yap Fishery Resources. FEDERATED STATES OF MICRONESIA ($27,071).

Interoceanic Comparisons. UNESCO ($16,250).

Are Population Densities of Herbivoreus Reef Fishes Determined by Productivity of the Habitat? (Year 2) SEA GRANT ($29,409).

University of Guam Sea Grant Extension Service. SEA GRANT ($23,075).

Role of Seagrass Communities in the Biology of Coral Reef Fishes: Experiments with Artificial Seagrass Beds. (Year 2) SEA GRANT ($12,255).

Coral Reef Newsletter, SOUTH PACIFIC REGIONAL ENVIRONMEN PROGRAMME ($2,000).

NEW PROJECTS

Air Sampling Collection. OFFICE OF ATMOSPHERIC ADMINISTRATION ($4,186).

Bioassays of Tanguisson Power Plant Discharge Water Toxicity and Apra Harbour Temperature Monitoring. GUAM POWER AUTHORITY ($10,000).

Chemical Interactions of Coral Reef Invertebrates. NATIONAL INSTITUTE OF HEALTH ($68,459).

Herbivore Deterrence as an Indicator of the Pharmacological Activities of Tropical Algae. SEA GRANT ($29,910).

University of Guam Sea Grant Extension Service. SEA GRANT ($22,998).

Program Development Project. SEA GRANT ($15,000).

Research Experience for Undergraduates. NATIONAL SCIENCE FOUNDATION ($4,310).

COMPLETED PROJECTS

Equipment and Refurbishment of an Analytical Laboratory on Coral Reef Biology at University of Guam. NATIONAL SCIENCE FOUNDATION ($38,000).

Flora and Fauna Survey of Tinian. HAWAIIAN AGRONOMICS ($30,025).

Ecological Interactions Among Tropical Coastal Ecosystems. SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME ($125,580).

Fagatele Bay Sanctuaries Project: Baseline Survey to Establish Biological Assessment for Resources. GOVERNMENT OF AMERICAN SAMOA ($28,962).

Air Sampling Collection. OFFICE OF ATMOSPHERIC ADMINISTRATION ($2,982).

Acquisition of Equipment for UOG Marine Laboratory. NATIONAL SCIENCE FOUNDATION ($41,000).

Role of Seagrass Communities in the Biology of Coral Reef Fishes: Experiments with Artificial Seagrass Beds. (Year 1) SEA GRANT ($12,766).

Are Population Densities of Herbivorous Reef Fishes Determined by Productivity of the Habitat? (Year 1) SEA GRANT ($31,994).

University of Guam Sea Grant Extension Service. SEA GRANT ($23,171).

Bioactive Secondary Metabolites from Tropical Marine Algae and their Role as Chemical Defenses Against Herbivores. SEA GRANT ($10,000).

Chemical Defense Adaptations in Tropical Marine Organisms. RESEARCH CORPORATION ($10,000).

Bioassays of Tanguisson Power Plant Discharge Water Toxicity and Apra Harbor Temperature Monitoring. GUAM POWER AUTHORITY ($12,000).

Nitrogen Budgets in Tropical Aquaculture Systems. USDA-HATCH PROGRAM ($9,000).

Survey of the Economic Seaweeds of Yap Lagoon with Survey with Existing Fishponds in Yap Proper. YAP STATE DEPARTMENT OF MARINE RESOURCES ($4,000)

Review of Aquaculture Development in the US-Affiliated Pacific Islands. OFFICE OF TECHNOLOGY ASSESSMENT ($2,000).

Review of Non-Living Marine Resources in the US-Affiliated Pacific Islands. OFFICE OF TECHNOLOGY ASSESSMENT ($2,000).

Review of Introduced Species in the US-Affiliated Pacific Islands. OFFICE OF TECHNOLOGY ASSESSMENT ($2,000).

MARINE LABORATORY
ANNUAL REPORT FISCAL YEAR 1988

CONTINUING PROJECTS

Marine Assessment of the Obyan-Naftan Reef Area, Saipan. COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS ($11,419).

Chemical Defenses in Tropical Marine Algae Herbivore Deterrence and its Relationship to Variation in the Production of Secondary Metabolites. NATIONAL SCIENCE FOUNDATION ($92,559).

Historic Inventory of Marine Mammals in Micronesia. SOUTH PACIFIC REGIONAL ENVIRONMENTAL PROGRAMME ($4,000).

Marine Assessment of Northern Tanapag Lagoon and Barrier Reef, Saipan. COMMONWEALTH OF THE NORTHERN MARIANAS ISLANDS ($10,611).

Survey of Yap Fishery Resources. FEDERATED STATES OF MICRONESIA ($27,071).

Interoceanic Comparisons. UNESCO ($16,250).

Coral Reef Newsletter, SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME ($2,000).

NEW PROJECTS

Air Sampling Collection. OFFICE OF ATMOSPHERIC ADMINISTRATION ($4,186).

Bioassays of Tanguisson Power Plant Discharge Water Toxicity and Apra Harbor Temperature Monitoring. GUAM POWER AUTHORITY ($10,000).

Chemical Interactions of Coral Reef Invertebrates. NATIONAL INSTITUTE OF HEALTH ($68,459).

Herbivore Deterrence as an Indicator of the Pharmacological Activities of Tropical Algae. SEA GRANT ($29,910).

University of Guam Sea Grant Extension Service. SEA GRANT ($22,998).

Program Development Project. SEA GRANT ($15,000).

Research Experience for Undergraduates. NATIONAL SCIENCE FOUNDATION ($4,310).

Baseline Survey of the Ngerukewid Reserve, Palau SOUTH PACIFIC REGIONAL ENVIRONMENT PROGRAMME (SPREP) ($9,300).

Sea Cucumber Fishery Development in Micronesia-Guam. PACIFIC FISHERIES DEVELOPMENT FOUNDATION ($65,000).

Reproductive Biology of Three Sea Cucumber Species of Potential Commercial Value. U.S. DEPARTMENT OF AGRICULTURE COOPERATIVE STATE RESEARCH SERVICE with COLLEGE OF AGRICULTURE AND LIFE SCIENCES (CALS) ($10,000).

AGRICULTURAL EXPERIMENT STATION
Research Projects
1987-88

HATCH SUPPORTED PROJECTS

Project No.	Title	Budget
GU001	General Administration of Federal Grant Funds Research	$239,481.00
GU008	Determination of Plant Diseases on Guam	$78,880.00
GU0011	Initial Soil Fertility Survey of Guam	$110,868.00
GU0020	Improving the Status of Tropical Fruits through Selection, Introduction & Breeding	$108,075.00
GU0024A	Development of Integrated Pest Management Systems on Guam	$105,964.00
GU0030	Evaluation of Different Cultural Methods for Production of Ornamental Plants in Guam	$98,342.00
GU0036	Economic Feasibility of Growing Selected Field Crops on Guam to Substitute Imported Feed Grains	$51,699.00
GU0052	Effect of Exogenous Growth Regulators On Growth, Yield and Quality	$108,999.00
GU0059	Reproductive Biology of Three Sea Cucumber Species of Potential Commercial Value	$10,000.00

GU0060	Bioenergetics and Behaviour of Larval Rabbitfishes (Siganus spp.)	$20,000.00

Subtotal $1,052,657.00

HATCH REGIONAL RESEARCH

GU0015-84	Establish, Improve, and Evaluate Biological Control in Pest Management	$70,862.00
GU0022-W124	Water and Nutrient Management of Crops Under Micro-Irrigation	$37,265.00
GU0022-W147	Biological Suppression of Soil-Borne Plant Pathogens	$4,000.00

Subtotal $112,127.00

SECTION 406 - GRANTS

GU0037	Use of Locally Produced and Available Feedstuff on Guam for Animal Production	$25,073.17
GU0045	Effect of Cultural Practices on Disease Incidence and Severity on Bellpepper	$40,312.69
GU0046	Biological Control of the Weed Chromolaena odorata	$10,898.51

