Annexes A-I

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VOLUME 1

! US Government Classification

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REPORT

of the

ASEAN WORKSHOP

on

WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME

3rd – 7th SEPTEMBER, 1979

KUALA LUMPUR

MALAYSIA

PN AAM 693

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LETTER OF TRANSMITTAL

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

LETTER OF TRANSMITTAL

Kuala Lumpur, 7 September 1979.

Sir,

We have the honour to transmit herewith the Report of the ASEAN Workshop on Watershed Conservation and Management Research Programme held in Kuala Lumpur (Genting Highlands) Malaysia on 3-7 September, 1979 for your kind consideration.

Accept, Sir, the assurances of our highest consideration.

IR. SOERJONO
Leader of the Indonesian Delegation

MR. MOHD. DARUS HJ. MAHMUD
Deputy Leader of the Malaysian Delegation

MR. EDUARDO ELAPITAN
Leader of the Philippine Delegation

MR. KOMON PRAGTONG
Leader of the Thai Delegation

Chairman,
Sub-Committee on Forestry,
Committee on Food, Agriculture and Forestry
of ASEAN Economic Ministers,
MANILA, PHILIPPINES.

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REPORT OF THE ASEAN WORKSHOP

ON WATERSHED CONSERVATION

AND MANAGEMENT RESEARCH PROGRAMME

3 - 7 SEPTEMBER 1979

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

REPORT

INTRODUCTION

1. The ASEAN Workshop on Watershed Conservation and Management Research Programme was held in Genting Highlands, Malaysia on 3-7 September, 1979 pursuant to the Memorandum of Understanding on ASEAN Agricultural Projects signed on April 25, 1979 by the Philippines on behalf of ASEAN, and the United States.

2. In accordance with the Memorandum, the United States Government agreed to allocate a grant of US$39,205 under the ASEAN-US Development Cooperation Programme for the conduct of a project design workshop in Malaysia to enable joint participation in the planning and implementation of the regional project proposal for the ASEAN Watershed Conservation and Management Research Project which was endorsed by the Third Meeting of the Committee on Food, Agriculture and Forestry in April, 1978.

3. The objectives of the Workshop were:

(a) To review ongoing or planned activities related to the proposed Project;

(b) To assess existing institutional and infrastructural facilities and their potential contribution to the proposed Project;

(c) To identify a time-phased programme of activities, estimate of resources and organisational structure required to implement the proposed Project; and

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(d) To finalise the Project design and proposals for submission to the U.S.

4. The Workshop was organised by the Forestry Department, Peninsular Malaysia with the cooperation of various agencies concerned with watershed conservation and management.

5. The Workshop was attended by 25 delegates and 18 observers from Indonesia, the Philippines, Thailand and Malaysia. The lists of delegates and observers are given in Annexes A and B respectively.

6. A total of 14 Country Reports, Technical and Information Papers were presented for information and discussion. The full list of documents is given in Annex C.

OPENING CEREMONY

7. Mr. Muhammad Jabil, Director General of Forestry, Peninsular Malaysia, welcomed the delegates and observers. He emphasized the need to conserve watersheds and expressed his appreciation of U.S. funding which made the Workshop possible. His welcome address is given in Annex D.

8. The Opening Address of the Honourable Datuk Arshad Ayub, Secretary General, Ministry of Agriculture, and concurrently Chairman of Malaysian National Committee on Food, Agriculture and Forestry, was read by Mr. Muhammad Jabil. The text of his Opening Address is given in Annex E.

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9. In his Opening Address, Datuk Arshad stressed the importance of watershed conservation and management based on sound guidelines developed from systematic research. He appealed to the delegates to be objective and pragmatic, despite differences of opinion and priorities, considering the tremendous scope for co-operation in this matter and the enormous benefits which would accrue.

CLOSE SESSION

Election

10. Mr. Muhammad Jabil, the leader of the Malaysian delegation, and Mr. Eduardo Llapitan, the leader of the Philippine delegation, were elected as Chairman and Vice-Chairman respectively.

Business Arrangements

11. The delegates agreed unanimously to meet in plenary.

12. A Drafting Committee was constituted to prepare the project proposal for the ASEAN Watershed Conservation and Management Research Programme as well as the report of the Workshop. The Committee was chaired by Mr. Mok Sian Tuan of Malaysia and comprised the following representatives from the ASEAN countries present:

Drs. Mursidin	-	Indonesia
Dr. S.P. Saplaco	-	Philippines
Mr. Sittichai Ungphakorn	-	Thailand
Mr. Tang Hon Tat	-	Malaysia

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SESSION I - COUNTRY REPORTS

Indonesia

13. The Indonesian delegation reported that the natural resources of the country are being depleted rapidly and water management and land preservation have been hampered as a result of the urgent need of land for cultivation. An estimated 20 million ha. of deforested land is unproductive and thus a major source of soil erosion. Consequently, the Government has given top priority to rehabilitate these areas through reforestation and afforestation. Indonesia would like to propose the creation of a Development Centre for Watershed Management in the Asean region on an extended and integrated basis to complement the existing centre in Solo. The full report is given as Annex F.

Philippines

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14. The Philippine delegation reported that the country's watersheds occupy 70% of the total land area. These watersheds supply the major water needs for agriculture, hydro-electric power, domestic and industrial water and also promote the country's socio-economic development. It was reported that abusive land use practices on the watersheds and other interrelated technical, institutional, social and economic constraints which hamper the optimal and beneficial use of watershed resources have warranted the Philippine Government to undertake responsive, rational and scientific management strategies geared towards optimal and beneficial use of watershed resources in the country. The full report is given as Annex G.

Thailand

15. The Thai delegation reported that watershed deterioration occurs in Northern Thailand because of shifting cultivation. Thailand has initiated a watershed improvement programme and is undertaking rehabilitation of devastated watersheds. An integrated approach is adopted in watershed research which encompasses also social, economic and environmental improvement programmes. The full report is given in Annex H.

Malaysia

16. The Malaysian delegation reported that forests still occupy 68% of the total land area but are being depleted at an alarming rate, especially in the lowland, as a result of land conversion. Accelerated forest exploitation and land development in line with the Government's socio-economic development policies have produced adverse environmental impacts which necessitated the initiation of appropriate research in watershed conservation and management. As conditions and problems in watershed conservation and management are similar in the ASEAN countries, Malaysia was confident that closer regional cooperation would materialise with the implementation of the proposed Programme. The full report is given in Annex I.

SESSION II - TECHNICAL PAPERS

Watershed Conservation and Management Research Programme in the Philippines

17. The Philippine delegation reported that over 5 million ha. of watersheds have become both unproductive and unstable ecosystems due to encroachments. The destruction of watersheds gave rise to soil erosion, flooding and related hydro-physical deterioration. Consequently, steps were currently being undertaken to check such further degradation of watersheds through integration and coordination of research and upgrading research capabilities of both personnel and institutions such as the University of Philippines and the Forest Research Institute.

18. The Philippine delegation reported that coordinated research in watershed resources management was formalised in 1972. Ongoing research programmes include the following:

1. Upland Hydro-ecology Research Program;
2. Hydrology of an Upland Farm;
3. Hydrometeorological Characterization of Upland Ecosystems at Mt. Makiling;
4. Forest Hydrology;
5. Plant Selection for Soil Erosion Control;
6. Grassland Uses Effects on Soil and Water Losses;
7. Upland Vegetation Management;
8. Socio-economic Assessment of Upland Cultivation (Kaingin) Management Schemes; and

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9. Effects of Different Crop Covers on Surface Runoff and Soil Erosion.

19. In view of the common characteristics of ASEAN watersheds, the Philippines delegation proposed the following for consideration:-

1. Center for Upland Watershed Management for the ASEAN Region (CUWMAR);
2. Integrated Upland Development and Research Project;
3. Hydrologic Influences of Various Vegetation and Land-Use Manipulations, Rehabilitation and Development Measures on ASEAN Upland Watersheds.
4. Social, Technical and Institutional Profile of Upland Watershed Conservation and Management in ASEAN region.

20. The Philippine paper is given as Annex J.

Malaysian Proposals for the ASEAN Watershed Conservation and Management Research Programme

21. The Malaysian delegation stated that with increasing demand for arable land under the country's agro-based socio-economic development policies, forest resources will eventually be confined to the watersheds. These watersheds will not only have to be the source of future timber supplies but are also critical for soil and

water conservation. It is thus imperative that sound guidelines and appropriate technology are applied in the management and utilisation of the natural resources in these watersheds.

22. Malaysia was of the opinion that knowledge and expertise necessary for sound watershed conservation and management are inadequate. Consequently, Malaysia has initiated a comprehensive, integrated multi-disciplinary research strategy and programmes for watershed research which will eventually cover the three broad types of watersheds encountered in the country, namely, forested, cultivated and devastated. The two major ongoing programmes are the National Programme for Representative and Experimental Basins and the Forest Hydrology Research Programme.

23. Under the proposed ASEAN Watershed Conservation and Management Research Programme, Malaysia hoped to be able to expand its ongoing programmes, particularly in respect of experimental watersheds and with emphasis on ascertaining the impact of human activities on forested watersheds on soil, water and various other parameters. The Malaysian proposals are:-

1. Proposed Studies on Forest Management and Development in a Watershed.
2. Proposed Studies on Conservation and Management of Water Resources.
3. Proposed Studies on Soil Erosion and Conservation in a Watershed.
4. Proposed Studies on the Effects of Landuse Changes on Soil Fertility.

5. Proposed Monitoring of Meteorological Parameters and Studies of Climatic Variations in a Watershed.

24. The Philippines and Malaysian proposals, particularly the proposal for the establishment of a centre, were discussed in great detail and at length. The Workshop finally agreed that the Programme to be submitted for U.S. consideration should incorporate the following components:-

1. A regional coordinating centre in one of the ASEAN member countries and country centres in others;

2. Relevant and appropriate research projects based on the Philippines and Malaysian proposals, in forested, cultivated and devastated watersheds; and

3. Social, environmental and human aspects.

25. Based on the above considerations, the Workshop agreed to recommend that

Recommendation 1

The proposed ASEAN Watershed Conservation and Management Research Programme to be submitted for U.S. consideration under the ASEAN-U.S. Development Cooperation Programme [illegible] four projects:

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Project No. 1	ASEAN Centre for Watershed Management and Development.
Project No. 2	Integrated Research Studies On the Management of Forested Watersheds.
Project No. 3	Integrated Research Studies on the Development of Non-Forested Watersheds.
Project No. 4	Integrated Studies on the Social, Economic and Institutional Profile of Watershed Conservation, Management and Development.

Detailed proposals are given in Annex I.

16. The Workshop agreed that the planning and implementation of the Programme should be coordinated by a Programme Steering Committee as decided at the Fifth Meeting of the Committee of Food, Agriculture and Forestry and recommended that

Recommendation 2

The first chairman of the Programme Steering Committee shall be Malaysia.
Malaysia

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27. The Workshop took note of the location of the Agricultural Development Planning Centre and Plant Protection Program in Thailand and the Philippines respectively and recommended that

Recommendation 3

The ASEAN Centre for Watershed Management and Development shall be located in Malaysia and country centres in other ASEAN member countries.

OTHER MATTERS

U.S. Department of Agriculture Resource Speakers

28. The Workshop noted the absence of the two U.S. Department of Agriculture resource speakers considered by the Fifth Meeting of the ASEAN Committee on Food, Agriculture and Forestry.

JOINT PRESS RELEASE

29. A joint press release outlining the deliberations and achievements of the Workshop and recommendations adopted was issued after the successful conclusion of the Workshop. The full text of the joint press release appears in Annex M.

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CONSIDERATION AND ADOPTION OF THE REPORT OF THE ASEAN WORKSHOP ON WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME

30. The Report of the ASEAN Workshop on Watershed Conservation and Management Research Programme held in Genting Highlands on 3-7 September, 1979 was adopted by the delegates.

ACKNOWLEDGEMENT

31. The delegates expressed their appreciation to the Government and people of Malaysia for their warm hospitality, the excellent facilities provided and efficient arrangements made for the Workshop and also to the United States Government for providing the necessary funds for the Workshop.

32. The Workshop was held in the traditional spirit of ASEAN cordiality and solidarity.

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ANNEX A

LIST OF DELEGATES

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LIST OF DELEGATES

INDONESIA

1. Ir. Soerjono, — Leader
   Director, Forest Research Institute,
   Bogor.

2. Ir. Djumra — Member
   Deputy Director of Reforestation & Rehabilitation,
   Directorate General of Forestry,
   Jakarta.

3. Ir. Engkah Sutadipraja — Member
   Chief, Soil Conservation Section,
   Directorate General of Forestry,
   Bogor.

4. Drs. Mursidin — Member
   Project Manager of Watershed Management Development Centre,
   Directorate General of Forestry,
   Solo.

5. Ir. Natigor Siagian — Member
   Senior Official, Bureau of Planning,
   Department of Agriculture,
   Jakarta.

PHILIPPINES

1. Mr. Eduardo Llapitan, — Leader
   Chief, Forest Protection and Infrastructure Division,
   Bureau of Forest Development,
   Manila.

2. Mr. Jose P. Castro, — Member
   Manager, Watershed Management Department,
   National Power Corporation,
   Ministry of Energy,
   Manila.

3. Mr. Benardo Jasmin, Member
Chief, Watershed and Range Research Division,
Forest Research Institute,
College, Laguna.

4. Dr. Severo R. Saplaco, Member
Watershed Management Specialist and Assistant Professor of Watershed Management,
UPLB College of Forestry, College, Laguna

5. Mr. Julius Jose, Member
ASEAN Co-ordinator,
Ministry of Foreign Affairs,
Padre Faura, Manila.

THAILAND

1. Mr. Komon Pragtong, Leader
Chief, Survey and Planning Section,
Royal Forest Department,
Bangkok.

2. Mr. Bhadharajaya Rajani, Member
Chief, Watershed Engineering Section,
Royal Forest Department,
Bangkok.

3. Mr. Sathit Sawintara, Member
Chief, Plantation and Improvement Section,
Royal Forest Department,
Bangkok.

4. Mr. Anant Hoodakorn, Member
Technical Forest Officer,
Royal Forest Department,
Bangkok.

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5. Mr. Sittichai Ungphakorn, Member
Chief, Watershed Survey and Planning Section,
Royal Forest Department,
Nonthaburi Provice.

MALAYSIA

1. Mr. Muhammad Jabil Leader
Director General of Forestry,
Forestry Department,
Peninsular Malaysia.

2. Mr. Mohd. Darus Hj. Mahmud, Alternate
Deputy Director General of Forestry,
Forestry Department,
Peninsular Malaysia.

3. Dr. Salleh Mohd. Nor, Member
Director, Forest Research Institute,
Forestry Department,
Peninsular Malaysia.

4. Mr. Mok Sian Tuan, Member
Director of Forest Management,
Forestry Department,
Peninsular Malaysia.

5. Mr. Tang Hon Tat, Member
Silviculturist, Forest Research Institute,
Forest Department,
Peninsular Malaysia.

6. Mr. I.H. Sario, Member
Forest Management Officer,
Forestry Department,
Sabah.

7. Dr. Low Kwai Sim, Member
Associate Professor, Geography Department,
University of Malaya,
Kuala Lumpur.

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8. Mr. Tan Kok Yeang, Member
Assistant General Manager,
FELDA Agricultural Services Corporation,
Kuala Lumpur.

9. Mr. Chung Sun Fatt, Member
Engineer,
Drainage and Irrigation Department,
Kuala Lumpur.

10. Mr. Tung Nam Ping, Member
Meteorologist,
Malaysian Meteorological Service,
Kuala Lumpur.

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ANNEX B

LIST OF OBSERVERS

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LIST OF OBSERVERS

1. Mr. Cheah Leong Chiew,
   Director of Silviculture,
   Forestry Department Headquarters,
   Kuala Lumpur.

2. Miss Ang Chai Hoon,
   Forest Engineer,
   Forestry Department Headquarters,
   Kuala Lumpur.

3. Mr. Tee Choon Hwa,
   Logging Engineer,
   Forestry Department Headquarters,
   Kuala Lumpur.

4. Mr. Abdul Rahmid Kidam,
   Forest Hydrologist,
   Forestry Research Institute,
   Kepong, Selangor.

5. Mr. Garry J. Blake,
   Hydrological Adviser,
   Forest Research Institute,
   Kepong, Selangor.

6. Mr. M.P. Udarbe,
   Senior Research Officer,
   Forest Department,
   Sabah.

7. Mr. Syed Sofi Omar,
   Agronomist,
   FELDA Agricultural Services Corporation,
   Sungei Tekam, Pahang.

8. Mr. Khoo Swee Hoe,
   Higher Executive Officer,
   Ministry of Foreign Affairs,
   Kuala Lumpur.

9. Mr. Hashim Daud,
Environmental Control Officer,
Department of Environment,
Kuala Lumpur.

10. Mr. Lai Cheng Cheong,
Water Supply Controller,
Public Works Department,
Kuala Lumpur.

11. Mr. Jasmi Abdul,
Deputy Director,
Department of Wildlife and National Parks,
Kuala Lumpur.

12. Mr. Hussein Abdul Jamil,
Lecturer,
Forestry Faculty,
University of Agriculture,
Serdang, Selangor.

13. Mr. Nik Muhamad Majid
Lecturer,
Forestry Faculty,
University of Agriculture,
Serdang, Selangor.

14. Mr. Peh Cheng Hock,
Lecturer,
Department of Geography,
University of Malaya.

15. Ir. Djoko Sasongko,
Chief, Survey Section,
Directorate of Rivers,
Jakarta.

16. Ir. S.P. Kuntjoro-Jakti,
Chief, Section of Planning and Programming,
Directorate of Planning and Programming,
Jakarta.

17. Ir. Taslim Amaludin,
Hydrologist,
Directorate Hydraulics Engineering,
Bandung.

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18. Mr. Jorge V. Arizabal,
Philippine Embassy,
Kuala Lumpur.

19. Mr. Mohamad Ali Hasan,
Lecturer,
Department of Geography,
University of Malaya.

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ANNEX C

LIST OF DOCUMENTS

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

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LIST OF DOCUMENTS

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1. Provisional List of Delegates
2. Provisional List of Observers
3. Welcome Address of Mr. Muhammad Jabil, Director General of Forestry, Peninsular Malaysia
4. Opening Address of Datuk Arshad Ayub, Secretary General, Ministry of Agriculture, and Chairman, National COFAF
5. Programme

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1. Malaysian Country Report
2. Proposed Studies in Forest Management and Development in a Watershed. (Malaysian Technical Paper No. 1)
3. Proposed Studies on Conservation and Management of Water Resources. (Malaysian Technical Paper No. 2)
4. Proposed Studies in Soil Erosion and Conservation in a Watershed. (Malaysian Technical Paper No. 3)
5. Proposed Studies on the Effects of Landuse Changes on Soil Fertility. (Malaysian Technical Paper No. 4)
6. Proposed Monitoring of Meteorological Parameters and Studies of Climatic Variations in a Watershed. (Malaysian Technical Paper No. 5)
7. Forest Hydrology Studies at Jengka and Bukit Berembun Hill Forests. (Malaysian Information Paper No. 1)
8. Sungai Tekam Experimental Basins - A Study of the Effects of Land-use Change on the Denudation and Hydrology of Small Watersheds. (Malaysian Information Paper No. 2)
9. Logging in Watershed Areas of Sabah. (Malaysian Information Paper No. 3)

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10. Country Report - Indonesia
11. Country Report - Republic of the Philippines
12. Country Report - Thailand
13. Watershed Conservation and Management Research Program in the Philippines
14. Malaysian Proposals for the ASEAN Watershed Conservation and Management Research Programme
15. Proposal for an ASEAN Watershed Conservation and Management Research Programme

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ANNEX D

WELCOME ADDRESS OF

MR. MUHAMMAD JABIL

DIRECTOR GENERAL OF FORESTRY

PENINSULAR MALAYSIA

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WELCOME ADDRESS OF
MR. MUHAMMAD JABIL
DIRECTOR GENERAL OF FORESTRY
PENINSULAR MALAYSIA

Distinguished Delegates,
Ladies and Gentlemen,

It is a great pleasure for me and an honour for Malaysia to be entrusted with the organisation of this ASEAN Workshop on Watershed Conservation and Management Research Programme. On behalf of my Government and personally, I would like to bid you a very warm welcome and to thank you for your participation.

This is the first time we are conducting a meeting under the aegis of the Sub-Committee on Forestry (formerly Meeting of ASEAN Forestry Experts) away from Kuala Lumpur. I hope you approve of the choice of venue and have an enjoyable stay here. Please accept our sincere apologies for any inconvenience or shortcoming.

As you are no doubt aware, this Workshop is sponsored by the United States Government under the ASEAN-U.S. Development Cooperation Programme. It is one of the three workshops approved for designing the ASEAN Agricultural Projects which have been accepted for consideration under the Programme. The Workshops on the ASEAN Agricultural Development Planning Centre and the ASEAN

Plant Protection Program have already been held in Thailand on 17-25 May, 1979 and the Philippines on 28 May to 1 June, 1979 respectively. I would like to take this opportunity to thank the United States Government for supporting this Workshop and to appeal to them to consider the proposed ASEAN Watershed Conservation and Management Research Programme favourably.

The ASEAN member countries have many common features, interests and problems. Amongst these are the similarities in forests and watersheds and the socio-economic pressures upon them. The growing pressure on the forests in watersheds for production of timber and for agricultural development has given rise to detrimental environmental, social and economic impacts. The urgent need to conserve the critical watersheds cannot be over-emphasized but to do so effectively and successfully, it is imperative that more information must be generated and more expertise acquired in the field of watershed conservation and management. Only then will we be in a position to formulate and apply the appropriate technology to optimise the management and utilisation of the valuable natural resources in the watersheds. This Workshop is obviously a step in the right direction and I sincerely hope that it will be the beginning of fruitful cooperation in this field amongst the ASEAN member countries.

This Workshop was to have been declared officially open by the Honourable Datuk Arshad Ayub, Chairman of the National COFAF and Secretary General of the Ministry of Agriculture,

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who unfortunately is not able to be with us because of other commitments. He has requested me to deliver his opening address on his behalf and to declare this Workshop officially open. He has also requested me to convey to you his sincere apologies and best wishes.

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ANNEX E

OFFICIAL OPENING ADDRESS OF

DATUK ARSHAD AYUB

CHAIRMAN, NATIONAL COFAF AND

SECRETARY GENERAL, MINISTRY OF AGRICULTURE

ASEAN 79/COFAF.WW/Inf. 4

OFFICIAL OPENING ADDRESS OF
THE HONOURABLE DATUK ARSHAD AYUB,
CHAIRMAN, NATIONAL COMMITTEE ON FOOD,
AGRICULTURE AND FORESTRY, AND
SECRETARY GENERAL, MINISTRY OF AGRICULTURE

Distinguished Delegates,

Ladies and Gentlemen,

It is indeed a privilege and a pleasure for me to be able to officiate at the official opening of this ASEAN Workshop on Watershed Conservation and Management Research Programme. First of all, I would like to take the opportunity of expressing a warm welcome to all our ASEAN friends who may find this environment rather cool in many ways compared to their home towns.

2. On the other hand, I am sure you will agree with me that the choice of venue for this Workshop is most appropriate as this whole resort sits on top of a watershed and provides a panoramic view of other watersheds and water catchments all around. The manner in which this resort is being developed and its impact on the watersheds may even be a relevant subject for fruitful discussion.

3. I have been informed that throughout the ASEAN region, increasing pressure on arable land for agricultural development and human settlement has rapidly depleted the valuable forest resources of the lowland in the respective countries. Although the process has

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turned the ASEAN region into the most important source of tropical hardwoods for the world market and contributed significantly to foreign exchange earnings for the countries concerned, it will ultimately force the ASEAN countries to practise forestry and even agriculture in the hilly and mountainous areas which are essentially watersheds with vital conservation functions.

4. The unwise use of hilly and mountainous watersheds is fraught with undesirable consequences and even disaster as many countries have learnt to their regret. Logging or cultivation of such hilly areas will inevitably increase soil erosion and run-off and lead to siltation of water courses, floods and other deleterious downstream effects. Such detrimental impacts on the environment are becoming increasingly evident in Malaysia and I am sure are equally common in other ASEAN countries.

5. As the economies of the ASEAN countries are basically agricultural in nature and because of the critical interdependence between the forest, water and soil resources, it is imperative that the overall management and utilisation of forest land do not adversely affect or impair the quality and availability of the other resources. Unfortunately, there is today inadequate knowledge and experience on the long-term effects of logging and cultivation of hill land on the environment, especially on soil and water resources in tropical countries. There is, therefore, an urgent and critical need to appraise

the situation, to draw up and implement a comprehensive research and development programme, and to formulate sound guidelines for the conservation and management of all critical watersheds.

6. The ASEAN countries have a common natural resources heritage. The forests have similar characteristics, because of the close geographical proximity of the ASEAN countries, and are usually referred to collectively as the Tropical Rainforests. Another common feature is that all ASEAN countries are aggressively developing agro-based industries which involve the conversion of forest land to agricultural crops and settlements. Such developments will have an important effect on the soil and water balance but they will also require sustained and adequate supplies of these resources. Consequently, a watershed conservation and management research programme offers tremendous scope for regional co-operation and will undoubtedly be of immense benefit to the ASEAN countries.

7. I understand that the ASEAN Committee on Food, Agriculture and Forestry has accepted Malaysia's proposal for a regional Watershed Conservation and Management Research Programme. The proposal has also been endorsed by the ASEAN Economic Ministers and has been received favourably by the United States under the ASEAN-U.S. Cooperation Programme. I have been informed that the United States of America have built up abundant expertise in watershed conservation and management and their interest in funding this Workshop is a reflection of their keen desire to transfer the appropriate technology they have developed

to the ASEAN countries. In this respect, I feel that the United States deserve our grateful thanks, which must go on proper records.

8. In this Workshop, I understand you will be reviewing the situation in the respective ASEAN countries and sharing your experiences and knowledge on watershed conservation and management. I see that you also hope to come to a common understanding and to agree on priorities in order to present an integrated and effective research and development programme proposal for the consideration of the United States. Such an approach is truly in the traditional spirit of ASEAN friendship and cordiality and augurs well for the future of the region. I am confident that this spirit will ensure harmonious and fruitful discussion in spite of possible differences of opinion and priorities.

9. As you have a heavy and serious agenda ahead of you, I shall not prolong my opening remarks any further except to wish you all success in your deliberations and a happy and enjoyable stay here. On this note, I declare the ASEAN Workshop on Watershed Conservation and Management Research Programme officially open.

Thank you.

Ministry of Agriculture,
Jalan Swettenham,
Kuala Lumpur.

September 3, 1979.

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

COUNTRY REPORT

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"F"

INDONESIA

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

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COUNTRY PAPER

SEMINAR "WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME"

IN KUALA LUMPUR

3 - 7 SEPTEMBER 1979

REHABILITATION EFFORT THROUGH WATERSHED APPROACH

INDONESIA, 1979.

REHABILITATION EFFORT THROUGH WATERSHED APPROACH.

Summary

The natural resources iz. forest, land and water are a prominent subject in Indonesia.

The uneven density of population, the rush population increase, have resulted an urgent need for land for cultivation. The natural resources are threatened and also water management and land preservation are endangered.

Aware of those condition the government has taken some efforts viz. Reforestation and Afforestation activities besides other activities such as transmigration and family planning. Especially as concern with the Reforestation and Afforestation implementation, an approching attitudes of Watershed Management has been applied. The approaching attitude is complemented through establishing basic principles concerning land, and water management preservation, beside considering also of how to increase the potency of land product. At this point, experiments in small scale have been also performed where futher experiments for a rather larger scale will be conducted later on.

At present the experiments has reached the moderate scale and implementation is being carried out on the feasibility study for the implementation in a large scale.
To approach the watershed management activities, an integrated actions with different instances dealing with watershed management have been performed through Development Centre for Watershed Management Project.

Development Centre for Watershed Management is an integrated system for the solving overlapped problems and it is an inter-supported agencies in managing watersheds.

Previous experiences can be improved after refering to the experiences of other countries especially Asean countries.

Therefore mutual cooperation is urgent needed through exchange of information or through establishing pilot projects.

INTRODUCTION

The increasing of population becomes also the increasing of living requirements such as food, clothes and house materials. In some places the raising of population has resulted devastation and damages to natural resources especially regarding forest, land and water.

From the data damages of natural resources in Indonesia is abvious that the devastation situation becomes worst from day after day, due to the fact that the greatest part of the people earns their living from agriculture and where it means that the environmental factors and the hydrological condition will also decrease.
In this connection the Indonesian government has taken all steps toward the rehabilitation of devastated land and forest land. One of the development program is the establishing of a Program for Preservation of Forest, Land and Water.

From time to time the efforts to rehabilitate bare lands and/or critical lands through reforestation for forest land and afforestation for land outside forest areas, have been raised either its physical activities volume or concerning the budget. There are surely occur hampering problems to be solved. A crash program in rehabilitation critical lands should be followed by the increasing the land product capabilities in order to create a suitable condition of environment and also improve the hydro-crological situation. This will also mean the improvement of the supporting capacities as well as the increasing of the farmers income. For that target an integrated exertion on watershed units has been exerted, which is actually to conduct an integrated effort in maintaining and utilizing the natural resources intensively with considering the methods on land preservation, forest vegetation and the water management in order that the balance between the natural resources as the object and the people as the subject can be managed accordingly.

To utilize land capabilities should be followed by an intensification means.

To reach the goal of managing watershed integratelly, several action has been performed e.a. through the trial of designs, methods and criterias in a small scale, where will be followed by surveys for its adaptation in greater scale.

In this article will be described briefly about land preservation efforts, water management maintanance and also about the development of land capabilities.

1. The extent, climate and the inhabitants

Indonesia occupies 1,9 million sq. km, consists of ca. 13.000 islets and islands, spread from West to East about 5.000 km, from North to South about 2.000 km, situates at equatorial region. Some big islands are found e.a. Kalimantan, Sumatera, Sulawesi, West Irian (Irian Jaya) and Java - Madura.

Generally Indonesia has a tropical climate with a high rain fall (about 2.000 mm/year), temperate wind, average daily temperature is 30° C, and high humidity (more than 80%).

In 1978 Indonesia was estimated to have 141 million inhabitants with an annual increasing of 2%, 63% of the whole inhabitants live in Java and Madura, where these two islands are about 6,9% of the whole ground of Indonesia. Most of the people earns their living from agriculture (ca. 65%). Due to the uneven density of the inhabitants, the land ownership in Java ranges between 0,3 - 0,7 hectare per family (ca. consists of 5 members). This situation results of shortage of land for agriculture cultivation in Java.

2. <u>The condition of forest, land and water as natural resources.</u>

It was estimated that Indonesia possessed about 20 million hectares (200.000 sq. km) of unproductive land consisted of lalang fields, bare lands which were in critical condition and become the source of erosion. These critical lands will increase every year with 1-2% if no management and protection efforts are taken. Especially in Java and other places outside Java the forested areas as protection agents for the upper river region are beneath the minimum requirements (about 20 % of the area). This will endanger the condition of water management and the environmental situation. Due to the living requirements, the need of land for seasonal agriculture cultivation seems to be urgent or because of the need for fuelwood, the cutting of trees is difficult to be avoided. This land is actually preserved as protection agent and should be covered with permanent vegetation. This condition is often becomes the cause of flood and erosion.

According to the location, the damages of forest, land and water can be divided as follow

a. In Java the causes are e.a. of the pressure of the inhabitants who live from agriculture works, the limited capital, the low knowledge and education in the field of agriculture, the limited opportunities for obtaining job in other field.

b. In outside Java with a large extend of region, is caused by the traditional way of life for example the shifting cultivation, the limited work capital, the shortage knowledge and education in the subject of

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agriculture and the limited opportunitie for a job in other field of work.

3. <u>Protection efforts against the damages of forest land and water.</u>

In the constelation of forest, land and water preservation as stated above, the Indonesian government has settled maintanance, preservation and rehabilita tions program as a priority government plan.
Basically these efforts covering the field of

a. Instruction, guidance and managemant for the society in the matter of utilization, processing of forest, land and water as natural resources.

b. Assistance to the farmers which consists of infra structure, energy and work capital.

c. Extension, information, education and training.

d. Oppertunities for jobs, especially in a very densed population areas and shortaged of land for agricul- ture.

e. Other undirected and basic principles such as trans- migration, family planning, home industries etc.

Direct attitudes toward the rehabilitation of bare lands, lalang field are through reforestation and afforestation efforts.
Forestation is an effort to rehabilitate bare lands at state forest areas by planting forest tree species, while afforestation is the planting activities of trees and land terracing at bare lands outside forest areas (private ownerships land).

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Based on the wide extend of lands to be refo - restated and to be afforested the action is planned consecutively viz. part of bare lands which has a direct and obvious influences on the environmental condition, the life of the inhabitants and also the preservation of investation in other field. The work unit in the rehabilitation of bare or critical land effort are Watershed areas. Reforestation is carried out by cultivating forest tree species with a planting space of about 3 x 2 m or about 1.600 stands per hectare, while afforestation is conducted by planting wood tree species or fruit trees with a planting space of about 5 x 5 m. (ca. 400 trees per hectare), or by establishing ridge terrain and planting stabilizer tree species in a row of 1.000 m. long per hectare.

As a description of reforestation and affores - tation activities toward the rehabilitation of critical land are illustrated as below :

(1) During the Second National Development Program (1974-1979) covering of ca. 304.500 ha. of reforestation, 524.100 ha. of afforestation or reforesta - tion and afforestation comprise of about 144.300 hectares per annum.

(2) In the Third National Development Program (1979-1984) the projection of reforestation effort is about 1.500.000 hectares and afforestation ca. 3.500.000 hectares or average annual reforestation plus afforestation will reach about 1.000.000 hectares.

The execution of reforestation and afforestation is conducted by the Local Government bodies and other technical instances.

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The budget is preserved by the Central Government plus the grant aid from the Local government. The average expences for one hectares reforestation is ca.Rp.74.000 (ca.US $ 118) and for afforestation is about Rp.26.000 (ca. US $ 41) (1979).

No much prominent problems should be faced during the reforest implementation because the land is completely under the possession of the state. But at afforestation activities many problems should be solved viz. the problem between the land owners who need the land for cultivation in order to fullfil their daily consumption and the aim of the land to be settled for protection purposes in a long run program.
In reference to such condition, it has been suggested that besides to carry out a crash program along the reforestation and afforestation purposes, an integrated effort of watershed management should be completed gradually.

4. Watershed management exertion.

An integrated watershed management is meant to manage a watershed unit in the context of managing, maintaining and utilizing of forest, land and water as a natural resource by applying coordinated, integrated and sinchronized plan of work among the activities of human being, variety of sciences, the tasks and the functions of several instances dealing with the watershed units.

All are directed toward a proportional and adaptable condition of forest, land and water as natural resources and will provide influences upon the optimum hydro-orological utilization, also will have a maximum

support capabilities to fullfil the need of human being's life.

A successful achievement in watershed management is the creation of a well suited hidro-orological condition.

The main integrated effort in watershed management is indicated below will cover some features :

(1) The conformation of land utilization program with the land capability in order to be able to achieve optimum land product without disturbing or resulting land damages or furnishing bad influences to the surrounding sites and to the hydro-orological condition whereas the condition will be still well maintained.

(2) The application of technical method on land utilization, land preservation and land fertilization as well as other aspect toward the sustain management.

(3) To create understanding, attitude and capability of the society to support the aim in maintaining watershed management activities. This goal can be achieved whenever the farmer's income is raised.

In these last time, the achievements toward the watershed management implementation are illustrated as below :

a. <u>Technical Assistance Project of UNDP/FAO at Solo</u>

Through technical aid from UNDP/FAO, during 1973 - 1978 was established Technical Assistance Project with the aim to search for a design, model and standard for the rehabilitation of critical

lands, especially in Java.

This project is located at Solo (Solo Watershed Management) and has produced several masterplan models for the management and development of Sub Watershed Management at Solo Watershed Unit.

The areas which were used for the application of this project plan were from seven Sub Watershed Management regions comprising of 200 - 500 hectares. Experiments were conducted at these places for rehabilitation and for the increasing of land product through considering the condition and situation of the landslopes, soil and climate with the assumption that the land productivity will be improved and the income of the farmers will also increase as well as the hydro-orological condition will be suitably. Other integrated activities were also carried out in the aspect of soil preservation, hydrology, agronomy, forestry, watershed economy, extension and education.

The development of these experiment results were performed in the sectors of forestry, agriculture, seasonal crops, animal husbandry, fishery and home gardening.

Some conclusion derived from this Technical Assistance Project are as followed .

- The damages of forest, land and water in Solo region were primarily caused by the pressure of the inhabitant condition, where the solution was not only concerning technical problem but also covering the social-economic aspects.

- The rehabilitation of critical lands should be supported and be participated by the society. This participation can be achieved if the land production and the farmers income could be raised up.

To reach this goal, a continues and integ - rated as well as direct actions are necessary in all aspect of regional development program. An integrated and correlated sectoral masterplan for each watershed should be formulated, (espe- cially in agriculture scope).

- Performing several masterplans of Sub Watershed at Solo Watershed, i.e. concerning the Samin river area (28.000 hectares).

b. <u>Samin River as watershed management and develop - ment trial.</u>

As the continuation of the watershed manage- ment and development exertion, futher program of implementation should be conducted covering a rather greater scale. One of those are the appli cation of management effort of Samin river Sub Watershed (28.000 ha) at Solo Watershed based on the masterplan produced by Technical Assistance Project of UNDP/FAO.

The excertion of this development project will be financed through IBRD loan where the negg tiation will be signed in October 1979.

The main effort cover .

- to reforest the area with a sloping grade more than 50 % through the planting of permanent tree species. No soil exploitation is needed. The planting of fruit trees will be mixed with grass for cattle fodder.

- to terrace the land for soil preservation purpo- ses and to intensify agriculture land through

planting superior tree species and fertilization. These are applied to lands which has a sloping grade 30 - 50 % at the elevation more than 500 m. where rice fields are not possible to be culti - vated anymore.

- the creation of new rice field areas with a suitable condition, water preservation and according to an economical estimation.

- the establishing of irrigation components comprising of moderate dam (suit for 200 ha) and small dam (suit for 20 ha).

- to develop home gardening.

- extension and information.

Those above performances are connected with other exertions in the field of animal breeding and fishery etc. to support and to utilize the program with the aim that the end product will be more effectively and efficiently.