GU0049	Potential of Potato Production in Guam, Saipan, and other Micronesian Islands	$46,914.00
GU0050	Developing Crop Models for Cassava, Corn and Papaya on Guam	$5,148.12
GU0053	Promote Flowering and Dwarfing of Winged Bean with Plant Growth Regulator	$50,358.96
GU0054	Biology and Control of Mango Shoot Moth and Mango Blotch Miner on Guam	$68,321.58
GU0055	Evaluation of Produce Market Potential and Production Constraints in Micronesia	$5,167.52
GU0057	Biology and Biological Control of Red Coconut Scale Furnacapis oceania Lindinger	$41,529.72
GU0058	Environmental Factors Affecting Flowering in Some Vanda and Dendrobium Hybrids in the Tropics	$25,774.23
With the University of Hawaii - The Role of Nitrogen Fixation in Sustainable Production of Agroforestry Systems		$4,037.00
	Subtotal	$323,535.50
	TOTAL	$1,488,319.50

GUAM AGRICULTURAL EXPERIMENT STATION HIGHLIGHTS

Continuing collaborative work with:

1. Asian Vegetable Research and Development Centre (AVRDC)
2. International Benchmark Sites for agrotechnology Transfer (IBSNAT)
3. Soil Management Support Services (SMSS) - The International Arm of the U.S.D.A., Soil Conservation Service (SCS)
4. Guam, USDA, Soil Conservation Service, (SCS)
5. University of Hawaii
6. South Pacific Commission (SPC)
7. Commonwealth Institute of Biological Control, Bangalore, India
8. U.S. Agency for International Development (AID)
9. Northern Marianas College
10. College of Micronesia
11. Republic of Belau
12. East-West Center
13. International Potato Research Center
14. United Nations Development Program (UNDP/FAO - SPC)
15. Cooperative State Research Service, National Pesticide Impact Assessment Program (CSRS - NAPIAP)

16. Animal and Plant Health Inspection Service (APHIS), USDA

17. U.S.D.A. Office of International Cooperation and Development (OICD)

18. International Board for Soil Research and Management (IBSRAM)

International Participation:

1. Coordinated and hosted the IX International Forum on Soil Taxonomy and Agrotechnology, Transfer, 1984

2. Coordinated the III International Workshop of Acid Soil Management, Belau, 1987

3. Coordinated the International Workshop on Biological Control of Chromolaena odorata, Thailand 1988

4. Scientists participation in International Meetings

International and National Recognition:

1. Three research projects cited in the U.S. Congressional Report justifying funding for various agricultural research grants for the nation's tropical and subtropical area.

2. Acknowledged leadership in the Pacific region in the fields of Biological Control of Insect Pests.

3. Resource person in International meetings in the fields of Entomology, Plant Pathology, Horticulture, and Soil Science.

Summary of publications, 1986 and 1987

Referred Journals	-	11
Abstracts	-	2
Proceedings	-	7
Technical Reports	-	5
Pamphlets	-	18
Chapters in Books	-	2

The Agricultural Experiment Station scientists - teach the bulk of the Resident Instruction Programs of the College of Agriculture and Life Sciences.

The AES has Hatch Projects with Marine Laboratory scientists (Drs. Nelson and Richmond) and one with a Professor (Dr. Chu-Tak Tseng) at the College of Arts and Sciences.

WORKING PAPER 11
THE USP/INSTITUTE OF RURAL DEVELOPMENT TONGA

S. Moengangongogo

I. INTRODUCTION

The Institute of Rural Development, one of the established institutes of the University of the South Pacific, is situated in the Kingdom of Tonga. It was established in 1981 with EEC funding from the regional Lome I allocation. The original funding enabled the University to develop a Complex in Tonga which, with other assistance, currently houses the IRD and the USP Tonga Extension Centre.

The capital development undertaken with EEC funding consists primarily of a dormitory block, a staff house, a workshop, a classroom, and a dining room facility. In addition, a minibus and a landrover were provided. Later, with Australian Aid donated funds, an office block and two workshops were completed in 1987. The old workshop was converted into a conference classroom block, while the old classroom was converted into an information-resource centre.

Extra funds were included in the Lome I for programmes, which continued with the allocation from the regional Lome II funds. Future programmes are to be developed by a consultancy team which will begin on the first week of March 1989. Funds are to be provided from the EEC Lome III regional allocation.

The prime objective of the Institute is to assist regional governments in their endeavours to develop the rural areas. More specifically, the outcomes that the Institute hopes to achieve are:

a) to encourage and further cooperative activities with other agencies which promote rural development in the region in order to provide an integrated approach to rural development while avoiding unwarranted duplication of resources thus achieving more effective programmes of action.

b) To acquire, adapt and develop products, techniques and processes which may improve the quality of rural activities and encourage innovation in the rural sector.

c) To increase the skills and knowledge of the rural population.

d) To encourage the wider participation of rural people in the establishment of national development priorities and the implementation action programmes.

e) To promote the recognition by rural people of the impact of rural development processes on the rural environment.

f) To stimulate the transfer of relevant information between other agencies and rural communities in a manner which is appropriate to the needs of rural communities.

2. ACTIVITIES

The Institute hopes to achieve its objective by adopting the following strategies:

a) conducting short training courses, seminars, workshops on a wide range of subjects aimed at increasing awareness of local potential.

b) collecting information concerning the social and economic parameters critical to the development of the rural communities.

c) building up a library of relevant publications, creating an information centre and disseminating this information by a variety of means including news sheets, course and workshop materials and public addresses.

d) mounting practical studies on the local applicability and acceptibility of techniques and technologies in agriculture, marine and rural technologies.

e) providing a consultancy service to regional governments in identifying areas and programmes most critical to the development of rural communities.

3. PROGRAMMES

So far, the IRD has focussed mostly on training. The research on the other hand has been oriented primarily towards obtaining information needed by the training programmes. Information from research projects was primarily used as basis for seminars or training programmes. An example was the technology programme. The stove workshops were based on adaptive research undertaken at the IRD.

The areas of activities covered a wide area of interest, ranging from rural business management to technology. Attempts were also made to avoid duplication with other existing agencies. Except for para-veterinary training, no direct agriculture activities were undertaken. The main areas were, at the beginning, rural business management, food technology, para-veterinary training, women in development and appropriate technology. The food technology programme was soon terminated due to shortage of funds.

3.1 Training

A number of training projects were undertaken in the above areas. The approach was at two levels:

a) regional level short term training undertaken at the IRD for trainers.

b) national level short term training using the trainers from the regional level training in each country. The rationale for the choice of the national level training is two fold:

1) to strengthen the training skills of the trainers, and

2) to begin to disseminate the skills that the trainers acquired.

3.2 Information Dissemination

The general objective of the information dissemination project is to reduce the gap in the available technical information at the national level. The IRD intends to obtain the relevant information either from other sources or from adaptive research and disseminate it through publications such as leaflets etc.

In addition, training materials have been developed for use both at the regional and national level training projects.

3.3 Research

The research activities have been directed to similar areas as discussed in the training section.

According to directives from the region, the priority area has been training, closely followed by information dissemination. It must be stressed here that the activities of the IRD are totally dependent on external assistance. Since the beginning, the EEC has been generous in providing the necessary funding. AIDAB through an NGO, provided the funds for the women in development project. All these projects have been completed successfully.

It is worthwhile mentioning here that the Government of Tonga provided funds from their bilateral programme for the IRD to undertake a training project in Tonga. None of this fund is available for the rest of the region.

4. INSTITUTIONAL ARRANGEMENTS

The IRD has an Advisory Board which meets once a year to determine future programmes and review previous activities. Because of the multicipliinary nature of rural development, it is difficult to determine membership in the board. In 1985, it was proposed to use the same advisory board for IRETA. Therefore the national representative at the board is the national Ministry of Agriculture or its equivalent.

5. FUTURE

The future programme of the IRD is dependent on a consultancy to be undertaken during the month of March (straight after this consultation). Funds will then be available for programmes in the future. The funds are provided from the regional allocation from the EEC Lome III programme. The areas concerned and the activities are unlikely to change. But it must be realized that this fund is for all the Pacific member states of the ACP. But this does not preclude other sources of funds which may be available at later dates.