The average expences to develop a "printed area" is Rp. 570.000/ha (ca. US $ 905) while for "gross area" is Rp. 273.000/ha. (ca. US $ 433). Although the cost for each hectare is relatively high but it is still profitable according to economical calculation (IRR Calculation). IRR for each activities range between 17,5 % and 34 % per annum.

c. <u>Development Centre for Watershed Management Project.</u>

To develop the Watershed Management, the Department of Agriculture has formed a body as a temporary project with its task as decribed below :

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- to give technical support as well as furnishing guidance and assistance for the implementation of watershed management efficiently and effectively.

- to perform those implementations, several steps are taken e.g. to identify the technological method in watershed management aspect, to conduct experiments, to formulate criteria, norms, standards as well as the design and the methods. Also providing mannual and instruction, technical assistance, training, education and extension.

To carry-out those activities, the Development Centre for Watershed Management Project is furnished with experts, building and office facilities as well as transportation facilities located in Solo.

The Project has several Watershed region as experimental plots for applying trial effort either through Foreign assistance financial program or through the Indonesian government budget.

d. The development projection of Watershed Management.

According to the urgency and priority, the development projection of watershed management will primarily conducted at 11 Watershed regions in Java. Since 1979 will be conducted the feasibility study, soil survey, aerial photography to produce masterplan for the beneficiary plots.

5. Proposals and Consideration.

Based on those above mentioned analysis, the Indonesian government has started to pioneer the creation of an integrated effort in watershed management.

These are conducted to preserve and to sustain the existence of forest, land and water as natural re - sources components nd as well as to increase the utilization of the region. Several Pilot projects are established, centralised in Solo, and act as Deve - lopment Centre for Watershed Management complimented with all equipments and facilities.

In this connection, with an openhearted proposal. the utilization of such Development Centre for Water-shed Management will aslo applied to Asean countries and the Development Centre for Watershed Management in Solo will be a part of land preservation activities in Asean Countries.

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ANNEX G

COUNTRY REPORT

REPUBLIC OF THE PHILIPPINES

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

COUNTRY REPORT

ASEAN 79/COFAF.WW/Doc. 11

REPUBLIC OF THE PHILIPPINES

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

COUNTRY PAPER [1]

REPUBLIC OF THE PHILIPPINES

By

Philippine Delegates [2]

Background Information:

The Philippines has a total land area of thirty (30) million hectares, 70% of which are watersheds of a little over four hundred rivers. Among the most important river basins in the country are the Agno and Cagayan river basins in Northern Luzon, Pampanga river basin in Central Luzon, Ilog-Hilabangan in the Visayas, and the Cotabato and Agusan river basins in the Mindanao region. These river basins cover approximately seven million hectares. These watersheds supply the major water needs of several irrigation systems, multi-million peso hydroelectric dams and domestic as well as industrial water systems.

Philippine watersheds are also the major settings of various natural resources utilization and developmental activities which help promote the country's socio-economic development. In addition, the watersheds in the country, with all their complex and dynamic components are vital ecosystems that help promote quality environment and ecological stability over a wide spectrum

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1/ Paper presented at the ASEAN Workshop in Watershed Conservation and Management Research Programme by Philippine Delegates, Kuala Lumpur, Malaysia, September 3-8, 1979.

2/ Philippine Delegates: Dr. Severo R. Saplaco, Watershed Management Specialist and Asst. Professor of Watershed Management, UPLB College of Forestry, College, Laguna; Forester Bernardo Jasmin, Chief, Watershed and Range Division, Forest Research Institute, College, Laguna; Forester Eduardo Llapitan, Chief, Forest Protection and Infrastructure Division, Bureau of Forest Development, Visayas Avenue, Quezon City, Metro Manila; Engineer Jose P. Castro, Manager, Watershed Management Department, National Power Corporation, Anda Circle, Port Area, Metro Manila; and Mr. Julius Jose, Ministry of Foreign Affairs, Padre Faura, Metro Manila.

of land scenes. However, the impositions of various land uses, resources utilization and developmental activities on the country's watersheds have resulted to various degrees of degradations of these important ecosystems. Among the various land uses and developmental activities on the watersheds include the following:

1. Shifting Cultivation - Shifting cultivation is one of the major causes of watershed resources degradation in the country. It is a land use practice whereby once stable watershed ecosystems are rendered very unstable and unproductive through repeated slash - burn cultivation on sloping lands. Prior to 1972, the annual forest destruction is about 172,000 hectares. About 53,000 hectares are destroyed by shifting cultivators per year.

2. Timber Harvesting - Uncontrolled timber harvesting coupled with construction of sub-standard and erosion-prone logging roads contribute to the increasing degradation of the watersheds.

3. Grazing - Most of the grazing lands in the Philippines are located in some important watersheds. Repeated burning practices on the grazing areas, coupled with apparent over-grazing result to severe soil compaction, accelerated soil erosion and their consequent bio-physical degradations.

4. Forest Fires and Mining - Forest fire is a serious problem in the country's pine watersheds during the dry months. Mining activities on the watersheds have aggravated the problems emanating from the improper use of these ecosystems. Specifically, the improper disposal of mining wastes has contributed significantly to the serious sedimentation of streams, reservoirs and valuable agricultural lands. The foregoing land use practices combined with other problems are seriously threatening the stability and productivity of the country's watersheds.

Watershed Management Problems:

Effective management of Philippine watersheds has been and is still being plagued by interrelated technical, economic and social problems. While a favorable atmosphere for the rational development of the country's watersheds has been made possible under the new society, years of mismanagement cannot be corrected in a short time.

In addition to the abusive land use practices on the watersheds (shifting, cultivation, uncontrolled timber harvesting, grazing, forest fire, mining, etc.), the major problems affecting watershed management in the Philippines are: (1) dearth of technically trained watershed managers and researchers; 2) dearth of local scientific information/data for effective, beneficial and viable watershed management strategies, (3) financial constraints for research and developmental projects and (4) institutional and social constraints.

The foregoing problems have been and still contributing significantly to the serious degradation of most of the country's watersheds. Many of these problems will continue to enhance watershed degradation and their consequent on-site and external disastrous effects unless beneficial and viable management strategies are evolved and operationalized.

Watershed Management Strategies

The Philippine government realizes the vital role of watershed resources in its socio-economic and developmental programs. In addition, the government recognizes the significance of watershed ecosystems in the promotion of quality environment and ecological stability. Consequently, the national government, including the general public has been and is still evolving management strategies geared towards the beneficial and optimal use of watershed resources in the country. These strategies could be classified into three general categories, namely: institutional, applied/developmental and research.

The institutional strategies include the policies of the national government in the management of watershed ecosystems. As a matter of general policy, the conservation, management and proper utilization of natural resources, which include the country's watersheds, rest on the government. Along this line, a policy of government ownership of almost all of the country's watersheds has been adopted.

Multiple use management of forest lands, which are essentially components of the watershed ecosystems, is an implicit government policy towards the use and management of watershed resources. In addition, watershed resources shall be protected, developed and rehabilitated so as to ensure their continuity in productive condition. Moreover, the consolidated nature of forest concessions into sufficiently large and contiguous units, provide an ideal set-up for the favorable administration and management control of watershed areas in the country. Furthermore, the long term nature of forest concessions adopted by the government (25 years, renewable for another 25 years) can provide the much needed stable tenure associated with the long term nature of forestry investments.

The foregoing government policies provide the institutional support/mechanisms to operationalize applied/developmental strategies geared towards the efficient use and management of watershed resources. Among the applied/developmental strategies that has been undertaken include both classical and current management activities. The construction of the Banawe Rice Terraces in the Mountain Province of Northern Luzon is a classical example of applied watershed management undertaken in the Philippines since 200 B.C. Terracing the mountain sides with an average slope of 70% was made in order to harness water resources from the mountains, thereby providing sustained water supply for irrigated agriculture on the mountain sides. The Banawe Rice Terraces cover about 40,000 hectares.

In 1966, the United Nation Development Program (UNPP) assisted project in Forest, Range and Watershed Management in the Philippines was undertaken in the Upper Agno and Angat River Basins. The project was oriented towards applied watershed management activities. Bench terracing, road stabilization, stream bank erosion control, check dam construction as well as reforestation were undertaken on a pilot scale in the project area. Likewise, training on reforestation, erosion and fire control techniques were undertaken by foreign specialists for filipino foresters.

Some few years back, the Bureau of Forest Development initiated the establishment of multiple use forest districts. The multiple use forest management concept aims to harness and develop the forest and watershed resources to promote optimum productive benefits in close harmony with the enhancement of ecological stability. While relatively new, the Bureau of Forest Development recognizes the wisdom and relevance of the multiple use forest management concept. Consequently, the Bureau of Forest Development has already established several multiple use forest districts in the country.

The concept of forest occupancy management (kaingin management) lately adopted and being implemented by the Bureau of Forest Development utilizes the humanistic and integrated approach towards addressing the problem of shifting cultivation in the country. This ameliorative strategy recognizes the failures of punitive measures against the shifting cultivators. As such, a policy of containment combined with the improvement of the productive and protective potentials of kaingin areas through

the implementation of improved technology is being adopted. Through this approach, the objectives of watershed management and the desires of the shifting cultivators may be significantly promoted. The forest occupancy management strategy also hopes to integrate the shifting cultivators into the mainstream of the national economy. Another form of watershed management strategy recently undertaken by the national government. Communal tree farms are designed to improve the productive and protective potentials of open upland areas.

Agro-forestry is one of the latest cropping systems being adopted for implementation on upland areas. It is a cropping system whereby agricultural crops are cultivated and intercropped with forest crops. As a new cropping strategy, agro-forestry is still under investigation to find out its usefulness in terms of helping promote the productive and protective values of watershed ecosystems.

Reforestation works are yearly endeavors of the national government. Through reforestation, the national government hopes to bridge the gap between forest destruction and conservation on watershed areas. Combined with reforestation is the forest protection and extension programs of the national government. Forest protection is essentially a function of the Bureau of Forest Development while forestry extension program is a joint venture of a number of government and private agencies including the Bureau of Forest Development. However, forestry extension is coordinated by the College of Forestry, University of the Philippines as Los Baños.

Finally, few activities on road bank stabilization and soil erosion control measures on watersheds are being undertaken essentially by the public highways ministry. Soil erosion control works on a pilot scale are also undertaken by some universities, not as direct ameliorative measures but as components of on-going research projects.

The institutional and applied/developmental strategies for watershed resources management need to be reinforced by scientific data. Scientific data for the effective management and optimal use of watershed resources are generated through intensive research works. As a result, the national government has adopted a coordinated and systematic approach of doing agriculture and forestry resources research in the country. This approach was operationalized in 1974 when the Philippine Council for Agriculture and Resources Research (PCARR) was created. This systematic and coordinated research strategy is equally applicable to all researches in watershed resources.

To support the national program of the Philippine government to restore and improve the productive and protective state of the watershed ecosystem, PCARR with FORI, UPLB and other research agencies has identified research thrust that would: (1) accelerate reforestation and watershed rehabilitation efforts and (2) intensify forest protection against destructive agencies and mass support for watershed programs.

Among the current researches on watershed conservation and management in the country are: Integrated Upland Hydroecology Research Program, Hydrology of Upland Farm, Hydrometeorologic Characterization of Upland Ecosystems at Mt. Makiling, Forest Hydrology, and other watershed rehabilitation and damage prevention measures. The detailed descriptions of these research programs are discussed in the technical report of the Philippine delegation to this workshop. As such, their discussions are not included in this paper.

Recommendations:

The following strategies are recommended to help minimize if not prevent further deterioration of the country's watershed resources:

1. Codification and integration of all policies, objectives and strategies, laws, rules and regulations, and institutional arrangements affecting watershed resources management;
2. Adherence to a watershed resources management policy characterized by an exhaustive and objective evaluation of the limits set by the physical, technical, politico-socio-economic constraints of management to promote sustained and income generating developmental programs to benefit the majority of the people without creating ecological instability for the longest possible time;
3. Maintenance of a technically-trained pool of watershed management staff;

4. Intensified generation of relevant scientific data needed for the preparation of viable and beneficial watershed management strategies;
5. Statement of watershed resources management objectives;
6. Preparation of watershed resources management plans that employ the "technocratic" but consultative and participative approach;
7. Intensified transfer of relevant technology and implementation of action programs in line with the set policies and management objectives;
8. Generation of support to the policies, objectives, and action programs that were evolved through the "technocratic" but consultative and participative approach; and
9. Adherence to a strong and determined leadership to carry out the adopted policies, objectives, and action programs.

Conclusions:

Effective watershed resources management in the Philippines is currently wanting. Interrelated technical, institutional, social and economic constraints continue to hamper the optimal and beneficial use of watershed resources. As a result, the ecological stability and productive capacity of most of the country's watersheds are seriously being threatened.

Unless the government undertakes responsive, rational and scientific management strategies, the watershed resources which contribute significantly to the country's socio-economic and institutional development will continue to be misused and be a cause of inevitable serious human sufferings in the Philippines.

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ASEAN WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
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ANNEX 4

COUNTRY REPORT - THAILAND

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KUALA LUMPUR MALAYSIA 3 - 7 SEPTEMBER 1979

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

COUNTRY REPORT

ASEAN 79/COFAF.WW/Doc. 12

THAILAND

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

THAILAND COUNTRY PAPER*

Background

Thailand declared here First National Social and Economic Plan in 1961. In this Plan, the stated forest policy was to reserve about 50 percent of the National land as a forest land under the Forest Reserve Act AD1964. Up to the present, there are 1,240 Forest areas which have been declared as National Reserved forests.

However, in the National Forest land there are problems of forest land clearings in the lowlands and of shifting cultivation in the mountainous areas.

It is estimated through remote sensing techniques together with land surveys, that only about 38.7 percent of the total land area in Thailand are still forested. It is estimated that about 40 percent of Watershed areas have been degraded by the shifting cultivation practised by the hill tribes.

Watersheds in Thailand

Thailand is an agarian country and about 80 percent of her population are engaged in agricultural activities. The deterioration of the watershed areas in the north will be a great hazard to the agricultural areas in the central plains. Realizing this problem, Thailand started a Watershed improvement programme in 1964.

The main activities encouraged from the beginning were as follows:

1. Data collection. A survey of basic information on watersheds has been done. Seven watershed research project stations have been established in the northern and central parts of the country to cover the main watersheds of the country.

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3 - 7 September, 1979.

2. Rehabilitation programs have been also carried out on denuded Upper Watershed areas. The reforestation of such Watershed areas has been encouraged. Up to the present, there are about 70 units of watershed rehabilitation programs in the various sub-watershed areas. About 291912 hectares of forest plantations have been established so far, in both highland and upland watershed areas.

Integrated Approaches in Watershed Management

Based on our long experience in watershed management in Thailand, we realize that the problems of watershed management cannot be solved by any one technique. These problems have various origins which reflect the various social and economic environments. To cope with these variations, the Maesa Integrated Watershed and Forest Land Use Project was initiated in 1973 under the joint cooperation among the F.A.O., U.N.D.P., and the Thai government. The objective of this project was to organize a pilot project which can be extended to other watershed rehabilitation units all over the country.

Under the integrated approach in Watershed Management in Thailand, there are various categories of work as follows:

1. Watershed Research Program

   Collection of basic data on vegetation and hydrology. Development of suitable methodology for use in particular areas.

2. Social improvement program

Organizing forest villages for those people who live in forest areas. Basic infra-structure has been installed for the villages. Agro-forestry projects have been adopted for these villages and are now being carried out with the support of the United Nations University. The use of community wood lots for supplying the basic wood requirements has also been introduced to these villages.

3. Economic improvement program

In order to improve the economic status of the people who stay in the forest land, cash crops have been adopted to replace the opium planting of the hill tribes. Contour farming techniques have been introduced to the farmers on the various slopes. Feeder roads for crop transportation have been constructed to the watershed areas. Suitable temperate crops have also been introduced as replacement for opium planting.

4. Environmental improvement program

Under the socio-economic program; the program for Environmental Improvement has also been encouraged. Erosion control techniques using various methods have been carried out on the sides of roads and in agriculture areas. Fire control measures have been promoted in the reforestation areas to protect the plantations. This has also been done in some natural Dry-dipterocarp forests. The last method used in the Environmental Improvement Program is afforestation, to convert denuded forest land to land containing the more economically valuable forest species.

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ANNEX I

1. COUNTRY PAPER - MALAYSIA
2. FOREST HYDROLOGY STUDIES AT JENGKA AND BUKIT BEREMBUN HILL FORESTS
3. SUNGEI TEKAM EXPERIMENTAL BASINS A STUDY OF THE EFFECTS OF LAND-USE CHANGE ON THE DENUDATION AND HYDROLOGY OF SMALL WATERSHEDS
4. LOGGING IN WATERSHED AREAS OF SABAH

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

COUNTRY REPORT

ASEAN/COFAF.WW/Doc. 1

MALAYSIA

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

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MALAYSIAN COUNTRY REPORT*

Introduction

The three renewable natural resources, namely, forest, soil and water, have been major contributing factors to socio-economic progress and prosperity in Malaysia, particularly during the present century. As renewable resources, they can continue to play a vital role in maintaining economic development and social well-being of the people long after the country's non-renewable natural resources, such as tin and petroleum, have been exhausted. Their ability to do so, however, is dependent on the maintenance of equilibrium between these three inter-related resources through balanced utilization and sound management of the forest and land in watershed areas.

In recent years, the rapid rate of forest depletion through excessive exploitation and conversion of forest to agriculture has given rise to increasing incidence of soil erosion and degradation, water pollution and shortage, and floods. With the depletion of the lowland forest, the practice of forestry for timber production, and perhaps agriculture, will inevitably be located in the hilly areas which are invariably also watersheds with protective functions of soil and watershed conservation. Environmentally-safe forestry and land use practices must, therefore, be evolved if the country's watersheds are to be conserved and managed for the generation of socio-economic benefits in perpetuity.

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

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The Malaysian Environment

Malaysia is located in South East Asia, north of the Equator, between latitudes 1° and 7° North and longitudes 100° and 119 East. Peninsular Malaysia is connected to mainland Asia while Sabah and Sarawak are located on Borneo Island. The total land area of Malaysia is 127,316 square miles (329,750 km^2) of which Peninsular Malaysia accounts for 50,806 square miles (131,590 km^2). The country has a coastline of almost 3,000 miles (4,830 km), a greater portion of which is exposed to the South China Sea.

The climate of Malaysia is strongly influenced by the proximity of the sea and the changing winds blowing from the Indian Ocean and the South China Sea. There are nominally two seasons, namely, South West Monsoon and North East Monsson Seasons, which last from May to September and October to February respectively. The North East Monsoon brings storms to the east coasts of Malaysia while the South West Monsoon brings rain to the west coasts. The average rainfall ranges between 80 inches (2030 mm) to 100 inches (2500 mm) a year. Average diurnal temperature ranges between 70° F (21°C) and 90° F (32°C) in the lowlands but can drop to as low as 36° F (2°C) on Gunung Kinabalu in Sabah. Relative humidity is always high and usually exceeds 80%.

Malaysia is generally hilly to mountainous with steep slopes even on low hills. The Main Range occurs as a parallel series down the centre of Peninsular Malaysia while in Sabah and Sarawak, the hills and mountains are found mainly in the south bordering Kalimantan in

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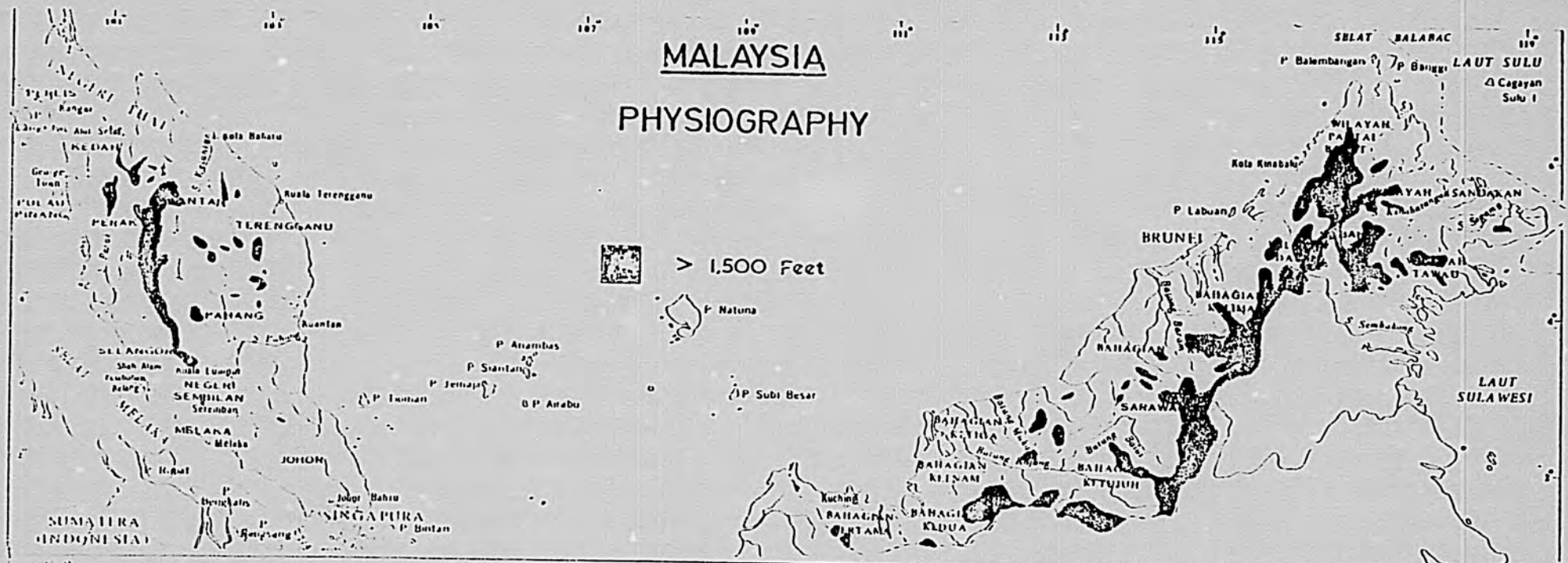
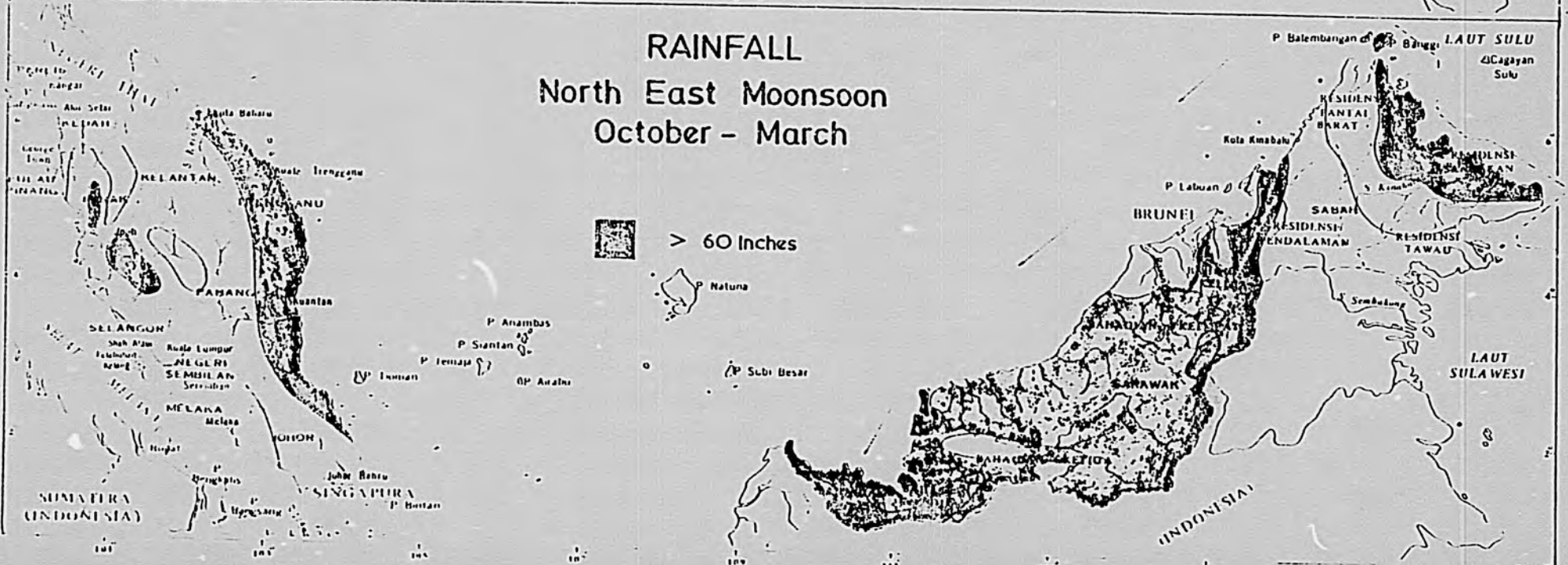
MALAYSIA

PHYSIOGRAPHY



RAINFALL

North East Moonsoon
October - March



Indonesia. Consequently, lowlands usually occur as relatively narrow river valleys or coastal plains. The country is basically a land mass of granite, the uneven roof of which forms the principal mountain ranges. The soils of Malaysia are thus generally of the sedentary and alluvial types and are highly erodible in nature.

The natural vegetation of Malaysia is Tropical Rain Forest. Such forest is characteristically evergreen, broadleafed, complex in structure and rich in speices. Tropical Rain Forest still occupies about 68 per cent of Malaysia's land area, mainly in the hills and mountains. The lowlands have been largely converted to agricultural use. Today's intensive logging followed by reforestation operations is changing the nature of the forest. It is unlikely that the original structure and diversity of the virgin forest can ever be recovered after heavy logging. Fast growing species, both native and introduced, are replacing the original stands of trees while the spread of weed species is inadvertently encouraged by the changing circumstances.

The dominant form of land-use at present is forestry which covers about 68 per cent of the total land area. The extent of agricultural land is about 21 per cent while the remaining 11 percent has been used for urban development and other purposes. In view of the country's agro-based socio-economic policies and the priority accorded to agricultural development and diversification, the forest cover is expected to be reduced to less than 50% in future.

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Socio-Economic Development

The Malaysian economy is based largely on a dynamic and progressive agricultural sector although industries, particularly those utilising local natural and agricultural resources, are actively being promoted. Agriculture accounts for about 30% of the gross domestic production and 55% of the export earnings and, in the process, provides employment for about 48% of the population. Malaysia is the world's largest producer of natural rubber and palm oil, accounting for 44% and 46% respectively of world exports, as well as black pepper. The country also ranks amongst the top producers of tropical hardwoods.

Malaysia's socio-economic policies are implemented through systematically formulated development plans. The First Malaysia Plan (1966-1970) was aimed at raising the living standard of the rural population and uniting the people. The objectives of the Plan were the diversification of the economy and the improvement of national infrastructures. The Second Malaysia Plan (1971-1975) was aimed at restructuring society in accordance with the country's New Economic Policy. The objectives were the reduction and eradication of poverty by increasing income and job opportunities and the correction of economic imbalance by accelerating economic change designed to bring about a more equitable distribution of economic opportunity, income and wealth among the population. The Third Malaysia Plan (1976-80) represents the second phase of the Perspective Plan (1970-90) in the implementation of the New Economic Policy.

The socio-economic development strategy and programmes are aimed at enhancing the role of the agricultural and industrial sectors in creating employment opportunities. Agricultural development will be based essentially on the opening up and settlement of new land to create new employment opportunities. The progress of the land development programmes is shown in Table 1.

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TABLE 1

Agricultural Development Programmes

Target and Achievement

Development Plan	Target (acres)	Achievement (acres)
First Malaysia Plan (1966 - 1970)	760,600 (Alienated)	493,800
Second Malaysia Plan (1971 - 1975)	1,212,800	1,010,570
Third Malaysia Plan (1976 - 1980)	1,000,000	647,480 (1976-78)

Environmental Impact of Development

The figures in Table 1 show that progress in agricultural Development has consistently fallen short of target. As land earmarked for agricultural development is usually cleared of forest well in advance of crop establishment, the time lag in planting up such areas could give rise to serious detrimental environment impacts. Unfortunately, the full environmental impact of forest resources exploitation and conversion of forests for other uses has yet to be fully ascertained in Malaysia. Only a few isolated studies are known to have been carried out but results from these and from observations are sufficient to indicate potential hazards of mismanagement of the land and natural resources.

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Large forest clearance has immediate and complex implications to water supply and demand. The total quantity of water used for purposes other than the natural process in Malaysia is estimated to be 5,000 million gallons per day in 1976 and expected to increase to 11,800 million gallons per day in the year 2,000 (Cheong, 1978). However, with forest resources and land development moving increasingly into hilly and mountainous terrain and encroaching into the watershed areas, supply is likely to decrease. The water crisis which has already surfaced, especially in the industrial conurbations such as the Klang Valley, will be felt with greater intensity in the near future. In the Cameron Highlands, water yields were found to be affected significantly by the conversion of forests for agriculture. The low flow yields were reduced by 50% and 75% in catchments of 50 sq. km. and 500 sq. km. respectively. In a catchment under plantation crops of rubber/oil-palm, it was found that peak storm run-off per unit area was twice that from a jungle catchment while low flows were exactly reversed.

The annual precipitation in Malaysia is often of very high intensity and the highly erodible nature of most Malaysian soils contribute to the severity of impact on soil stability and fertility. Studies in the Cameron Highlands showed that conversion of the forests on steep slopes for tea planting and vegetable gardening increased soil losses in the ratio of 1: 20: 30 respectively (Daniel & Kulasingam, 1974). On lowland it was found that conversion of forest to rubber/oil palm increased soil losses in the ratios of 1: 1.5 and 1: 2.8 for small and large catchments respectively. Soil erosion in varying degrees of severity resulting from improper land-use was also observed in Sabah (Jones, 1976). A substantial fraction of eroded soil tends to end up as suspended

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sediments in rivers eventually silting up the river bed and giving rise to floods. A comparison of the heavily polluted Klang River on the west coast and the Cerul River in Trengganu on the east coast revealed mean suspended sediment of 5635 mg/l and 9 mg/l respectively (Anon., 1977.)

Environmental Conservation Measures

In Malaysia environmental issues have not been neglected in the past. The Environmental Quality Act was passed in 1974 and the Department of the Environment, now in the Ministry of Science, Technology and the Environment, was established in 1975. Environmental issues have been implicity taken into account in the planning and implementation of the Government's development programmes and projects, for example, in the selection of land for agricultural development and in the formulation of conservation enactments relating to soil, water, land, forest and mining.

Malaysia's National Environmental Policy takes into account:-

(i) the impact that population growth and man's activities in resource development, industrialization and urbanization have on the environment.

(ii) the critical importance of maintaning the quality of the environment relative to the needs of the population, particularly in regard to the productive capacity of the of the country's land resources in agriculture, forestry, fisheries and water.

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(iii) the need to maintain a healthy environment for human habitation.

In the attainment of these objectives, the Government has actively promoted environmental awareness and environmental impact assessment procedures and guidelines are being prepared which will seek to evaluate and optimise the relevant trade-offs. Implementation of environmental policies will be pragmatic but every effort will be made to preserve representative ecological systems. Consequently, provisions for the conservation of soil, water and forest under several enactments dealing with the use and exploitation of natural resources as well as the use of sound cutlivation, cropping and conservation techniques have in general resulted in minimal impairment of the potential of these resources.

Research in Environmental Conservation

Malaysia is fully cognizant of the importance of balanced use of its natural resources and sound environmental management but currently has inadequate knowledge and expertise for appropriate environmental conservation. In order to maintain, and where possible enhance, the capability of the country's land resources for sustained production, research on land use and management, forest utilisation and management, water resources conservation and management, and prospects for multiple use is being pursued vigorously as a matter of priority.

As the vital natural resources of forests, soil and water

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and agricultural crops are inextricably tied to the land, Malaysia is endeavouring to adopt an integrated approach and to formulate comprehensive research programmes which are designed to achieve maximum socio-economic benefits from land use and development for the people. The two most ambitious research programmes, which are wide-ranging and multi-disciplinary in concept and implementation, are the National Porgramme for Experimental and Representative Basins, spearheaded by the Drainage and Irrigation Department, and the Forest Hydrology and Conservation Programme spearheaded by the Forestry Department. Detailed descriptions of these two programmes and progress achieved to date are given in Appendices 1 and 2 respectively as well as in Malaysia Information Papers No. 1 and 2.

Conclusion and Recommendation

The problems of environmental conservation and management in general and of watershed conservation and management in particular are not unique to Malaysia. They are common to all countries, both developed and developing, which have not yet achieved rational land use through the application of sound policies and appropriate technologies. As such policies and technologies can only be formulated or developed on the basis of relevant information, which is often inadequate, it is imperative that the necessary surveys and research to acquire the information are carried out as a matter of urgency.

In most developing countries in general and in the ASEAN Member Countries in particular, time is the essence in as far as the

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introduction of environmentally sound land use practices is concerned. Since a watershed conservation and management research programme necessary for the elucidation of such practices require substantial inputs of scarce technical expertise and resources as well as being very time consuming, it is obvious that cooperation amongst countries with similar problems would be the logical way to find the solutions. The scope and prospects for such cooperation amongst the ASEAN Member Countries would appear to be enormous considering the similarity of natural resources conditions, problems and aspirations as well as the prevailing mood and commitment for closer and more effective regional cooperation.

Malaysia would, therefore, recommend very strongly that all ASEAN Member Countries consider very seriously and objectively and support very positively and actively the proposal to implement a cooperative ASEAN Watershed Conservation and Management Research Programme with technical assistance under the ASEAN-United States Cooperation Programme. With such cooperation, ASEAN would be demonstrating to the rest of the world the true meaning of the concept of Technical Cooperation amongst Developing Countries (TCDC) currently being promoted by the United Nations.

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Appendix 1

MALAYSIAN NATIONAL PROGRAMME FOR EXPERIMENTAL AND REPRESENTATIVE BASINS

Introduction

In 1974 the Drainage and Irrigation Department (DID) published the first in a series of Water Resources Publications entitled "Surface Water Resources Map (Provisional) of Peninsular Malaysia. The limitations of using a P-PE (Precipitation minus Potential Evapotranspiration) approach were realised but the map did provide a "first order" estimation of the areal distribution of potential water resources in Peninsular Malaysia.

The second publication in the same series was a map of the Hydrological Regions of Peninsular Malaysia, aimed at assisting, in particular, the assessment of water resources. For this reason the classification was based mainly on geological and climatic characteristics, both of these being significant in the assessment of water yield and low flow. The rock porosity or lithology was selected as the main geological parameter and P-PE (taken from the W.R.P. No.1 map) as the important climatic factor.

The combination of the lithological parameter (L) and the P-PE parameter (W) forms a quantitative classification system and the combination of the five lithological groups (L_1 to L_5) and the four P-PE groups (W_1 & W_4) has a maximum of twenty possible classes. Using the system, Peninsular Malaysia was divided into 66 individual hydrological regions within which hydrological similarity is presumed.

Based on this map, the most important hydrological regions were identified and an initial network of representative and experimental basins was proposed with the assistance of ENEX of New Zealand.

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Following numerous field trips to select suitable catchments, five Representative Basins have been established as well as one Experimental Basin. While it is intended to eventually have a network of nine or ten Representative Basins, DID is at present concentrating on the establishment of those five already selected.

Due to the large commitment of funds, the inevitable delays in establishing the basins and the length of study involved before any analysis can be attempted, DID is reluctant to further expand its existing network until assessments have been made of the applicability of such studies. While the problems associated with Representative and Experimental Basins are new to DID, the experience gained in monitoring the existing basins will no doubt prove to be very beneficial when the time comes to select the remaining basins.

Anak Sungai Keroh Representative Basin

Lying within the Federal Territory, this catchment was established in early 1977. Over most of this catchment of 2.6 km^2 the relief is gently rolling, becoming steep in the catchment headwaters. At the start of monitoring the basin, 98% of the catchment was under rubber plantation, forming part of the Edinburgh Rubber Estate, which was established in the late 1940's. The remaining two per cent was the estate village plus a small portion of an urban housing scheme. By August 1978 an additional 5% of the basin area had been cleared of rubber trees and was being levelled as part of a major new housing development centred north-west of the basin itself. Within the next five years it is planned to develop

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an estimated 70% of the catchment into urban housing.

It is anticipated that both peak discharges and flood volumes will increase markedly and the base flow will decrease as urbanisation occurs. This gradual change in the basin landuse was the major reason this particular catchment was chosen since the study objectives are:-

1. To study changes to the hydrological regime resulting from urban development, particularly changes to catchment yield, detention storage, peak discharge and flood volumes.
2. To provide information on rainfall/runoff relationships under urban situations leading to the construction and testing of mathematical simulation models, and so extend prediction to other catchments scheduled for urban development.
3. To study changes in water quality resulting from urban development, in particular sediment load and water chemistry.

Present instrumentation of the basin consists of two automatic rainfall recorders using weekly charts together with weekly check gauges plus a weekly automatic water level recorder at the flow recording station. Present data collection includes water quality and suspended sediment sampling and it is intended to establish a climate station in the near future. A semi-detailed soil survey is planned as well as periodic landuse surveys to monitor the rate of change of conversion to urban housing.

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Parit Madirono Representative Basin

As part of the Western Johore Agricultural Development Project, Parit Madirono drains a flat area of peat land. The catchment area defined to form the representative basin totals 1.9 km^2, and the elevation range is only 3-7.5 metres above msl.

A detailed topographic survey showing elevation contours, lot boundaries and the drainage pattern has already been completed together with a landuse map. Current landuse is typical for this region and comprises small holdings of rubber, pineapple, banana and coffee. Whilst much of the rubber area is currently reverting to forest, it is likely that with continued drainage, the area will be eventually developed to pineapple cropping. At the present, rubber holdings represent 33% of the basin area, forest and scrubland 28% and pineapples 27%.

The basin study objectives have initially been defined as:

1. To provide information on rainfall-runoff relationships for peatlands by determining the temporal distribution of runoff from rainfall and ascertaining the catchment conditions that control variations in the time responses.
2. To provide information on the influences of drain spacing and depths on the flow characteristics, including flood volume, peak discharge, time of concentration, detention storage and baseflow.

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3. To study changes to the soil moisture and groundwater regimes together with changes to soil properties resulting from improved drainage.

The basin has been fully operational since May 1979. Present instrumentation consists of 4 rainfall stations (2 having automatic rainfall recorders) and a 120° V-notch weir. To monitor fluctuations in groundwater levels, four wells have been sunk, each being installed with an automatic water-level recorder. It is also intended to establish a climate station. A fortnightly programme of water quality sampling and suspended sediment sampling in the parit have been initiated since May, 1979.

Sg. Chalok Representative Basin

This catchment of 20.4 km^2 is located 55 kms north of Kuala Trengganu on the east coast of Peninsular Malaysia. For most of the catchment the relief is gently rolling except for the steep slopes of Bukit Tinggi in the north-western corner. Current landuse is typical of the region with rubber dominant and jungle covering the remainder. Much of the catchment has only been opened up for rubber in the last five or six years while logging is still being carried out in parts of the jungle.