WORKING PAPER 12
THE USP SCHOOL OF AGRICULTURE AND INSTITUTE FOR RESEARCH, EXTENSION AND TRAINING IN AGRICULTURE (IRETA): ATOLL AGRICULTURAL ACTIVITIES AND ROLE IN ATOLL RESEARCH FOR DEVELOPMENT

Seumanatafa Malcolm Hazelman[1]

BACKGROUND

The agricultural faculty of the University of the South Pacific is located on its Alafua Campus in Western Samoa. It's academic arm is the School of Agriculture (SOA) which currently offers programmes of study leading to various agricultural qualifications - a one-year Certificate in Practical Agriculture, a 2-year Diploma in Tropical Agriculture, a 3-year Bachelor of Agriculture, a one-year Advanced Certificate in Teaching Agriculture, and a 2-year Master in Agricultural Extension is currently being considered to address a need expressed by national departments of agriculture in this area. Graduates of Alafua can be found at all levels of government, private enterprises and regional institutions with approximately 90 percent in government service.

The "problem solving and service arm" of the Alafua Campus is its Institute for Research, Extension and Training in Agriculture (IRETA) which as its name indicates, has 3 focus areas - Research, Extension Outreach and Training. In addition it has service functions to support regional and national needs in the areas of chemical analysis, statistical advising, plant tissue culture, consultancy service and library services to name a few.

In support of the work of the campus all staff have both SOA teaching as well as institute functions. Financial and other support is provided by a number of donors, namely EC, USAID, UNDP/FAO, AIDB, CTA, ISNAR, CGA, and UNICEF. In addition are a number of collaborative projects with ACIAR, ADAP, and others.

---

[1]. Associate Director for Extension and Training, IRETA.

2.0 RESEARCH AND DEVELOPMENT ACTIVITIES IN ATOLL AGRICULTURE

2.1 Current Research

IRETA's current research is focussed under nine (9) research themes. These include:

i) Intensified, Sustained Cropping Systems,
ii) Improved Genotypes,
iii) Tissue Culture,
iv) Controlling Pests and Diseases,
v) Atoll Agriculture,
vi) Local Ingredients for Livestock Feeds,
vii) Appropriate Cost-Effective Technologies,
viii) Agricultural Economics, and
ix) Youth and Women in Agriculture.

2.2 Guidance

The guidance for IRETA's (and the SOA's) work is provided by the Directors of Agriculture of national governments in their role as IRETA's Regional Advisory Board (RAB). It was with this group's initiative that IRETA, in Kiribati in October of 1985, coordinated a meeting of staff of Agriculture Departments of atoll countries to examine the unique problems and needs of these countries. That meeting prioritized the research, extension and training needs of atoll countries as follows:

i) Study of the traditional and improved farming systems in atoll countries,
ii) Development of low-cost irrigation systems for vegetable production,
iii) Analysis of local livestock feeds,
iv) Soil management in regard to the mineral content of mulches and compost; and water relations,
v) The offer of meristem tip cultured and disease indexed cloves of sweet potatoes,
vi) Training of local staff in coconut production and experimentation,

vii) Intercropping of coconut,
viii) Micronutrient fertilisation of coconut,
ix) Social science study of farmers' attitudes toward the adoption of new technology, especially to the coconut replanting schemes,
x) Cyrtosperma breeding for salt tolerance for short duration; tissue culture and descriptor list,
xi) Vegetable production integration with livestock rearing.

Other priorities that ranked equal but lower than the above topics were:

i) National extension workshops
ii) Production of farm radio programmes
iii) Development of the techniques for the rapid propagation of Pandanus
iv) Publication of methods of propagating breadfruit
v) Tissue culture of breadfruit
vi) Stocking rates and management of goats; management of pigs and poultry
vii) Study of different systems of mulching
viii) Study of salinity in Cyrtosperma pits
ix) Conducting of soil surveys
x) Coconut post-harvest technology
xi) Information on methods of cultivating Colocasia on the atolls
xii) Development of Colocasia cultivars for leaf and corm production on the atolls
xiii) Update Small's book on "Atoll Agriculture".

2.3 Current Activities

Guided by the above as well as by other information, (e.g. the annual RAB meetings), IRETA has initiated research, extension and training activities which have tried to address the needs as prioritized. A summary of such activities follows.

2.3.1 Research

I. Atoll Agriculture

Studies determining the usefulness of composts with added fertilizers, use of different plant media with fertilizers, use of water-saving techniques (polythene sheeting bags and Agrostoke), trickle irrigation for sweet potatoes, cultivar introductions and selection with sweet potato; pandanus rapid multiplication, and plant introductions and evaluations of potentially useful plants which include citrus, VI, cutnut, black pepper, taro and sapodilla. With livestock, research has concentrated on local feed formulation for pigs. The latter has shown excellent results with formulations as local fresh fish, copra, coral sand and greens.

II. Regional Research with Potential Atoll Application

These include vegetable varietal screenings, biological pest control of Mimosa invisa, and tissue culture activities which will enable safe transfer of plant genetic material as well as for the safe keeping of germplasm collections.

2.3.2 Training

I Formal

Condensed course formats were offered in 1986 to allow regional staff from departments of agriculture to undertake courses at Alafua while not being away from work for too long. Due to the limited number of such students, these courses were not offered thereafter. Currently the Certificate in Agriculture and the Preparatory Year of the Diploma in Agriculture Programme enables students with limited high school preparation (especially those from atoll countries) to gain valuable qualifications and preparation for higher levels of study at Alafua.

II Informal

Requests for national workshops in Agricultural Extension methods were fulfilled with such workshops for 30 plus Kiribati and 20 plus Cook Islands Extension staff in 1987 and for 20 plus Tuvaluan and 3 Tokelauan staff in 1988. Plans are in place for a workshop in June this year for 20 plus Tuvaluan and Tokelauan staff in the use of radio, and for 6-8 Cook Islands staff for a November workshop on report writing.

2.3.3 Information Outreach Services

IRETA has in place an Agricultural Information Support Network which includes the Agricultural Liaison Officer (ALO) Network, the Agricultural Information Network (AIN), Radio and Satellite (and to be added this year, Video) Communications, Library Services, agricultural publications geared to various categories of clientele, important links with regional and international agricultural information data bases (AGRIS, CARIS, etc) bibliographic services, institutions and agencies.

3.0 IRETA AND THE PROPOSED KIRIBATI ATOLL RESEARCH FOR DEVELOPMENT PROJECT

3.1 SOA/IRETA as a Regional Institution

The SOA/IRETA as a regional institution mandated to support the agricultural education research and support needs for member countries of the University of the South Pacific is committed to these roles. Thus if requested by the Kiribati government, and if the resources are made available for implementation of an atoll based development project, the SOA/IRETA would be very interested in and qualified to play a leading role.

3.2 Areas of Expertise

Areas in which IRETA can make signficant contributions include:

Agricultural Education
Agricultural Extension and Communication
Agricultural Economics and Farm Management
Agricultural Engineering and Appropriate Technology
Animal Science and Production
Soil Science and Agronomy
Tissue Culture
Research Planning, Management and Analysis
Training
Others

3.3 Past Experience

Based on past experience, it is imperative however that the following factors be given adequate attention if any effort in this planned project is to have a major impact:

i) Political commitment beyond lip service to the importance of atoll research;

ii) Organisational support and coordination from the important government and non-government ministries and agencies that play important roles;

iii) Adequate financial and manpower (several disciplines and at all levels) support to ensure success;

iv) Guidance from an influential and knowledgeable group or body to ensure that programmes and projects undertaken are relevant to atoll (Kiribati) needs, including adequate attention to the early inclusion of needs analysis, learning about traditional knowledge, and communications and extension phases as well.

3.4 Participation in Consultation

The participation of an SOA/IRETA representative at this consultation will help to further clarify IRETA's role and position as regards to this project proposal. We thank the organisers for extending to us the invitation to attend.

WORKING PAPER 13
CCOP/SOPAC: ONGOING ACTIVITIES AND CAPABILITIES WITH PARTICULAR FOCUS ON KIRIBATI

Jim Eade[1]

1. INTRODUCTION

The Committee for Co-ordination of Joint Prospecting for Mineral Resources in South Pacific Offshore Areas (referred to briefly as the Co-ordinating Committee for Offshore Prospecting, South Pacific, and abbreviated CCOP/SOPAC) is an inter-governmental body established to:

a) investigate mineral and other nonliving resource potential in coastal, inshore, nearshore and offshore areas of its member countries;

b) gather baseline data to determine design criteria for engineering works or other developments in the coastal zone;

c) co-ordinate marine geological and geophysical studies being made in the region; and

d) train nationals in the implementation and management of their work programmes. Member countries are currently Australia, Cook Islands, Fiji, Guam, Kiribati, New Zealand, Papua New Guinea, Solomon Islands, Tonga, Tuvalu, Vanuatu and Western Samoa.