The current study objectives include:

1. To study rainfall-runoff relationships for a catchment lying within a region having abundant annual water resources and in particular the flood volume and peak discharge resulting from the north-east monsoon.

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2. To observe the hydrological changes produced by maturing rubber in particular the recession curve shape and base flow volumes.

The permanent water level recording structure was completed in the middle of 1978 while three rainfall stations (two of which have automatic recorders) were constructed in late 1977. A regular programme of water quality and suspended sediment sampling has been implemented.

Sg. Kipis Representative Basin

This catchment of 21 km^2 is located within the driest region of Peninsular Malaysia having an average annual rainfall of about 1900 mm. Typical of the Kuala Pilah Hydrological Region, the relief over most of the catchment is gently rolling but broad flood plains occur along the valley floors of the major streams. Padi cultivation is confined to these flood plains and there is a small headworks in the upper catchment to provide supplementary irrigation and encourage double rice cropping downstream. The landuse is dominated by rubber holdings (70% of the total catchment area) and jungle (20%). The forest in the headwaters of the catchment is currently being logged.

The study objectives for the basin include the following:-

1. To obtain information on rainfall-runoff relationships for a low water resources region and to monitor changes to the relationships resulting from continued agricultural development.

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2. To obtain information on hydrograph characteristics associated with this relief type and geology.

3. To study the influence of small headworks and gravity drain irrigation of padi land on the availability and distribution of water resources.

The catchment has only just been established with the construction of four rainfall stations (two automatic recorders and two manually read gauges) and the stilling well for the Ott weekly floattype water-level recorder. The development of a stage-discharge relationship is now underway together with water quality and suspended sediment sampling. More detailed information on the catchment landuse, soils and geology will also be sought with the co-operation of other government departments.

Sg. Lui Representative Basin

While this catchment is the longest established DID representative basin, having officially been established in 1971, it has in fact been used for a number of specialised studies since 1959. Following nomination as a representative basin in early 1971, a broad crested weir was constructed about 150 metres upstream from the previous streamflow station. The water level recorder was resited and recording commenced in December 1971.

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The research objectives have been revised over the period since 1959 and are documented in the first of two published reports on the Sg. Lui basin. The main study objectives, however, include:

1. The forecasting of low and mean flows for Sg. Lui and extension to the remainder of the Hydrological Region.
2. The study of various hydrological processes.
3. The development of mathematic models describing the hydrological regimen.

Current instrumentation consists of four rainfall stations (two Capricorder punched tape recorders and two manually-read storage gauges) plus an Ott long term automatic water level recorder. Considerable problems have been experienced in the past with certain exposure difficulties particularly at the one upper catchment rainfall station and also with the previously installed Capricorder punch tape event water level recorder. This recorder was subsequently replaced by a more reliable and easily serviced long term chart-type recorder.

Analyses to date have included a very comprehensive forest interception and water balance study by Dr. Low Kwai Sim for her Doctorate thesis plus such flow characteristics as base flow recession, base flow component, hydrograph time to rise and basin lag as compiled by Scarf in the first R.B publication (1977). In the second report by Koh Kah Hock (1978) the Boughton Catchment Model was introduced and calibrated for the catchment using rainfall and streamflow data for the period June 1972

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to June 1974. The model was then tested for the period July 1974 to June 1976. However the subsequent generated monthly flows were somewhat higher than those recorded flows.

Sg. Tekam Experimental Basin

In 1973, following interdepartmental meetings among Drainage and Irrigation Department (D.I.D), Federal Land Development Authority (Felda), Agriculture Department, Forestry Department, Malaysian Meteorological Services (MMS) and Geography Department of University Malaya, Felda agreed to set aside about 1500 acres of land in Sg. Tekam area for DID to organise the proposed research project to study the effects of land use changes from logged forest to oil palm. A working group of the Malaysian Committee for International Hydrological Programmes (I.H.P.), comprising these agencies and the Division of Environment with DID as chairman, is carrying out a detailed programme of study for this project.

The Sg. Tekam Experimental Basin is located within the area of the Felda Tun Razak Agricultural Research Station in Jerantut District, Pahang. The Research station lies on the edge of the Jengka Triangle which is currently being developed under oil palm and rubber. The basin lies within approximately 1000 acres of selectively logged forest land which is to be converted into oil palm or cocoa.

The research objectives of the basin are:-

1. to study the effect of a change in land use on the hydrological characteristics of the basin.

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2. to study how the soil moisture status can be improved to increase palm oil production and whether oil palm is the most suitable crop considering the hydrological conditions.

3. to study different planting patterns and management techniques in relation to soil moisture behaviour and production.

4. to train local personnel in experimental basin studies.

The basin for the study project consists of three catchments A, B and C. Catchments A and B are operational catchments which are scheduled to be converted into oil palm or cocoa after an initial calibration period of three years. Catchment C is to be retained under a forest cover throughout the period of study as a control catchment. The catchment areas are: Catchment A = 94 acres, Catchment B = 241 acres, and Catchment C = 143 acres.

The original date chosen for the start of basin calibration was 1st. July, 1976 after the survey, design and construction of the hydrological structures were completed. The hydrological structures include three HL flumes to gauge river flow for the three catchments. However, many problems were encountered in the operation of the HL flumes which delayed the starting date to 1st. April, 1977. This project has three phases: (a) 3 years calibration under present condition from 1st. April, 1977 to 30th. June, 1980; (b) 1 year transition for forest

clearing and planting and establishment of permanent crop at catchment A and B from 1st. July, 1980 to 30th. June, 1981; and (c) 4 years evaluation under crops at catchments A and B from 1st. July, 1981 to 30th. June, 1985.

There are at present five DID rainfall stations in the Sg. Tekam Experimental Basin and the instruments consist of four automatic rainfall recorders and one storage gauge. In addition, weekly check gauges are installed in all the four rainfall recorders. To date the river stage at each flow recorder sites of all three catchments are being recorded by means of Ott Weekly Water level recorders. Stick gauges are erected alongside with the recorders to act as checks. The stage-discharge relationship has been obtained by regular volumetric gaugings and currentmeter gaugings. Climate data is at present being recorded at the Tun Razak Agricultural Research station situated about 24 km from the Sg. Tekam Experimental Basin. The following instruments are installed: 1 manual raingauge, 1 recording raingauge, 1 cup anemometer, 1 standard stevenson screen, 1 US class A galvanised iron evaporation pan, 1 sunshine recorder, and 1 black porous disk atmometer. Since 2nd. April, 1974, water quality samples have been collected at each flow recorder site. All samples are taken from mid-stream at the surface, usually fortnightly, and samples are sent to the Chemistry Department at Petaling Jaya for analysis.

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THE MALAYSIAN FORESTER

THE STATUS OF HYDROLOGICAL STUDIES AT THE FOREST RESEARCH INSTITUTE, KEPONG*

by

TANG H.T., MANOKARAN, N. & BLAKE, G.J.*

Summary

The influence of forests on the water and soil balance is briefly reviewed and the status of hydrological studies at the Forest Research Institute, Kepong, described. These studies were initiated in 1974 and there is an urgent need to expand and intensify them to provide the information needed to ensure that forest management is practised with the minimum amount of environmental deterioration.

Introduction

Forested land is the source of most of the country's water supply for irrigation industry, domestic use and recreation. The demand for water for these uses is continually increasing. These same forests, upon felling, have also been a major source of revenue for the country and in the past two decades have been subjected to a very alarming rate of depletion. Between 1971 and 1976, about 1.66 million hectares of forests were felled for conversion to agriculture and a further 0.57 million hectares of forest reserves were opened for logging.

As the area of forest land continues to decrease, more and often conflicting, demands will be placed on the remaining forests. A classic example of such a situation is the logging, albeit under stricter than normal supervision and conditions, of some domestic water supply catchments in this country. The importance of incorporating proper watershed management principles into the management of our remaining forests cannot be overemphasised. In order to do this, reliable quantitative information on the effects of logging on the water and soil balance must be made available.

In Malaysia, hydrological studies of land use change have traditionally been carried out by the Drainage and Irrigation Department and, to a lesser extent, by the Universities. Most of these studies have been confined to areas covered by agricultural crops and, with few exceptions, have not involved the upper reaches of the river systems. Since a large part of the forests covering these upper reaches have been, and will continue to be,

* Paper presented at the Symposium on Water — Agriculture — Malaysia, March 16 – 17, 1979 Kuala Lumpur.

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logged the ensuing changes to the environment and the hydrological cycle must be properly studied and quantified.

The influence of forests on water and soil balance

Water is essential to life. However, as with most things in life, it is usually required in moderation and excesses or shortages of it can result in serious consequences to life. The hydrological cycle, expressed by the movement of water, in any ecosystem is of fundamental importance, affecting the energy balance of the system and providing a route for the movement of nutrients (Kenworthy, 1971). This is particularly true in the tropics because of the high utilisation of water by the tropical vegetation. Whether precipitation occurence is influenced by the presence of forests is difficult to prove. However, changes in the type and density of the vegetation cover do alter the rate and volume of water reaching the land surface, as well as the flow and quality of water discharged into the streams. Much evidence to this effect has been found in many countries (Borman *et al.*, 1968; Likens *et al.*, 1970). Likens *et al.* (1970) found that by removing all vegetation in a small watershed ecosystem and suppressing their regrowth for two years by periodic application of herbicides, the annual stream-flow increased by 39% in the first year and 28% in the second.

In Malaysia, Shallow (1956) found that on steep slopes at the Cameron Highlands, when the forests were converted to tea plantations and vegetable gardens, low stream flows were reduced by 50% in small catchments (50 sq. km) and 75% on larger catchments (500 sq. km). In a study carried out by the Huntings Technical Services Co. (reported by Daniel and Kulasingam, 1974) in Johor, it was found that the peak run-off per unit area from a rubber/oil palm catchment was twice that of the forested catchment. The converse was reported for the low flows.

These increased peak run-offs invariably carry an increased sediment and nutrient load with them. In the study by Shallow (1956) soil losses from forests, tea-plantations and vegetable gardens were found to be in the ratio of 1:20:30. In the Huntings Study (reported by Daniel and Kulasingam, 1974), soil losses increased by a ratio of 1:1.5 in the small catchments and by 1:2.8 in the larger catchments. Extensive studies in Kelantan have indicated that where catchments have more then 30 to 40 per cent of their area under logging and related forest-disturbing land uses, the annual sediment yield is about 300 $m^3/km^2/yr$. compared with 100 $m^3/km^2/yr$. in catchments not recently disturbed (ENEX, 1977). Where the entire catchment is being logged by present methods, the yield was estimated to be about 2500 $m^3/km^2/yr$. Under proper management, these sediment yields may be reduced to acceptable levels. Poor management, however, will result in much larger amounts of sediment, with serious consequences to other users of the water resource.

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Recent hydrological studies in Peninsular Malaysian Forests

Although forest hydrology studies in Peninsular Malaysia date as early as Shallow (1956), most studies are quite recent (Douglas, 1968; Kenworthy, 1971; Low, 1971, 1972; Manokaran, 1977; Peh, 1978; Leigh, 1978a, 1978b; Leigh *et al.*, in press). In addition to these, several river basin studies have also been carried out by various consultants but their results have not generally been published.

Hydrological studies at the F.R.I., Kepong

Since the 1960's it has been apparent that most of the future permanent productive forests of Peninsular Malaysia would be hill forests. Although the logging limits prescribed usually result in the retention of a considerable amount of vegetation in the residual stand, adverse effects on the water yield and quality do occur.

It was not until 1974 that the first hydrological study was initiated by the FRI with the recruitment of a U.S. Peace Corps volunteer experienced in watershed management (B.J. Graves). In that same year, the Kedah Forest Department, reported that the water discharged from the Gunung Jerai catchment frequently contained a high sediment content supposedly caused by the logging activities being carried out within the catchment. This became the site for the first hydrological study which was aimed at determining and reducing the effects of logging activities on water yield and sediment load. Two catchments, one of which was to be logged, were selected for the study and water samples were collected weekly from the streams and analysed for suspended sediment and other water quality variables by the Chemistry Department, Penang. In March 1977, automatic sediment samplers were installed to collect water samples during high-flow periods and in June 1977 a weekly water-level recorder was installed.

A similar study was established in Selangor using three catchments in the Ulu Gombak Forest Reserve. A summary of these studies is shown in Table 1. Both these studies were planned and implemented with the help of several U.S. Peace Corps volunteers (B.J. Graves and J.N. Tornow from 1974 to 1976, H. Thurston and B. Anderson from 1976 to 1978). These two studies are still being monitored and the results collected to date are being analysed by B. Anderson and will be published as an F.R.I. Research Pamphlet.

Briefly, the results endorsed that the major source of increased sediment load in the streams is the improper construction of logging roads. Usually these roads are built by the loggers themselves and are not designed to reduce soil erosion and sediment yields. It was found that by observing some simple rules, e.g. construction of water bars on all unused skid trails and

Table 1. Summary of F.R.I. Hydrological studies

Location of Study	Name of Stream	Treatments	Type of Data Collected	Period Data Collected	Type of Equipment Used
1. Gunong Jerai F.R.	(a) Sg. Tok Pawang (b) Sg. Bujang	(a) Control (b) Logged	(a) suspended sediment (b) water level (c) rainfall (by DID)	May 1975 to present	(a) hand-sampling (b) automatic sediment sampler (from March '77) (c) pressure-bulb water level recorder (June '77 – Sept. '78)
2. Ulu Gombak F.R.	(a) Sg. Gabok (b) Sg. Semaping (c) Sg. Batu Asah	(a) Control (b) Logged (c) Previously logged	(a) suspended sediment (b) rainfall (c) water-level	May 1975 to present	(a) hand-sampling (b) automatic sediment samplers (c) pressure-bulb water level recorder (d) Rainfall recorder
3. Tekam F.R.	Sg. Kundung Balol	(a) Control (b) logging by high-lead (c) logging by 'san-tai-wong'	(a) rainfall (b) water-level	December '78 to present	(a) Rainfall recorder (b) Rain gauge (c) water-level recorder
4. Bt. Berembun F.R.	Sg. Kolinchi	(a) Control (b) logging by modified san-tai-wong	To be started in 1979		

main haul roads, reduction of road grades to below 30% (preferably 20%), use of concrete culverts instead of log culverts etc., the suspended sediment load was reduced very considerably (Anderson, per. comm.). A set of guidelines on road building have been drawn up and will be included in the final report on these two studies.

In January, 1978, a Watershed Research Section (WRS) was officially formed at the F.R.I. with the approval of the post for a Forest Hydrologist. In May 1978 a forest hydrologist advisor, G.J. Blake, joined the WRS on a two year New Zealand Bilateral Aid Project and two experimental basin studies were initiated. The first study is located on sedimentary geology at the Syarikat Jengka Sdn. Bhd. forest concession in Tekam F.R., Pahang. Three small catchments have been selected and the construction of weirs and installation of equipment for calibration studies began in August 1978. The calibration studies are scheduled to be completed by March 1981, after which one catchment will be logged using cable-ways, the second using the san-tai-wong and the third will remain unlogged.

The second study is located on granite geology in the Bt. Berembun F.R. Negeri Sembilan. Three small catchments in the Sg. Kelinchi tributary have been selected and plans for the construction of access roads and weirs, topographical surveys and installation of equipment are being completed. After the completion of the calibration studies, two of these catchments will be logged using san-tai-wong and modified san-tai-wong methods whilst the third will remain as an unlogged control. Both these studies will continue for at least five years after which their progress and necessity for extension will be reviewed.

The primary purpose of these studies is to quantify the hydrological consequences of logging activities in the hill forests with the view to developing guidelines to minimise these consequences. However, this will not be the only objective as the study sites will be used for several other related studies, e.g. nutrient cycling, plant and animal population changes, ecological changes, regeneration and silvicultural studies, etc. Plans for these related studies have not been finalised yet but it is hoped that they will be drawn up and implemented jointly by the FRI and other interested organisations, e.g. the various universities, Agriculture Department, etc.

In addition to these hydrological studies, it is also proposed to carry out a forest erosion survey. Previous studies in Kelantan (ENEX, 1977) have indicated that by mapping the water turbidity of major tributaries at low flow, from an aircraft, the erosion status of catchment areas may be assessed. Correlation with suspended sediment data will enable approximate sediment yields to be calculated. It is proposed to extend the work done in Kelantan to Kedah, Perlis and Perak in 1979 and thereafter to the other

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states. This will provide a means of identifying catchments in urgent need of water resource management.

The Forestry Department is also currently planning to carry out a closely related (to hydrology) project (Mok, per. comm.). This will be aimed at developing criteria for zoning forests in terms of their erosion susceptibility, e.g. production forests with little or no limitations to logging or roading; with minor limitations, moderate limitations, severe limitations, etc. This project is expected to be initiated within the next year or so with the aid of foreign advisors.

Conclusions

The influence of forests, particularly hill forests, on the regulation and quality of water flowing into the rivers of the country cannot be underestimated, or, worse, ignored anymore without very serious consequences to the nation. Logging practices in the hill forests have created hydrological problems by increasing soil erosion and stream sedimentation, changing flow patterns and decreasing water quality and much needs to be done to quantify these effects as the first step towards their mitigation. Recent studies have indicated that these adverse effects can be reduced considerably by the observance of some basic rules on road construction and logging.

The recently initiated experimental basin studies will provide much more quantitative data on the effects of current and future logging practices on the hydrology of forested catchments. It is hoped that in the not too distant future, the remaining forests of the country will be managed to produce not only the maximum amount of timber for revenue, but the maximum benefits, e.g. abundant, clean water, fresh air, recreation areas, wildlife retention etc., to the country in general and to the people in particular.

Acknowledgements

We wish to thank B.J. Graves, J. Tornow, B. Anderson and H. Thurston, all former U.S. Peace Crops Volunteers, for their efforts in initiating and maintaining the first hydrological studies at the F.R.I.

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ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

MALAYSIAN
INFORMATION PAPER
No. 1

ASEAN 79/COFAF.WW/Doc.7

FOREST HYDROLOGY STUDIES AT JENGKA AND BUKIT BEREMBUN HILL FORESTS

KUALA LUMPUR, MALAYSIA
3 - 7 SEPTEMBER, 1979

FOREST HYDROLOGY STUDIES AT JENGKA AND BUKIT BEREMBUN HILL FORESTS*

by

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Summary

The on going forest hydrology studies undertaken jointly by Forestry Department, Peninsular Malaysia and the New Zealand Government under the N.Z. Bi-lateral Aid Programme are briefly reviewed and described. The primary purpose of these studies is to elucidate the hydrological consequence of selective logging activities utilising different mechanised logging systems in Peninsular Malaysia hill forests; and to quantify hydrological consequences with the view to formulating guidelines for minimising these consequences.

1.0 Introduction

At present, forestry activities in Peninsular Malaysia are confined mainly in the hilly regions, especially in the hill dipterocarp forest. Exploitive selection logging practices in this region have created a number of hydrological problems such as increased slope erosion, increased river sedimentation and decreased water quality. This "hydrological instability" often resulted in severe soil erosion and sedimentation of reservoirs built for domestic water supply, irrigation, hydropower production, and agricultural and industrial purposes (Rahmid, 1979).

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

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There are a number of hydrological studies conducted in Peninsular Malaysian Forests. They are, as early as Shallow (1956), Douglas (1968), Kenworthy (1971), Low (1977, 1972), Manokaran (1977), Peh (1978), Leigh (1978a, 1978b), Tang et al. (1979) and include a number of Consultant Reports Apart from small scale studies undertaken by Forest Research Institute, Kepong, and the U.S. Peace Corps Volunteers, there has been no hydrological research programmes implemented to quantify the mechanisms and magnitudes of logging - caused hydrological changes.

It was felt that setting up a hydrological programme for data collection relating to hydrological problems in hill forests and formulation of an appropriate forest management practices are urgently needed by the Forestry Department.

2.0 Background

In 1976, the Malaysian Forestry Department requested assistance from the New Zealand Government to investigate the existing and potential erosion and hydrological problems of the hill forests. Under the New Zealand Bi-lateral Aid Programme a soil and water conservation project was proposed that would study the effects of different mechanised logging systems on stream flow, water attributes, soil erosion and other soil/water parameters in hill forests.

During June 1977, Dr. Colin O'Loughlin (N.Z. FRI official) undertook a brief but comprehensive appraisal of the forest conservation/hydrology problems in Peninsular Malaysia's hill forest. Based on his report it was proposed that a modest three catchment experiment should be established to identify the hydrological consequences of two different selection logging treatments. Following this, a number of discussions were held whereby the Malaysian Forestry Department and the New Zealand Ministry of Foreign Affairs came to an agreement to jointly undertake an experimental catchment programme and forest conservation (later zoning) project in Peninsular Malaysia. It was mutually agreed that the catchment project would be partly financed by the New Zealand Government and partly by the Malaysian Government.

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Provisional approval for financing the project was obtained in 1978 and a New Zealand consulting hydrologist was appointed to the project beginning in May 1978. In June 1978, with the help of Dr. Colin O'Loughlin (the N.Z. Project Supervisor), Gary Blake (N.Z. consulting hydrologist), Malaysian Forestry Department, Department of Irrigation and Drainage, Chemistry Department and Meteorological Department officers, an experimental basin research programme was formulated, the design of the required hydraulic structures was completed and the selection of suitable catchments for the experiment was finalised (O'Loughlin, 1978).

3.0 Purpose and Objective

The purpose of this project is to elucidate the hydrological consequences of selective logging utilising different mechanised logging systems in a Peninsular Malaysian hill forests. The objective is to study the effects of a cable logging method (a modified "south bend" skyline method) and tractor-san tai wong logging methods on:

1) Stream flow quantities (low flows, flood flows, monthly and annual yields);

2) Physical, chemical and biological water quality;

3) Soil erosion and sediment yields;

4) Soil water regimes.

4.0 Method of Study

It was proposed to establish six small experimental catchments (Fig. 1) on two contrasting types of terrain:

1) Jengka experimental basin (Fig. 2)
Forested hill country underlain by Mesozoic sedimentary rocks. Three catchments have been selected for study in the Syarikat Jengka Sdn. Bhd. hill forest concession (Compartment 10B) of the Hutan Simpan Sungai Tekam, Pahang. These catchments which cover 58 ha. are essentially adjacent to each other and are tributaries of the Sungai Balok Kudong, Sg. Tekam, Pahang. Slopes are

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steep averaging about 25°, underlain by arenaceous sedimentary rocks and carry a dense cover of primary forest. These catchments are situated about 40 km by road north of the FELDA Tun Abdul Razak Research Station. Reference Malaya 1: 63360 Sheet 70. 141518.

2) Bukit Berembun experimental basin (Fig. 3)

Three more catchments, one control and two treatment catchments, have also been established on granite terrain at Hutan Simpan Bukit Berembun, near Kuala Pilah, Negri Sembilan. These catchments cover an area of about 53 ha. and are in the Sg. Kelinchi tributary, Sg. Muar, Negri Sembilan. The catchments are situated about 25 km from Seremban. Reference Malaya 1:63360 Sheet 103, 997356.

At each location one catchment will remain as a control catchment while the other two will be logged (at Jengka by cable-logging and san tai wong methods; at Bukit Berembun by traditional and modified san tai wong methods).

5.0 Duration of Study

The experimental research programme involves four phases:

Phase 1: Experimental catchment selection, establishment of stream flow weirs, sediment traps and instrumentation, initial surveys of soil, vegetation and geomorphological surveys (May 1978 - Nov. 1979).

Phase 2: Pre-logging calibration, Measurement of stream flow, water quality, sediment yield and rainfall will be made under virgin forest conditions in all catchments to enable establishment of inter-catchment relationships(January 1979 - March 1981).

Phase 3: Logging. At each experimental basin, two catchments will be logged and the third left undisturbed as a control (March 1981 - October 1981).

Phase 4: Post logging. Measurements of hydrological parameters will continue in all catchment (November 1981 to at least 1985).

6.0 Logging Treatments

With the introduction of cable logging systems in the Syarikat Jengka Timber Complex, it offers an opportunity to test the environmental effects of cable logging as well as tractor logging. It is proposed to log one Jengka catchment with a "Skagit" logging system adopting a "south bend" cable method. The second catchment will be logged using a traditional tractor/san-tai-wong method with no special constraints or controls operating.

For Bukit Berembun granite catchments, it is proposed to log the two treatment catchments with tractor/San-tai-wong methods; one employing carefully designed roads, landings and protection zones and close supervision of harvesting operations, the other by the traditional tractor/San-tai-wong methods with no special restrictions. The treatments as stated above will indicate the differences in sensitivity to traditional tractor/San-tai-wong logging of sedimentary and granite hill forest as well as indicating the degree to which the adverse effects of poor quality logging can be ameliorated by improved logging techniques.

7.0 Instrumentation and Structures

Each catchment is equipped with a 120 degree sharp crested V notch weir and sediment trap - stilling pond instrumented with an automatic water level recorder Stevens Type F water level recorder with 8 day clock). Input from precipitation is measured by automatic and manual rain gauges. Three OTA tipping bucket rain gauges equipped with Ota Keiki recorders plus a network of 8 manual gauges have been installed at Jengka catchments and a similar network has also been partly installed at Bukit Berembun. A small climatological station equipped with maximum and minimum thermometers, wet and dry bulb thermometers, and anemometer (Munro IM 113, and a sunshine recorder (Negretti Zambra, Cambell Stokes types, have been established at Jengka

and a similar climatological station will soon be set up at Bukit Berembun. Photo 1 - 5 show some aspects of Jengka experimental basin.

8.0 Data Collection, Processing and Analyses

The data collection programme for both experimental basins are as follows:

1. Weekly servicing of the water level recorders, checking that they are properly calibrated for stage height and changing of charts.
2. Weekly servicing of the automatic and manual raingauges, checking calibrations and changing of charts.
3. Daily readings of temperature, windrun, thermometers (wet, dry, minimum and maximum) and other climate recordings.
4. Periodic manual collection of 5 litre water samples at the weir outflows for water quality analyses. Sampling through a range of low flows and high flows is essential to characterise the physical, chemical and biological quality of stream flow.
5. Periodic sampling and measurement of sediments accumulated in the sediment traps. This task will be carried out once every 3 to 6 months during the pre-logged period. At each measurement time, the wet volume and wet weight of sediments and organic materials accumulated in the traps will be recorded and a 10 kg. sample will be taken for particle size analysis and organic/mineral ratio determination (O'Loughlin, 1978).

The processing and analyses of stream flow and rainfall are undertaken by the staff of Forest Hydrology Section, FRI and the Engineering Unit, Forestry Headquarters with the help of the Drainage and Irrigation Department which has the "Nova" digitiser, chart analyser and computer facilities. The rainfall and stream flow charts are being digitised in monthly batches; during the first week of each month. The digitised data are stored on magnetic tape for later computer processing. A Tideda programme which lists mean hourly stream flow and hourly rainfall totals, daily, weekly, monthly

and annual stream flow and rainfall quantities and mean hourly flow duration information is being developed. The early stages of the stream flow and rainfall records will be processed manually for checking purposes.

Stream water samples from both experimental basins (Bukit Berembun from October 1979) are being analysed at the Chemistry Department's laboratories in Petaling Jaya. Two-five litre samples are to be collected at each stream gauging station at various intervals to cover a range of flow conditions (low, medium and flood flows). Essentially, determinations of total P, PO_4-P, total N, NO_3-N, NH_4-N, Na, K, Mg, Ca and Fe will be required.

The Meteorological Department will store the climate data.

9.0 Project staffing

The Director of Silviculture, Forestry HQ, is the Co-ordinator for the whole project. Day to day management of the project is the responsibility of the Forest Hydrology Section of FRI, assisted from time to time by other FRI and Forestry Department Headquarters Units. For this function, FRI (Kepong) has established a Forest Hydrology Section which currently consists of one Hydrologist (NZ), two Hydrologists (local counterpart), one Assistant Hydrologist, five Research Assistants (of which 4 are temporary), three technicians (temporary) and two field officers (uniformed staff).

10.0 Preliminary Results

10.1 Available Data

At this time few conclusions may be made from the data so far collected. Computer processing of river flow and rainfall records is making good progress but has yet to reach the analysis phase.

Surveys of slope, vegetation and soils are in progress at Jengka and Bukit Berembun.

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Rainfall records at Jengka started in December 1978 with one automatic station. Six further manual and automatic gauges were installed January 1979 and the climat. station April 1979. At Bukit Berembun rainfall recording started June 1979 and the climat. station has yet to be installed pending delivery of equipment.

By the end of June 1979 Jengka Catchment 3 had produced 29 weeks of flow record, Catchment 2 18 weeks and Catchment 1 19 weeks. The three flow gauging structures at Bukit Berembun have been completed but are yet to produce flow records.

Suspended sediment and water quality sampling is under way at Jengka on a storm basis. The bedload sediment traps are about to be cleaned out to start official measurements prior to the next monsoon.

The Jengka interception/ soil moisture study has been installed and data production is about to start.

10.2 Comments

The aim of the present programme is to obtain two years of good data, for catchment calibration, prior to selective logging of the study early in 1981.

10.2.1 Surveys

A trial slope, vegetation and soil survey was carried out on Jengka Catchment 3 to determine the feasibility of combining detailed survey work. The resulting map, (Scale 1:500, contour interval 5 metres) is adequate for land form studies, location of timber trees and soil surveys. Work is now in progress to extend the project to all catchments at Jengka and Bukit Berembun.

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10.2.1.1 Land forms

Jengka Catchment 3 has some interesting land form features which appear to exist also in Catchments 1 and 2. The lower stream profile is convex consisting of colluvial sediments eroded from a crescent-shaped area of slumping in the middle of the catchment. A major erosion event has occurred possibly within the last 100 - 200 years but until wood samples are dated the timing of the event is not certain. Slopes in all catchments are steep, less than 40°, and mass movement is evident in a number of localities.

From rock samples along the catchment ridges, Catchment 1 appears to have a medium sandstone lithology, Catchment 2 sandstone replaced by siltstone to the south and Catchment 3 finely jointed siltstone.

10.2.1.2 Vegetation

Several different vegetation surveys will be done for the basin. Of immediate concern are the types and location of trees likely to be felled. The Catchment 3 survey indicated, that of the timber species, there are:

100 Dominant trees
47 Co-Dominant trees
53 Suppressed trees

The number of trees exceeding 46 cm stem diameter is 67. This information is necessary to locate various hydrological sampling exercises.

10.2.1.3 Soils

The hill soils of Peninsular Malaysia have yet to be typed and mapped. Initial work at Jengka has shown the soils to be somewhat like the Serdang Series which is described as a fine sandy clay loam. The profile is well developed with a 0-2 cm litter layer

2-10 cm A horizon	- Clay loam with fine to medium subangular blocky structure, 10YR 5/4 to 6/8.
10-20 cm B_1 horizon 20 + cm B_2 horizon	- fine sandy clay with fine subangular blocky structure, 10YR 5/6 to 5/8. Lower limit defined by presence of angular quartz fragments and/or parent rock.

Roots are confined mainly to the top 30 cm. Below 30 cm the profile contains yellow and brown streaks and sometimes pink and red mottles. Carbon fragments occur in a number of profiles. In deeper profiles fine, angular, quartz fragments occur between 40 and 80 cm and in ridge location finely jointed, pink siltstone porent rock is present. To include sand in the soil description seems to be a misnomer for it is very difficult to find sand particles present.

10.2.2 Rainfall

From January to June 1979 the storage raingauge network (excluding the climat. station) recorded total rainfalls of

Station		Dev. from Basin Mean	Station		Dev. from Basin Mean	Station	Dev. from Basin Mean
BG	747mm	0.94	AL	753mm	0.94	BB 803mm	1.01
CG	852mm	1.07	Y/Z	811mm	1.02	AF 793mm	0.99
14/15	825mm	1.03					
Arithmetic Basin Mean 798mm							

For the 6 month period total rainfall varied between +7% and -6% of Basin mean rainfall. Despite the small catchment areas involved (Ca. 1:28.56 ha.; Ca. 2:25.26 ha.; Ca. 3:4.11 ha.) rainfall variation is a significant feature of the hydrology. Compare the maximum and minimum weekly rainfall for the same period.

.	Max.	D.B. Mean	Min.	D.B. Mean	Stat.	Max.	D.B. Mean	Min.	D.B. Mean	Stat.	Max.	D.B. Mean	Min.	D.B. Mean
	116mm	0.92	2.0mm	0.95	AL	123mm	0.98	1.9mm	0.90	BB	120mm	0.95	1.8mm	[illegible]
	134mm	1.06	3.0mm	1.43	Y/Z	126mm	1.00	1.8mm	0.86	AF	120mm	0.95	2.0mm	[illegible]
5	141mm	1.12	2.5mm	1.19										

Arithmetic basin mean maximum weekly rainfall = 126mm + 12%
- 8 %

" " " minimum weekly rainfall = 2.1mm - 43%
- 14%

Note: D.B. Mean = Deviation from Basin Mean

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The rainfall pattern becomes less variable as the storm size increases. Thunderstorm activity outside the northeast monsoon period (November to January) is the main reason for the big variations in storm rainfall totals but it should be noted that when it does rain all gauges are usually effected. Big differences in rainfall intensity rather than rain/no rain cause the difference in totals. This issue will be investigated further when the automatic records have been fully processed. Fig. 4 compares the intensity pattern for the week beginning 8.5.79 for all 3 automatic stations. The majority of rain occurs in the evening about 1800 hours ± 5 hours. Early morning rain is less likely occurring about 0400 hours ± 3 hours. On many occasions storms appear to group, for example on three consecutive days a storm may occur each day at about the same time.

10.2.3 Flow

The water level record for the week beginning 8.5.79 are shown in Fig. 5. The response of the three catchments to rainfall is in proportion to catchment area. Catchment 1 produces the largest flood hydrographs and one would expect Catchment 2 to be close behind. Except for large storms the Catchment 2 hydrographs are smaller than the difference in catchment area would suggest. Greater subsurface water movement in Catchment 2 is thought to be the reason. During low flow periods (more than 5 days without rain) diurnal variations of 4mm in water level occur in Catchment 1. Maximum draw down occurs about 6 pm and this is replenished by about 8 am the following day. This evaporation effect is less obvious in Catchment 2 suggesting that subsurface flow to the channel is less or deeper and therefore not influenced by evaporation. Catchment 3 flucutates daily less than 1mm.

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Catchment 3 being much smaller in area is more responsive to storm rainfall. Approximate times to peak after rainfall starts, maximum recorded discharge (to August 1979) and lowest dischage for all catchments are:

Catchment	Time to Peak	Peak discharge (5.5.79)	Lowest discharge (10.7.79)
1	35 mins.	26.2 l/sec.	0.3 l/sec.
2	25 mins.	22.2 l/sec.	0.3 l/sec.
3	15 mins.	6.0 l/sec.	0.3 l/sec.

Initial data processing has yet to be completed and more definitive data will be produced when all instruments are converted from weekly to daily chart changing.

10.2.4 Climate

Data has been collected from mid June. Readings are made at 0730 and 1330 hours. Some tentative results are:

	0730 hours	1330 hours
Minimum Dry Bulb Temperature, °C (20.6.79 to 21.8.79)	21.8	26.6
Maximum Dry Bulb Temperature, °C	25.0	32.5
Maximum Temperature, °C for sample period	34.3	33.4
		0730 hours
Number of days when sunshine hours > 8		7
> 6		27
Mean daily wind run, km/day		25
Mean daily open pan evaporation, mm/day (25.6.79 to 21.8.79)		3.25

Not all types of data being collected have been included.

10. 2.5 Suspended Sediment

Suspended sediment is sampled on a storm basis and one example is given for a storm occurring 25.6.79. The sediment concentration is given in mg/litre with the stage reading (height of water flow in cm above 120° V notch zero flow):

	Weir 1		Weir 2		Weir 3	
	Stage cm	Sediment mg/l	Stage cm	Sediment mg/l	Stage cm	Sediment mg/l
At storm peak	45.0	-	38.5	-	38.0	-
Sample 1	44.8	449	36.1	118	31.6 ↑	1072
Sample 2	36.0 ↓	29	32.5 ↓	70	31.6 ↓	293
Sample 3	31.4	5	29.4	11	27.8	19
Zero flow	26.3	-	26.1	-	25.0	-

Source Drainage and Irrigation Department, 1979

* ↑↓ Indicates whether samples were collected during rising or falling water levels.

Ideally all the samples should have been collected for the same relative positions on the hydrograph because suspended sediment concentrations vary with amount of water passing over the weir. However this one example does indicate a number of points. A sample for Weir 2 at peak would be higher than 118 mg/l but additional observation have shown that Catchment 2 produces the least suspended sediment. The high concentrations in Catchment 3 are partly the result of channel modifications upstream of the bedload sediment trap. These concentrations will become less as the channel settles down. Sediment concentrations are often higher on the rising water level than the falling water level particularly where fine sediment is present. This appears to be supported by the Weir 3 samples.

10.2.6 Water Quality

Insufficient data for water quality also precludes any detailed analyses. An example of some data collected at the peak of a small storm (14.6.79) is:

	Weir 1	Weir 2	Weir 3
	(All data in mg/l unless otherwise indicated)		
Turbidity	9	2	143
Conductivity (μS)	119	175	148
Total solids	160	145	265
pH (pH units)	7.4	7.7	7.5
Calcium	12.4	26.8	21.6
Chloride	2.6	3.0	2.7
Total Nitrogen	0.06	0.03	0.15
BOD (5 days @ 20%)	0.9	1.0	0.9
Iron	1.2	1.0	3.2
Silica	82.0	41.0	16.0
Sodium	11.5	7.3	7.9

Source Chemistry Department, 1979.

11.0 Conclusion

In view of the rapid land development in Malaysia and other ASEAN Countries, and the lack of data available on the hydrological effects of development, priority must be given to basin type study. These studies provide data and hence guidelines for the improvement of watershed management techniques.

Basin studies are required to determine forested watershed behaviour and response to different logging practices. Where upland forested watersheds exist, their management should be tied closely to the interests of downstream water users, fully recognizing that forest practices and other

activities are reflected in downstream effects.

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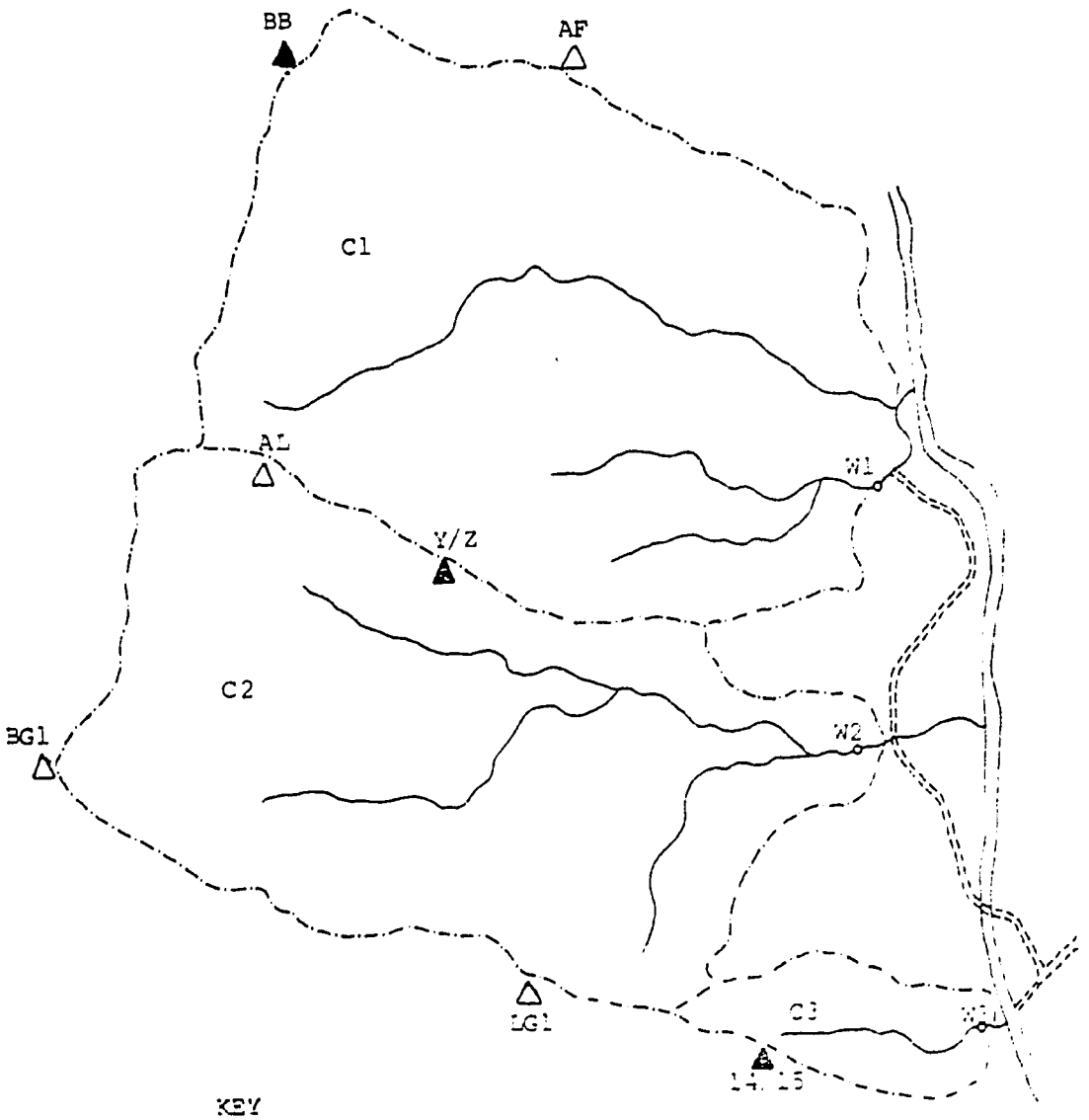
Fig. 1 MAP SHOWING LOCATION OF THE EXPERIMENTAL BASINS AT JENGKA AND BUKIT BEREMBUN

Scale 1" : 46 Miles

Fig. 2 JENGKA EXPERIMENTAL CATCHMENTS AT TEKAM FOREST RESERVE

Scale 1" : 600 Feet



KEY

.....	Catchment Boundary
- - - -	Branch Road
~~	Stream
o	Weir
△	Manual Rainfall Recorder
▲	Automatic Rainfall
C1	28.6 ha.
C2	25.3 ha.
C3	4.1 ha.

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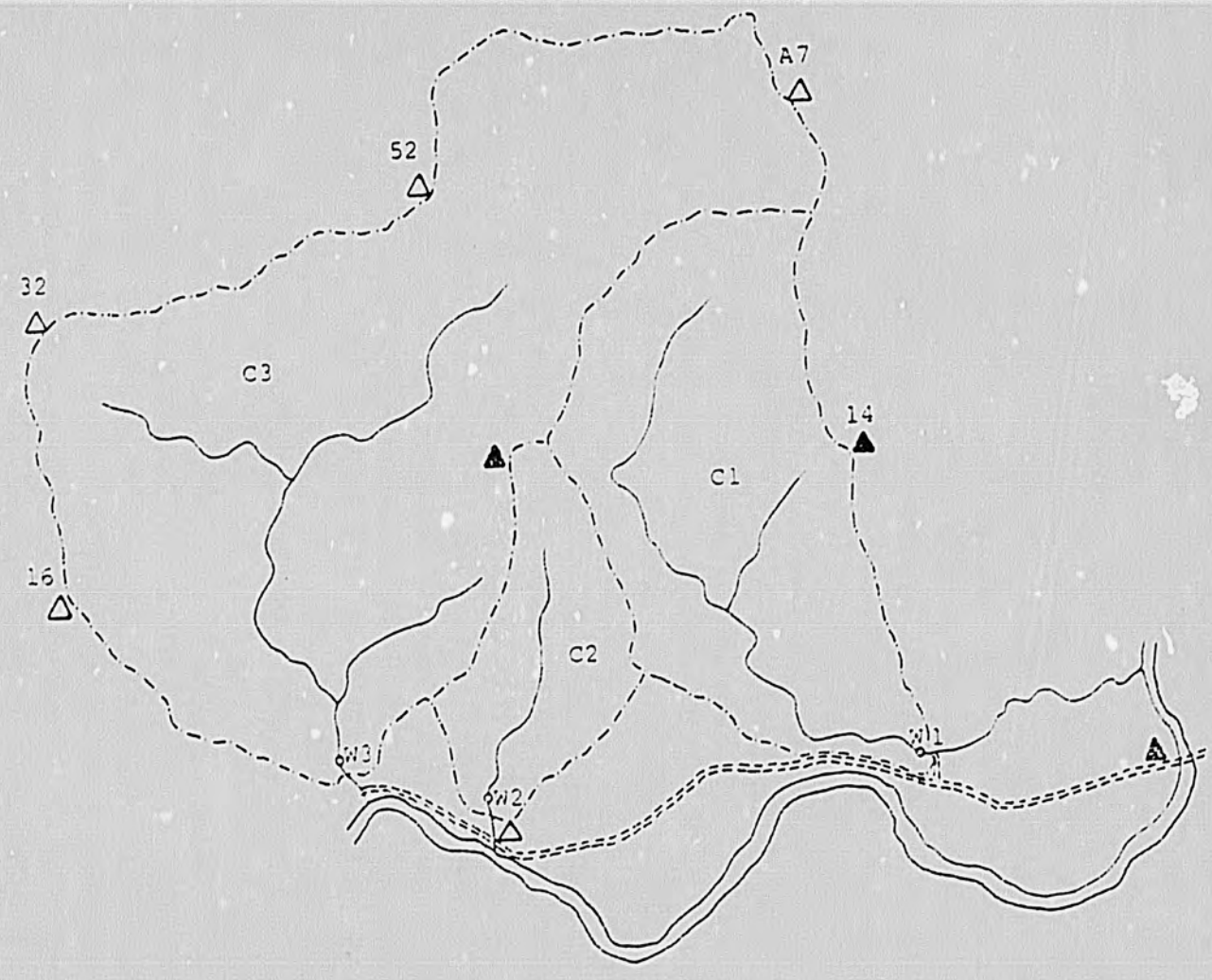
Fig. 3 EXPERIMENTAL CATCHMENTS AT BUKIT BEREMBUN, KUALA PILAH

Scale 1" : 600 Feet



KEY

———	Catchment Boundary
———	Branch Road
———	Stream
o	Weir
△	Manual Rainfall
▲	Automatic Rainfall
C1	10.7 ha.
C2	7.5 ha.
C3	29.1 ha.

125

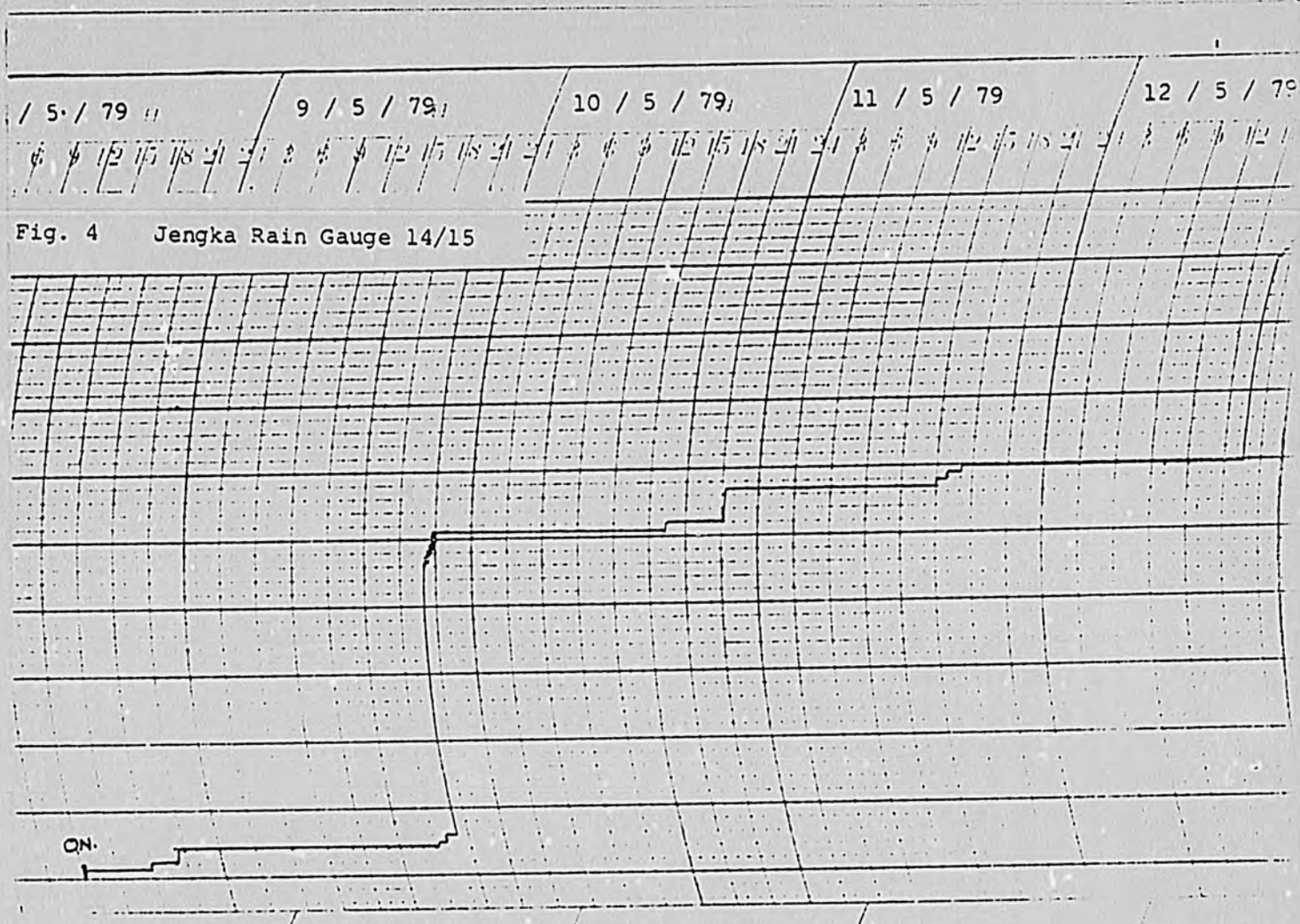


Fig. 4 Jengka Rain Gauge 14/15

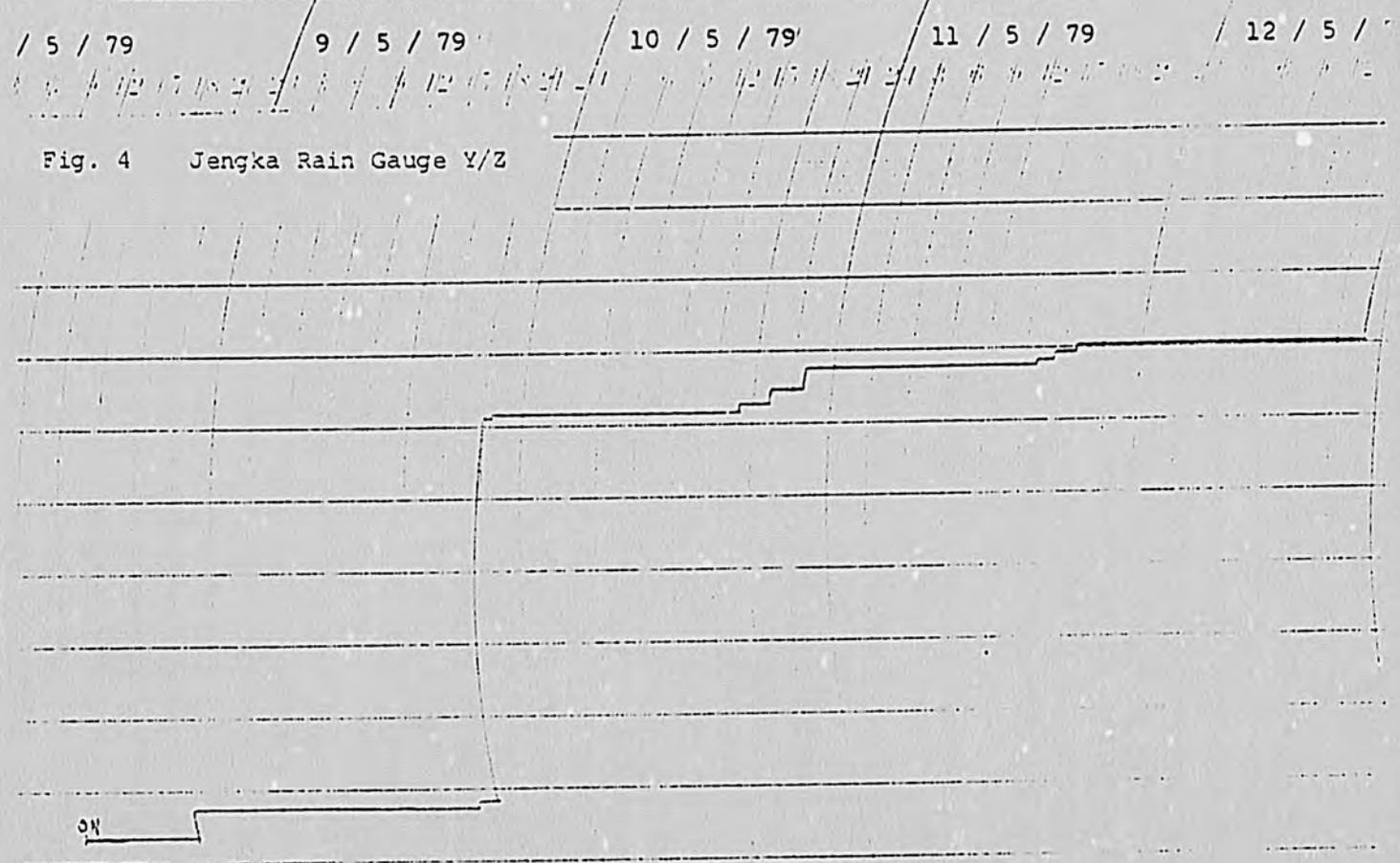


Fig. 4 Jengka Rain Gauge Y/Z

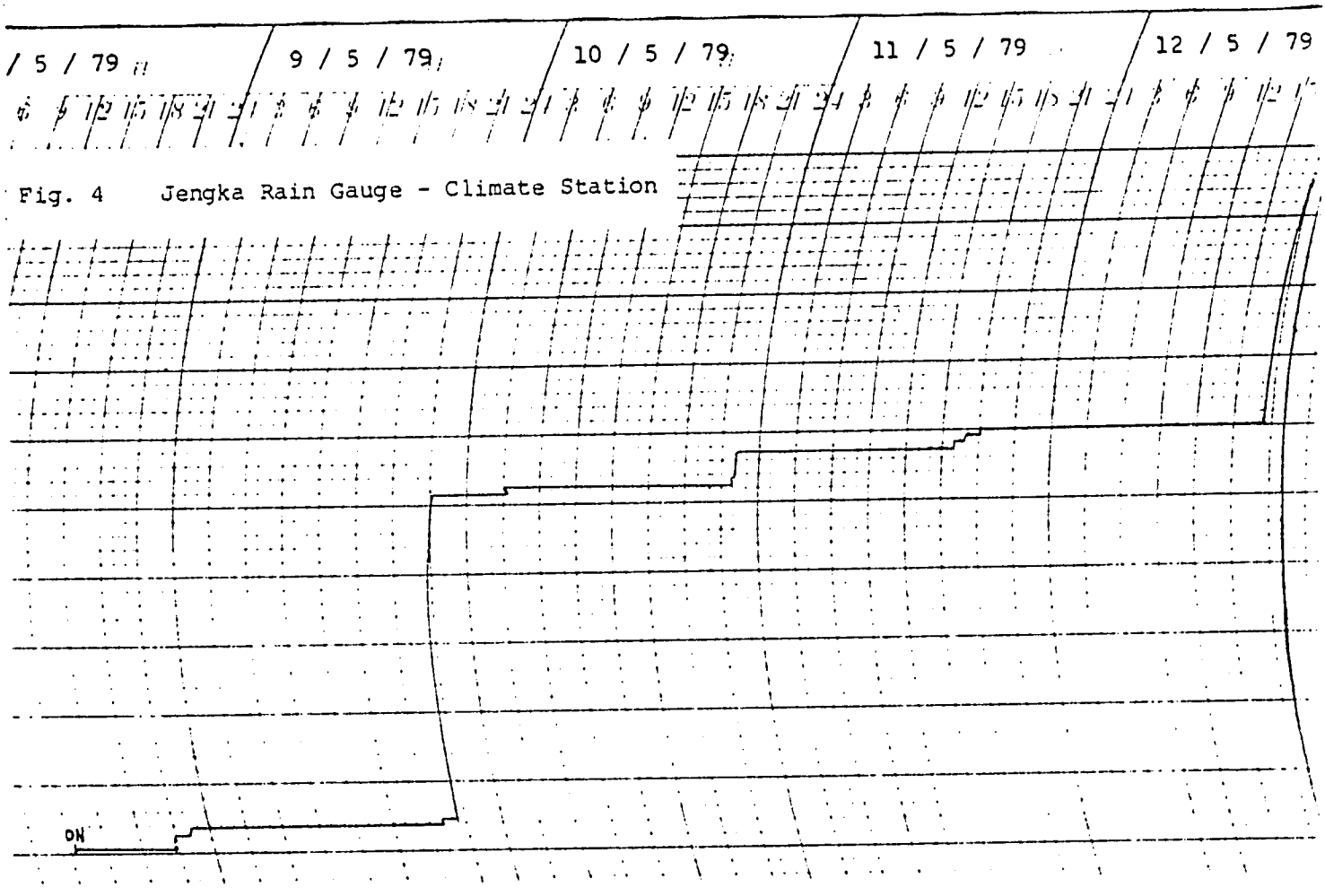
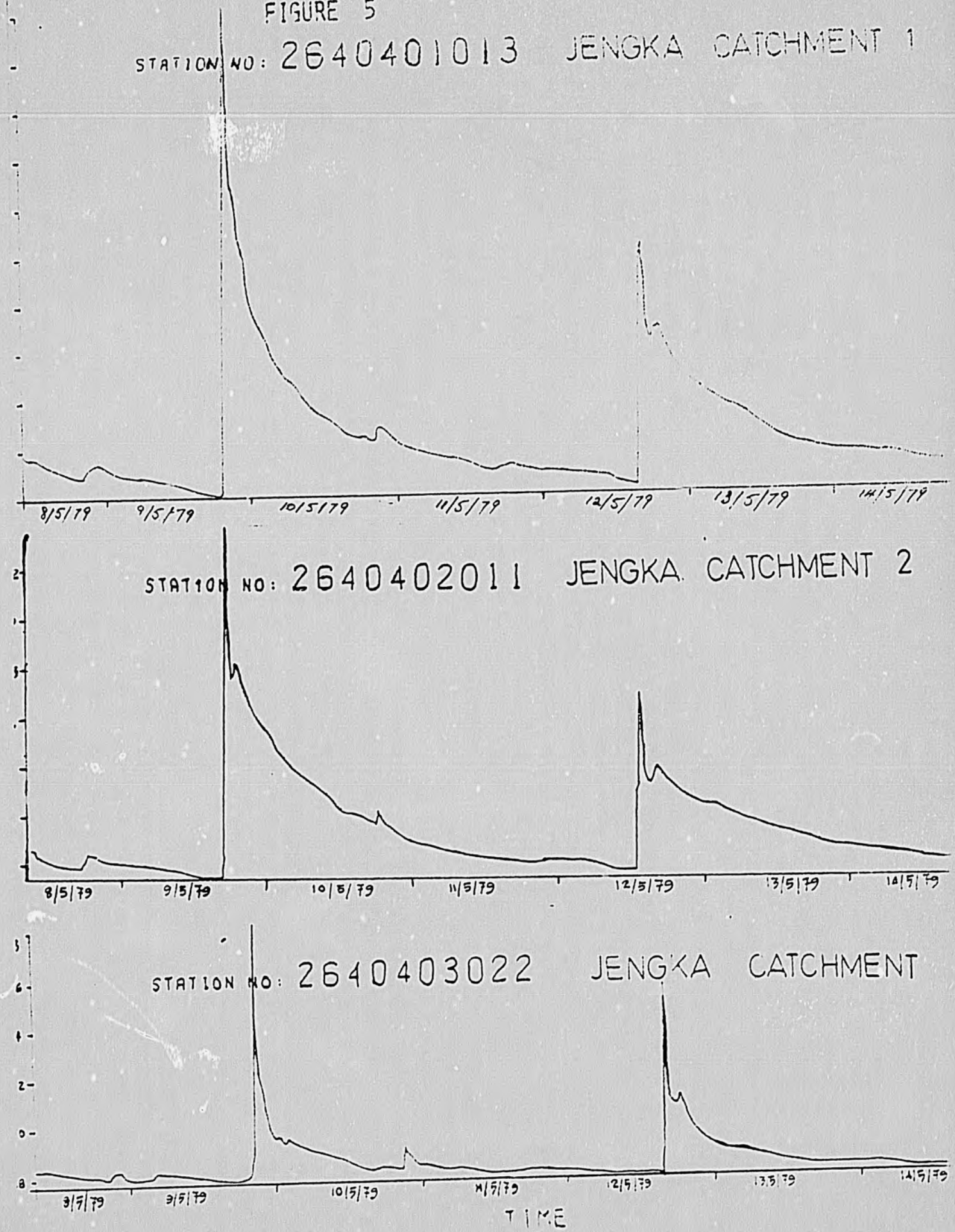


Fig. 4 Jengka Rain Gauge - Climate Station

FIGURE 5


STATION NO: 2640401013 JENGKA CATCHMENT 1
8/5/79
9/5/79
10/5/79
11/5/79
12/5/79
13/5/79
14/5/79
STATION NO: 2640402011 JENGKA CATCHMENT 2
8/5/79
9/5/79
10/5/79
11/5/79
12/5/79
13/5/79
14/5/79
STATION NO: 2640403022 JENGKA CATCHMENT
8/5/79
9/5/79
10/5/79
11/5/79
12/5/79
13/5/79
14/5/79
TIME

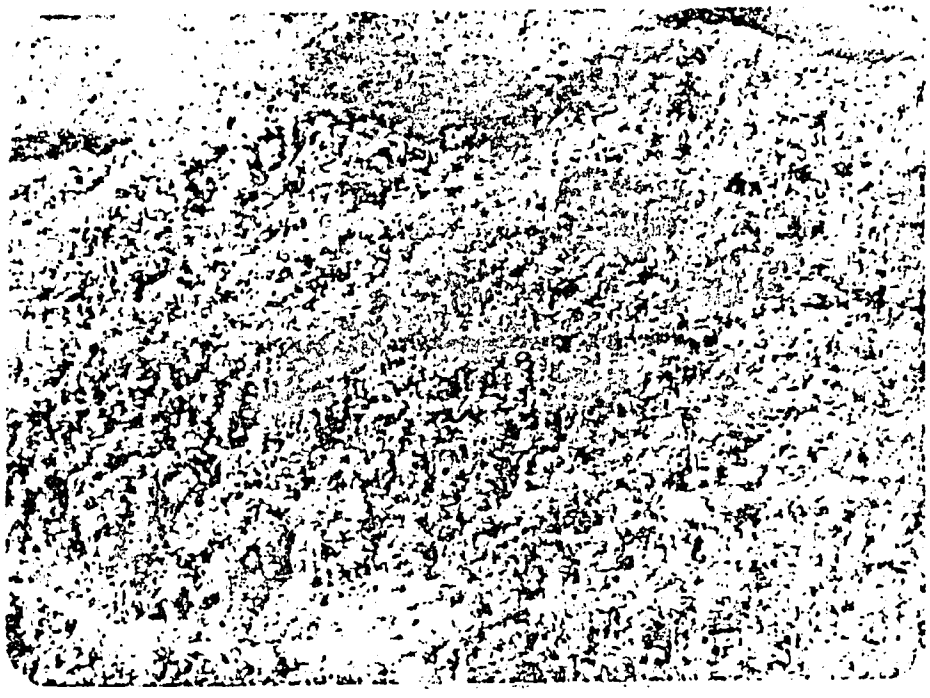


Photo 1 Jengka experimental basin.
The "Field station" at the entrance to Catchment 3 (behind), Catchment 2 and 1 (to right of photograph).

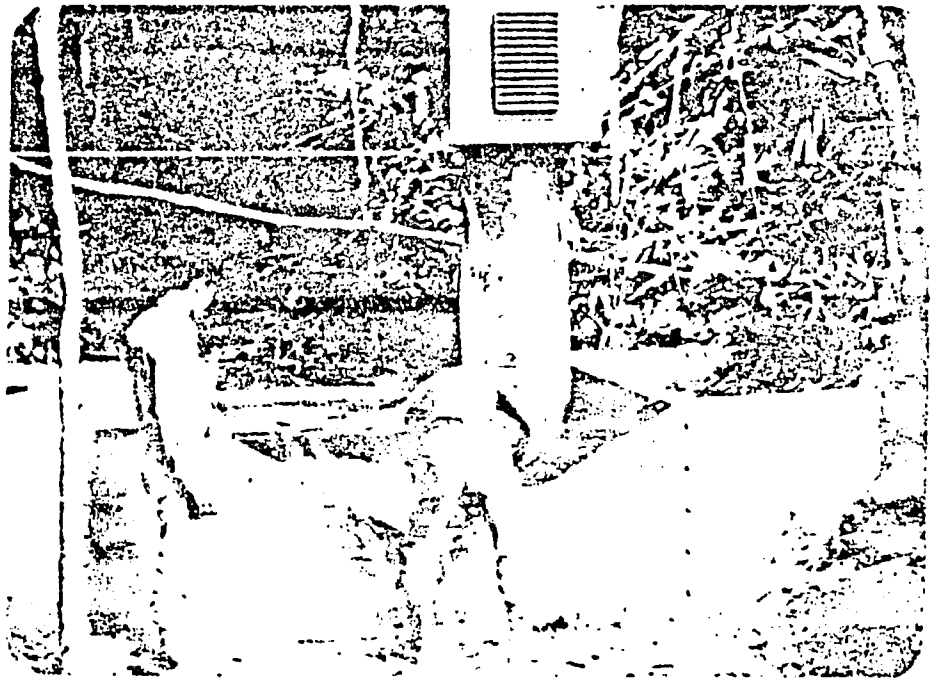


Photo 2 Preparing the edge of the 120° V notch weir, Catchment 3.

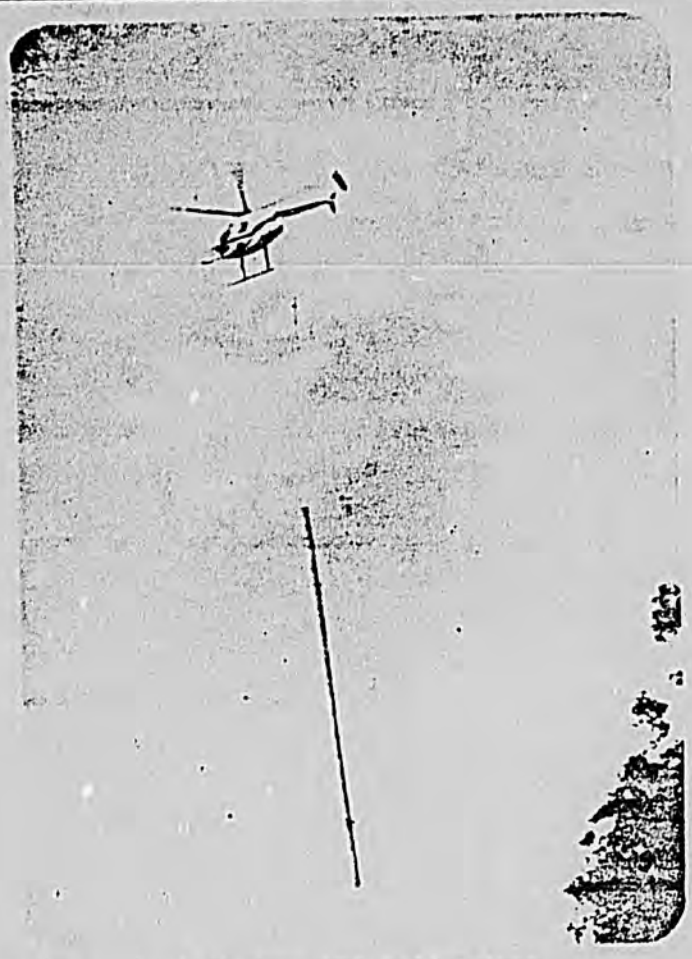


Photo 3 A Hughes 500 helicopter test lifting a raingauge pole.

Photo 5 Raingauge station 3G with manua gauge.

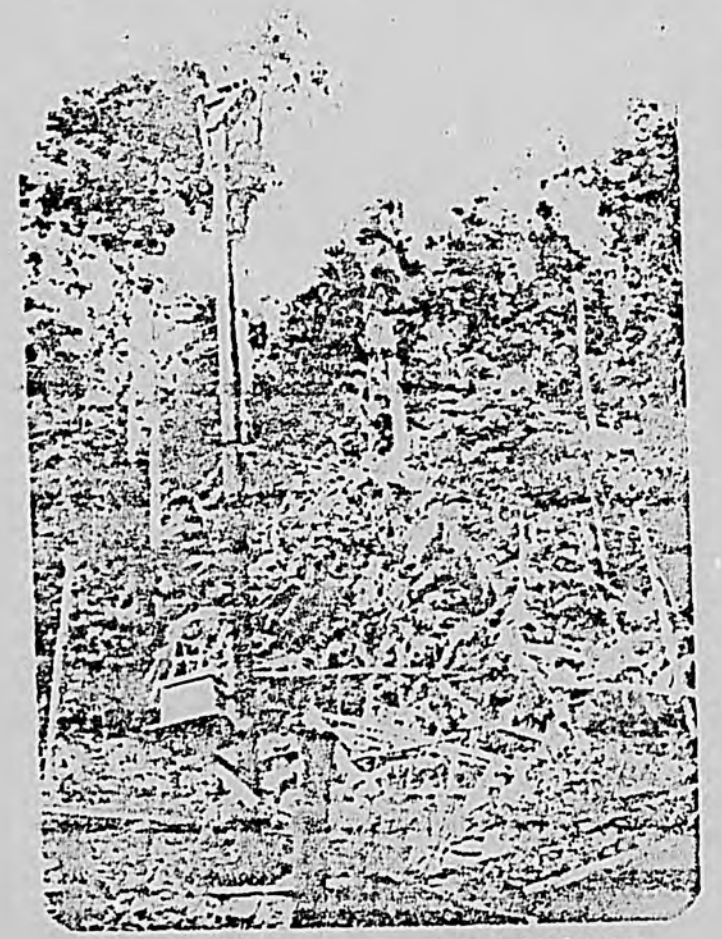


Photo 4 Raingauge station 14/15 with an automatic and manual gauge.

ASEAN WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

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SUNGEI TEKAM EXPERIMENTAL BASINS
A STUDY OF THE EFFECTS OF LAND-USE CHANGE ON THE DENUDATION AND HYDROLOGY OF SMALL WATERSHEDS

KUALA LUMPUR, MALAYSIA
3 - 7 SEPTEMBER, 1979

SUNGEI TEKAM EXPERIMENTAL BASINS
A STUDY OF THE EFFECTS OF LAND-USE CHANGE ON THE DENUDATION AND HYDROLOGY OF SMALL WATERSHEDS*

by

K.S. LOW and C.H. PEH**

Introduction

The drainage basin provides an ideal areal unit for the monitoring of changes to the denudation system and the hydrological cycle consequent to landuse alteration. It is after all, the area which hydrological processes are integrated and for which a water balance can be constructed to show the disposal of precipitation into a number of subsequent forms such as interception, evapotranspiration, soil moisture, groundwater storages and streamflow. It is also the area over which denudational processes operating can be integrated and for which an energy balance can be constructed whereby the precipitation input is equated to an erosional output of water and gravity-moved load. General acceptance by geomorphologists, hydrologists, watershed managers and water resource planners of the use of drainage basins as an ideal unit of study is best illustrated by the concept of drainage basins being used as 'representative' and 'experimental' basins under the research programmes of the International Hydrological Decade and the International Hydrological Programme, UNESCO (Toebes & Ouryvaev, 1970; Rodda, 1976). To date many such basins are calibrated all over the world

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

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for studies on basic hydrological processes, the effects of land-use changes, water resource inventory, and in general, water resource development and management purposes. Notable among such studies are the Coweeta Experimental Basins in North Carolina, United States of America (Dils, 1957; Hadley, 1969), basin studies in East Africa (Pereira, 1952; Pereira, et al, 1962), Australia (AWRC, 1974) and in New Zealand (Ministry of Works, 1970).

It is in this perspective that three small basins of second order streams draining into the Sungai Tekam were selected as areal units of study. The Sungai Tekam Experimental Basins represent the first such study utilizing the 'experimental' basin concept (Toebes & Ouryvaev, 1970) in Malaysia. Owing to the high capital cost of experimental watersheds and the multi-disciplinary nature of watershed studies, the Sungai Tekam Experimental Basins were initiated as a joint cooperative effort by the University of Malaya, Federal Land Development Authority (FELDA), Drainage and Irrigation Department (DID), Forestry Department, Department of Agriculture and Department of Environment as early as 1975. The following are the objectives of the Sungai Tekam Experimental Basin study:

(1) the establishment of denudation rates at two levels of space scale, namely, at the micro-scale level of hillslope and along stream channels (reflecting the overall denudation within the watershed) under forested conditions and during phases of land clearance, replanting and subsequent growth of agricultural crops. Rates of denudation will

be investigated in relation to factors influencing the efficiency of denudational processes such as rainfall variables and morphometric characteristics of the drainage basins. It is envisaged that such studies will form the basis for the prediction of potential sources of sediment supply within small watersheds.

(2) the investigation of the runoff generation process in small watersheds representing an attempt in elucidating controversies such as the Hortonian concept of overland flow as opposed to the variable source area concepts of Hewlett & Hibbert (1967) and Dunne & Black (1970). This is also invaluable in an objective determination of the relative contribution of overland flow, subsurface flow and baseflow to the hydrograph shape and in catchment modelling.

(3) the effects of forest alteration on the streamflow regime of small watersheds such as lag-time, peak flow, recession flow, baseflow and low flows.

(4) the effects of forest alteration on the water yield, the overall water balance of small watersheds.

(5) the effects of various planting and agricultural management techniques on the sediment yield, water yield and water quality of small watersheds.

4/-...

Methodology - the Use of the Experimental Basin Concept

The Sungai Tekam study utilizes the 'experimental' basin concept (Toebes & Ouryvaev, 1970). Experimental basins as defined are essentially small watersheds (small for the reason of sensivity to changes) which have relatively uniform physical characteristics and in which natural conditions, particularly the vegetation cover, will be deliberately modified and an attempt made to determine the effects of this modification (Ward, 1971). In the use of experimental basins, it is significant to note that one of the essential prerequisite is that any cultural change is preceded by a precalibration period. Also when more than one basin is used, a 'control' catchment which is left in its natural state to provide a means for comparison is highly desirable. The Sungai Tekam Experimental Basins which consist of three small drainage basins are selected with these considerations in mind.

Location of Experimental Basins

The Sungai Tekam Experimental Basins are located within the area of the FELDA Tun Razak Agricultural Research Station, in Jerantut District, Pahang (Fig. 1). The area lies within 420 ha (1040 acres) of selectively-logged forest land. The three experimental basins are named Catchment A, which is nested within a greater catchment named Catchment B (Fig. 2), both of which are classified as 'operational' catchment. These two catchments will be logged after an initial calibration period and replanted with agricultural crops. Catchment C will remain under its forest cover to serve as a 'control' catchment for comparison purposes - this being one of the most essential feature in the experimental basin concept.

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Duration of Experiments

To achieve the aims and objectives of the study, the duration of experiments is divided into three main phases, namely:

Phase 1 - A calibration period under present forest conditions at the three catchments is considered to be essential and is scheduled to be from 1st April, 1977 to 30th June, 1980.

Phase 2 - A transition period for forest clearing, planting and establishment of permanent crops (oil palm and cocoa) at Basins A and B, from 1st July, 1980 to 30th June, 1981.

Phase 3 - An evaluation period under crops (Basins A and B) from 1st July, 1981 to 30th June, 1985.

Instrumentation

Hydrometeorological data is at present being recorded at the Tun Razak Agricultural Research Station (Plate 1), situated about 2½ km. from the basins. It has been in operation since March, 1969, under FELDA staff. The following instruments have been installed:

- 1 manual raingauge, 125 mm capacity (5 inch).
- 1 automatic recording raingauge (0.5 mm tipping bucket rainfall sensor with Hattori weekly recorder).
- 1 cup anemometer (wind run only).
- 1 standard Stevenson screen containing maximum, minimum wet and dry bulb thermometers.
- 1 US Class A White galvanised iron evaporation pan.
- 1 sunshine recorder.
- 1 black porous disk atmometer.

6/-...

Figure [illegible] Location Map of the Sungai Tekam Experimental Basins.