2. ORGANISATIONAL STRUCTURE

Since its inception at Suva in 1972 under the sponsorship of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the Committee has met annually to review work completed, and to discuss and plan future work. In 1984 the Committee reaffirmed its legal status as an independent, regional

---

1. Deputy Director, CCOP/SOPAC Technical Secretariat.

inter-governmental body by its member countries signing a Memorandum of Understanding.

In late 1974, a United Nations Development Programme (UNDP) Marine Geologist was appointed and a Technical Secretariat established in Suva, Fiji. By the end of 1988 staffing at the Technical Secretariat (including UNDP project staff) had grown to a level of 19 professional and 19 support persons.

The Committee has a well developed Work Programme consisting of more than 100 Country Projects and more than 40 Regional Projects. Country Projects define applied work required by individual members to assist with their countries' development programmes. Each year, at the Committee's Annual Session, the Work Programme is reviewed and work required by members to help them meet their Project objectives is identified and programmed for the following year. This work is then done by the Technical Secretariat or with assistance from others and co-ordinated by the Secretariat.

3. NATURE OF WORK PROGRAMME

Survey work investigating nearshore and offshore minerals started in 1975. Vessels were chartered for offshore surveys every year from 1977 to 1981 including a 6-month charter each year for the 3-year period 1979-1981. Since 1981 offshore work has continued on major oceanographic vessels provided as special contributions to CCOP/SOPAC by donor governments, and on vessels available locally throughout the region. Offshore prospecting work has been undertaken for hydrocarbons, polymetallic ferromanganese nodules and crusts, hydrothermal deposits, submarine phosphates, and precious corals. Nearshore work began in 1975 with searches being made for placer gold and lagoonal bauxite deposits. In 1978 the nearshore programme was expanded to include construction materials and precious corals. In 1980 coastal and inshore baseline and environmental studies commenced. Subsequently wave energy and geological hazards have been incorporated into the CCOP/SOPAC Work Programme.

Training of national staff has been conducted onboard ships, at the Technical Secretariat, and at workshops and special courses, including the annual Earth Science Certificate course conducted

jointly with USP. CCOP/SOPAC publishes technical information through the South Pacific Marine Geological Notes, its Technical Bulletin series, and internal reports, and produces a quarterly Newsletter and an Annual Proceedings volume. It has sponsored workshops on petroleum potential, offshore and nearshore mineral resources, concrete from coral aggregate, coastal processes, and regional tectonics.

4. FUNDING AND SUPPORT

Financial support of approximately Fiji $1.5 million annually is currently being provided by international agencies (primarily the UNDP), donor governments, and the member countries themselves. Substantial additional support in the form of services is provided to CCOP/SOPAC by donor governments mainly through major joint activities, supporting countries include Australia, Canada, Federal Republic of Germany, France, Japan, Netherlands, New Zealand, Norway, Peoples Republic of China, United Kingdom, USA and USSR. They provide assistance in areas such as funding, training, shiptime, non-reimbursable consultants, gifts and loans of equipment, editorial services, and publishing and printing, etc. Member countries also provide considerable support in kind, especially during survey work, by providing personnel, facilities (including ships), equipment and supplies.

International organisations, such as the Commonwealth Science Council (CSC), the European Economic Community (EEC), the United Nations Educational Scientific and Cultural Organisation (UNESCO) and its associated Inter-Governmental Oceanographic Commission (IOC), and the International Decade of Ocean Exploration (IDOE), have also assisted CCOP/SOPAC.

5. KIRIBATI WORK PROGRAMME

Within the CCOP/SOPAC work programme, Kiribati has 8 country Projects. These are:

KI.1: Distribution and Economic Potential of Submarine and Lagoonal Phosphate Deposits in Kiribati Waters

Studies have focussed on deposits in lagoons. The potential for large commercial deposits is very small, but small non-commercial deposits do exist which may be useful locally.

KI.2: Investigation of the Occurrence of Manganese Nodules in the Kiribati Region

Studies have shown that potentially rich nodule fields exist in the North Penrhyn Basin, southwest of the Line Islands.

KI.3: Search for Precious Corals in Kiribati Waters

Reconnaisance surveys for Coralliun and black coral have been completed in the Gilbert Islands group with disappointing results. Work with more encouraging results is continuing in other areas.

KI.4: Baseline Studies of Inshore Areas in Kiribati for Coastal Development and Protection Programmes

Much of the Technical Secretariat's work in Kiribati is providing assistance under this project. Current work includes: monitoring of sediment movement, accumulation, and erosion on beaches and reef flats along the Betio-Bairiki Causeway; baseline studies of areas identified as possible sites for tourist resorts; preparation of composite geological maps of coastal areas; providing information on results of research by others on sealevel movements, especially rises predicted from studies of the greenhouse effect.

KI.5: Search for Cobalt-Rich Crusts in Offshore Areas of Kiribati

Crust deposits have a similar mineral content to nodules but are found in shallower wate: on ridges and seamounts. Reconnaissance work is continuing in association with the nodule work.

KI.6: Investigation of Nearshore and Coastal Areas for Landfill and Construction Materials

Work done in South Tarawa is continuing along with the Betio-Bairiki Causeway monitoring project as a study of the sediment budget in that area.

KI.7: Data Management

The Technical Secretariat acts on Kiribati's behalf in obtaining, storing and managing marine data relevant to its Work Programme. A personal computer will be provided to the Department of Natural Resources so that data can be stored and be available in Kiribati as well as at the Technical Secretariat.

KI.8: Seabed Mapping in Offshore Areas of Kiribati

A programme of bathymetric mapping is continuing. Attempts are being made to do combined bathymetric and image mapping of the seafloor using the latest swath mapping technology. Interpretation of satellite data has identified a number of large seamounts previously unknown.

WORKING PAPER 14
THE UNIVERSITY OF RHODE ISLAND'S EXPERIENCE IN TRANSFERRING IMPLEMENTABLE COASTAL RESOURCES MANAGEMENT

William V. Branan[1]

1. ABSTRACT

The University of Rhode Island's Coastal Resources Management Project assists several nations in the development of appropriate and sustainable coastal resources management (CRM) programs. As in the United States, the successful formulation, testing and implementation of CRM requires a basic recognition that problems exist, plus social and political support at local and national levels. Such support must be created or strengthened by public education aimed at developing an appreciation for the critical function of natural systems. This requires that scientists, educators, land planners, environmentalists, and governmental officials periodically meet to develop CRM strategies that are sensitive to currently evolving public and bureaucratic attitudes.

2. INTRODUCTION

The United States (US) Coastal Zone Management Act of 1972 stimulated a wide exchange of coastal resources management (CRM) information among American universities, state and federal agencies. The act recognized that states and municipalities must make their own critical decisions to reflect local goals and desires. It provided considerable federal funding assistance, advice, and encouragement to develop technical plans and policies. State programs which met federal standards, were then provided with implementation funds and the agreement that future federal actions would have to be consistent with the approved plans.

---

2. Ph.D., Technical Coordinator, International Coastal Resources Management Project, The University of Rhode Island, Narrangansett, RI, USA.

Exchanges of CRM knowledge have also occurred between many nations, and increasingly those in the ASEAN region. The goal for these exchanges, at all levels, is to design and implement policies and programs that balance coastal resource uses with the capacity of the resource base to sustain these uses.

The University of Rhode Island's International Coastal Resource Management Project operates in Ecuador, Sri Lanka, and Thailand, with the goal of assisting in the development of CRM programs in each country, and in sharing insights about the experiences derived in other nations. The University of Rhode Island (URI) has assisted developing nations in problem focusing, policy development, local decision processes, special area planning, developing incentives for performance and compliance, creation of federal-state-local partnerships, linking local problems to national issues, resource inventories, conflict resolution, zonation, and resource allocation. We have learned that many US CRM experiences can be transferred to other nations, if various cultural, economic and governmental differences are considered. URI's role has been to assist in the process of evaluating impacts and formulating CRM options, allowing the host nations to select the preferred options in light of national and local goals.