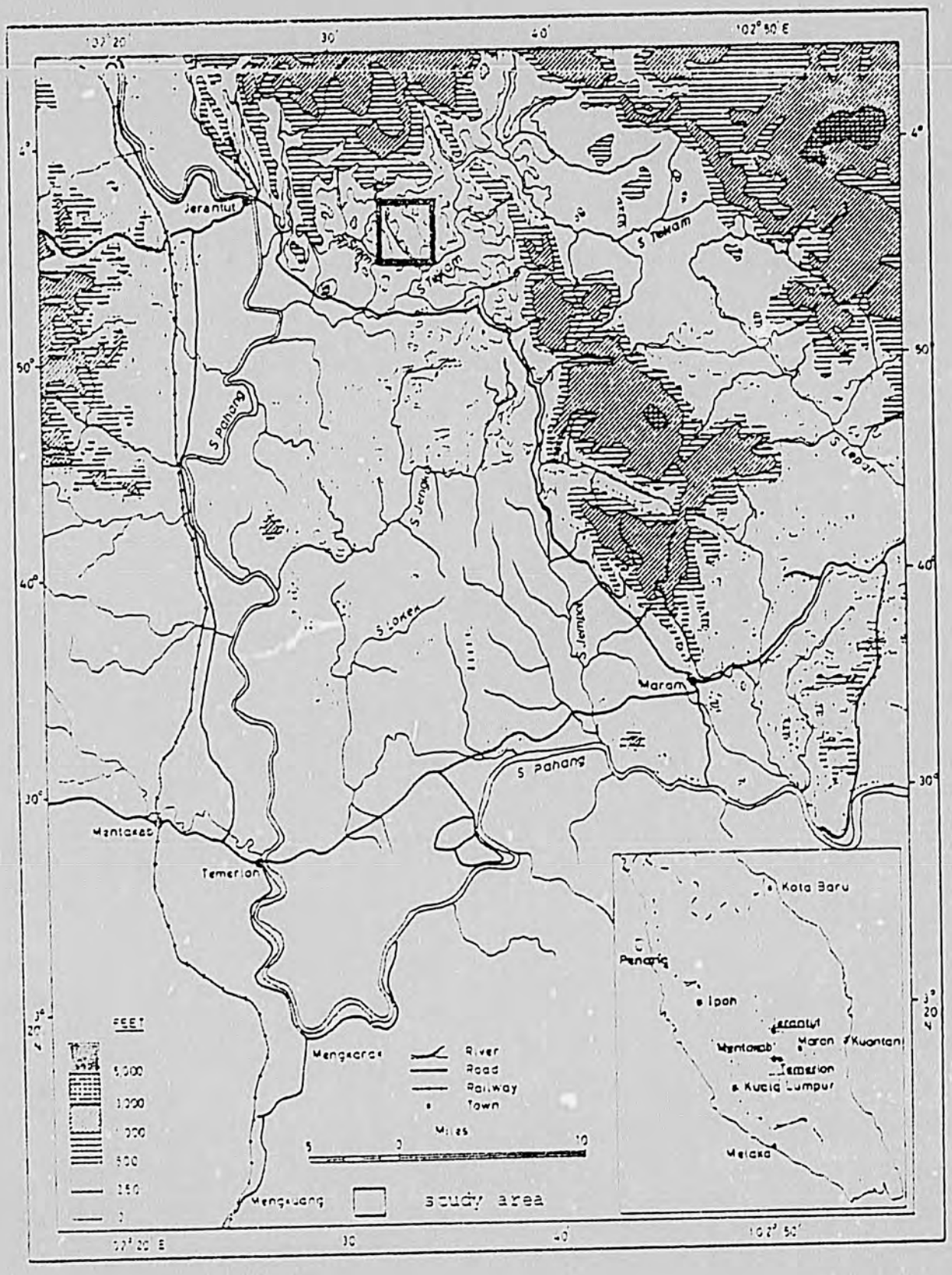

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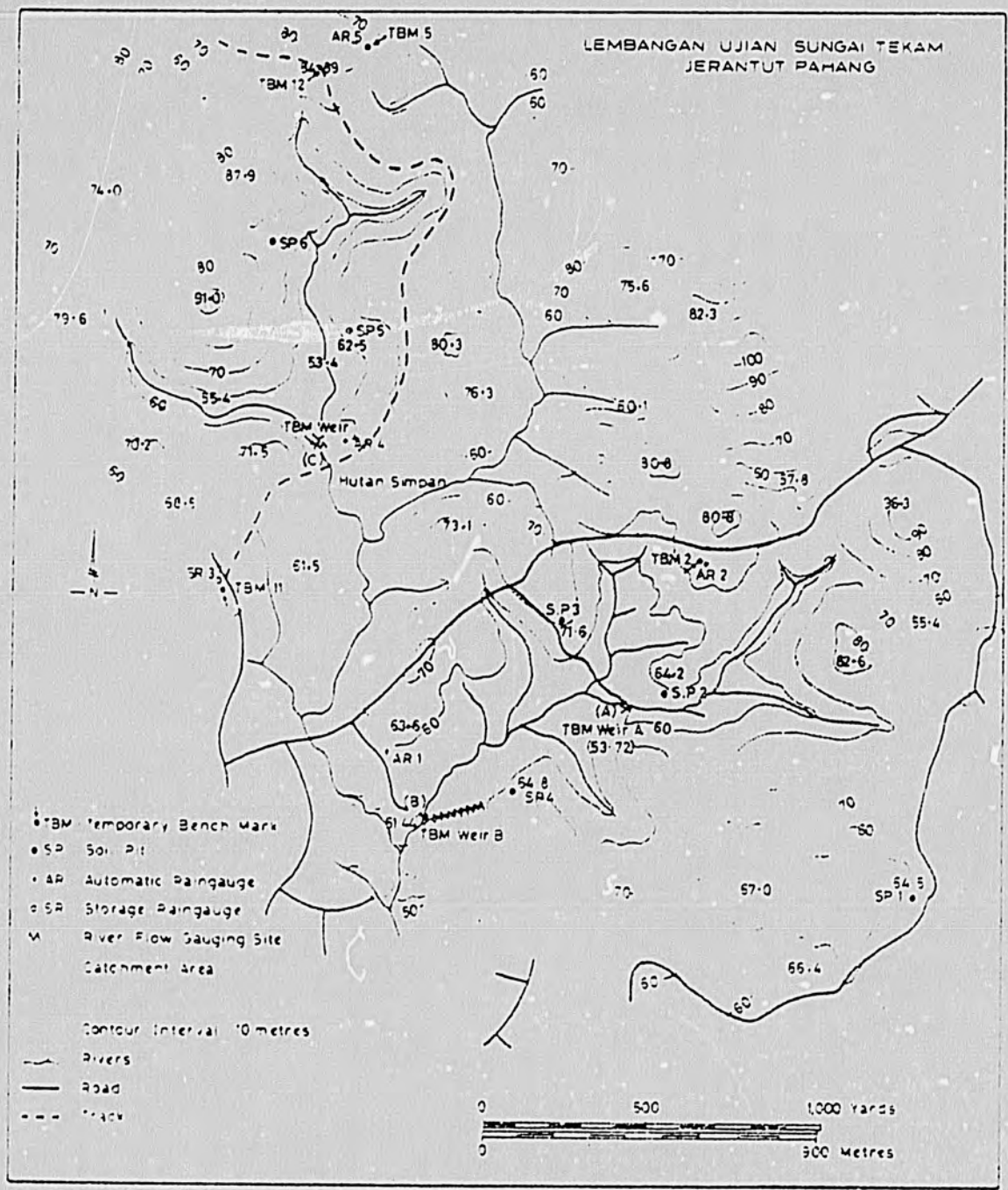
FIGURE 2 - Ground Survey Map of the Sungai Tekam Experimental Basins.



Map of Sungai Tekam drainage basins based on ground survey (1 5,000) carried out by Jabatan Ukur Malaysia

Besides this climate station, the Drainage and Irrigation Department has set up a network of five rainfall stations in the Sungai Tekam Experimental Basins (Fig. 2, Plate 2). Four of the rainfall stations are equipped with automatic recording raingauges of the Hattori tipping bucket, rainfall sensor type with weekly OTA recorder. All the rainfall stations are maintained by DID and FELDA staff.

Three water level stations were installed by the DID at selected sites of the three drainage basins (Catchment A, B and C). As early as 1976, 'HL' flumes were installed at these stations for the measurement of discharge. However, these were found to be unsuitable as the gradient of the stream channels was not great enough to allow for free-flow conditions. Subsequently, these were replaced by 120° V-notch sharp crested weirs in 1977, (Plates 3, 4 & 5). As a further check on the accuracy of the weirs, automatic water-level recorders of the Ott weekly type were installed, (Plate 6). These are all maintained by the DID.

For the rating and measurement of suspended and dissolved sediments depth integrated stage sediment samplers have been installed at each of the weir sites. These are maintained by the Geography Department , University of Malaya.

The sites for installing towers to measure the amount of interception of precipitation have been chosen at Catchments B and C. Small evaporimeter dishes will also be purchased and attached to these towers at 1 metre intervals to measure the aerodynamic flow of wind with tree height for a more accurate measurement of evaporation and evapotranspiration.

7/-...

Basin Details

The area and mean elevation of the three basins are indicated in Table 1. Particle size analysis of the regolith at five soil pits in the basins indicate a highly weathered regolith with the clay-sized fractions exceeding 80% except at Pit 6 where an indurated band of laterite occurs at a depth of approximately 60 cm (Table 2).

TABLE 1

AREA AND MEAN ELEVATION OF THE SUNGAI TEKAM EXPERIMENTAL BASINS

CATCHMENT	AREA (ha)	MEAN ELEVATION (m)
A	35.9	72.5
B	94.6	68.5
C	57.5	70.0

Textural differences in the weathered regolith have been noted to affect soil porosity, infiltration rates and ultimately the generation of runoff on hillslopes and streamflow in drainage basins (Eyles, 1968; Horton, 1933; Hewlett & Hibbert, 1967). Table 3 provides an indication of the moisture retention characteristics at the five soil pits in the basins. The relatively higher volume of 'quick' drainage pores for the top surface layer of the regolith would seem to suggest relatively more rapid infilration rates.

TABLE 2

SOIL PARTICLE-SIZE DISTRIBUTION OF

THE SUNGAI TEKAM DRAINAGE BASINS

DRAINAGE BASIN	SOIL SAMPLE PIT NO.	SAMPLE DEPTH (cm)	GRANULOMETRY*			SILT/CLAY RATIO
			Clay %	Silt %	Sand %	
BASIN A	2	0-15	79.8	14.8	6.4	0.18
		15-30	82.5	13.7	5.5	0.17
		30-60	84.1	13.5	4.4	0.16
		60-91	84.5	11.3	3.8	0.13
		> 91	83.7	13.6	4.1	0.16
BASIN B	3	0-15	86.3	10.6	3.2	0.12
		15-30	87.5	10.9	3.1	0.12
		30-60	90.1	8.6	2.3	0.09
		60-91	88.8	10.6	2.6	0.11
		> 91	89.4	10.2	2.5	0.11
	4	0-15	83.5	9	7.4	0.11
		15-30	85.2	10.2	6.3	0.12
		30-60	82.8	9.3	7.9	0.11
		60-91	83.6	9.7	5.5	0.12
		> 91	79**	12.3**	6.8**	0.15
BASIN C	5	0-15	81.4	16.7	9.3	0.20
		15-30	76.7	15.7	7.4	0.20
		30-60	81.5	12.6	5.5	0.15
		60-91	83.7	11.6	4.2	0.14
		> 91	83.6	10.8	7.4	0.13
	6	0-15	84.6	9.2	6	0.11
		15-30	86.9	9.2	3.1	0.10
		30-60	84.0**	8.1**	7.9**	0.09
		60-91	68.0	8.2	23.0	0.12
		> 91	-***	-***	-***	-***

* Analyses by pipette method

** Analyses by Department of Agriculture, Malaysia.

*** No analysis due to laterite layer.

9/-...

TABLE 3

SOIL MOISTURE RETENTION CHARACTERISTICS IN SUNGAI TEKAM DRAINAGE BASINS

DRAINAGE BASIN	SAMPLE PIT NO.	SAMPLE DEPTH (cm)	BULK* DENSITY (gm. cm^{-3})	TOTAL PORE SPACE (% volume)	MOISTURE CONTENT (% volume) at*					QUICK DRAINAGE PORES (% Vol. Tps-% Vol. pF2)	SLOW DRAINAGE PORES (% Vol. pF2- % Vol. pF2.54)
					pF 0	pF 1	pF 2	pF2.54	pF4.19		
BASIN A	2	3-71	1.081	58.33	67.96	58.93	55.14	53.78	47.43	3.19	1.36
		71-118	1.086	57.62	70.82	60.77	55.32	53.13	50.92	2.30	2.19
BASIN B	3	4-50	1.104	58.70	53.22	50.93	49.18	48.18	43.53	9.52	1.00
		> 95	1.132	58.26	64.00	58.24	53.76	52.91	47.94	4.50	0.85
	4	4-50	1.017	60.00	67.23	58.63	53.38	51.39	46.91	6.62	1.99
		50-95	1.033	60.23	63.72	58.51	56.13	54.26	49.72	4.10	1.87
BASIN C	5	2-39	1.043	62.86	62.37	55.06	50.15	47.63	40.91	12.71	2.53
		39-72	1.042	56.80	61.04	55.93	51.88	48.92	42.23	4.92	4.25
		72-130	1.152	57.15	71.30	59.93	53.27	52.24	46.87	3.88	1.03
	6	1-33	1.066	60.77	65.25	54.68	52.98	50.40	47.63	7.79	2.58

* Analyses undertaken by Soil Laboratory, University of Agriculture Malaysia.

Slope Forms

Hillslope form constitutes the basic land surface component which collectively gives expression to the morphometry of drainage basins. Also it constitutes the basic response unit for the operation of drainage basin processes being the focal point of controversy pertaining to runoff generation processes in watersheds such as the Hortonian concept of overland flow (1933) as opposed to the variable source area concept of Hewlett & Hibbert (1967) and Dunne & Black (1970). The validity of such concepts is vital in the determination of potential sediment source areas and in catchment modelling.

The Sungai Tekam drainage basins are located in a landform region which is described by Eyles (1968) as consisting of low convex hills. Frequency analyses of slope angles in the three basins gives an average of 6° - 8° (Figures 3 & 4). Typical profiles of valleyside slopes are characterised by slope segments rising abruptly from valley floors and immediately reaching its maximum slope before proceeding upslope to interfluve crests of gentle convexity. Maximum segments of valley-side slopes have been observed to rise up to as much as 25°. However, these are limited in occurrence. Asymmetry of valley cross-sections is noted to occur. Valley-head slopes of the three basins are found to be different in form from valley-side slopes. Generally, such slopes are amphitheatre-like consisting of moderately steep rectilinear basal sections and interfluve crests of gentle convexity. A notable feature is the limited occurrence of concave slope sections in the basins.

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FIGURE 3 - Slope Angle Frequency Distribution of Sungai Tekam Experimental Basins.

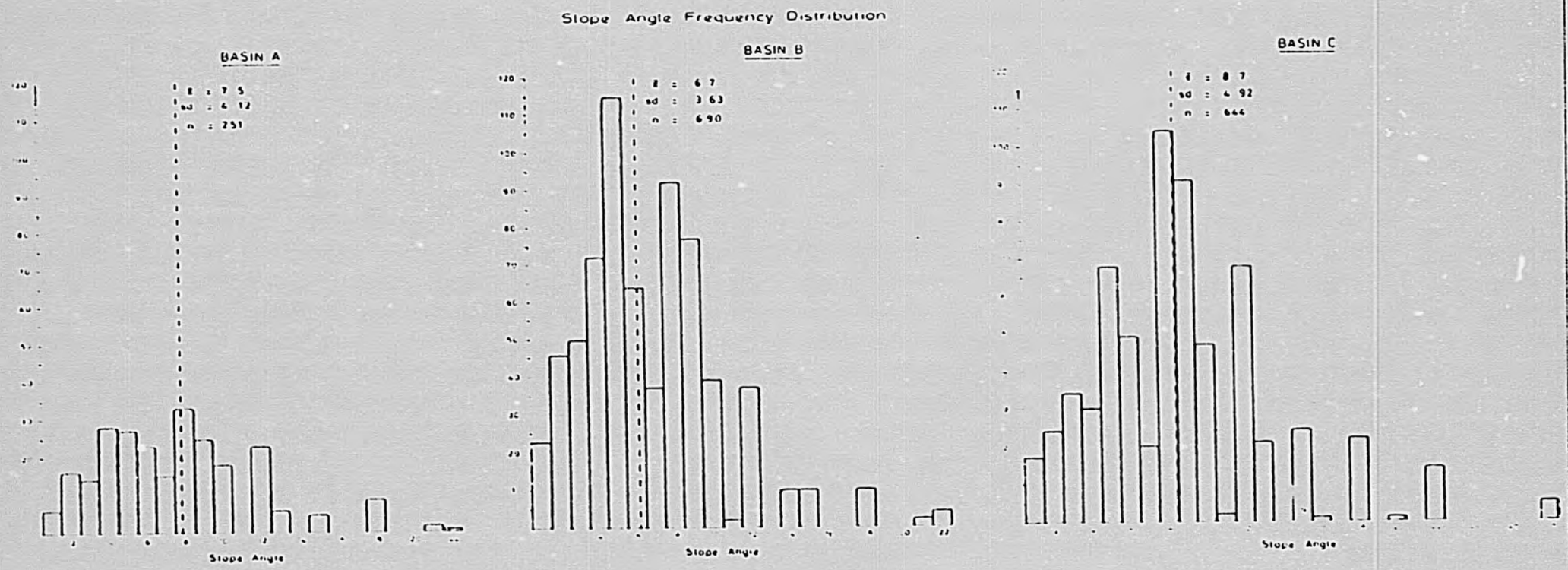

FIGURE 4 - Slope Angle Frequency Distribution of the Sungai Tekam Experimental Basins.

Morphometry of Basins

The influence of morphometric properties of drainage basins on denudational and hydrological processes of drainage basins has been generally accepted. A host of morphometric properties exist and has been used to relate empirically and inductively the form and process of the drainage basin (Abrahams, 1972; Carlston, 1963; Mustenon, 1967; Patton & Baker, 1976; Seyhan, 1976; Strahler, 1964; Taylor & Schwartz, 1952). However, in this study only four morphometric parameters have been derived, namely, hypsometric integral, drainage density constant of channel maintenance and the length of overland flow (Table 4). Owing to the smallness of the drainage basins (the three basins being drained by only second order streams) certain morphometric parameters could not be computed such as the bifurcation ratios.

The hyspometric integral provides a quantitative measure of the stage of dissection that a drainage basin has undergone. The numerical value of the integral indicates the amount of material above local base level that still remains to be removed by denudational processes. In basins A & B similar values of the hypsometric integral were derived indicating the similar level of dissection which has been reached by the three basins. The similarity of these integrals (Figure 5) is significant in the sense that it justified the choice of Basins A, B and C as experimental basins as the very concept of experimental basin necessitates that all physical parameters be similar so as to validate comparisons between control and operational catchments.

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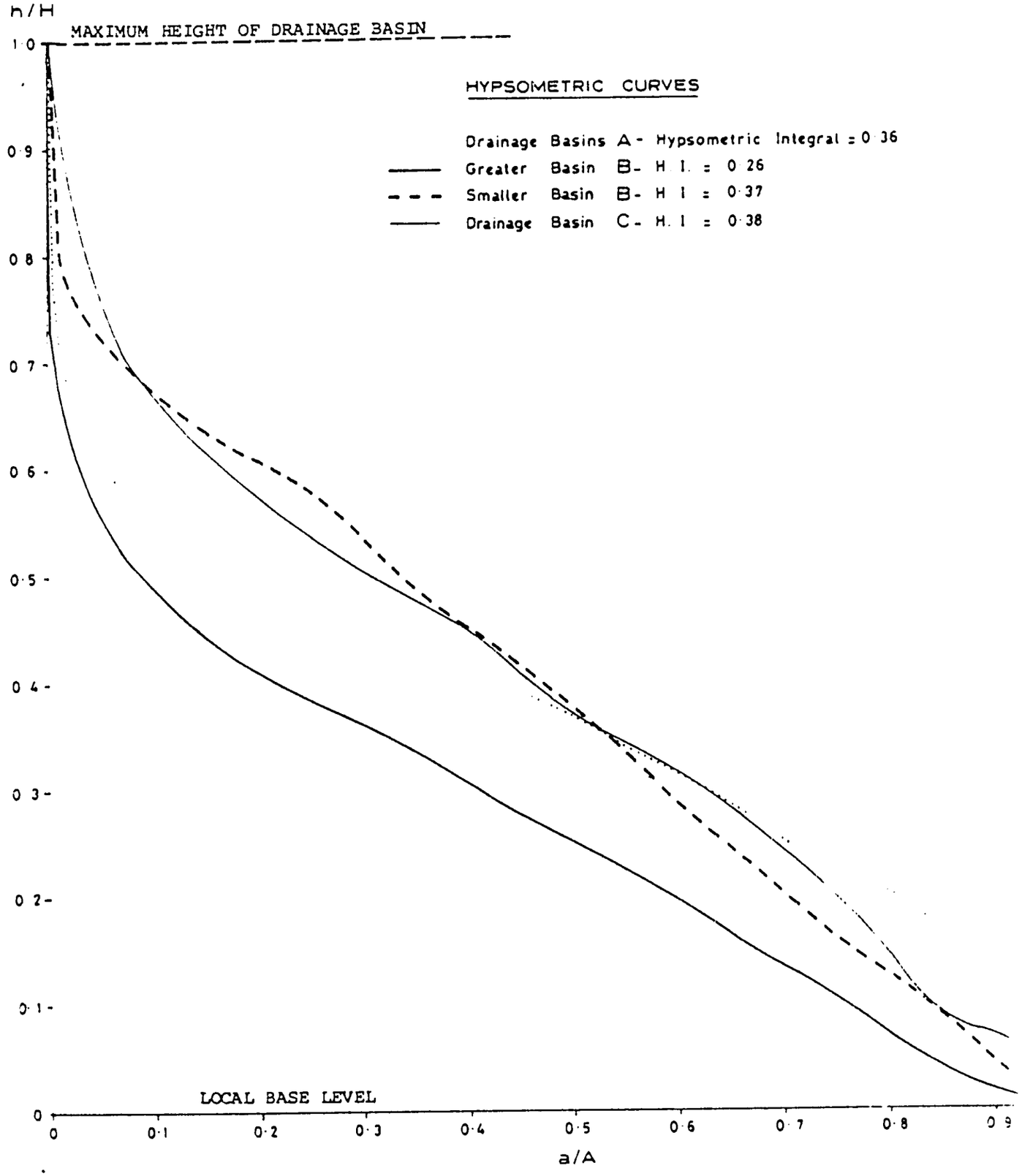

FIGURE 5 - Hypsometric Integrals of the Sungai Tekam Experimental Basins.

TABLE 4

MORPHOMETRIC PROPERTIES OF SUNGAI TEKAM DRAINAGE BASINS

DRAINAGE BASIN	AREA (ha.)	DRAINAGE DENSITY (metres ha^{-1})	HYPSOMETRIC INTEGRAL	CONSTANT OF CHANNEL MAINTENANCE	LENGTH OF OVERLAND FLOW
Basin A	35.9	43.34	0.36	230	115
Basin B smaller	58.75	48.52	0.37	206	103
Greater (A + B)	94.65	46.55	0.26	214	107
Basin C	57.48	36.98	0.38	270	135

Drainage density is the total length of all the streams in the basin divided by the area. It is thus the average length of stream channel for each unit area. The constant of channel maintenance is the reciprocal of drainage density, which empirically indicates the area required to maintain each unit length of stream (Schumm, 1956). Half the value of the constant of channel maintenance gives the average horizontal distance between all the watersheds and streams within the basin. This is generally termed the length of overland flow. The speed of the unconcentrated flow overland is very much lower than when concentrated in a channel. It follows that the smaller the value of the length of overland flow, the quicker surface runoff will enter the streams. In a relatively homogeneous area, therefore, less rainfall is required to contribute a significant volume

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of surface runoff to stream discharge when the value of the length of overland flow is small than when it is large. This concept is used to explain partially the flashy nature of streamflow in small watersheds. The lower value of the length of overland flow in Basin B suggests a faster response to runoff should all other factors remain equal (Table 4).

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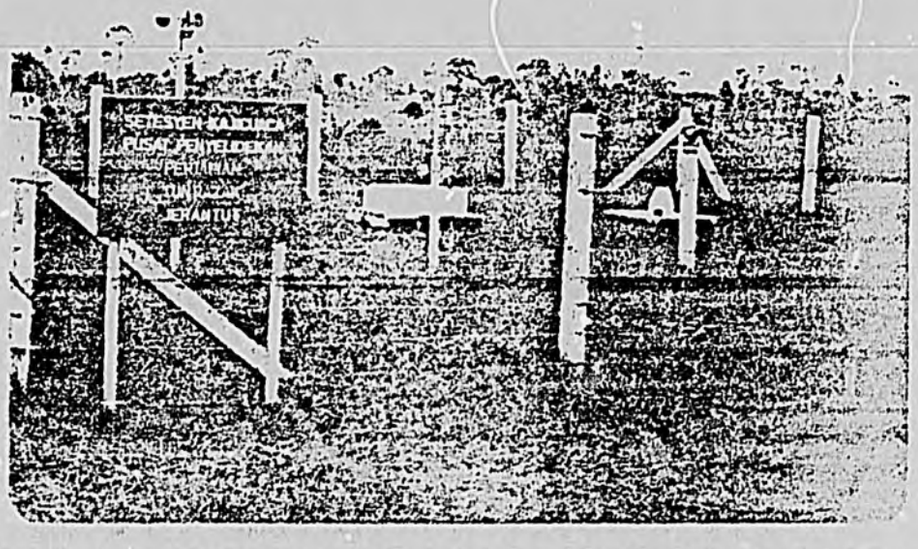

Plate 1 Meteorological Station for the experimental basins.

Plate 2

Automatic rainfall recorder (Type Hattori, tipping bucket with weekly OTA recorder) at Rainfall Station 2, Catchment B.

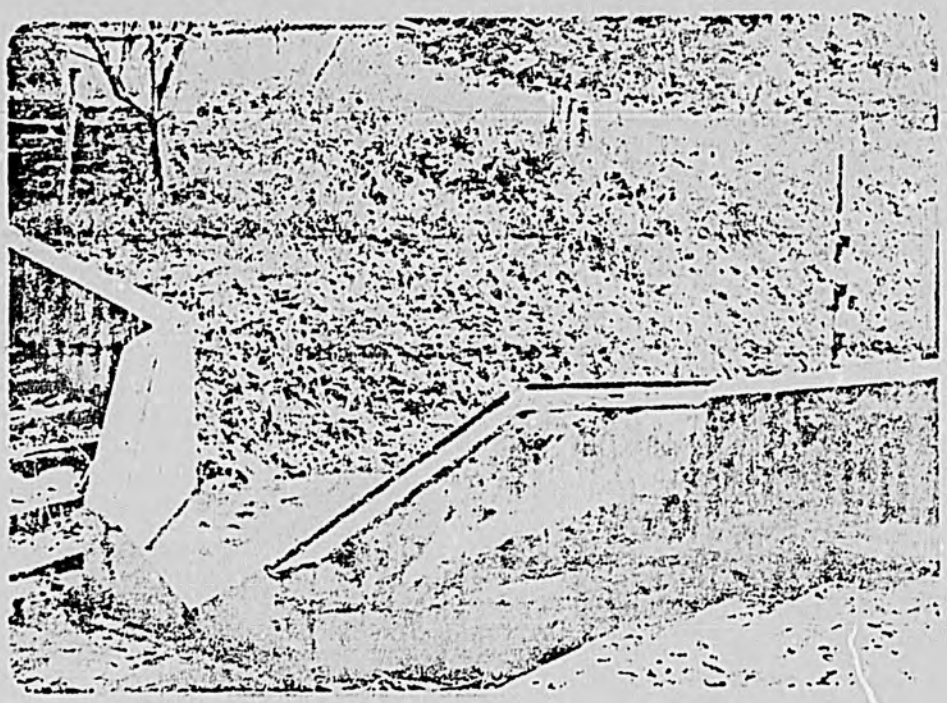

Plate 3 Sharp crested weir (120°V-notch) at Catchment A

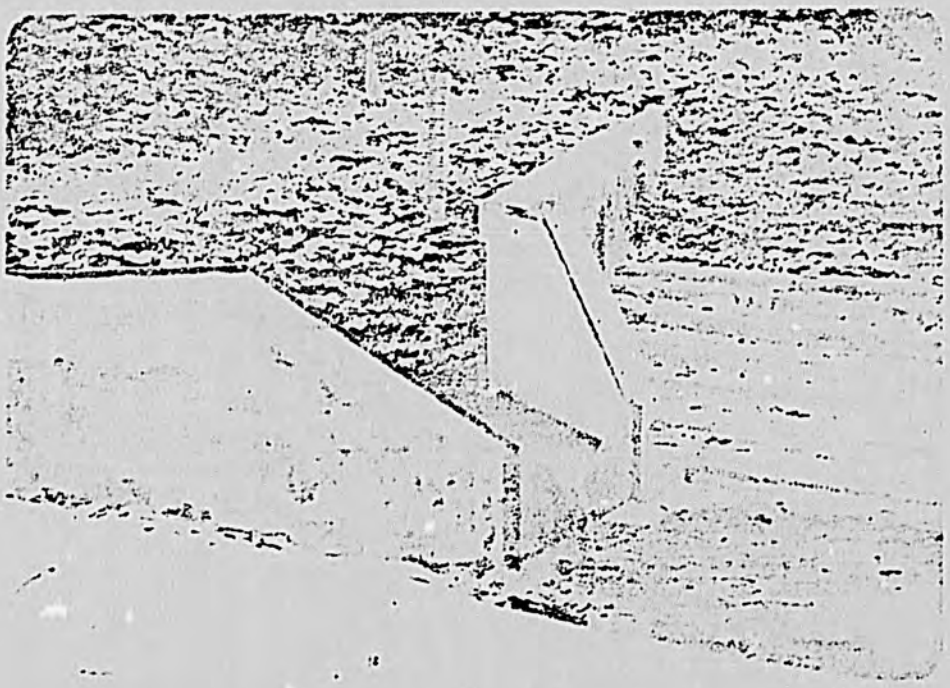

Plate 4 Sharp crested weir (120°V-notch) at Catchment B

Plate 5 Sharp crested weir (120°V-notch) at Catchment C

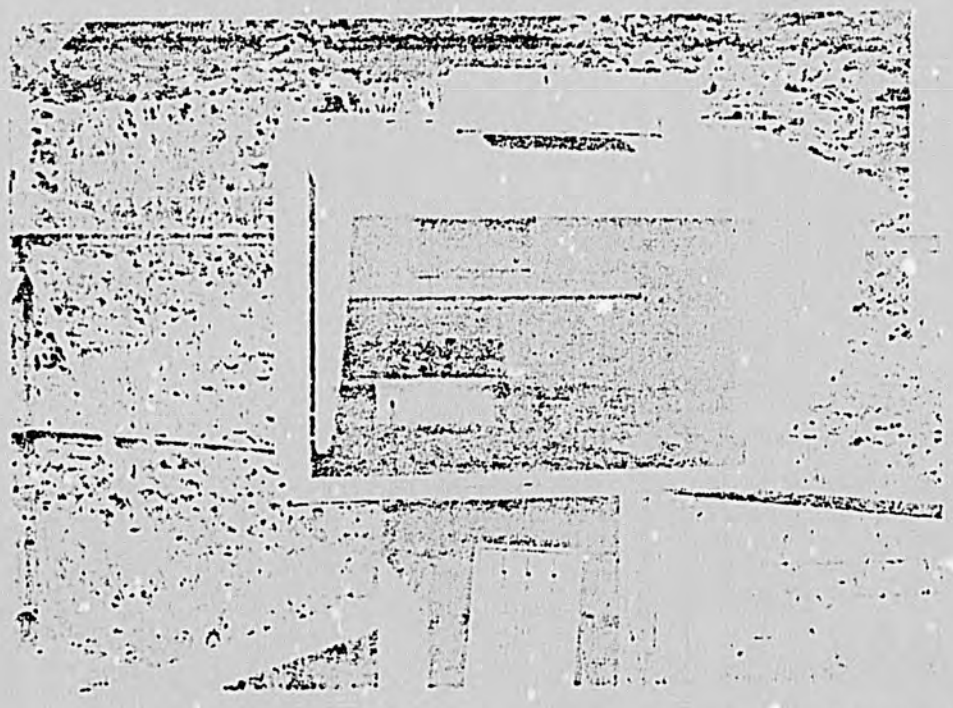

Plate 6 Ott Automatic weekly water level recorder at Catchment B

ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

MALAYSIA

INFORMATION PAPER

No. 3

ASEAN 79/COFAF.WW/Doc.9

LOGGING IN WATERSHED AREAS OF SABAH

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

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LOGGING IN WATERSHED AREAS OF SABAH

BY

I. H. Sario

I. Introduction

In Sabah the concept of forest management by the conservationists is largely a matter of emphasising the protective functions of the watershed relative to its forest cover. It is a known fact that, forest cover is an important factor in watershed management because firstly it constitutes a barrier between rainfall and the stream channel, and secondly, because it uses large quantities of water.

The barrier is composed of leaves, branches, trunks - the parts of the tree to which water can cling, from which water can drip and down which water can run. This includes the tree proper, the undergrowth and the ground vegetation which are living barriers to catch and delay falling precipitation. Below this, lies a second obstacle, the litter, the accumulation of dead material which stores some water and passes the remainder to the soil. The forest soil is a third obstacle, a mesh of pathways through which water is temporarily stored before finding its way to the stream channel or be absorbed by the plant roots.

Briefly then, the protective watershed function of the forest are; the barriers cast up against free water movement by the successive forest layers ensuring that rainfall will not run headlong to the stream channel.

Large quantities of water transpired signify the large quantities of precipitation that can be stored in the soil and is thus withheld from stream flow.

Differences in the degree of protection depend on type, condition and age of the forest. For example forest conditions where with reduced forest cover, also reduces the functions as mentioned in the foregoing. In cases where there is an over-cut and/or under stocked forest stands by the not fully occupying sites do not exert their protective potential.

This paper deals with the felling schedules currently enforced by the Sabah Forest Department in watershed areas, current logging practices and their effects on their protective functions and some suggestions for watershed - management guidelines for felling and logging to balance the protective function and the harvesting of matured and overmatured crops in such areas.

II. Felling Schedules and Logging Regulations Currently Enforced by the Sabah Forest Department in Watershed Areas.

Harvesting timber products has a two-fold effect on the watershed. First by reducing the amount of the forest cover, cutting reduces interception and transpiration; less precipitation can then be stored on the foliage and, throughout the transpiring season, in the soil, hence more water goes to stream flow. Second in the process of getting into the forest, cutting the trees and getting out of the woods, considerable area is disturbed, the soil is compacted and runoff is facilitated.

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However it should be noted that in Sabah generally there are about 4 canopy level in a virgin dipterocarp forest namely; the top canopy comprising the moribund and matured individuals the next one would be the intermediate sizes, the 3rd would be the pole size comprising dipterocarps and tolerant Lauracae, Meliaceae, Myrtaceae, Ebenaceae etc., and the 4th canopy would be saplings and seedlings of dipterocarps and other tolerant species in association with shrubs, herbs, and palms. Finally the forest floor is matted with litter from the various canopies. Please see Appendix III for the diagramatic structure of the forest canopy as described.

With the above in view it would be safe to assume that even with the removal of the top and some of the second canopy the protective function of the forest is not yet seriously impaired. Bearing this in mind, the felling schedules and logging regulations currently enforced by the Sabah Forest Department in watershed areas are as follows :-

(a) The felling schedule is the compulsory felling of commercial species as defined in Rule II of the Forest Rules, 1969, found in areas in all logging licences (concession agreements, Special Licences, Form I licences and Form IIB Licences) issued. These are :-

CLASS A

Vernacular Name	Botanical Name	Minimum Felling Girth in
Belian	Eusideroxylon zwageri	$2\frac{1}{2}$
Melangangai	Eusideroxylon malagangai	$2\frac{1}{2}$
Merbau	Intsia spp.	6
Resak Batu	All hard and heavy voticas and cotylelobions	4
Selangan Batu No.1	All hard and heavy hopeas and shoreas	6

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CLASS A

Vernacular Name	Botanical Name	Minimum Felling Girth in
Selangan Batu No. 2	All medium and heavy hopeas and shoreas	6

CLASS B

Geriting	Lumnitzera littorea	2
Mengkulang	Tarrietia spp.	6
Oba Suluk	Shorea pauciflora and its allied species	6
Seraya merah	Shorea loprosula Shorea smithiana Shorea leptocladus and other species of Shorea having a mild red or pink wood	6
Urat mata	Parashorea malaanonon spp. P. tomentella	6

CLASS C

Gagil	Hopea sangal	6
Kapur	Dryobalanops spp.	6
Kapur paya	Dryobalanops rappa	6
Keruing	Dipterocarpus spp.	6
Limpaga	Cedrela spp.	6
Melapi	Shorea bracteclata, S. symingtonii and other species of Shorea of the Anthoshorea group having a whitish or ochere wood	6
Nyatoh	Palaqium spp. and Payena spp.	6
Sepetir	Sindora spp.	6
Seraya Kuning	Shorea acuminatisima Shorea gibbosa	6

CLASS C

Vernacular Name	Botanical Name	Minimum Felling Girth in
Yellow Seraya	Shorea faguetiana and other species of Shorea having a mild yellow wood	6
Serungan	Cratoxylon arborescens	6
Temasuk	Fagraea fragans	6
CLASS D		
Jongkong	Datoylocladus stenostachys	6
CLASS E		
Ramin	Gonystylus bancanus	6

(b) The cutting regulations on area basis in all classes of logging licences except Form IIB Licences.

(c) The regulation of production through export quota allocated to its individual licence currently enforced.

(d) Registration of logging equipment to control traffic in logging areas and density of logging roads and skidroads.

It would be of interest to note that the first recorded logging of water catchment in Sabah was in 1925 by Sabah Timbers company Limited. The area logged is the Garinono water catchment and the method used for yarding is high lead steam yarding. High lead yarding is destructive to advance growth and is still in use in Sabah by Syarikat Kennedy Bay Timber Company Ltd. in their concession at Silam.