3. THE URI EXPERIENCE

In the 1960s, several American states were just beginning to recognize the need to plan and regulate the use of coastal, shore lines and aquatic habitats. Some leaders envisioned the need but questioned whether CRM could be implemented because of social, political and economic pressures that favored growth and development. In time, most of the 22 coastal states adopted CRM programs that met federal approval while reflecting local needs. Many policies were borrowed or adapted from other states to fit local circumstances. Today, the US has more comprehensive CRM than many believed could be accomplished, and, as a result, most coastal US waters are cleaner than 25 years ago, in spite of increasing coastal populations. Yet, over the same period, the US also learned that its CRM problems are far more complicated than previously imagined.

Three basic factors contributed to CRM development in the US:

1. Scientists developed a greater understanding of the environmental systems involved, i.e., impacts of sewage and related threats to the water quality, estimates of storm flows, etc.

2. Environmental, recreational, educational and civic organizations produced the social and economic desire to maintain the environment. Investors, often the decision-makers, had to be shown that environmental protection is the key to maintaining a sustaining, robust, economy.

3. Political leaders, interacting with scientists, planners and activists, developed enforceable protective laws and regulations. This is the essential process whereby society defines its priorities. This process was especially difficult where enforcement was underfunded, and attitudes were divided about resource ownership and use.

These three elements reinforced one another and allowed technical options to be formulated and tested in light of local social and economic goals. Remove one and CRM would not have occurred.

In other countries, we believe the above three elements are also critical, and as in the United States:

1. The problem in achieving CRM implementation is usually not technical, but social and political. The role of the planner is to evaluate biological and environmental trends, and make suggestions for correcting problems.

2. Local goals and the willingness of citizens and their leaders to cooperate will ultimately dictate whether a technically feasible alternative will succeed or fail.

3. Implementing a technical option where large numbers of people are involved is very expensive and time-consuming, especially if these citizens do not understand, agree, or co-operate with the objectives.

4. Through a process that includes joint discussions and workshops between representatives of all interest groups, various technical options can be evaluated in light of social, economic and political realities so that the preferred option can be selected. Such a process prevents the initiation of methods that have no chance of success, produces a consensus among the impact groups, and helps derive realistic expectations.

Environmental problems exist in the coastal zone because citizen input has been indifferent or adverse, creating inappropriate and uncontrolled resource use. The goal of CRM is to provide co-operative citizen participation. To productively involve local citizens in CRM:

1. Local citizens and their leaders must respond to real problems. They must understand the goals of CRM as well as its costs and benefits to them and their children.

2. A process must be derived whereby local people have input to the design of their local CRM plan. Thus, the planning process must be both top-down and bottom-up, with the national and state governments providing environmental standards and encouragement (often financial), while local citizens working through their governmental representatives determine appropriate details, i.e., highway routes, as well as the locations of treatment plants, parks and protected areas, consistent with local objectives and capabilities as well as national standards.

3. It is critical to begin slowly and to develop consensus between citizens and leaders, rather than to move rapidly but with a lack of consensus.

4. The role of consultants or advisors, whether local or foreign, is to assist in deriving the necessary information that will provide a list of realistic CRM alternatives and their probable outcomes, so that the local decision process can be used to select the preferred alternatives.

Coastal resource managers must monitor and react to current, local attitudes about CRM. These attitudes evolve through stages, which can be shortened but not eliminated:

1. Initially, few citizens think much about coastal resources, but they assume the sea can provide all needs and absorb all pollutants. As populations increase, or as resource exploitation methods become more efficient, the resource base may shrink below sustainable levels. Unfortunately, many countries currently maintain their Gross National Product by reducing the sustainability of their environmental resource base.

2. Some citizens become aware of problems elsewhere, but assume that such problems will not occur locally, or that local changes will be slow and manageable.

3. As changes (growth, development) accelerate, affected citizens recognize some problems, but place the blame elsewhere. Many feel that the future should not or cannot be directed, that market forces will favor positive changes, that regulations will suffocate opportunity, or that growth pays for the cost of needed infrastructure (roads, sewers, services). The underlying causes of environmental degradation are often not acknowledged, especially by those who profit by ignoring problems.

4. Planning guidelines are tolerated, but not enforced. Many believe that CRM does not need to be comprehensive, or that regulations would be too expensive, too anti-economy (anti-growth), or would deny individual freedoms. Here, public officials continue to have difficulty in selecting the long-term view for the public good when short-term private profits are substantial.

5. Where there is widespread public education about CRM, there is a growing recognition and acceptance that comprehensive CRM is desirable and that a long-term CRM view is a long-term people's view.

6. In a few cases, local citizens develop comprehensive, implementable, and enforceable CRM.

As representatives from one organization (university, agency, etc.) advise another organization, their cooperative relationship may go through stages that include: 1) zealous optimism, 2) frustrations and doubts, and 3) realistic expectations. The key is in surviving the second stage.

4. SUMMARY

To achieve CRM, any municipality, province or nation must:

1. Start with real problems.

2. Involve scientists, citizens and political leaders in a dialogue to pre-test and build consensus for the preferred management options.

3. Begin with simple, manageable tasks that produce visible results.

4. Avoid overselling CRM, because too much expectation can be detrimental as unforeseen problems arise.

5. Periodically convene informal discussion workshops where representatives from all sides can review progress, consider new issues, and evaluate new information.

6. Keep smiling; the ability to tolerate glitches together is the key to ultimate success.

7. Respect people first, knowledge second, techniques third.

Finally, URI has been fortunate to work in great countries on great projects with great people. We wish the same fortune for all projects.

WORKING PAPER 15
THE UNIVERSITY OF RHODE ISLAND'S INTERNATIONAL COASTAL RESOURCES MANAGEMENT PROJECT

William V. Branan[1]

1. ABSTRACT

Coastal resource management (CRM) is needed to reduce the adverse impact of major population increases upon the environmental quality in coastal areas, worldwide. The University of Rhode Island's Coastal Resources Center (CRC) operates cooperative CRM programs in Ecuador, Sri Lanka, Thailand and the United States. In each country, CRC works with CRM in-country teams to formulate, implement and test local and national CRM strategies. Because management recommendations from previous studies usually exist, CRC focuses more on program implementation. CRC helps to review any existing research and recommendations; defines future studies or activities that will have the greatest likelihood of being directly applicable to formulation and management strategies; designs procedures to assess the impacts of coastal development proposals; investigates the forces that affect trends in the condition and use of coastal ecosystems; strengthens the in-country professional staff to plan for and manage coastal development and infrastructure; and helps countries develop the institutional capabilities to effectively address resource use conflicts.

2. INTRODUCTION

Nearly three-fourths of the earth's population is concentrated in the coastal zone. As this population doubles, perhaps by 2020, most of the increase will concentrate in tropical coastal areas. To help protect these environments, The University of Rhode Island's Coastal Resources Center (CRC) collaborates with leaders of

1. Ph.D., Technical Coordinator, International Coastal Resources Management Project, The University of Rhode Island, Narragansett, RI 02882, USA.

developing nations in formulating, implementing and testing integrated coastal resource management (CRM) programs.

3. BASIC ELEMENTS

CRC regularly provides:

1. Training programs and workshops to institutions, agencies, and officials. By strengthening the in-country technical capability and comprehension of the forces affecting trends in coastal ecosystems, decision makers will be better able to address resource use conflicts.

2. Public Education and outreach through the schools and media to increase local involvement in CRM and assist officials in the decision process.

3. Special Area Management Planning advice and assistance to agencies and officials to help focus on issues and formulate comprehensive and integrated CRM in selected demonstration sites, where management options are tested against real issues.

4. National Policy Development to help establish realistic, implementable, nation-wide environmental quality protection standards coupled to consistency reviews.

4. EMPHASIS ON IMPLEMENTATION

CRC reviews existing research and recommendations; defines further studies or activities that will have the greatest likelihood of being directly applicable to the formulation and management strategies; develops procedures to assess the impacts of coastal development proposals; investigates the forces that affect trends in the condition and use of coastal ecosystems; strengthens the in-country professional staff to plan for and manage coastal development and infrastructure; and develops the institutional capabilities to effectively address resource use conflicts.