In para.3 of a report by Dr. W. Meijer (Forest Botanist) on 17th May, 1963 to the Conservator of Forest quote -

"It has now appeared that there have twice been made studies of recovery of the Bettotan (Garinono) area, once in 1950 under the direction of G.S. Brown (see

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Malayan Forester 1950 issue 4 p.330) covering an area of 112 acres in 4 strips and once in 1954 a half chain square sampling by Luis N. Nobleza and F.G. Jimit (see Walton Empire For Review 33; 338-343. Both articles were unearthed by the Ecologist. Especially the first paper confirms my original results. The strips were cut through the 1928 logged area where the average volume per acre loaded at the yarders was 1,062 cu.ft. per acre show after 21 years a merchantable volume on the same area of 450 cu.ft. per acre." End of quote.

For table of the result of sampling done by L. Nobleza and Jimit and enumeration carried out by Dr. Meijer, please see Table I, II and III below. The articles of G. S. Brown and part of W. Meijer article are reproduced and is given as Appendix I & II.

TABLE I

Volume of Dipterocarps in cu.ft. in 10 acres
Plot I (logged)

Class	Measurement (clean bole)		Volume (cu.ft.)
4 ft.	21 x 51	=	1,071
5 ft.	21 x 84	=	1,764
6 ft.	18 x 126	=	2,268
7 ft.	15 x 182	=	2,730
8 ft.	19 x 247	=	4,693
9 ft.	6 x 319	=	1,914
10 ft.	4 x 405	=	1,620
11 ft.	2 x 507	=	1,014
12 ft.	3 x 631	=	1,893
13 ft.	-	=	-
14 ft.	1 x 948	=	948
15 ft.	-	=	-
16 ft.	-	=	-
20 ft.	-	=	-
			19,915

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TABLE II

Volume of Dipterocarps in Cu.ft. in 10 Acres
Plot II (Unlogged)

Class	Measurement (Clean bole)		Volume (Cu.ft.)
4 ft.	-		-
5 ft.	-		-
6 ft.	15 x 126	=	1,890
7 ft.	14 x 182	=	2,580
8 ft.	9 x 247	=	2,223
9 ft.	8 x 319	=	2,552
10 ft.	9 x 405	=	3,645
11 ft.	2 x 507	=	1,014
12 ft.	2 x 631	=	1,262
13 ft.	4 x 779	=	3,116
14 ft.	3 x 948	=	2,844
15 ft.	2 x 1159	=	2,318
16 ft.	1 x 1400	=	1,400
20 ft.	1 x 2150	=	2,150
			26,994

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TABLE III

ANALYSIS OF HALF CHAIN SQUARE SAMPLING

Sungai Betotan Camp, B.B.T. Company
Sampling by F.R.I. Luis N. Nobleza and F.G. Jimit Ingguai;
17th, 19th and 21st January, 1954; District of Sandakan.

Area sampled: 320 samples = 8 acres

Species	Selected Tree	DIAMETER CLASS					CROWN CLASS					Percent-age of species
		2 in-4 in.	4 in-8 in.	8 in-12in.	12 in-20 in.	Over 20 in.	D	CD	d	c	p	
Selangan Batu	16	11	4	-	1	-	-	6	10	3	11	10.9
Kapur	20	12	5	1	1	1	4	6	10	4	17	13.6
Kerning	28	19	3	3	3	-	4	5	19	8	22	19.0
Urat Mata	32	16	7	5	2	2	7	10	15	12	23	21.8
Majau	7	-	-	2	4	1	1	4	2	2	6	4.8
Seraya	30	5	7	9	5	4	17	10	3	2	19	20.4
Belian	14	6	1	2	4	1	1	6	7	5	9	9.5
All Species	147	69	27	22	20	9	34	47	66	36	107	
Percentage	45.9	46.9	18.4	14.9	13.6	6.2	23.1	32.0	44.9	24.5	72.8	100.0
Unstocked Sample Plot	173											
Percentage	54.1											

D - Dominant CD - Co. dominant d - Dominated p - stock Dominated by unfelled trees.
c - stock affected by climber or vines.

Research studies made by Forest Department Research Branch (logging of Tawau Hills Forest Reserve Report by Forest Department dated 26th August, 1977 - PPK. 3206/1/49) research plot layed in this water catchment area for the supply of water to Tawau Town, shows that about 66% of the original vegetation is retained after the area had been logged by tractor. Please see Tables IV and V below. Similarly two Senior Forest Officers have examined the logged-over forests at the Tawau Hills watershed. They estimated that the damage is in the vicinity of 20% or less. The damage is in the form of tractor paths, landings and logging roads, thus, the main forest structure is still intact after logging. A study made by J.E.D. Fox in lowland dipterocarp forest (Segaliud-Lokan Forest Reserve) found that 27.4 per cent of an area of 108.9 acres was with tractor path.

TABLE IV

R.P.348 Tawau Hills (Before Logging)

ize Class Groups	12"-20"	20"-30"	30"-40"	40"-50"	50"-60"	60"-70"	70"-80"	80"-90"	90"-100"-	100"+	Tot
mmercial	8	34	28	19	14	15	17	15	10	31	19
n-mmercial	63	195	92	57	28	15	11	2	3	9	47
and 1	71	229	120	76	42	30	28	17	13	40	66
r acre	14	45	25	14	8	6	6	4	3	8	1

TABLE V

R.P.348 F.R. Tawau Hills (After Logging)

mmercial	5	22	23	11	7	9	8	15	10	21	
n-mmercial	34	130	67	39	16	9	5	1	2	5	
and Total	39	152	90	50	23	18	13	16	12	26	
r acre	9	33	20	11	5	4	3	3	3	6	

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In tractor logging however wherever ground dragging is is used the tractor and load dig in and in wet weather churn up the soil into mud. However the effect of tractor working as shown above shows that it is possible to get the timber out with very little damage of the regeneration and structure of the forest on area logged in the Tawau Hills watershed.

In tractor logging a study carried out of an area logged in the lowlands an average of 45% of the stand was damaged but there still remained about 8 trees per acre between one foot and 6 feet girth which have suffered no damage and which could yield a stand as good or better than the areas logged (An analysis of logging Damage in Tropical Rain Forest, North Borneo by D.I. Nicholson Malayan Forester Vol. XXI - 1958). In this particular case 55% of the forest structure remained which can provide protection for the first 6 months and there after full functions of its protective functions.

III. Recovery of the Forest After Logging

It has been shown by the Garinono Logging that after 40 years even though logging was done by high lead yarding and provided that the forest is left by itself to recover, the establishment of a normal forest develops enabling it to produce commercial merchantable timber of about 400-500 cu.ft. per acre.

With previous experiences in Sabah when intensities of logging was so severe in the late sixties followed by silvicultural treatment to eliminate unwanted commercial species and lesser known species, the severe canopy opening makes nature to, if possible duplicate its previous ecological environment; the result is the site domination within 6 months by Laran, Sedaman, Binuang and to some extent Bangkal but mostly climbers, notably climbing bamboos, Kukualang (Mezoneurum sumbtranum) Akar bilaran (Merremia spp). All these are intercepting barriers to precipitation and are factors in reducing soil movements.

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A.B. Walton reported abundance of seedling regeneration and valuable stand of young trees on areas logged about a year ago by high lead logging in the concession area of the Basilan Lumber Company; in Basilan, Philippines; on the same concession area in a different locality on an area logged 5 or 6 years ago, secondary growth had in the interval, covered the scars of logging operation and the seedling regeneration present when felling occured had developed with it into pole sizes - the Empire Forestry Review Vol.33, 1954 p.338). Similar observation was noted by Nicholson (Malayan Forester Vol.XXVI - October 1963) in his studies during 1961 and 1962 by sampling of the regeneration and logging damage around a number of spar trees in the Silabukan F.R. and he concluded that highlead logging leaves a very high stocking of commercial species but that greater damage is done to standing trees by the logging cables and the load itself. Please see pictures in Appendix IV of high lead operation and other allied activities of logging; areas that had been logged by high lead yarding in 1963 in the Sg. Segama F. Reserve which is part of the Sg. Taliwas watershed; area logged by tractor in 1972 in the Tawau Hills F. Reserve which is part of the watershed of Sg. Balung and area currently logged by tractor in the Tawau Hills F. Reserve which is part of the Sg. Merotai Kanan watershed. In all please notice the damage on the forest and the recovery of the forest after a period of years where the forest is left to recover undisturbed. The case in point here is the ability of the forest to recover even if yarding is done by high lead yarding. The protective function is not unnecessarily delayed.

Recommendations and Conclusions

Sabah's rainfall is well distributed averaging from about 100-130 inches a year. There is no very well defined dry or wet season but usually it is very wet during the north monsoon which usually starts about September to the early part of March the following year. With this as back ground for protective requirement, it is agreed that forest cover is essential on critical water catchment areas and on watersheds. However, let us not for one moment forget that commercial forest growing in such areas are the nation's resource and asset and must be utilized, in such a manner that the protective

function of the forest is not unduly impaired. This practice of logging water catchment and watershed areas is being practice all over the world. Therefore water catchment areas and water shed areas should continue to be logged on the current felling schedule now enforced by the Forest Department of Sabah to non-critical watershed areas. But on critical water catchment areas like the Tawau Hills watershed, before exploitation, the timber stand of the whole catchment has to be enumerated according to size classes and the location of size classes with heavy stocked of sizes 8 ft girth and above as well as mild slopes less than 25° are to be mapped and demarcated. On areas where these two conditions exists logging should be permitted with entirely different felling schedule in that in areas above 25° to less than 45° slopes the minimum felling girth for dipterocarps should be increased from 6 ft. to 8 ft. and on areas less than 25° slopes the current felling schedule applies. In both cases all hauling roads and skid roads must be preplanned by the Logging Engineer of the Forest Department. In both cases strict supervision on the progress of logging has to be supervised by the Forest Department.

The concept of multiple use of Forest Lands is now the trend of modern forestry. It is a concept that the conservationist has to accept as long as the environmental quality of the forest is not unduly impaired by the logger - this is where a strong Forest Department can play an active role.

Glossary

Watershed	- The ridge dividing two drainage areas or the region or area drained by a river.
Water catchment	- A drainage area especially of a reservoir or river.
Critical Water catchment area	- A drainage area where water is pipe for water supply.
High lead	- Cable yarding system where the layout is triangular with the mainline and haul back forming the two sides of the triangle is formed by the haulbk running between the corner block and the tail block and the apex is the tower or spar tree.
Laran	- Anthocephalus cadamba.
Sedaman	- Macaranga spp.
Binuang	- Octomeles sumatrana.
Bangkal	- Nauclea spp.

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References

1. Note on Recovery of Lowland Dipterocarp Forest from Winch Logging in North Borneo by G.S. Brown - Malayan Forester. Vol. XIII pp 230.
2. The Regeneration of Commercial Dipterocarp Lowland Forest Near Sandakan (Sabah) Forty Years After Logging by W. Meijer Malayan Forester Vol. 33 pp 204-229.
3. The Regeneration of Dipterocarp Forest After Highlead Logging, By A.B. Walton Empire Forester Review 33(4) pp 338-344.
4. An Analysis of Logging Damage in Tropical Rain Forest, North Borneo by D.I. Nicholson - Malayan Forester Vol. XXI pp 235-244.
5. Watershed Management Guidelines for Logging and Road Construction by R. L. Rothwell.
6. Logging Practices by Steve Conway.
7. Watershed Management Research by Howard W. Lull, Northeastern Forest Experiment Station United States Forest Service.
8. Damage from Highlead Logging in Sabah by D.I. Nicholson. Malayan Forester Vol.XXVI.
9. The Soil Damage Factor in Present Day Logging in Sabah - Fox 1968.

APPENDIX I

Note on Recovery of Lowland Dipterocarp Forest from Winch Logging in North Borneo

by G. S. Brown

Recent enumeration surveys have made possible fair attempt at an assessment of the effect of high lead winch logging on a typical area of lowland dipterocarp forest in North Borneo. The area concerned is at Bettotan, Sandakan District, and was logged in 1928 by high lead to steam winches.

The manager of the Company concerned informs me from memory that at time there was no demand for keruing, and not much for white seraya (Parashorea malannonan) and that therefore some at least of the large trees of these groups were left. His recollection is that the amount of damage done by yarding was "not much greater than by hand-logging" but that moving the yarders (which dragged themselves along in the usual fashion) did a fair amount of damage.

Fortunately a map survives of the areas logged, showing the volumes yarded and loaded at each spar tree. The figures are high for North Borneo, suggesting that either the forest was exceptionally good or that not very much could have been left, or both. Soil and locality factors are not exceptionally good, and I have seen one photograph of the steam logging operations, which shows the devasted appearance that one would expect; so that on the whole I think it probable that the operation was not significantly less brutal than the average for such operations. This makes the results of the recent survey particularly interesting.

The survey consisted of enumeration strips laid down to embrace a wide area and to include a representative proportion of valley and hill slope, but otherwise at random. They included not only the known 1928 areas but also some similarly logged subsequently (but not much later). The total area of the strip sample was 112 acres, which should be large enough to give fairly reliable figures. Trees were callipered into diameter classes. Recent measurements of felled trees giving the volume extracted from the forest were used to supply a factor for the conversion of volumes from existing "total volume" tables to "merchantable" volumes, for comparison with the steam-logging figures.

These "merchantable" volumes include all belian over 8" diameter, and all ordinarily listed "commercial" species over 26" diameter, corresponding to what is believed to have been about the minima applied in practice in 1928. (The legal minimum was 4' 6" girth for species other than belian).

The following is a summary of the results of the survey:-

Strip No.	Strip area (acres)	Merchantable Vol.per acre 1949(cu.ft. ¼g)	
1	32	476	All areas logged 1928 or later
2	40	1,234	
3	20	863	
4	20	426	
Total	112	average 807 cu.ft. per acre	

Strips located strictly in the 1928 steam-logged area were Nos. 1 and 4. In 1928 the average volume per acre loaded at the yarders was 1,062 cu.ft. per acre, and the present (i.e. after 21 years) merchantable volume on the same area is 450 cu.ft. per acre. (The output of considerable areas of virgin forest by hand-logging has been less than 450 cu.ft. ¼g per acre).

Regeneration is well and evenly distributed over the area. Serayas and kapur are the commonest species. A few trees, probably of the original top canopy, still remain; nearly all are defective.

No improvement fellings or cultural operations have been carried out in this forest. It seems that in the absence of clear felling and fire, its powers of recovery are remarkable, and that appearances immediately after logging operations may be misleading.

If one could assume that nothing merchantable had been left at the time of logging, the above figures would indicate an effective merchantable increment of from 20 to 59 cu.ft.$\frac{1}{4}$g per acre per annum. Such an assumption cannot safely be completely accepted but it is approximately true, so that it would appear to be reasonable to regard 20 cu.ft. per acre per annum as a conservative average to use in management calculations, in the complete absence of any other statistics.

APPENDIX II

The Regeneration of Commercial Dipterocarp Lowland Forest Near Sandakan (Sabah) Forty Years after Logging

by

W. Meijer

Forest Botanist

March 1966

Introduction

During the latter half of 1965 the need was felt in the cartographic Branch of the Forest Department of Sabah to make accurate studies of the stands of emergent trees in permanent sample plots which can be studied on aerial photographs. A plot size of 10 acres divided in 100 squares of one chain was chosen for this work. Staff members of the Cartographic Branch together with staff of the Botanical (Herbarium) Branch carried out this field work which was planned in close co-operation with Mr. Marvel Nobleza and the Forest Botanist. Mr. A. Kanis, Assistant Forest Botanist joined in the field work and assisted in calculation of the results. The method was first tried out in the field in Leila Forest Reserve behind the Herbarium then in Sample Plot 15, Sepilok Forest Reserve and in 10 acres of the

Research Forest at Mile 45, Labuk Road. Though the initial aim of these studies was to identify on the ground trees which might be recognized on colour photographs from the air it soon appeared that our plot method supplies us with "models" of Forest structure which can be used for all kind of studies of forest structure, regeneration and ecology. After working out the first results of our studies at Sepilok and Mile 45 we started to apply this method to a comparison of logged and non-logged forest. For this we chose 2 plots of 10 acres in the Sg. Garinono - Bettotan catchment area 27 miles west of Sandakan.

Some fourty years ago this area was logged with high lead steam engine logging. On the earliest aerial photos of the Sandakan area dated 1937 we can easily detect star shaped traces of logging around spar trees. Mr. Nobleza reported by letter of 1st November, 1963: -

> " The area was totally logged-out except for a few small patches. A number of small crowns were left standing and some with large crowns. (probably non-commercial) dotted here and there. Appearance of the same area on the 1965 photos.
> A great change in the whole forest canopy. Small crowns that were left standing in photos of 1937 have grown much larger though not as large as the neighbouring crowns in the untouched forest. Tree crowns have also appeared on areas shown as totally logged in 1937 photos.
> On the whole the tree density of the logged-over area is very good considering that the area has only a period of 40 years of regeneration."

From the Manager of Sabah Timber Company Limited (formerly British Borneo Timbers) we received very useful technical information about the logging methods followed. He quoted from a report made in 1951 by Mr. P.Y. Robinson from which we give here an excerpt :-

" The system employed at Bettotan was the use of a steam loader and two steam yarders to a side. The loader proceeded to her loading spar along side rail, generally 1,000 feet away by dragging herself on skids under her own power; she hauled the timber within a radius of 1000 feet around the spar. Two logs per day had to be supplied to each unit for the purpose of firewood which meant for the whole Bettotan yarding and transport system 14 logs per day were consumed, or a monthly conservative estimate of 40,000 cubic feet. We very often had to leave standing in the jungle Selangan Kacha (Shorea acuminatissima), Keruing (Dipterocarpus) and Kapur (Dryobalanops)."

Selection of Plots

Two square plots of 10 acres each were selected on the aerial photos. Plot I a logged area South East of a small creek in the forest and Plot II unlogged North West of this creek. The slopes of the areas and the soil and drainage conditions are almost the same. From study of old maps shown to us by the Manager of Sabah Timbers we conclude that the area was logged around 1925 (see map).

Technique of enumeration

A gang of one Forest Ranger and three Labourers divided the plot in numbered subplots with simple trails cut in the undergrowth and putting numbers of each plot at the boundaries of the 100 subplots. It appeared quite possible to note and enumerate all trees above 6 ft. girth within a distance of half a chain (33 ft.) at both sides of the trail. The route of traverse was noted on a map of the plot and positions of the trees were noted with D for distance from plot boundary, L as left of trail, R distance at right of trail. The girth of trees was measured or estimated and identifications were made at the spot under supervision of the Forest Botanist. Each tree enumerated got a number which was painted on the bole. Trees which were difficult to identify were

collected afterwards by our professional tree climbers. It appeared to be possible with a party of about 10 men to enumerate this way 20 acres in 4-5 days time. The measuring of the location of each tree appeared to be rather time consuming but it is indispensable for locating individual crowns on the air photos and for studies of the pattern of distribution of species. Special notes were made about defect of crowns and boles. In the process members of the Cartographic Branch learned to recognize the common trees from bark, slash and leaf characters.

In the logged forest we included trees of 4 ft. girth and above however without giving a complete enumeration of class 4 and 5 except for individuals of Anthocephalus cadamba, a tree which we wanted to study more in detail. In plot II (unlogged) we enumerated only trees above 6 ft. girth. It will of course be possible to make in the future the enumerations complete for all trees above 4 ft. girth.

Discussion of the Results

We have not yet made any special study of geology and soils of the Garinono area. Recently Collenette has distringuished a new Garinono formation (see ann. Report Geol. Surveys, 1964), probably of upper miocene age, blue clay with sedimentary and volcanic rocks. Possibly the result of a submarine mudflow or mud-volcanos. (See Annual Report Geol. Surveys 1965 for more recent ideas on origin and distribution of the Garinono.

The general forest composition of the Sg. Garinono area is very similar with the flat or slightly undulating terrain on the Sandakan Peninsula and Lokan peneplain. Differences in geological age and rock formations seem to be smoothened out by a soil formation of rather uniform fertility, most similar to clayish alluvial soils in the sandstone and shale areas. On such soils we always find among the emergents a fair amount of Shorea leptoclados and high frequences of Dryobalanops lanceolata, Parashorea tomentella and P. malaanonan and Dipterocarpus caudiferus and more sparsely large trees of Shorea acuminatissima

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and some sparse Selangan Batus (Shorea atrinervosa, S. superba) and Melapi (S. symingtonii) besides a sprinkle of Red Serayas other than Majau.

In the understorey is by far the most frequent tree with girth above 6 ft. the iron wood tree Eusideroxylon zwageri, local name Belian. The further understorey is a mixture of some Legumes, Lauraceae, Gonystylis, Lithocarpus, Diospyros, Nephelium, Guttiferae, Irvingia and Pentace, most of which occur only with one tree per 10 acre.

The logged plot has more or less the same composition only an occassional different species of Selangan Batu (Shorea domatiosa) and two species of Hopea and a few rare non-Dipterocarps again only 1-3 trees per species per acre and most of these restricted to the smaller girth classes.

The species composition between the two plots is not considerably different though the unlogged plot is slightly on higher ground along a ridge.

The following table gives an impression of number of trees and species of trees above 6ft. girth.

	No. of trees above 6 ft. girth	Total species trees *) (commercial in brackets)
Plot I (logged)	107 (80)	36 (17 sp.)
Plot II (unlogged)	113 (79)	37 (18 sp.)

The logged forest is decidedly not poorer in commercial trees than the unlogged. The amount of species and trees of non-commercial species (all trees above 6 ft. girth except Dipterocarps and iron wood) is as follows :-

Plot I (logged) 27 trees - 18 species.
Plot II (unlogged) 41 trees - 19 species.

*) Commercial trees: Dipterocarps and Belian.

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From this we see that the logged forest had 2.7 non-commercial trees per acre and the unlogged 4.3. The number of species is practically the same. Quite a number of the so-called non-commercial trees of more than 6 ft. girth would be useful if utilization would improve. Calculated in numbers of trees we can state that 80 per cent of the emergent trees belong to the commercial trees. We should not forget that in volume this percentage is still higher, about 90 per cent at least.

From our studies in Sample Plot 15 and in one acres of the 10 acre sample Plot at Mile 45 we learned that the greatest amount of tree species (30 per acre including 8 commercial species) occur in classes below the 6 ft. girth class which form together about half of the biomass of the forest.

Total Volume of Dipterocarps and Number of Trees Per Acre.

The commercial volume per acre in the Sandakan Peninsula - Lokan Peneplain area varies roughly between 1000-2500 cu.ft., in exceptional cases 3000 cu.ft. per acre. Actual outturn figures are lower because 20-40 per cent of the trees may be defective according to figures collected by the Forest Cartographer Mr. E.C. Francis in Research Plot 91, 300 acres and in a 100 acre Plot at Lungmanis R 5 roadside (Manager Sabah Timbers, in litt.).

The Forest Cartographer calculated that in a 100 acre test area there were about 1010 crowns of 35 ft. diameter and above representing approximately 860 commercial trees of 6 feet girth and above with a gross timber volume of 2.459 cubic feet per acre. This would represent 8.6 commercial trees per acre. In sample Plot 15 we have the high amount of 15 trees per acre with the highest known volume of 3500 cubic feet (including ironwood). In that plot it is likely that about 20 years ago pre-felling regeneration methods were applied which amounted to killing of overaged and defective trees without disturbing the natural floristic composition of this forest.

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For a rough calculation of the volume of Dipterocarp timber in sample Plots I and II we have used the following simple table based on girth classes only. This table is based on North Borneo Forest Record No. 4 and has been prepared by the former Silviculturist Mr. D.I. Nicholson.

Girth Class (breast height or above buttresses)	Tree Volume Cu.ft.
1 - 2 feet	4
2 - 3 feet	13
3 - 4 feet	29
4 - 5 feet	51
5 - 6 feet	84
6 - 7 feet	126
7 - 8 feet	182
8 - 9 feet	247
9 - 10 feet	319
10 - 11 feet	405
11 - 12 feet	507
12 - 13 feet	631
13 - 14 feet	779
14 - 15 feet	948
15 - 16 feet	1159
16 - 17 feet	1400
17 - 18 feet	1650
18 - 19 feet	1900

We can now put our records of the sample plot in tables III and IV which shows the distribution of trees over the girth classes.

We get from this the following distribution of Dipterocarps:-

Class:	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Plot I (logged)	21	21	15		19	6	4	2	3	-	1	-	-	-	-	-
Plot II (unlogged)	7	7	15		14	9	8	9	2	2	4	3	2	1	-	-

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According to theory the logged forest should have a relative high amount of non commercial trees because these were left and not poison girdled 40 years ago. However, we can see from Table III and IV that the logged forest has 39 trees above 6 ft. girth and the unlogged 62 trees. Assuming that only trees between 6-12 ft. girth are sound, we find

Plot I (logged)	67 trees
Plot II (unlogged)	59 trees

From this we see that the logged Forest has quite an adequate stocking of trees at half the time of the rotation. The volume of these trees is also already considerable.

TABLE V

Volume of Dipterocarps in Cu. ft. in 10 Acres

	Plot I (logged)		Plot II (unlogged)	
Class 4 ft.	21 x 51	= 1071		
5 ft.	21 x 84	= 1764		
6 ft.	15 x 126	= 2268	15 x 126	= 1890
7 ft.	15 x 182	= 2730	14 x 182	= 2580
8 ft.	19 x 247	= 4693	9 x 247	= 2223
9 ft.	6 x 319	= 1914	8 x 319	= 2552
10 ft.	4 x 405	= 1620	9 x 405	= 3645
11 ft.	2 x 507	= 1014	2 x 507	= 1014
12 ft.	3 x 631	= 1893	2 x 631	= 1262
13 ft.	--------	----	4 x 779	= 3116
14 ft.	1 x 948	= 948	3 x 948	= 2844
15 ft.			2 x 1159	= 2318
16 ft.			1 x 1400	= 1400
16 ft.			1 x 2150	= 2150
20 ft.		19915		26994

Total volume above 6 ft. girth 17.080 cu.ft. in Plot I.

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APPENDIX III

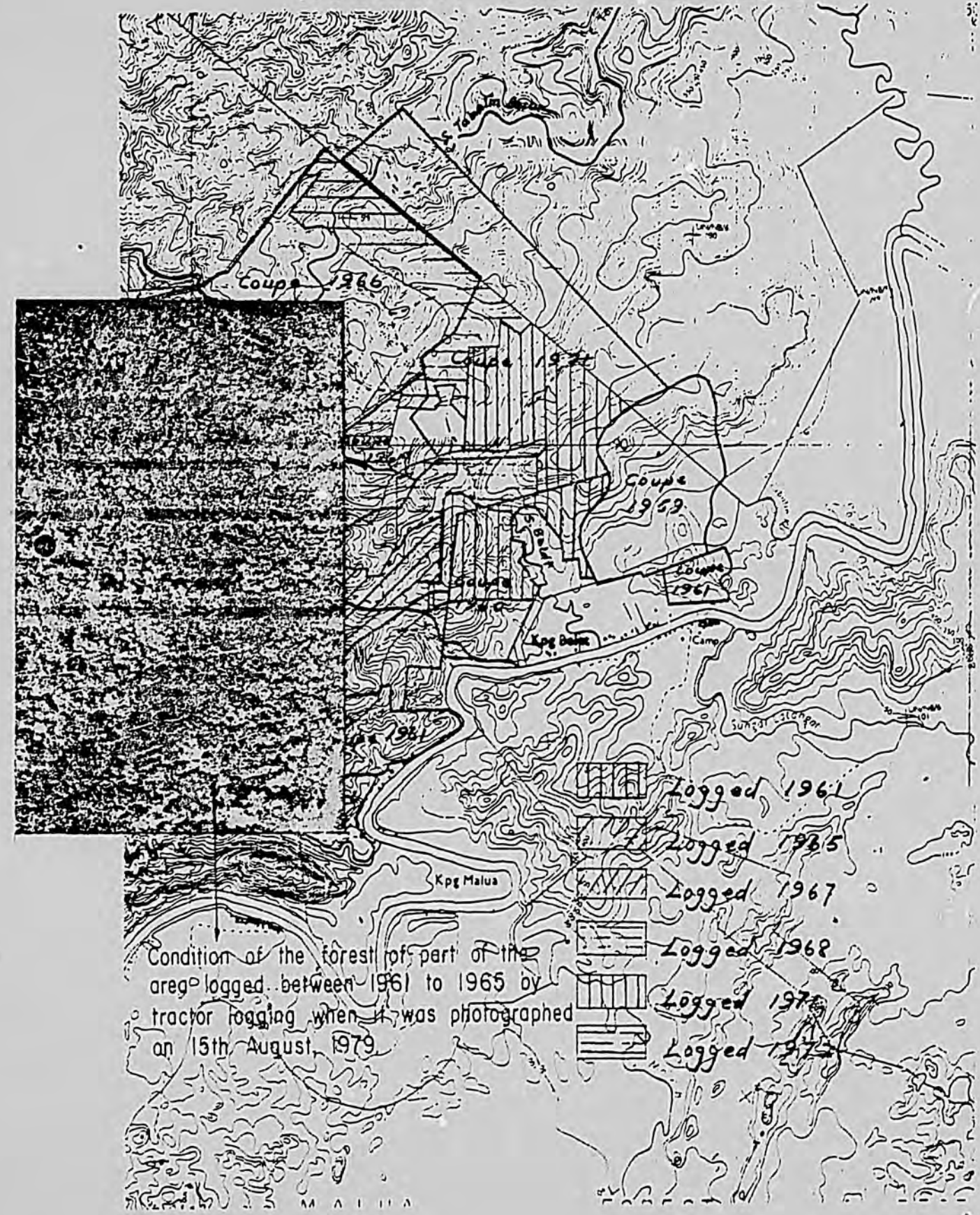
DIAGRAMMATIC STRUCTURE OF DIPTEROCARP FOREST IN SABAH

(TOP CANOPHY, INTERMEDIATE, POLE, SAPLING AND SEEDLING)

APPENDIX IV

Logged By United Timbers

(DERAMAKOT FOREST RESERVE)

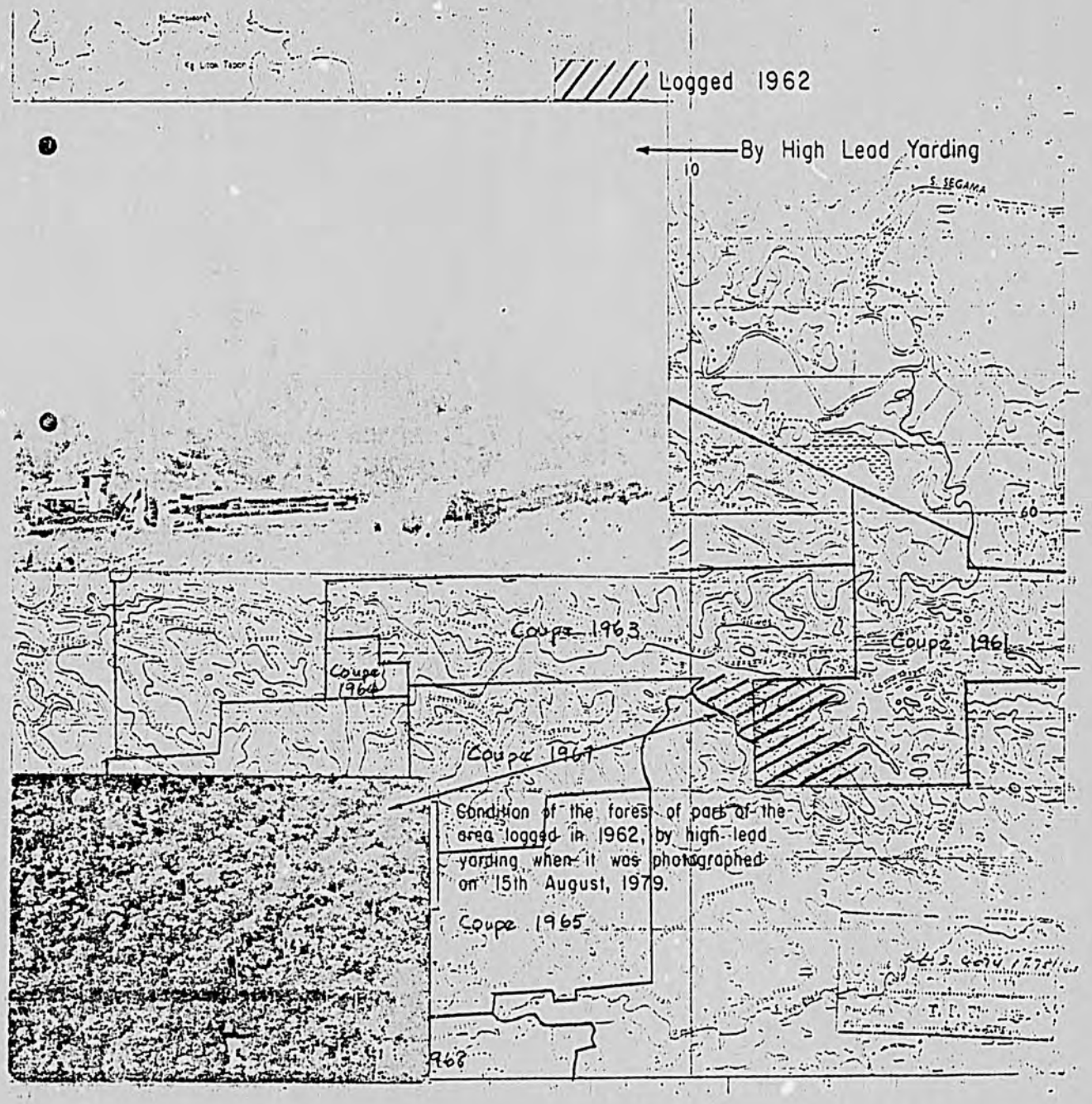


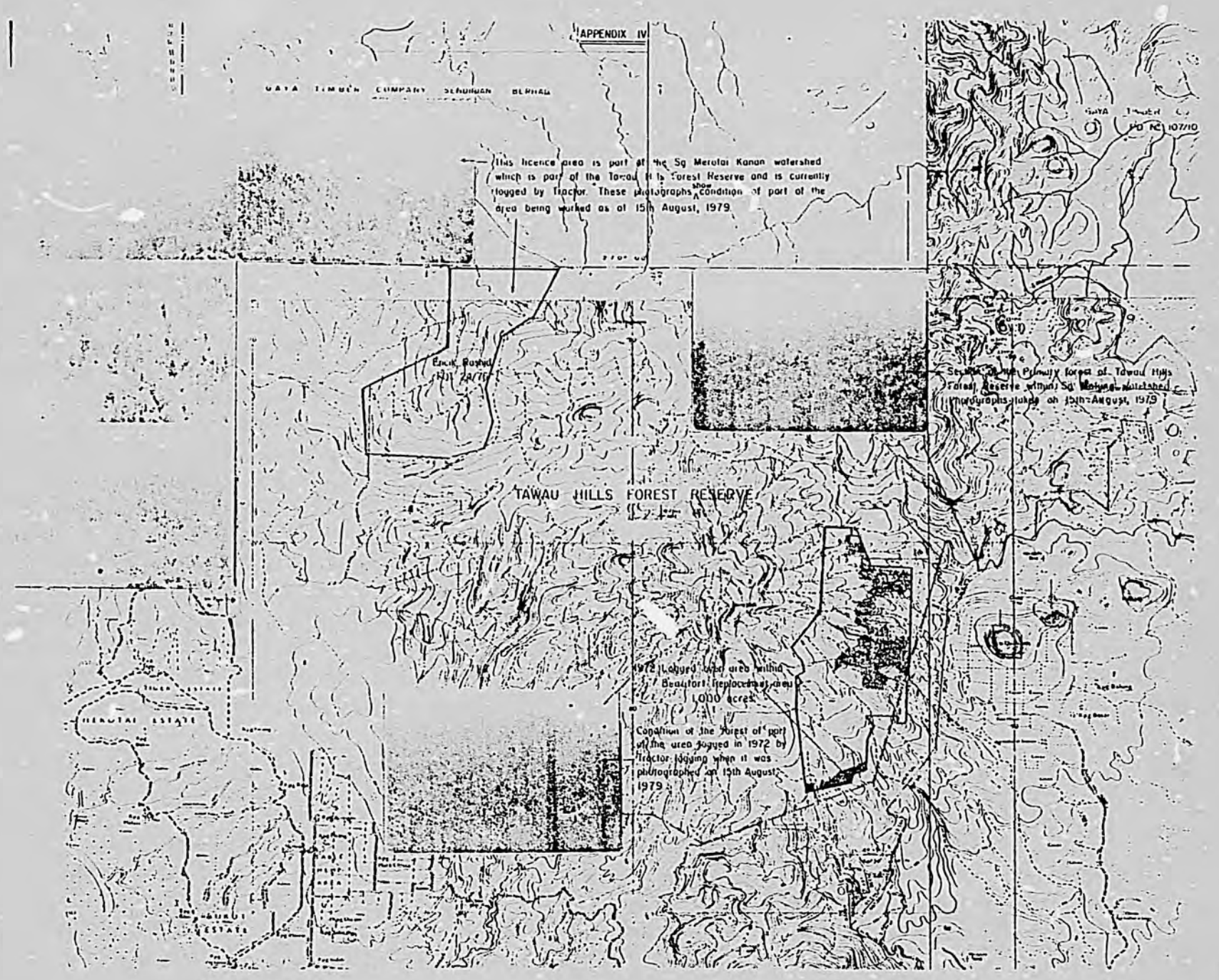
Condition of the forest of part of the area logged between 1961 to 1965 by tractor logging when it was photographed on 15th August, 1979.

APPENDIX IV

Part Of Kennedy Bay Concession Area

(ULU SEGAMA FOREST RESERVE)




APPENDIX IV
GATA TIMBER COMPANY SDN/BHD BERHAD
This licence area is part of the Sg Merotai Kanan watershed which is part of the Tawau Hills Forest Reserve and is currently logged by tractor. These photographs show condition of part of the area being worked as at 15th August, 1979
Brick Road
TAWAU HILLS FOREST RESERVE
1972 Logged area within Beaufort replacement area 1,000 acres
Condition of the forest of part of the area logged in 1972 by tractor logging when it was photographed on 15th August, 1979
MEROTAI ESTATE
Section of the Primary forest of Tawau Hills Forest Reserve within Sg Merotai watershed photographs taken on 15th August, 1979
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CONFIDENTIAL

REPORT

of the

ASEAN WORKSHOP

on

WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME

3rd - 7th SEPTEMBER, 1979

KUALA LUMPUR

MALAYSIA

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ANNEX J

WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAM IN THE PHILIPPINES

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WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

PHILIPPINES
TECHNICAL PAPER

ASEAN 79/COFAF.WW/Doc. 13

WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAM IN THE PHILIPPINES

KUALA LUMPUR, MALAYSIA
3 - 7 SEPTEMBER, 1979

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Watershed Conservation and Management Research
Program in the Philippines 1/

by

Philippine Delegation 2/

Background and Supporting Information:

Philippine watersheds are continuously and increasingly being encroached upon exacting serious degradation of bio-physical and socio-economic resources. Consequently, vast areas of upland watersheds have become virtually unproductive and very unstable ecosystems. Current estimates indicate that about five million hectares of Philippine watersheds are grasslands. Only about 30 percent of the total land area of the country (30 million hectares) are under forestcover. Approximately 66,000 hectares of the remaining forest cover are destroyed annually (2). The hydrologic behavior of about 1.4 million hectares of watersheds in the Philippines are considered critical. These watersheds continue to be the major sourses of accelerated soil erosion, flash flooding and related hydro-physical deteriorations that are seriously affecting multi-million pesos infrastructure projects, productive agricultural lands and other ecological imbalances over a wide spectrum of land scenes (9).

1/ Paper presented at the ASEAN Workshop in Watershed Conservation and Management Research Programme by Philippine Delegates, Kuala Lumpur, Malaysia, Sept. 3 - 8, 1979.

2/ Philippine Delegates: Dr. Severo R. Saplaco, Watershed Management Specialist and Asst. Professor of Watershed Management, UPLB College of Forestry, College, Laguna; Forester Bernardo B. Jasmin, Chief, Watershed and Range Research Division, Forest Research Institute, College, Laguna; Engr. Jose P. Castro, Manager, Watershed Management Department, National Power Corporation, Metro Manila, Forester Eduardo Llamitan, Chief, Forest Protection and Infrastructure Division, Bureau of Forest Development, Visayas Avenue, Quezon City, Metro Manila; and Mr. Julius Jose, Ministry of Foreign Affairs.

Flash floodings and their consequent destructive effects on bio-physical resources and human lives are increasingly getting serious through the years. The big floods on 1972, 1974, 1976 and 1978 which destroyed properties worth million of pesos and claimed human lives in Cental Luzon are clear manifestations of the greatly disturbed and unstable hydrologic behavior of the degraded upland watersheds.

Accelerated loss of valuable soil and nutrient resources from the watersheds due to soil erosion increases the degrading influence of flash floodings. In Lake Buhi, Luzon (home of the smallest fish in the world), a little over 20 thousand cubic meters of eroded soil is deposited every year (3). Soil erosion impoverishes not only the land but eventually causes irreversible and detrimental impacts on the aquatic resources of Lake Buhi. In the Pantabangan multi-purpose reservoir, about 50 percent of the watersheds is open land. Similar situation excists in the watersheds of the Ambuklao and Binga reservoirs, two (2) important multi-million pesos hydroelectric dams in the country. Many cases of deteriorated watershed conditions abound from the northern down to the southern part of the country. Cases of minor dust storms have been observed in the north (6). These dust storms are indications of serious watershed deteriorations. More watershed deteriorations are expected to occur due to anticipated population pressure unless beneficial and viable management strategies are evolved and operationalized (10).

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There is an urgent need to check the continuing degradation of watersheds in the country. Effective watershed management and developmental strategies have to be evolved and operationalized through intensive research to restore, improve and harness the productive as well as protective potentials of the watersheds (7). In so doing, economic prosperity is close harmony with watershed resources conservation (soil, water, forage, timber, etc.) and environmental stability could be promoted (1).

Research Orientation. Research efforts on watershed conservation and management in the country used to be fragmentary and at best, minimal. There was hardly any unified, well defined, integrated and coordinated efforts to address relevent research issues on watershed conservation and management. This situation resulted to the dearth of scientific data that could form the bases in evolving and operationalizing viable and beneficial watershed conservation and management strategies.

It was in 1972, when the Philippine Council for Agriculture and Resources Research (PCARR) was created that a coordinated research effort in agriculture and forestry resources, which includes watershed resources, was operationalized. PCARR is the coordinating and monitoring agency of the national government for all researches in agriculture and forestry researches. This institutional set-up helped facilitated the identification and implimentation of priority research programs in the Philippines.

Currently, watershed conservation and management research efforts are not only coordinated but also reoriented towards a holistic, integrated and interdisciplinary approach geared towards countryside development in close harmony with the promotion of environmental stability. This is a research strategy whereby research issues/problems are addressed simultaneously, from its bio-physical to its socio-economic as well as institutional components. Specifically, the Upland Hydro-ecology Research Program of the University of the Philippines at Los Baños (UPLB), has been operationalizing this research scheme (5). Some forestry research programs of the College of Forestry, UPLB, were conceptualized within the framework of this strategy. The Ministry of Natural Resources, through its Forest Research Institute is likewise adopting the holistic approach of addressing research issues in watershed conservation and management under the PCARR system. As such, a number of research programs is now oriented and operationalized using this research strategy. It is anticipated that in the next few years, this research strategy would become the standard guideline in addressing watershed conservation and management research problems. Inevitably, the use of limited research resources would be optimized and at the same time maximize the generation of scientific data as bases in evolving viable and beneficial watershed conservation and management alternatives.

With the shift in research coordination, orientation and thrust, it is expected that current researches in watershed conservation and management stand benefited. It is also expected that scientific data generation would be significantly accelerated.

Research Capabilities. An integrated, coordinated and holistic research in watershed conservation and management can only be operationalized through the collective efforts of qualified research manpower supported by physical resources and institutional linkages.

The University of the Philippines at Los Baños (UPLB), College of Forestry, in close collaboration with other units of the University has a very qualified core staff to operationalize the holistic, integrated and interdisciplinary research approach on watershed resources conservation and management. The research staff and physical resources of UPLB can be further strengthened by an equally qualified staff and excellent physical resources of national and international agencies within the University complex. The Ministry of Natural Resources, through its Forest Research Institute (FORI) is a national government agency that, with its graduate scholarship program, has an increasing number of interdisciplinary qualified research staff in its Watershed and other technical Divisions. The Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) is also an excellent regional agency within the University complex that is actually capable of helping promote research endeavors in the conservation and management of watershed resources.

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Other agencies that can lend technical and resource research supports include national government offices such as the National Power Corporation, National Irrigation Administration, Natural Resources Management Center, Man and the Biosphere, Technology Resource Center and many others. On the whole, the University of the Philippines at Los Baños, primarily through its College of Forestry, a recognized center of Forestry education in Southeast Asia, is technically qualified to form the core of a research group to implement the holistic, integrated and interdisciplimary strategy of doing relevant and priority researches in watershed conservation and management.

Current Research Programs:

Watershed conservation and management research is very recent in the Philippines. It was only in 1972 that a coordinated research effort in watershed resources management was formalized. Prior to 1972, recording flumes to calibrate two pine watersheds in the Mountain Province were installed (9). Mini-weather station comprising of sunshine recorder, evaporation pan, wind vane, anenometer, hydro-thermograph, and few other instruments were installed within the same watershed complex. At present, these instrumentations are still operational. In addition to these instumentations, five stream gaging stations were installed for watershed management studies by FORI as follows: two H-flumes in grassland watersheds, one 120° V-notch weir secondary dipterocarp forest and two 120° V-notch weirs in the mossy forest, all designed to study streamflow characteristics and erosional patterns with land uses in those areas.

Stream gaging efforts were also started attwo major streams of the Makiling Forest. These instrumentations has been abandoned. Other sporadic researches along watershed conservation and management include few studies of surface runoff, rainfall interception and soil erosion control measures. Other than these few and sporadic research efforts, not much research work on conservation and management of watershed resources has been undertaken.

On-going research programs on watershed conservation and management after 1972 include the following:

1. Upland Hydro-ecology Research Program;
2. Hydrology of an Upland Farm;
3. Hydrometeorological Characterization of Upland Ecosystems at Mt. Makiling;
4. Forest Hydrology;
5. Plant Selection for Soil Erosion Control;
6. Grassland Uses Effects on Soil and Water Losses;
7. Upland Vegetation Management;
8. Socio-economic Assessment of Upland Cultivation (Kaingin) Management Schemes; and
9. Effects of Different Crop Covers on Surface Runoff and Soil Erosion.

The detailed descriptions of the above on-going research programs are shown in Appendix A.

Research and Project Proposals:

Viewed from the common characteristics of ASEAN watersheds, close similarities in climate, topography, vegetation and land use patterns, regional research and project proposals are herewith submitted for the consideration and approval of this body.

The titles of these proposals are:

1. Center for Upland Watershed Management for Southeast Asia (CUWMSA);
2. Integrated Upland Development and Research Project;
3. Hydrologic Influences of Various Vegetation and Land-Use Manipulations, Rehabilitation and Development Measures on ASEAN Upland Watersheds.
4. Social, Technical and Institutional Profile of Upland Watershed Conservation and Management in ASEAN region.

The detailed descriptions of the research and project proposals are given in Appendix B.

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APPENDIX A

CURRENT RESEARCHES ON WATERSHED CONSERVATION AND MANAGEMENT IN THE PHILIPPINES

1. Upland Hydroecology Research Program (UPLB)

Objectives:

The general objectives of the program are:

a. To broaden the basic understanding of upland ecosystem dynamics in order that schemes for land use classification/allocation of upland areas and the management of kaingin, grassland, second-growth forests and industrial plantations as protective watersheds in the country may be improved or developed appropriately;

b. To establish a training center for basic and applied research in upland ecosystem management in the country; and

c. To organize a National Applied Research Network on Hydroecology.

Methods:

The program is operationalizing under the concept of an interdisciplinary, integrated and coordinated approach. A core group of researchers with diverse fields of interest (ecologist, hydrologist, biologist, economist, soil and water scientist, bio-chemist, sociologist, statisticians, entomologist, agronomist, veterinarian, forester, botanist, physiologist, etc.) work together in addressing the various components of a research problem simultaneously. In this strategy, it is believed that the potentials of generating maximum relevant research data is enhanced while promoting the optimal use of scarce research resources.

The experimental area covers a little over ten (10) hectares with three (3) mini-basins. Specifically, surface runoff, sedimentation, soil erosion, soil moisture content recharge and depletion, streamflow and other climatic data are monitored using both the plot and basin methods. The hydrologic behavior of five ecosystems (old kaingin, new kaingin, grassland, plantation and secondary forest) are being evaluated for comparative analysis. Three slope categories (36, 50, 70 percent) are also considered in the comparative evaluation of the various parameters.

Status and Findings:

The research findings is still in progress. Preliminary findings are therefore not conclusive at this time.

2. Hydrology of an Upland Farm (UPLB)

Objectives:

This research project has the following objectives:

a. To evaluate the water budget of an upland farm subjected to different cropping patterns;

b. To evaluate surface runoff, soil erosion, soil moisture content and suspended sediment associated with the various cropping patterns;

c. To develop regression models of surface runoff, soil erosion, soil moisture content and suspended sediment; and

d. To analyze chemical quality of surface runoff from the various cropping pattern.

Methods:

The plot method (4) is being used to monitor various hydrologic parameters on areas under various cropping patterns. These parameters include surface runoff, soil erosion, suspended sediment and moisture content. Other data being monitored ; include rainfall, evaporation, relative humidity, sunshine duration, temperature and wind velocity.

The plot area is eight (8) square meters replicated three times. The plots are located on an experimental site of the Upland Hydroecology Program, about one hectare in size. Comparative analysis of the hydrologic cropping patterns shall be undertaken.

Status and Findings:

The research project is just being implemented. In the next two years, data should be available for comparative analysis.

3. Hydrometeorological Characterization of Upland Ecosystem at Mt. Makiling (UPLB):

Objectives:

The research project has the following objectives:

a. To develop regression models of surface runoff, soil moisture content and suspended sediment;
b. To evaluate the hydrologic banavior of five upland ecosystem;
c. To synthesize the water budget of the various upland ecosystems.

Methods:

The plot and basin approaches are employed to monitor hydrologic data from the five upland ecosystems. These hydrologic data include surface runoff, soil erosion, soil moisture content and suspended sediment. Other data being monitored are rainfall, relative humidity, wind velocity, solar radiation, evaporation, soil and air temperature.

The plot area is eight (8) square meters replicated three times for each ecosystem. The basin area ranges from 0.8 to 5.95 hectares. Three slope categories (36, 70, 50 percent) are also considered along with the five upland ecosystems.

Comparative analysis of the hydrologic behavior associated with the five upland ecosystem are being undertaken.

Status and Findings:

The research project is still in progress. Preliminary data analyses show the following:

1. Rainfall intensity is a significant variable in predicting soil erosion and sedimentation;
2. Average surface runoff from the five ecosystems increases with increasing slopes;
3. Surface runoff was highest at the old kaingin, followed by new kaingin, secondary forest, and grassland;
4. Surface runoff accounted for an average of 6.4 percent of the total runoff producing rainfall;
5. Soil moisture content accounted for about 20 percent of the total runoff producing rainfall.

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4. Forest Hydrology (FORI)

Objectives:

a. To study the streamflow characteristics and sediment yield pattern as affected by land use and vegetation;
b. To establish the relationship of rainfall with quick flow or direct surface runoff and delayed flow or base flow with changes in land use and vegetation,
c. To determine possible changes in water yield or quantity and water quality due to introduction of watershed treatments in selected sub-catchments; and
d. To determine the variability of streamflow throughout the year due to land use changes or soil and conservation measures.

Methods:

In these studies, the paired and single-watershed techniques are used with post treatment calibration. In the paired-watershed, two adjacent small catchments, are selected. One catchment is treated after calibration period, while the other is left untreated. In single-catchment, treatment follows immediately after calibration period. Measurements of streamflow, sediment yield, precipitation and other useful climatic data are monitored throughout the study period. The effects of treatments will be evaluated in terms of changes of relationships between the treated and control catchments. For single-catchments, the relationship of rainfall and streamflow is used.

Under this research project, the hydrology of four major forest types are being studied, namely: grassland, secondary dipterocarp forest, pine, forest, and mossy forest. At present the treatments are burning, kaingin or primitive cultivation

in uplands, terracing for vegetable garden, change of vegetation from grass to trees or from tree species to another species. Other treatments like timber harvesting, cutting intensities, road construction, and other land use practices relevant to the study are being considered .

Status and Findings:

All studies under this project are still in their calibration period. Treatments will be introduced after significant correlations or relationships in the catchments during the calibration period is attained.

5. Plants Selection for Soil Erosion Control (FORI)

Objectives:

The project aims:

a. To assess different plant species (endemic and exotic) for their adaptability and suitability for soil erosion control in varying sites;

b. To determine the effectiveness of methods in establishing vegetation for controlling soil erosion under local conditions; and

c. To determine the rate of stabilization by the different rehabilitation methods.

Methods:

Different structural and vegetative measures or combination of both are established in varying sites and compared in their effectiveness in controlling erosion. Plant species possessing desirable qualities for soil erosion control are tested and screened for their adaptability and suitability in different

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erosion [illegible] banks, open cast mined areas, [illegible] areas with depleted or disturbed so[illegible] are rate of growth, biomass production, soil loss under each plant cover and reproduction or seed heads. Methods of vegetation establishment are likewise compared.

Status and Findings:

The project is in progress. Initial findings show that in areas below 1500 meter a.s.l. species found effective and providing prompt cover for eroding soil are the African star grass (Cynodon plectostachyus), guinea grass (Panicum maximum) Schofield stylo (Stylosanthes guyanensis) and Giant ipil-ipil (Leucaena leucocephala). In higher elevations, Kikuyu (Pennisetum clandestinum), and Alnus)Alnus maritimus and Alnus nepalensis) are proving superior to other species that were tested.

The use of soil amendments or fertilizers proved very effective in vegetation establishment in eroded sites. The project is still in progress with further introduction of more species.

6. Grassland Uses Effects on Soil and Water Losses (FORE)

Objectives:

The project aims:

a. To determine the amount of surface runoff and sediment yields on a grassland slope;

b. To determine the changes of important hydrologic characteristics of the soil as affected by grassland treatments.

Methods:

The paired plot method of assessing treatment effects was used with one plot as the control and the four plots treated each with (1) annual burning, (2) cultivated and planted to corn, (3) cultivated and planted to rice, and (4) moderate grazing. Surface runoff and sediment yield every storm flow were measured throughout the study. A three-year calibration period was followed by a 4-year treatment period. Hydrologic characteristics of the soil were evaluated before and after the treatments.

Status and Findings:

The continuation of this project is awaiting financial support. However, partial results has been published.

Findings indicated that the undisturbed burned plot had the highest increase of surface runoff - 25.2 percent, followed by corn plot - 16.1 percent, then rice - 12.6 percent. Runoff was lowest in the protected and moderately grazed plots. Although the undisturbed burned plot had the greatest increase in surface runoff, it had the least sediment yield. The rice plot produced the most sediment followed by corn plot. The protected and moderately grazed plots had also the least sediment. Significant improvements in the soil structure of the protected plot was noted with increased organic matter, but significantly reduced in burned and cultivated plots. With cultivation on grassland slopes, the frequency of surface runoff causing soil erosion was increased.

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7. Upland Vegetation Management (FORI)

Objectives:

The project aims:

a. To determine the rate of sedimentation from different upland agriculture cropping patterns.

b. To determine the effects of successive partial cuttings on streamflow and sediment production.

c. To assess streamflow characteristics and sediment yield changes as affected by different tree plantation stocking rates.

d. To evaluate effectiveness of agro-forestry as a revegetation strategy for upland watersheds.

Methods:

The plot and paired catchment methods of assessing treatment effects of land use are used in this project. Treatment effects are expressed in terms of the changes in parameter values associated with the control and treated plots from calibration to treatment period.

Status and Findings:

The studies under this project are in their establishment phases.

8. Socio-economic Assessment of Upland Cultivation (kaingin) Management Schemes (FORI)

Objectives:

This project has the following objectives:

a. To determine the most effective approach and medium of communication in order to gain the interest of cultural minorities towards reforestation and conser_ vation of watershed resources.

b. To assess changes in the socio-economic patterns of kaingineros as a result of different kaingin management schemes.

C. To determine the factors influencing the success or failure of the kaingin control project.

Methods:

A periodic survey of the socio-economic trends of upland cultivators (kaingineros) and evaluation of watershed values or kaingin areas with varying management strategies shall be conducted.

Status and Findings:

Studies under this project are recently initiated and results will be forthcoming.

APPENDIX B

RESEARCH AND PROJECT PROPOSALS

1. CENTER FOR UPLAND WATERSHED MANAGEMENT IN THE ASEAN REGION (CUWMAR)

I. Project Background and Detailed Description

A. Background

Upland watersheds are unique and complex ecosystems. They include not only bio-physical but also sociological, institutional and human components. The watersheds can support diverse faunal and floral population which when left alone are the basic components of an ever dynamic and stable ecological complex. Upland watersheds are also the major settings of man's management and developmental efforts for economic as well as political, social and institutional benefits. However, many upland watersheds, in the course of man's management and developmental manipulations, have been wantonly misused, such that their potential role for economic development and as basic component for an ecological stability is seriously jeopardized.

In the Philippines, just like in many countries, upland watersheds support vital hydroelectric plants. They are also the major water sources for domestic, agricultural and industrial users. In addition, upland watersheds act as physical barriers to stave off potential environmental and ecological extremities. Furthermore, upland watersheds are potential sites for agricultural and/or industrial expansion to satisfy demands of future generations; natural resource base for outdoor and other related recreational activities; and as natural resource base for perpetual faunal and floral gene pools.

The abusive use of many upland watersheds can become acute in future years due to increasing population pressure unless appropriate technical, management and administrative mechanisms and strategies are developed for their effective management and conservation.

The Centre for Upland Watershed Management for the ASEAN Region (CUWMAR) hopes to institutionalize upland watershed management and conservation efforts in ASEAN countries and be the forerunner in identifying common upland watershed management problems as basis in evolving and operationalizing effective watershed management and development strategies for the region.

B. Scope of the Project

The project shall establish, support and operationalize a regional center for upland watershed conservation and management for ASEAN countries.

The duration of the project is continuing. The main office of CUWMAR shall be located in the Philippines after consultation with all ASEAN member countries. Country branch offices of CUWMAR may be maintained.

The objectives of CUWMAR are:

1. To operationalize and support a regional set-up designed to pool and promote optimal use of limited but common upland watershed management and resources in the region;

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2. To initiate and/or support research, training and extension/developmental projects for an effective ASEAN upland watershed management strategies;

3. To evolve common standard/criteria/guidelines for the identification/classification of ASEAN upland watersheds;

4. To initiate and strengthen international linkages on effective upland watershed management and conservation;

5. To develop self-sustaining and income generating projects on upland watersheds designed to promote countryside development in the ASEAN region;

6. To generate funds to support research, training and extension/developmental projects on ASEAN upland watershed conservation and management;

7. To document and evaluate upland watershed management orientations, policies and strategies in the ASEAN region;

8. To evolve methodologies and strategies for a systematic data generation, storage, retrieval and analysis for ASEAN upland watershed conservation and management;

9. To evolve effective management and developmental guidelines for ASEAN upland watershed management;

10. To promote, institutionalize and strengthen regional cooperation in upland watershed conservation and management among ASEAN countries;

11. To develop a systematic method of initiating, monitoring and coordinating all research, training and extension/developmental strategies for an effective upland watershed conservation and management in ASEAN countries.

C. Detailed Project Description

1. Project Inputs

a. Technical Support

Technical support/expertise for CUWMAR shall come from ASEAN member countries. However, necessary but currently unavailable technical expertise/manpower shall come from outside sources such as foreign consultants or through manpower training and staff development. It is intended that staff development and manpower training be accelerated to finally take over the functions of foreign consultants.

b. Manpower Training

As envisioned, a manpower training and staff development shall be accelerated to fill in the necessary technical requirements of CUWMAR. As such, ASEAN expertise on watershed conservation and management have to be determined soonest, in order to determine additional expertise or technical support that could be filled in by foreign consultants, and finally replaced by trained staff from ASEAN member countries.

c. Field and Laboratory Equipment

Field laboratories/experimental sites shall be obtained from government lands, either from national government offices, state universities or other instrumentalities. The bulk of laboratory equipment for CUWMAR shall come from existing facilities of ASEAN member countries and from purchases.

2. Project Outputs

The establishment and operationalization of CUWMAR will institutionalize watershed conservation and management among ASEAN member countries. It is expected that CUWMAR will enhance the beneficial and optimal use of watershed resources in the ASEAN region, through the satisfaction of CUWMAR's various objectives.

3. End-of-Project Status

It is intended that CUWMAR's is a continuing regional institution designed to promote and enhance the beneficial and optimal use of watershed resources in the ASEAN region. CUWMAR shall be a regional institution that will serve as the forerunner of a well developed, productive and protective watershed ecosystems in the region.

II. Project Analyses

A. Technical Analysis

The Center (CUWMAR) aims to institutionalize all current and future watershed conservation and management efforts designed to promote a well developed, productive and protective watershed ecosystems in the ASEAN region. It cannot be over-emphasized that watersheds and their resources are vital components for socio-economic and institutional development in any country. Watersheds also act as physical barriers to stave off serious environmental and ecological imbalances and extremities. Consequently, proper use of watershed resources in the light of current and future constraints and developments have to be developed. Through CUWMAR it is expected that common pool of regional watershed resources (physical, institutional, technical, etc.) are optimally used and developed to enhance the productive and protective values of watershed ecosystems harmonized with the maintenance of environmental quality and ecological stability in the region.

B. Financial Analysis and Plan

Table 1 shows a capsulized five-year budget for CUWMAR.

Table 1. Capsulized Five-Year Budget for CUWMAR. (US$1000)

ITEMS	YEAR 1	2	3	4	5
A. Personal Services					
Salaries	150	150	150	150	150
Wages	25	25	25	25	25
Honoraria	30	30	30	30	30
B. Supplies and Materials	15	15	15	15	15
C. Capital Outlays					
Buildings and furnishings	2000	-	-	-	-
Transport/Vehicle	50	-	-	-	50
Laboratory/Office Equipment	100	-	-	-	-
D. Operating/Maintenance	30	30	30	30	30
E. Contingencies	25	25	25	25	25
TOTAL	2425	275	275	275	325

The above capsulized budget is for a period of five years. It is envisioned that as soon as CUWMAR is approved and adopted by ASEAN member countries, a continuing source of fund shall be identified and institutionalized.

C. Social Analysis

The functions of CUWMAR include three major components: research, management/development and extension. All these major functional components are expected to generate far-reaching social benefits not only in terms of individual country but also in the ASEAN region as a whole.

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Through research, necessary basic and applied data are generated which will form the bases in evolving viable, realistic and beneficial strategies for a well developed and managed watersheds. Finally, in order that the benefits of a well developed and managed watersheds will permeate to the greater mass of the common people, an intensive extension service is necessary. In short, in the process of operationalizing the major functions of CUWMAR, direct and beneficial multiplier benefits are generated for the welfare of society of an individual member country in particular, and the ASEAN society in general.

D. Economic Analysis

The direct economic benefits that could be derived from a well managed and developed watershed depends on the intensity/magnitude of development or management activities imposed on the watersheds. It cannot be overemphasized that the potential economic benefits that could be derived from efficient use and development of watershed resources are tremendous. In addition to the direct economic benefits are the promotion of indirect values such as stable and protective watershed ecosystems and quality environment.

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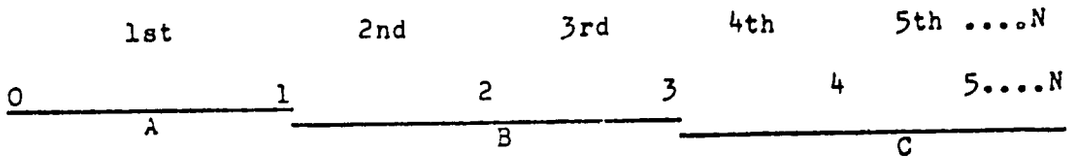
III. Implementation Plan

YEAR



A - Establishment of contacts for institutional and government support for CUWMAR

- Formation of technical working group from ASEAN member countries
- Formation of administrative set-up for
- Fund generation for CUWMAR

B - Facilities construction

- Project identification
- Project prioritizing
- Project implementation

C - Data/output collection, collation, analyses, storage, retrieval

- Technology development
- Technology transfer

IV. Evaluation Arrangements for the Project

A review board shall evaluate the progress and annual reports of CUWMAR . This review board shall be the Board of Trustees to be created as a governing council/board of CUWMAR . The Board of Trustees shall be composed of one representative each from all participating ASEAN countries plus a representative from supporting countries.

Figure 1 shows the proposed organization chart for CUWMAR.

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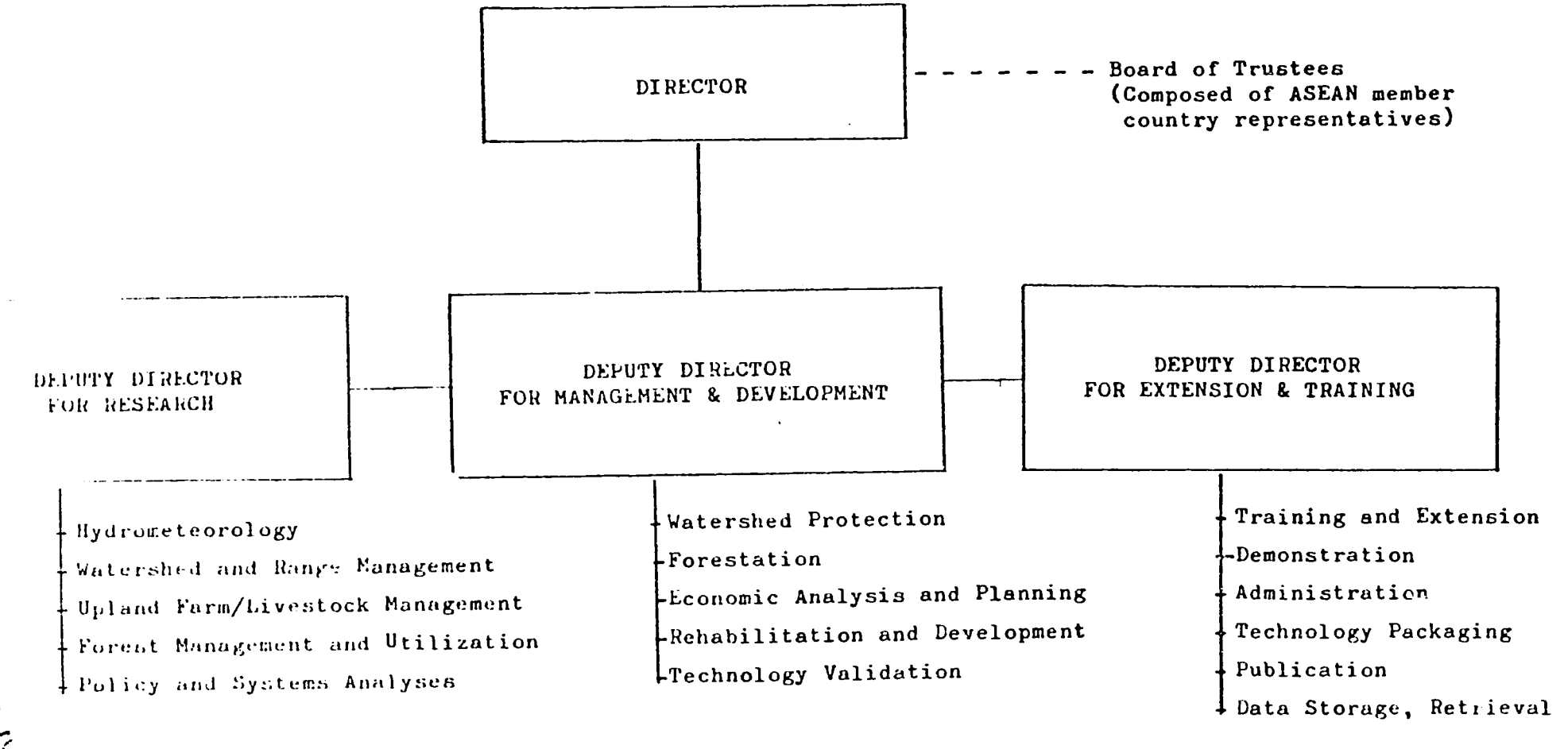
FIGURE 1. CUWMAR PROPOSED ORGANIZATION CHART



2. INTEGRATED UPLAND WATERSHED DEVELOPMENT AND RESEARCH PROJECT

I. Project Background and Detailed Description

A. Background

Upland watersheds are increasingly encroached upon exacting serious degradation of bio-geophysical resources. As a result, large areas of upland watersheds have become very unstable ecosystems and virtually unproductive. To compound the problem, these same areas continue to be the major sources of accelerated soil erosion and related hydro-physical problems that are ruining expensive irrigation infrastructures, productive agricultural lands and a balanced ecology over a wide spectrum of land scenes.

The problems that beset upland watersheds will continue due to anticipated population increase. An increased population will certainly bring about an accelerated upland occupancy with their concommitant degrading repercussions. Compounding the population problems is the physical (land area) constraint. Sooner, greater number of people have to make do with the same land base. Unless effective developmental and management strategies on upland watersheds are evolved and operationalized, the worsening conditions of these ecosystems will continue to upset the socio-economic as well as environmental and development efforts of ASEAN countries.

There is an urgent need to check the continuing degradation of upland watersheds. Effective management and developmental strategies have to be evolved and

and operationalized to restore, improve or harness the productive as well as protective values of upland watersheds. Consequently, economic prosperity in the countryside in close harmony with resources conservation (soil, water, forage, timber, etc.) and environmental stability could be promoted.

This watershed development and research project hopes to address pressing problems affecting ASEAN upland watersheds through an integrated, coordinated and applied participative approach.

B. Scope of the Project

The project shall establish and operationalize self-sustaining/income generating upland watershed farms under the concept of an integrated, intensified and applied participative approach. Combined with the developmental aspect is the research component of the project.

The duration of the developmental component of the project is continuing. However, the research aspect shall last up to five years. It is suggested that the first field site of this project shall be in the Philippines. The project may be replicated in other ASEAN member countries.

The objectives of this project are :

1. To develop and operationalized self-sustaining/income generating and integrated upland watershed farms;

2. To accelerate transfer and application of improved technology/strategies for the beneficial and optimal use of upland watershed resources geared towards bringing economic prosperity in the countryside in close harmony with the promotion of quality environment and ecological stability.

3. To evaluate the changes in the socio-economic, hydrologic and watershed resources conditions due to upland watershed management and developmental activities.

4. To evolve strategies for sustained public involvement in the beneficial use and development of upland watershed resources.

C. Detailed Project Description

1. Project Inputs

a. TEchnical Support -

Technical expertise/support to operationalize the project shall come from ASEAN member countries. It is expected that the needed expertise for the project are available.

b. Manpower Training -

It is necessary to train manpower on the technician level. The technicians are the project implementors. In addition, training or project participants (kaingineros, upland farmers, etc.) may be undertaken. As such, short or in-service training courses designed for technicians and project participants shall be undertaken.

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c. Field and Laboratory Equipment -

Field laboratories/experimental sites shall be obtained from government lands, either from national government offices, state universities or other instrumentalities. Necessary field and laboratory facilities and materials shall come from purchases. Other facilities such as nursery sheds, livestock sheds, transport facilities, and others shall be obtained through purchases or other means.

2. Project Outputs

The project hopes to operationalize an income generating and integrated upland watershed farms geared towards harnessing the productive and protective values of the watersheds to promote socio-economic prosperity in the countryside in close harmony with the promotion of environmental stability. In addition, basic and applied research data which include evaluation of the socio-economic conditions of project participants before and after the project, and the evaluation of the hydrologic influences of various upland developmental projects shall be undertaken.

3. End-of-Project Status

The project is intended to be continuing and income generating. It is expected that the productive and protective values of the upland watershed farms are enhanced. At the same time, environmental stability is promoted.

II. Project Analysis

A. Technical Analysis

The project hopes to develop a productive and protective integrated upland watershed farms in close harmony with the promotion of quality environment and ecological stability. It is envisioned that the marginal productive and protective conditions of many upland watersheds are improved through the impositions of viable land use alternatives and management strategies.

B. Financial Analysis and Plan

Table 1 shows a capsulized five-year budget for the project.

ITEMS	YEAR 1	2	3	4	5
A. Personal Services					
Salaries, honoraria	20	20	20	20	20
Wages	5	5	5	5	5
B. Supplies and Materials	10	10	10	10	10
C. Capital Outlays					
Buildings/shed	25	-	-	-	-
Transport/Vehicle	50	-	-	-	-
Farm implements	25	-	-	-	-
D. Operating/Maintenance	10	10	10	10	10
E. Contingencies	4.5	4.5	4.5	4.5	4.5
TOTAL	149.5	49.5	49.5	49.5	49.5

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C. Social Analysis

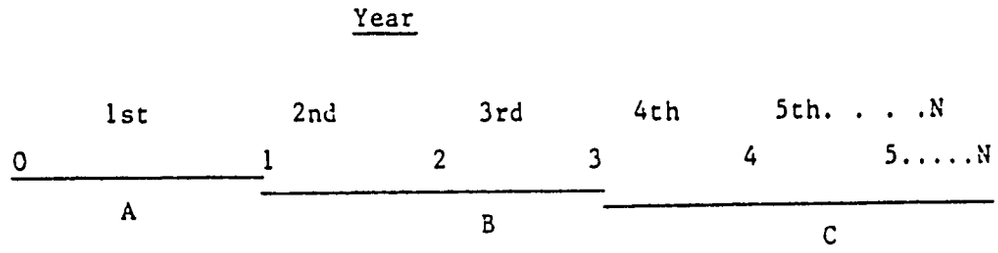
A well developed upland watershed farm, which incorporates both the productive and protective components as well as quality environment is expected to benefit society as a whole. It is anticipated that integrated upland watershed farms will spur a just, fair and equitable sharing/ distribution of the benefits of a well developed natural resource.

D. Economic Analysis

The project is an income generating venture. It is expected that the direct economic returns from the project will yield a comfortable rate of return. This is not to include the indirect protective values generated from a well managed watershed ecosystem.

III. Implementation Plan

Following is a five-year plan of operation:



A - Project area location
- Staff recruitment
- formation of administrative set-up
- logistic preparation

B - Facilities construction
- Project implementation
- Research identification/implementation

C - Data monitoring, collation, analyses
- Report preparation/submission.

IV. Evaluation Arrangements for the Project

A review committee for the project shall be created. The committee shall be composed of one representative each from all participating ASEAN countries plus a representative from supporting countries.

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3. HYDROLOGIC INFLUENCES OF VARIOUS VEGETATION AND LAND-USE PRACTICES, MANIPULATIONS, REHABILITATION AND DEVELOPMENT MEASURES ON ASEAN UPLAND WATERSHEDS

I. Project Background and Detailed Description

A. Background :

Workable and viable programs for watershed conservation and management calls for data or information on how water and soil is handled by the various vegetation and methods of land manipulation. Such information are currently wanting under the ASEAN watershed conditions. This dearth of hydrologic and other scientific information poses constraints to the preparation of effective programs for the conservation and management of watersheds in the ASEAN region.

Although developed countries may have acquired ample information from their watersheds, they may not necessarily apply under conditions prevailing in ASEAN member countries.

The ASEAN watersheds lie within similar climatic conditions and has almost identical characteristics, vegetation and land use patterns that may allow common use of scientific data by ASEAN member countries. Watershed researches in the ASEAN countries are scarse due to limited trained watershed researchers in this region.

B. Scope of the Project

The project shall include impact assessment of vegetation manipulation, forestation, land use changes, biological and mechanical rehabilitation measures, and developmental projects (agro-forestry, cropping systems, logging methods, grazing practices, etc.) on water supply (quantity, quality,

regimen), soil erosion and sedimentation, faunal and floral population, as well as ecological trends and conditions. Development of alternative management strategies and technology shall be undertaken considering management goals and upland resources use orientations.

Objectives

The primary objective of the project is to evaluate the hydrologic influences of various vegetation and land use manipulations, rehabilitation and developmental measures on the upland watersheds of ASEAN member countries.

Specific objectives are the following :

1. To determine the streamflow pattern and water yield as to quality,quantity and regimen as influenced by vegetation manipulation and land use practices;
2. To determine changes in hydrologic characteristics and conditions of the soil as influenced by land use practices;
3. To determine effective strategies and techniques in manipulating watershed resources to control or prevent deterioration of upland watershed values, and
4. Prepare guidelines for watershed conservation and management based from results of studies.

C. Detailed Project Description

1. Project Inputs

a) Technical support -

A group of watershed researchers from representatives of ASEAN countries shall man the project. A project leader to coordinate the activities shall be chosen from among the representatives.

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Studies under this project shall be conducted by the representatives as the study leaders and supporting researchers and personnel to come from the country where it shall be conducted. A study shall be conducted in a country where the research problem critically prevails and where it can be efficiently executed with its existing resources (personnel and facilities).