CRC's critical step is implementation of appropriate CRM strategies. In many countries, good studies and CRM recommendations have been provided by local and foreign consultants, yet their value is limited because they have not been implemented. Often, this is because no implementation capability is available, or similar problems have not been addressed in the past, so that the proper linkages have not been established among the regulatory and implementing agencies and citizens. CRC stresses that training, public education, special area planning, and national policy development must foster appropriate CRM implementation.

5. PHASED APPROACH

CRC's basic approach:

1. Recognizes a country's social history, environmental assets, and development goals.

2. Places great emphasis on developing public participation.

3. Focuses on relatively few, well-defined CRM issues.

4. Builds in an orderly and low-risk manner, in which the designs of succeeding phases depend upon responses to previous phases.

6. PILOT PROGRAMS

The University of Rhode Island's Coastal Resources Center was created in 1971 to undertake the research, planning and policy formulation required by state agencies charged with the management of Rhode Island's coastal ecosystems. Building on that experience, CRC now operates collaborative projects in Ecuador, Sri Lanka and Thailand through agreements with the United States Agency for International Development. The timing for CRM is good in many developing countries, and many techniques can be adapted from the United States and several European countries, which have more than a decade's experience in designing and implementing integrated CRM programs.

Following are brief summaries of our pilot programs:

6.1 Ecuador

CRC assists the Directorate for the Environment, Ministry of Energy and Mines to develop management strategy for the generally arid and sparsely inhabited 1,800 km mainland coast. Here, coastal development has been dominated by boom-bust cycles, e.g., ship building died around turn of century when forests were depleted, with this having been followed by booms in taiga, cacao, coffee and bananas.

The current boom is shrimp production in coastal ponds, which employs nearly 100,000 people and makes Ecuador the world's largest producer of farm-grown shrimp. Due to an inadequate permitting system, construction of shrimp ponds has caused great losses of mangroves even within national parks. In 1984, eleven percent of the country's original mangroves had been lost. By 1988, more than one third had been lost.

Urbanization is a second major issue. Guayaquil and other urban areas are growing explosively, and there are no realistic prospects for sewage treatment in most areas. Also, newly initiated near-shore oil drilling has created considerable concerns about water quality impacts.

CRC's initial efforts helped to:

1. Maintain water quality.
2. Protect and maintain wild shrimp stocks.
3. Upgrade product quality control.
4. Simplify the permit system for new ponds.
5. Evaluate economic policies affecting the shrimp industry.
6. Develop technical assistance programs and training options for mariculturists.
7. Develop public education.

CRC's current efforts are designed to:

1. Form a Ranger corps to improve enforcement of existing statutes throughout the coastal area.

2. Designate Special Management Zones in areas that serve as microcosms for the resolution of priority coastal management issues and to create a decision-making body for each management zone.

3. Create advisory committees in each special management zone, representing the full range of interests in the area, plus appropriate local and regional government entities.

4. Establish a small and precise structure to provide high-level governmental support for CRM, to assure political and adminitrative backing to solve conflicts, obtain international support, and promote inter-agency cooperation.

5. Establish a public education program to convey the important role that CRM has in the present and future of Ecuador.

6. Promote a research program on coastal issues to improve the understanding of specific resource management issues.

7. Implement a training program for all levels participating in CRM.

6.2 Sri Lanka

CRC assists the Coast Conservation Department, Ministry of Fisheries in preserving and managing critical coastal habitats nationwide. Although coastal management programs date back to the 1940s, serious environmental problems are becoming more threatening in the very populated coastal zone.

A major problem is the loss of coastal land to erosion, noted for centuries, but increasingly viewed as a problem when large

numbers of people began settling into coastal areas, early this century. Coastal erosion results from powerful monsoons and other natural forces, yet, Sri Lanka has many natural defenses against coastal erosion: near shore reefs buffer the energy of large waves, and sediments from rivers replenish eroded beaches. These defenses are being comprised by human activities, especially on the dynamic beaches of the southwest: coral is illegally mined to produce plaster and mortar, and sand is mined (often illegally) along all coasts and in all major estuaries, also to supply the construction industry. The Coast Conservation Department strives to control coral mining, sand mining, habitat degradation, pollution, over fishing, and other CRM problems.

Sri Lanka's Coastal Management Plan has just been completed. It avoids trying to do too much too quickly, while focusing on three major issues:

1. Coastal erosion.

2. Loss or degradation of natural coastal habitats.

3. Loss or degradation of historical, archaeological and cultural sites and scenic and recreational sites along the coast.

The Plan, and other CRM efforts in Sri Lanka will:

1. Strengthen CCD's enforcement capability.

   (a) standardize responses to speed response time to permit requests.
   (b) computerize permit monitoring (post processing).

2. Insure consistency between the National Coastal Management Plan and the Coast Conservation Act.

3. Resettle squatters away from erosion-prone coastal areas.

4. Acquire erosion-prone land.

5. Divest CRM authority and responsibility from central government to provinces, for (a) regulation, (b) planning, and (c) permits inspections. Training for district officers is being offered through the Sri Lanka Institute of Development Administration.

6. Map and describe historical coastlines and scenic sites.

7. Establish a post graduate course in coastal resources.

8. Build community support through public education.

Future efforts include further studies leading to publication of another CRM planning document, status of the coast 2000.

6.3 Thailand

CRC assists the Office of National Environment Board (ONEB), Ministry of Science and Technology in the formulation, implementation, and testing of local and provincial CRM, ultimately to formulate a national CRM policy, for incorporation into the Kingdom's Seventh National Economic and Social Development Plan.

Thailand's coastal population varies from sparse to dense, while its coastal waters are often severely degraded by siltation, pollution and over fishing. Mounting pressures are being added by an expanding tourist industry (tourism is Thailand's major foreign exchange earner, and coastal tourism is surpassed only by tourism in Bangkok).

CRC is mid-way through a 3-year cooperative CRM project, which includes:

1. A provincial CRM demonstration project on Phuket island.

2. Public awareness and involvement.

3. Formulation of national CRM policies.

4. Training in CRM for governmental personnel.

5. Marine Parks management demonstration projects.

Phuket Island is CRC's initial demonstration site. It had 27 first-class hotel rooms in 1969. This was increased to 6,000 by 1987, yet the infrastructure (roads, sewers, and services) had largely been forgotten, and the degraded environment reflected a critical need for comprehensive long-range environmental planning. The current level of 500,000 tourists per year in Phuket has been projected to reach 3,000,000 annually by year 2000. Other problems include encroachment of public lands by rubber plantations and tourist developments, destruction of coral reefs by boat anchors, sediments from inland quarries and construction and offshore tin mining.

CRC's activities in Phuket include:

1. Protecting coral reefs and other near-shore marine resources.

2. Improving water quality by assisting in the implementation of a sewer district in Patong watershed, constructing a demonstration septic system for houses, and developing a storm-water handling system.

3. Developing administrative systems to plan and manage future land use, including developments, public roads and facilities and stabilizing tin, gravel, and lignite quarries.

4. Conducting and publishing a thorough resource profile for Phuket.

5. Developing a legal framework for environmental protection.

6. Building public awareness for CRM through school and media campaigns.

7. Training hotel sewage plant operators, tour boat guides, and local officials.

Together, these activities are designed to maintain a robust local economy.

CRC has signed a second USAID agreement to advise ONEB and other Thai agencies and institutions through 1996. This will include:y

1. Formulation and implementation of special area management plans. CRM will be established in five additional sites.

2. National CRM policy development. The collective experience from special areas will be incorporated into national CRM policies.

3. Project integration and outreach. Various media campaigns, public meetings, and school programs will be used to build public participation in CRM.

4. Institutional strengthening. The research and management capability of selected Thai institutions will be strengthened through:

   (a) Seminars at Thai universities and agencies,
   (b) Observation tours in the United States,
   (c) Direct experience from participation in ongoing CRC activities in Thailand, and
   (d) Assistance in developing CRM curricula in Thailand.

5. Training capacity development. The instructional capability of selected Thai agencies and institutions will be increased through:

   (a) MS and PhD degrees through various US universities,
   (b) Special long-term non-degree internships in the US, and
   (c) In-country CRM training programs.

WORKING PAPER 16
ANNUAL REPORT FOR 1988
ICLARM COASTAL AQUACULTURE CENTRE
GUADALCANAL, SOLOMON ISLANDS

---

1. INTRODUCTION

ICLARM is an international, non-governmental not-for-profit fisheries and aquacultural research organization. Its orientation is towards the small-scale activities of the least-priveledged fisherfolk of the world and the social and economic problems which they face as a result of over exploitation of marine and freshwater resources, indifferent coastal management and competition for resources from large commercial enterprises.

ICLARM is a global organization, with headquarters in Manila, Philippines. Our Regional Office for the South Pacific administers and is located within our Coastal Aquaculture Centre (CAC) near Honiara in Solomon Islands. Development of the CAC is our principal activity at present and our primary focus is on the cultivation of Tridacna gigas, the largest of the seven species of giant clams. Other projects in a developmental stage concern reef ranching and work in fish stock assessment.

ICLARM's usual mode of operation is to seek its own funding from international agencies for specific projects or for core support of its activities. In particular, we do not expect access to bilateral aid funds, except if this is specifically offered by a government. For example, funds for our activities in Solomon Islands have been raised internationally and we have not at any time asked the Government of Solomon Islands for financial contributions to our work. Nevertheless, all of our work is always done in collaboration with a host country institution. We are, of course, always willing to participate and collaborate in international, multiagency projects.

In the context of Kiribati, we are now in a position to offer assistance in the planning development and operation of a small-scale cost-effective giant clam hatchery, which would be appropriate to the needs of the nation, if that were desired. Previous work by

ICLARM in 1986 showed that large giant clams are now uncommon at Tarawa and relatively sparse in the atolls of the Central Kiribati group. It appeared that the Atoll Research and Development Unit (ADRU) had much of basic facilities required to undertake a simple giant clam research and development project.

ICLARM have specific ideas on how a giant clam hatchery and nursery might be economically developed in an atoll environment, drawing heavily on solar, wind, or tidal power for the operations, and it would be happy to develop these ideas further if invited to do so in the context of the possible Kiribati Atoll Research for Development Project.

2. BACKGROUND TO THE COASTAL AQUACULTURAL CENTRE

The Coastal Aquaculture Centre (CAC) had its origins in 1983, when ICLARM first launched an international giant clam mariculture project, in which research on giant clams was started at a number of collaborating institutions. A particular objective of ICLARM's work was to establish a giantclam hatchery in a representative equatorial island environment, at which the results on current research could be applied to the development of economically-viable farming systems for giant clams, the world's only phototrophic and thus self-feeding potential farm animals.

A suitable site for a giant clam hatchery was identified on the north-west coast of Guadalcanal, in Solomon Islands and, on June 14, 1986, a formal agreement was signed by ICLARM, the Government of Solomon Islands and the Guadalcanal Provincial Government. Construction of the facilities of the CAC started on October 14, 1986 following the registration of the lease on the 5 ha site. ICLARM's South Pacific Regional Office transferred to the CAC in January 1988.

The period under review was highlighted by the official opening of the Centre by the Prime Minister of Solomon Islands, the Hon. Ezikiel Alebua, on April 12, 1988, at a smalll ceremony attended by various Members of Parliament, diplomats, senior civil servants, and representatives of various granting agencies and regional organizations.

3. INFRASTRUCTURE DEVELOPMENT

At the year's end, completed buildings included the hatchery/laboratory, a house for the Hatchery Manager, cottages for the Foreman and Deputy Foreman and three of a planned set of four small chalets. A house for the Director was very near to completion and the fourth chalet will be completed early in 1989. A 12.5kw diesel generator provides general power supplies and two small freshwater pumps supply potable water from a spring which emerges on site.

The basic aquaculture facility consists of one two-inch and one four-inch Yanmar diesel powered pumps, drawing water from the adjacent reef. The sea water then passes through 80mm PVC pressure pipes mounted 2-3m above ground to a variety of circular fibreglass (4), vinyl (4) and ferro-cement (5) tanks, used for broodstock holding and spawning, larval culture and settlement of spat constructed for use as giant clam nurseries. The raceways are simple troughs constructed of 5.6m of "Canvacon" fabric fitted between four sections of coconut logs on a sandy base to give a tank of 5.0 x 1.0 x 0.3m. The tanks are very inexpensive to construct.

The hatchery/laboratory building was occupied at the start of the year. The upper floor consists of 53m^2 of general office space and a 12m^2 of veranda/conference area. Airconditioned space includes a small (7.3 m^2) computer room and scientific laboratory (9.7 m^2), with a 4.9m^2 annex intended in the longer term for larval culture work. The laboratory and computer room have 1.5kw power conditioners to ensure stable voltages for electronic equipment. The wet laboratory is on the ground floor of the laboratory/office building, has sea water reticulation, two 1.6m^3 fibreglass larval culture tanks, aquaria and wet benches.

A modest array of scientific and technical equipment had been assembled from various sources, including a significant component loaned to the giant clam project by out collarobators, Solomon Islands Fisheries Division derived from Japanese bilateral grants.

4. SCIENTIFIC RESEARCH

Work on giant clam cultivation has proceeded in parallel with the construction of the facilities and by the end of July 1987 a total of 35 broodstock of the largest species of giant clam, Tridacha gigas, had been collected and transported to the CAC. The first spawnings of giant clams occurred on November 3, 1987, less than a year after acquisition of the site. By the end of 1988, spat originating from clam spawnings in January, March, June, July and October 1988 were being raised in the tank and raceway complex and cohorts of clams spawned in November 1988, had been transferred to ocean nurseries on the CAC's exclusive reef leaseholding. In October a batch of 200 giant clam juveniles were transferred to the first village-operated ocean nursery at Ghulavu Village on the west coast of Guadalcanal.

While most efforts were focused on completing the facilities of the CAC, a number of comparative experiments were set up in the raceways to test the effects on stocking densities and the addition of fertilizers on growth and survival rates. The use of different grazers to control algal growth and the use of different substrata for attachment of spat have been studied. Analyses were made of the effects of clumping of spat upon their growth rates.

The addition of horticultural fertilizers had a marked positive effect on the growth of spat while high stocking densities inhibited growth, suggesting that the availability of nutrients could be a limiting factor. The correct combination of stocking densities and fetilizer dosage will clearly optimize output from the system.

The Mozambique Tilapia, Oreochromis mossambicus, has proven particularly useful for containing algal overgrowths in tanks, the ready availability of fry being a major factor. They adapt readily to sea water.

Serotonin was frequently used as a spawning stimulus and reliably resulted in sperm production, and less often in egg production. Several spawnings were spontaneous and appeared to be synchronized between tanks and between broodstock in the sea. Whether the stimulus is a water-borne chemical or is controlled by ambient conditions such as light is not yet clear.

Part of the first cohort of giant clams, spawned on November 6-7, 1987, and averaging about 2 cm in length were stocked into the ocean nurseries at the end of June. The nurseries are small wire mesh cages with cement bases intended for emplacement at a depth of 2-3 m on the CAC"s fringing reef. Additionally, construction was started on a large intertidal pond which will be used as a nursey area.

By the end of the year approximately 12,500 3-13 month old Tridacna gigas spat were in the ocean nurseries and a further 30,000-40,000 spat (<15 mm shell length) in the land based-nurseries and raceways.

5. INTERREGIONAL LINKAGES

During 1988, ICLARM"s new Coastal Aquaculture Network (CAN) was formally created. The first step was to absorb the existing membership of the International Giant Clam Mariculture Project into the new Network and rename it the "Giant Clam Research Group". This has thirteen institutional members and the mailing list for "Clamlines" the Group's newsletter, now includes over 100 individuals. Two issues of the newsletter were published during the year.

The CAN has a small pool of funds to finance visits to participating institutions to do collaborative research on topics of prime interest. The first recipient of support within the Giant Clam Research Group was Mr Paul Southgate of James Cook University who spent two months at the CAC to test the utility of micro-encapsulated foods for the rearing of giant clam larvae.

6. TRAINING

There is a shortage of aquaculture and fisheries scientists in the South Pacific Region and one of the most effective methods for attaining research instruction is to employ young graduates as Research Assistants on the understanding that a part of their research will form the body of a higher degree thesis. This provides an opportunity for gainful employment while at the same time fulfilling higher degree aspirations.

Appropriate arrangements have therefore been made with the University of the South Pacific for the CAC to offer supervision in research methods to candidates for higher degrees of that university.

At the local level the Centre has already attracted considerable interest from schools and several groups of secondary and high school students have visited the CAC. It is expected that field trips to the Centre will become a regular feature of the curriculum of Honiara schools.

7. PROGRAMME PLANS FOR 1989

With the major portion of the first phase of building construction completed, the main thrust of the work at the Coastal Aquaculture Centre in 1989 will be directed toward increasing the overall output of giant clams (particularly Tridacna gigas) from the hatchery and nursery systems and on expanding the ocean nurseries.

Emphasis will be placed on improving the reliability of spawning induction and on methods for more accurately judging the maturity of giant clams. Larval rearing methods have been successful in producing extremely large numbers of pediveligers and newly-settled spat, but improvements in survival during the land-based post-settlement stage are needed. Irregular and largely inexplicable mortalities reduced the output of spat during 1988.

The ocean nurseries have been highly successful to date in that both survival and growth rates in the ocean nursery cages have been excellent. The current style of cages are relatively robust and inexpensive but improved designs will nevertheless be sought. A large ($75m^2$) intertidal nursery pond will be completed early in 1989 and stocked with juveniles. If successful the pond will substantially increase the ease with which clams can be raised through the ocean nursery stages. In addition to the ocean nurseries operated at the CAC, the number of village-operated giant clam nurseries will be substantially increased and will be sited in many of the different habitats available in Solomon Islands.

A project, funded by the U.K. Overseas Development Administration (ODA), will be started on giant clam product

development and marketing. Consultants from the Overseas Development Natural Resources Institute (NRI) will be used for the drying, storage and marketing aspects. The work will be directed towards the production of acceptable dried adductor muscle for sale as "kaibashira", and the freezing, storage and preparation of clam mantle meat and muscle. Development of various items made from clam shells will also be investigated.

A "Manual of methods for the cultivation of Giant Clams" will be prepared and published during the year and economic analyses will be made of the comparative costs of hatchery and nursery operations.

A visitors information bureau will be constructed near the main entrance to the site. This will have a small aquarium, display tanks, poster presentations of information about ICLARM, coastal aquaculture in general and giant clam cultivation in particular.

Some preliminary work is planned on the potentialities for coral reef fish ranching. This is expected to concentrate initially on making an inventory of species of potential interest and studies of their relative range of movement.

The Coastal Aquaculture Network (CAN) will be expanded and consideration will be given to the formation of additional research groups and the formation of linkages with other institutions concerned with tropical marine aquaculture.

8. MEETINGS ATTENDED - PAPERS PRESENTED

8.1 South Pacific Commission Workshop on Inshore Fishery Resources, Noumea, New Caledonia, 13-25 March, (J.L. Munro, H. Govan)

Paper presented:

Munro, J.L. Status of giant clam stocks in the Central Gilbert Islands group, Republic of Kiribati.

8.2 Australian Centre for International Agricultural Research (ACIAR)/James Cook University Workshop on the Biology and Culture of Giant Clams,Townsville, Australia. 18-22 April. (J.L. Munro, G.F. Usher)

Papers presented:

Govan, H. Experience in sea transport of Tridacna gigas broodstock.

Govan, H., P.V. Nichols and H. Tafea. Giant clam resource investigations in Solomon Islands.

Munro, J.L. Growth, mortality and potential aquaculture production in Tridacna gigas and T. derasa.

Usher, G.F. and J.L. Munro. ICLARM Coastal Aquaculture Centre: Current facilities and progress.

8.3 Sixth International Coral Reef Symposium, Townsville, Australia. 8-13 August. (J.L. Munro)

9. PUBLICATIONS AND CONSULTANCY REPORTS

Govan, H. Experiences in sea transport of Tridacna gigas broodstock. In: J. Copland and J.S. Lucas (eds.), Proceedings of a workshop on the biology and culture of giant clams. Australian Centre for International Agricultural Research, Canberra, pp. 173-175.

Govan, H., P.V. Nichols and H. Tafea. Giant clam resource investigations in Solomon Islands. In: J. Copland and J.S. Lucas (eds.), Proceedings of a workshop on the biology and culture of giant clams. Australian Centre for International Agricultural Research, Canberra. pp. 54-57.

Munro, J.L. Growth, mortality and potential aquaculture production inTridacna gigas and T. derasa. In: J. Copland and J.S. Lucas (eds.), Proceedings of a workshop on the biology and culture of giant clams. Australian Centre for

International Agricultural Research, Canberra. pp. 218-220.

Usher, G.F. and J.L. Munro. ICLARM Coastal Aquaculture Centre: Current facilities and progress. In: J. Copland and J.S. Lucas (eds.). Proceedings of a workshop on the biology and culture of giant clams. Australian Centre for International Agricultural Research, Canberra. pp. 54-57.

10. STAFF

10.1 Scientific and Technical Staff

Professional and technical staff who served at the Centre during the year were as follows:

Dr John L. Munro. Senior Scientist and Director (South Pacific).

Mr Graham F. Usher. Research Associate/Hatchery Manager (Technical Cooperation Officer of the U.K. Overseas Development Administration, seconded to ICLARM).

Mr Mark H. Gervis, Research Associate (Assistant Professional Officer of the U.K. Overseas Development Administration, seconded to ICLARM since September 1988)

Mr Hugh Govan, Scientific Assistant (sponsored by U.K. Voluntary Service Overseas).

Ms Cathreena M.T. Gervis, Scientific Assistant. (Appointed October 14, 1988)

Mr Hugo Tafea, Fisheries Officer of Solomon Islands Department of Fisheries. (Assigned to the CAC since January 1988).

Mrs Julie Topping, Administrative Assistant/Secretary (Appointed February 29, 1988).

10.2 Support Staff

At December 31, 1988 the CAC employed a total of ten locally-recruited support staff, all residents of the nearby village of Horabau. viz.

Mr John Suli, Foreman/Caretaker

Mr Benson Kalea, Deputy Foreman/Caretaker

Mr Jack Kola, General Laborer

Mr Alfred Lau, General Laborer

Mr Timothy Line, General Laborer

Mr George Lionel, General Laborer

Mr Texlee Meve, General Laborer

Mr Ngara, General Laborer

Mr Maxwell Sau, General Laborer

Ms Julia Kakau, Cleaner

During the course of the year Mr Augustino Folibuana, Driver and Mr Elijah Inuri, General Laborer resigned. Numerous temporary builders' laborers and artisans were also employed on construction work.

Appendix IV. Proposed activities of the Pacific Islands Marine Resources Information System (PIMRIS).

PIMRIS

A regional information system for fisheries and marine resources is being developed by the Forum Fisheries Agency in Honiara, the University of the South Pacific in Suva, and the South Pacific Commission in Noumea. The system is designed to serve the information needs of the twenty-two island member countries of the SPC region; government officers; staff of regional organizations with interest in marine activities, research and training. The system will also include the resources and services of the information system on marine geology and non-living resources being developed by CCOP/SOPAC, Suva. In the first phase and throughout its operations, PIMRIS regional organizations will act as clearing houses for member countries. In the second phase, or year two of the programme, it is hoped to begin development of selected PIMRIS national focal points.

The regional information system, PIMRIS, will be composed of a regional co-ordinating centre, regional focal points or regional organizations active in marine resources development, and national focal points which will form the link to the regional co-ordinating centre. The national focal points will be the fisheries departments. This will ensure effective exchange and participation in terms of input and output and use of services. The resulting co-operation will be mutually beneficial to users of PIMRIS at all levels and help to:

1. establish a regional bibliographic (and possibly text) data base for fisheries and marine resources, PIMRIS;

2. produce a series of publications to include: general and specialised bibliographies, a bi-monthly newsletter, and brochures;

3. provide basic information services to include:

    a) Current Awareness Service - abstracting current journal articles and monographs of interest to marine resource

researchers and distribution on a regular basis,

b) Table of Contents Service - copying the table of contents from current periodicals and distribution on a regular basis,

c) Bibliographic Searches - provide searches of online bibliographic databases on specific research topics, as well as, selective dissemination of new entries to online databases on a regular basis,

d) Copying - copying of journal articles and portions of monographs upon request;

4. assist national fisheries departments in acquiring basic trade journals and documents on fisheries and marine resources;

5. provide professional advice and training for national fisheries departments in establishing and organizing a collection;

6. train a regional librarian and regional library assistants.