Consultation with ASEAN-US experts shall be reported to when necessary in the pursuance of the project. The University of the Philippines at Los Baños and the Forest Research Institute under the Ministry of Natural Resources possess qualified expertise and facilities for the project.

The proposed studies, among others that are identified pressing, are the following :

1. Run off and sediment yield of land use practices from upland watershed;
2. Streamflow characteristics and sediment yield as affected by different vegetation types;
3. Biological and mechanical rehabilitation measures to ameliorate damaged watershed;
4. Special management requirements of erosive and critical watersheds to prevent deterioration under use;
5. Identification and evaluation of potential plants for erosion control;
6. Improving land use practices (logging, silviculture, grazing, burning, cultivation, etc.) to minimize surface runoff and prevent erosion.

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b) Manpower training

There shall be employed an understudy leader to assist and train under the expertise of the senior researcher, who may be the project or study leader.

Annual seminar/workshop on the project to discuss the progress of the project as a means of research extension and to plan strategies of action toward successful attainment of goals shall be conducted. REsearchers from ASEAN members and watershed managers may participate to have first hand information from the researchers. Country host shall alternate among participating ASEAN members.

c) Field and Laboratory Equipment

The experimental forest or government owned watershed of state universities and government research agencies of member country shall be made available for studies conducted in that country. Non-available equipment and supplies shall be procured.

d) Office

The office of the project leader shall be held within his agency's offices if available or within a local ASEAN office to be arranged.

Similarly a study leader shall hold office in his agency's office in the country where the study is conducted. Memorandum of undertanding shall be executed for the use of the office space and research facilities for this project if necessary.

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2. Project Outputs

a) From the project, important data will be generated as useful indeces and guides in evolving viable strategies or alternatives for the conservation and management of ASEAN upland watersheds.

b) With the findings from this project, public awareness can be intensified to support programs on watershed conservation and development. Cooperation of local watershed communities will be greater in pursuing programs on the conservation and wise use of watershed resources.

3. End of Project Status

At the end of the project researches on watershed conservation and management shall have been directed towards proper orientation. All on-going research which warrant extension may be continued and more relevant studies may be conducted, for a given period, upon approval of the country representatives and consultants with same supporting agencies, after which studies shall be absorbed by research agencies of the country. The regional cooperation and consultative approach shall be continued among ASEAN members in the pursuance of the project.

II. Project Analysis :

A. Technical Analysis

As a final result of the project the science of watershed ecosystem and its management within ASEAN countries will be advanced. Watershed managers and local watershed communities shall be provided with more reliable working knowledge in pursuing a workable program of watershed conservation and development.

B. Financial Analysis and Plan

1. Sources of Fund

a) Participating ASEAN country - shall provide fund for the personal services (salaries and wages) of researchers and supporting staff working on the project within the country.

b) Donor country - shall provide fund for the maintenance and operation, equipment, capital outlay and honoraria for consultants and researchers.

c) Social analysis

From the scientific information obtained from the project, improvement of the public apathy in watershed programs will be intensified as follows :

2. BUDGET SCHEDULE :

Table 1. Capitalized six-year Budget for the Project (US$ 1000)

ITEMS	YEAR 1	2	3	4	5	6	TOTAL
	$	$	$	$	$	$	$
A. Personal Services							
Honoraria for :							
1 - Project Director ($250/mo) (Research Supervisor)	3.0	3.0	3.0	3.0	3.0	3.0	18.0
6 - Study leaders ($150/mo) (Sr. Researchers)	10.8	10.8	10.8	10.8	10.8	10.8	64.8
6 - Understudy Leaders (Junior Researchers)	7.2	7.2	7.2	7.2	7.2	7.2	43.2
12 - Research Aides) 15 - Laborers) 2500 - Mandays (contractual hired) personnel-clerk, computer,) etc.)	Salaries and wages to be paid by country government						
SUB-TOTAL	20.4	20.4	20.4	20.4	20.4	20.4	126.0
B. Maintenance and Operation							
Travel	8.0	10.0	7.0	6.0	6.0	6.0	43.0
Supplies and Materials	5.0	6.0	5.0	3.5	3.5	3.5	26.5
Sundry	3.0	4.0	3.0	2.5	2.5	2.5	17.5
SUB-TOTAL	16.0	20.0	15.0	12.0	12.0	12.0	87.0
C. Equipment	55.0	60.0	10.0	5.0	5.0	5.0	145.0
D. Capital Outlay	50.0	60.0	20.0	18.0	16.0	6.0	170.0
TOTAL	141.4	160.4	65.4	60.4	53.4	43.4	528.0

1. Public understanding and interest (policy makers and local watershed communities) will be aroused toward more active and dynamic involvement in the conservation and management of upland watersheds.

2. A more positive cooperation and support in pursuing programs of watershed conservation and management is expected among beneficiaries of the watersheds and operators involved in the watershed.

3. With a workable and viable guidelines and strategies evolved from the scientific data or information obtained, greater success shall be realized with better programs in the conservation and management of watersheds with wider public evolvement.

4. Creation of local organization of watershed communities will be facilitated to establish conservation and development projects, such as small irrigation projects, water conservation measures or water impounding and upland fishponds, pollution abatement, etc.

D. Economic Analysis

The generated data are not directly quantifiable in monetary terms, but are basic management data for scientific, viable and effective conservation and management of ASEAN upland watersheds. Effective guidelines and strategies for watershed conservation and management can be prepared designed to reduce flood water damages, prevent sedi-

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ment deposition on flood plain lands, in streams and in reservoirs, increase area service by irrigation with more water conserved in reservoirs; abatement of pollution; regulation of streamflow; providing water for generation, fish recreation, wildlife and projects needing water. In addition intangible or non-monetary benefits may also occur, such as the prevention of loss of life, reduction of fear of possible flood losses on the part of the individual and enhancement of the ecological environment.

All these resulting benefits indirectly derived from the research project are expected to increase crop production and income of the people and decrease damages from erosion, sedimentation and floods, and decrease normal farm expenses in uplands.

Consequently, more food, clothing, shelter and other basic human needs in life can be produced.

III. Implementing Plan -

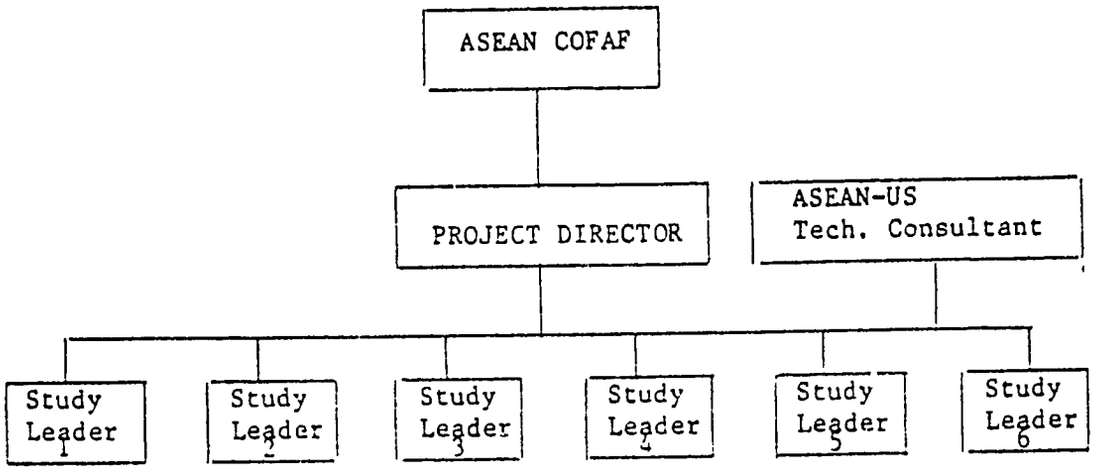
A. Organization

The research project shall be headed by a project director to be chosen from the participating country. He must be trained and experienced researcher possibly holding a supervisory position in watershed management.

The studies shall be headed by study leaders who shall be a senior research officer in watershed or related fields and assisted by a junior researcher as the understudy

Research aides and laborers shall be employed to assist the researchers in the pursuance of the studies.

ORGANIZATIONAL CHART



B. Research Study assignment and outline preparation

A research study shall be assigned to a country forestry research agency where the results of the study would be most useful. This shall be done through evaluation of reports and actual appraisal of the country's problems on watershed. Upon determination of the country study, qualified study leaders are assigned by the country government who shall then prepare a detailed working outline for the study indicating among other information, 1) objectives, 2) methodology, 3) study budget estimate and 4) duration and schedule of activities. The working outline shall be forwarded to the project director for review with the consultants and approval.

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C. Funding

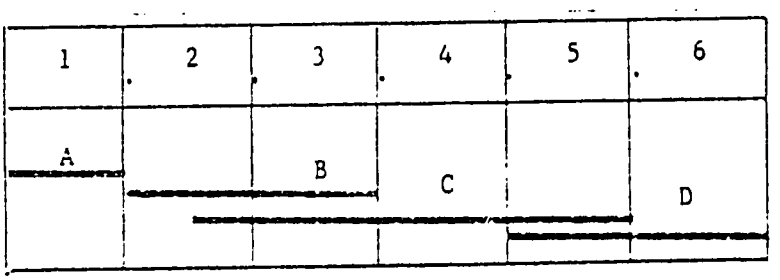
Upon the approval of the funds for the study shall be released from the country government research allotment and sponsoring agency. Funds of the government shall be spent in accordance with the existing regulation of the country, likewise with standing rules of sponsoring agency.

D. Research execution

The study leader shall be prepared with all resources within his means for the implementation of the study upon receipt of the funds.

He shall submit reports on 1) establishment, 2) semi-annual progress report, 3) annual progress report and 4) final or completion report.

SCHEDULE OF ACTIVITIES



A - Organization of technical working force,
- country study problem identification and planning
- fund generation for the project
- preliminary activities for studies implementation

B - Establishment of studies

C - Collection of data and monitoring of results

D - Data analysis, and publication
- Technology development
- Guideline preparation.

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E. Supervision

At least once a year the project director shall conduct a detailed review of the study activities conducted in different countries In the course of his review he shall conduct a frank discussion of problems and difficulties and agreement reached to solve the problems.

Iv. Evaluation Arrangements for the Project

The project director shall arrange for an annual evaluation of the project. Every year beginning from the 3rd year a country where a study is conducted shall host an evaluation group participated by all forestry and other agencies concerned with watershed resources conservation and management to review and discuss the progress of the project activities. Salient findings from the project shall be discussed in a symposium and in field visit to the studies.

4. SOCIAL, TECHNICAL AND INSTITUTIONAL PROFILE OF UPLAND WATERSHED CONSERVATION AND MANAGEMENT IN ASEAN COUNTRIES

I. Project Background and Detailed Description

A. Background

One of the important components of a watershed is the local community which is recognized as a determinant factor in the success of any watershed conservation and management program. Current issues concerning the degradation of ASEAN watersneds are traced from social, technical and institutional set-up in the watershed communities. It is therefore, essential that these factors be investigated as they affect watershed conservation and management programs.

B. Scope of the Project

The project shall include data collation, evaluation and documentation of current and projected social, technical and institutional parameters that may influence the systematic and overall conservation and management of ASEAN upland watersneds. The interactions of the three named parameters with economic, hydrologic, social, as well as ecological consideration snall be emphasized.

C. Detailed Project Description

1. Project Inputs

a) Technical Support

Each ASEAN member country shall be represented by a project representative. This project shall be headed by a project coordinator to be chosen from among the project representatives. Consultants from ASEAN-US experts may be availed of when local expertise is not available.

Personnel Requirements -

One technical project representative from each ASEAN member country, one project leader, one research assistant from each ASEAN member country, six research aides, two research assistants for the project leader and contractual personnel.

b) Manpower training -

Before the start of data collection, researchers and supporting members shall receive training/briefing on the implementation and execution of the project by the project leader and consultants.

c) Field and Laboratory equipment -

Studies under this project shall be conducted within ASEAN watersheds and shall use office and laboratory facilities of the forestry research agencies, state universities or private offices selected to the project of the participating ASEAN country. Equipment or research facilities not available shall be procured.

2. Project Outputs

The major outputs from this research project such as: documentation of the public's perceptions, attitudes, and involvement is upland watershed conservation and management; codification of management alternatives/terminologies, criteria or standards; development of appropriate criteria for watershed identification and classification;

determination of the extent of upland watersheds; monitoring of land use and vegetation changes; documentation of upland watershed land use policies; and development of institutional arrangement for the conservation and management of upland watersheds in ASEAN countries are not directly and easily quantifiable in terms of monetary benefits. However, these expected outputs are basic and major information/data that are necessary to effect successful conservation and management of upland watershed in ASEAN countries.

- End-of-Project Status

At the end of the project, the objectives are expected to have been attained. However, more scientific information related to the project may be needed so that extension of the studies become inevitable. Studies which warrant continuation shall be taken over by the forest research agency or state university of the country where the study is conducted. Regional consultation and cooperation among ASEAN researchers shall be maintained.

II. Project Analysis

A. Technical Analysis

Social, technical and institutional characterization of upland watershed conservation and management in ASEAN countries shall be documented to serve as basic guide in operationalizing local watershed communities towards conservation of the watershed.

The output of this project are basic and necessary in evolving and strengthening management capabilities and strategies for upland watersheds in the ASEAN region.

B. Financial Analysis and Plan

1. Source of Funds

The participating ASEAN countries shall put up a counterpart fund that will supplement the donor country's expenses for operation and maintenance, equipment and capital outlay.

2. Schedule of Budget

(See Table 1)

C. Social Analysis

From the data generated, guidelines can be prepared and tailored toward social and technical upliftment of the watershed communities. Organizations of local communities can be facilitated to work on watershed conservation and development projects with strategies geared towards their own improvement.

D. Economic Analysis

With greater number of persons involved in the conservation of watershed resources greater success is expected, and hence damages worth millions pesos within the watershed ecosystem (above and below the common drainage) can be tremendously minimized. The savings from damages and rehabilitation cost can be equated to the economic progress of the community.

Table 1. Capsulized Five-year Budget (US $1,000)

ITEM	YEAR 1	2	3	4	5	TOTAL
A. Personal Services						
Salaries	50	50	50	50	50	250
Wages	6	6	6	6	6	30
Honoraria	6	6	6	6	6	30
B. Operation/Maintenance						
Travel expenses	9	9	9	9	9	45
Supplies & Materials	6	6	6	6	6	30
Other Services	3	3	3	3	3	15
C. Equipment	10	5	-	-	-	15
D. Capital Outlays	20	5	-	-	-	25
E. Contingencies	11	9	8	8	8	44
TOTAL ...	121	99	88	88	88	484

The total counterpart fund may be prorated among the ASEAN member country based on upland watershed area or shared on any terms agreed upon by all participating countries.

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III. Implementation Plan

1. Schedule of Activities

```
                    Y E A R
1     :     2     :     3     :     4     :     5
      :           :           :           :
Axxxxxxxxxxxxxxx  :           :           :
      :Bxxxxxxxxxx:           :           :
      :           :Cxxxxxxxxxxxxxxxxxxxxxxx:
      :           :           :           :Dxxxxxxxxxx
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A - Personnel recruitment, training and field assignment
  - Fund generation
  - Arrangements for office and equipment
  - Facilities procurement

B - Project implementation

C - Data collection and analysis

D - Data evaluation and report submission Documentation

IV. Evaluation Arrangement for the Project -

Annual review and evaluation of the project shall be conducted by the project leader with the consultants and a representative of sponsoring agency. At the termination of the project a symposium shall be conducted to discuss salient findings from the project.

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ANNEX K

1. MALAYSIAN PROPOSALS FOR THE ASEAN WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME
2. PROPOSED STUDIES IN FOREST MANAGEMENT AND DEVELOPMENT IN A WATERSHED
3. PROPOSED STUDIES IN CONSERVATION AND MANAGEMENT OF WATER RESOURCES
4. PROPOSED STUDIES IN SOIL EROSION AND CONSERVATION IN A WATERSHED
5. PROPOSED STUDIES ON THE EFFECTS OF LANDUSE CHANGES ON SOIL FERTILITY
6. PROPOSED MONITORING OF METEOROLOGICAL PARAMETERS AND STUDIES OF CLIMATIC VARIATIONS IN A WATERSHED

ASEAN WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

MALAYSIAN
TECHNICAL PAPER
No. 6

ASEAN 79/COFAF.WW/Doc. 14

MALAYSIAN PROPOSALS FOR THE ASEAN WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME

KUALA LUMPUR, MALAYSIA
3 - 7 SEPTEMBER, 1979

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MALAYSIAN PROPOSALS FOR THE ASEAN WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME*

I. PROJECT BACKGROUND AND DETAILED DESCRIPTION

A. Background

Throughout the ASEAN region, increasing pressure for arable land has steadily decimated the valued forest resources of the countries concerned. Ultimately, it is envisaged that the region's forest resources will be confined mainly to the hilly and mountainous areas which are essentially watersheds with vital conservation functions. In spite of these functions, however, it is inevitable that some of these areas will have to be managed for multiple use, including timber production, in the long run.

Logging in such hilly areas by mechanised means will increase soil erosion, run-off, siltation of water courses and other deleterious downstream effects caused by activities associated with logging road construction, and the actual felling and removal of timber from the forest. Because of the very critical interdependence between the forest and the water resources, it is imperative that in the overall management and harvesting of the former, maximum care must be taken so as not to adversely affect or impair the quality, availability and productive potential of the latter. At the same time the cost of timber harvesting which involves heavy expenditure on equipment, forest road construction etc, must be kept within economical limits. There is, therefore, a need to balance these requirements. To-date, unfortunately, there is scant

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme held from 3-7th September 1979 in Kuala Lumpur, Malaysia.

knowledge and experience on the long-term effects of soil/water changes as a result of logging using different mechanised systems in the hill forests in particular. There is, therefore, an urgent and critical need to appraise the situation and to draw up and implement a comprehensive programme of studies that will have direct applications in the overall conservation and management of the watersheds.

The natural resources of the ASEAN countries, such as forests, soil and water, share some very common characteristics because of the close geographical proximity of these countries. In fact, with respect to forest resources, it is usual to refer to the forests found in the ASEAN countries collectively as the Tropical Rainforests since the countries have almost similar forest vegetation and rainfall patterns. Another feature common to ASEAN countries is that currently all the member countries have their own development plans which are invariably agro-based and involve the conversion of forest lands to agricultural development and settlement which have an important effect on the soil and water balance of the land. Therefore, a watershed conservation and management research project on a regional basis, with the objective of formulating sound conservation and management prescriptions compatible with development from the point of view of reduced impairment to the productive potential of soil and water, will be of immense benefit to the ASEAN countries.

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In terms of research efforts for the conservation and management of watersheds in this region, it is beneficial for ASEAN member countries to aim for centralisation of all these research activities through the establishment of a regional research centre.

B. Scope of the Programme

1 Justification

An ASEAN Watershed Conservation and Management Research Programme can have various objectives and can be amply justified. These objectives and the justification will become apparent with a brief survey of the scale and dimension of the resource problems in the five ASEAN countries which will enable watershed management to be given shape and form and to be viewed in the proper perspective.

In Peninsular Malaysia, forests covered 74% of the total land area in 1958, but by 1976 only about 7.2 million ha. out of the total area of 13.2 million ha. or 55% was left. In Sabah, the 1971 forest inventory figures showed that 86% (6.00 million ha.) of the land was forested of which more than 22% have been logged over or disturbed by shifting cultivation. For Sarawak, by 1975, only about 76.5% (9.3 million ha.) out of the total land area of 12.1 million ha. was classified as under permanent forests and other forests. With the launching of the Third Malaysia Plan, where land clearance for agriculture and settlements will continue at an accelerated rate, it is estimated that most lowland forests within Malaysia would have disappeared in the mid 1980's. Meanwhile, the boundary which was

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arbitrarily taken to delineate the "productive" forests from the "protective" forests, has been pushed upwards from the 1,000 ft. (330 m) to the 3,000 ft. (990 m) contour. Logging in these high elevation forests has generally been identified as the reason for the heavy sedimentation and more frequent flooding experienced downstream.

The situation is also true in the Philippines although the form of forest exploitation is different. The very fast forest destruction in the Philippines is primarily due to the widespread practice of shifting cultivation and secondarily to exploitative logging, fires and other causes. It is estimated that the forest is denuded at the annual rate of 172,000 hectares. The remaining forest is under the permanent jurisdiction of the Bureau of Forestry for the protection of watersheds which are the major sources of potable water supply. The situation is more critical in that most of the watersheds in the Philippines are very small and therefore do not yield a sufficient amount of freshwater for its growing population and other form of uses.

In Indonesia, except for Kalimantan, Sumatra and Moluccas, most of the lowland forests have virtually been harvested. In Kalimantan, of the 10 million hectares of forest left as productive forest, 7.6 million hectares have been approved for logging. The rate of depletion of the lowland and hill forests in Kalimantan is a cause of considerable concern.

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In Thailand, tropical rainforest exist in two juxtaposed areas, the southeastern and the peninsular areas. However, the acreage of forest is subjected to devastation not only by natural phenomenon, such as the hurricane of 1961 which devasted a large tract of the primary forest, but also heavy exploitation for timber and other forest products. The accelerated rate of agricultural development and settlement schemes, mining and highway construction have resulted in a considerable loss of the national forest reserves.

Although there is hardly any forest left in Singapore, there are many critical watersheds which are vital for water supplies. The Ministry of Environment's dynamic programme to plant trees and shrubs is an indication of the country's positive conservation and management policy to protect the watersheds.

2 Objectives of the Programme

General Objectives:

The long-term objectives of the Programme are to enable ASEAN Member Countries:

(a) To upgrade technical expertise and to improve technology for the conservation and management of watersheds; and

(b) To apply appropriate technology for watershed conservation, management and multiple-use so as to ensure a sustained yield of socio-economic benefits.

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Specific Objectives:

The immediate and specific objectives of the Programme are to assist ASEAN Member Countries:-

(a) To develop appropriate criteria for the identification and classification of watersheds;

(b) To determine the extent of these watersheds;

(c) To conduct research aimed at the formulation of sound principles and guidelines for watershed conservation and management;

(d) To develop appropriate technology for the conservation and management of watersheds for protection and/or production;

(e) To investigate the feasibility of multiple use, with particular reference to timber production in watersheds.

3 Structure

The Programme will comprise projects and components specifically designed for integrated research aimed at the conservation and management of the three broad types of watersheds, namely,

(a) Forested Watersheds;
(b) Cultivated Watersheds; and
(c) Devastated Watersheds.

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It is envisaged that the Programme will consist of three phases as follows:-

Phase I - A survey and inventory of existing resources in the ASEAN countries, including identification, classification and determination of the extent of critical and environmentally sensitive watersheds.

Phase II - Identification of urgent and problematic issues for research in critical watersheds, including the following:-

(a) Effects of forest harvesting/clearance on sedimentation, siltation and loss of nutrients; climate; hydrological characteristics; and environment generally;

(b) Effects of various logging systems on reforestation; erosion and sedimentation; and hydrological characteristics;

(c) Effects of forest management and timber harvesting regimes on sustained yield; erosion and sedimentation; and hydrological characteristics;

(d) Effects of exclusive-and/or multiple-use on conservation for scientific and other non-wood purposes.

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(e) Effects of choice of species and silvicultural practices on degraded or impoverished areas.

Phase III - (a) Pilot rehabilitation schemes in areas badly affected by erosion and deforestation especially in the headwaters regions.

(b) Conservation and management of selected watersheds including timber production management on pilot scales.

It is envisaged that the phases I and II would have identified the location of these pilot areas. Development of technology from these pilot schemes will lead to the formulation of standard operational techniques for the conservation and management of watersheds.

4 Duration

The Programme will essentially be long-term but specific projects involving technical assistance under the ASEAN-U.S. Development Cooperation Programme will initially be for five years. If necessary, such projects may be extended by mutual agreement.

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5 Location

It is proposed that a project on integrated studies of forested watersheds be located in Malaysia. We would also be interested to participate actively in, and if necessary even host, the studies of cultivated and devasted watersheds.

6 Coordination

The location of projects and components in various ASEAN countries will necessitate the creation of a network system for coordination to ensure effective implementation of the Programme. It is proposed that the Programme be coordinated by Malaysia.

7 Detailed descriptions of the proposed Integrated Forested Watershed Project

Since a multi-disciplinary approach is essential for such integrated studies, the project will consist of five closely related components. These are,

1. Forest management and development.
2. Conservation and management of water resources.
3. Soil erosion and conservation.
4. Effects of land use changes on soil fertility and
5. Effects of deforestation on meteorological parameters.

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Detailed descriptions of each of these components are described in Malaysian Technical Papers No. 1 to 5 (ASEAN 79/COFAF.WW/Doc. 2 to 6). A summary of the total cost of these components is shown in Table 1.

TABLE I

Summary of the total cost of the Integrated Forested Watersheds Project

Component No.	Title	Cost (Malaysian Ringgit)
1	Studies on Forest Management and Development in a Watershed.	$ 1,880,000
2	Studies on Conservation and Management of Water Resources.	$ 3,773,500
3	Studies on Soil Erosion and Conservation in a Watershed.	$ 1,138,740
4	Studies on the Effect of Landuse Changes on Soil Fertility.	$ 250,000
5	Studies on the Effects of Deforestation on Meteorological Parameters.	$ 1,343,400
	Total	M$ 8,385,640
		US$ 4,192,820

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ASEAN

WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

MALAYSIAN
TECHNICAL PAPER
No. 1

ASEAN 79/COFAF.WW/Doc.2

PROPOSED STUDIES ON FOREST MANAGEMENT AND DEVELOPMENT IN A WATERSHED

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

PROPOSED STUDIES ON FOREST MANAGEMENT AND DEVELOPMENT IN A WATERSHED*

by

Tang H.T., Mok S.T., Ang C.H. and Tee C.H.**

1. Introduction

In Peninsular Malaysia, 55% of the total land area of 32.5 million acres is forested. Five million acres of the forested land will be converted to agricultural use, whilst 8.1 million acres will be managed as productive forests and the remaining 4.7 million acres as protective forests.

The 8.1 million acres of productive forests represent a very much reduced timber resource base compared to the resource base available in the past. The demand for timber and other forest products, however, have been increasing rapidly in recent years and will continue to do so in the future. In short, increasingly strong demands, sometimes diametrically opposite in nature, will be placed on the limited forest resource base.

Most of the productive forests in Peninsular Malaysia are on hilly and steep country and constitute the major watersheds of the Peninsula. Under such conditions, the impact of forest harvesting operations on the environment, particularly on soil erosion and on water quality and yield, can be severe, if not devastating. The management of such forests must, therefore, be aimed at producing not only timber, but also all the other forest-related benefits for the use and enjoyment of the people.

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

** Forestry Department, Peninsular Malaysia.

In the past, hydrological studies of land-use change have been carried out mainly by the Drainage and Irrigation Department and to a lesser extent by the various universities. Most of these studies have been confined to areas covered by agricultural crops and, with few exceptions, have not involved the upper reaches of the river systems. Forest harvesting has also, traditionally, been geared primarily towards timber production with the ensuing environmental impacts receiving little consideration. However, with the shift of logging activities from the flat, lowland forests to the steep hill forests, their impact on the environment and the hydrological cycle cannot be ignored and must be properly studied and quantified. This is particularly so since forest management practices must be intensified if the reduced forest resource base is to be able to meet the increased and diverse demands placed on it.

In 1974, the Forest Research Institute, Kepong, initiated two small catchment studies to monitor and quantify the effects of logging activities on water quality and yield. This project was carried out largely by U.S. Peace Corps Volunteers and was effectively terminated in early 1979. In mid-1978, a more ambitious experimental basin project was initiated with technical aid from New Zealand. Details of this project have been described in one of the technical papers presented at this workshop.

The efforts by the Department are still quite limited in scale and scope and much more comprehensive studies on forest management and development in watersheds are needed in order to develop proper, long-term and environmentally sound forest management techniques. This paper will outline our proposal for such studies.

2. Scope of the project

The proposed project will cover the following aspects of forest management and development,

(i) cutting regimes

The highly variable nature of our natural forests makes it necessary to prescribe cutting regimes according to the composition and structure of each

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individual forest stand. At the one extreme, a clear cutting and planting regime may be prescribed. At the other extreme, a high diameter cutting limit (say, 60 cm dbh) may be prescribed.

It is proposed to study the impact of a range of cutting regimes (between these two extremes) on the environment in general and on soil and water properties in particular.

(ii) logging systems

The following methods of logging will be considered for study,

(a) san tai wong (winch lorries)

(b) skidders (wheel and crawler types)

(c) cable logging (high-lead yarding and skyline)

(iii) roading and log haulage

The impact of various types, intensities and standards of roading used to get to the logging areas and to haul the logs out will be studied. The impact of the usage of different types of vehicles, e.g. semi-trailer trucks, flat deck lorries and san tai wong, will also be considered.

(iv) forest development

The type of forest development activities to be carried out for any one area will be closely related to the cutting regime used. It is proposed to study the impact of forest development alternatives ranging from the use of natural regeneration (from seedlings to advanced growth), enrichment planting, artificial regeneration to open plantations. The impact of the subsequent maintenance of the new forest crops will also be assessed.

(v) cost studies

Costing will be an important and integral part of all the proposed studies described above.

3. Project inputs

3.1 Technical support

The main activities of the proposed studies will be planned and implemented largely by staff of the Forestry Department, Peninsular Malaysia. It is anticipated that the Forest Research Institute, Kepong; the Forest Management Unit, Silviculture Unit, Forest Engineering Unit and Forest Economics Unit of the Forestry Department Headquarters; and the State Forestry Department concerned will be closely involved in the studies.

The assessment of the impact of the above activities on the various environmental variables will be carried out by the various Universities or Government Departments as well as the F.R.I. as described by their respective papers presented at this workshop.

For the forest management and development activities, technical support on logging systems and roading studies will be sought.

3.2 Manpower training

It is proposed to send the relevant persons involved in the project on short training courses in their respective fields. In particular, training in forest hydrology, logging engineering and forest engineering will be required. Wherever possible, such training should be conducted under conditions similar to our local conditions.

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3.3 Estimated costs

It is estimated that a total sum of M$1,880,000 will be required for the project, made up as follows:

3.3.1 Training (for 6 persons) M$100,000

3.3.2 Field and laboratory equipment

The following equipment will be required,

	Estimated cost
(a) Staff Transportation	
2 units of 4 wheel-drive, 10 seat station wagon	M$ 60,000
(b) Logging Machinery	
2 units Crawler Tractor	M$ 500,000
1 unit Wheel Skidder	200,000
2 units San Tai Wong	70,000
1 unit Log Loader	200,000
1 unit Yarding Machine	400,000
5 units Chainsaw	10,000
1 unit Road Grader	300,000
(c) Communication equipment	
1 set stationary wireless base station for radio communication	M$ 4,000
2 sets portable wireless units to be fixed on the station wagons	6,000
3 sets portable manpack units to be kept at experimental sites	20,000
(d) Gauging Facility	
All gauging stations to be equipped with weirs, sediment traps, stream flow, recording and sampling equipment and weather recording devices	Please refer to other Technical Papers
(e) Survey Instruments	
A complete set of survey instruments to include theodolite, clinometer, altimeter, compass, dumpy level, quick set level, prismatic compass, staff, ranging pole, tripod, tapes etc.	M$ 10,000
Estimated equipment cost	M$1,780,000
Estimated total cost	M$1,880,000

4. Project outputs

4.1 Development of sound forest management and development procedures

It is anticipated that the project will provide the information needed for this purpose. However, it is recognised that the procedures developed will need continuous reviewing and revision based on new information becoming available.

4.2 Training of staff

The project will be used to train staff from Malaysia and other ASEAN countries in their respective fields of forest management and development. The provision of such opportunities, under conditions similar to those encountered by the trainees in their own local working environments will be a very important and effective benefit accruing from the project.

4.3 Establishment of standard

The project will also serve as a proper example of how tropical rainforest watersheds should be managed and it is expected that such a standard will serve to encourage the implementation of similar practices in other countries in the region.

5. End of project status

At the termination of the project, a set of recommendations and guidelines on forest management and development practices and their various impacts will be drawn up. These recommendations and guidelines, together with the results and experiences obtained from the project will be compiled into a document and will probably be published for dissemination.

The project itself will probably be expanded to cover other parts of the country and other aspects of forest management and development indicated by the results obtained from the project at that point. It is anticipated that the Forestry Department, in collaboration with other relevant institutions and departments will be able to undertake this expansion. Continued regional participation in the expanded project is also envisaged.

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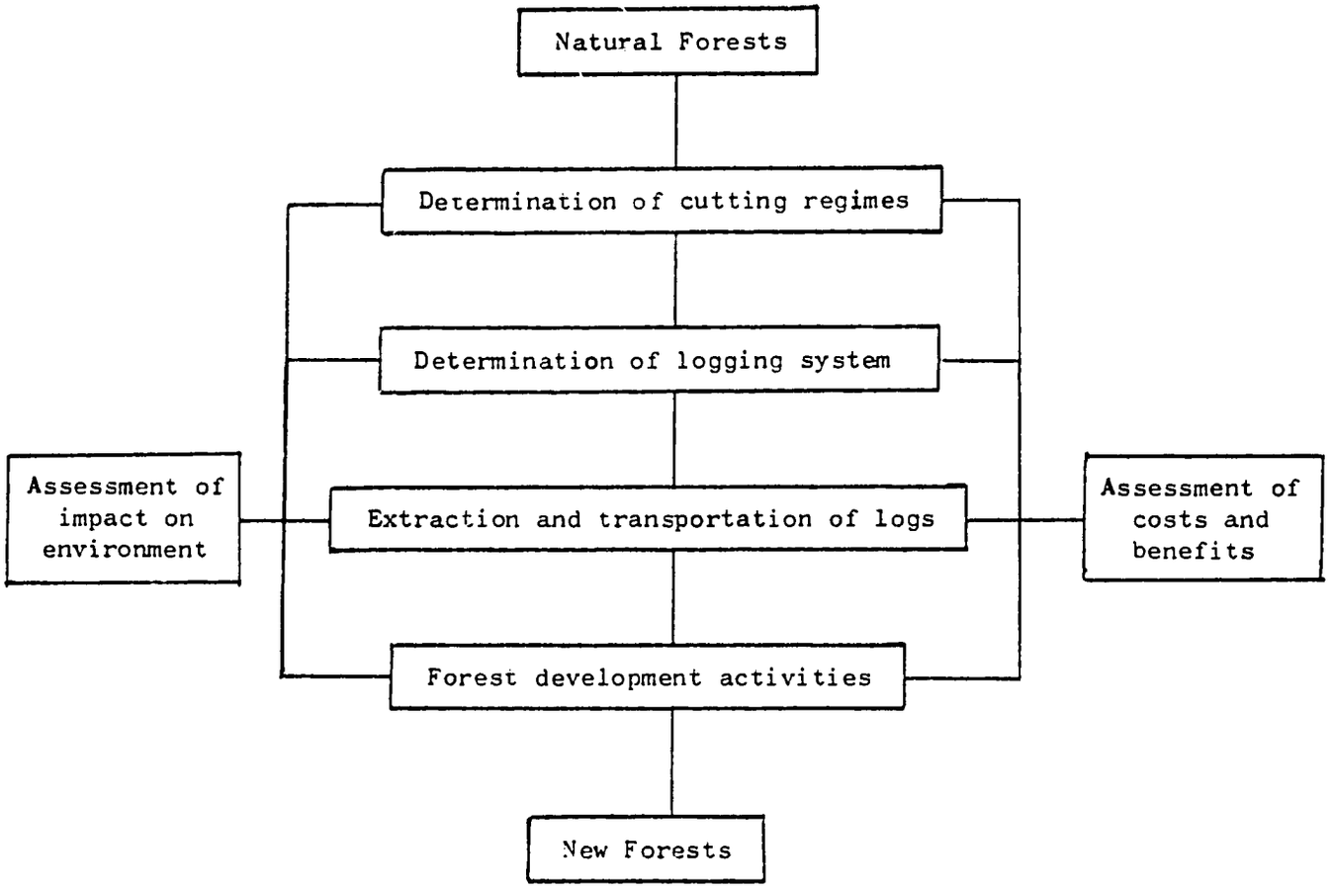
Fig. 1. Scope of proposed forest management and development studies



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WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

MALAYSIAN
TECHNICAL PAPER
No. 2

ASEAN 79/COFAF.WW/Doc. 3

PROPOSED STUDIES ON CONSERVATION AND MANAGEMENT OF WATER RESOURCES

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

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PROPOSED STUDIES ON CONSERVATION AND MANAGEMENT OF WATER RESOURCES+

Background

The post-independence period of Malaysia saw considerable emphasis on the effective development of the country through its national development plans. Concomitant with these plans is the development of water resources for flood control, power generation, irrigation works, water supply and for the maintenance of sustainable river systems to support aquatic life. While under such programmes water is maintained as an important basic resource, the demand for water assumes greater importance in areas where it is required to produce the food supply for the country's ever-increasing population of approximately 12.4 million in 1976* with a growth rate of 2.8% per annum, and where there is an urgent need to develop the industrial base of the economy to sustain this high rate of population growth. In the light that the development plans will proceed and that vast tracts of forests will be cleared (Table 1) to make way for these development, the search for water of sufficient quantity and quality must proceed at a pace which is greater than or equal to the pace in which forests are cleared.

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* 1976 World Pop. Data Sheet, USA.

+ Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

TABLE 1. DIMENSION OF FOREST CLEARANCE FOR DEVELOPMENT

First Malaysia Plan 1966 - 1970	330,000 acres 164,000 acres	Peninsular Malaysia East Malaysia
Second Malaysia Plan 1971 - 1975	750,000 acres 309,800 acres	Peninsular Malaysia East Malaysia
Third Malaysia Plan 1976 - 1980	1,000,000 acres	Malaysia

Most of the land schemes which involve forest clearance will be implemented by the Federal and State government agencies, such as -

(1) Federal Land Development Authority (FELDA),

(2) Federal Land Consolidation and Rehabilitation Authority (FELCRA), and

(3) Rubber Industry Smallholders Development Authority (RISDA),

within the framework of regional development schemes such as the Jengka Triangle, Pahang Tenggara (DARA), Johore Tengah (KEJORA), Trengganu Tengah (KETENGAH) and Kelantan Selatan (KESEDAR). Consequent to achieving the aims of land development and increasing forest exploitation for saleable timber, the total acreages under forest, therefore, has been reduced from 75% in 1954 to 17.8 million acres or 55% of the total land area in Peninsular Malaysia in 1977.

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In relation to water resources, such large forest clearance has immediate and complex implications to water supply and demands. In the early 1959's and 1960's, most of the forest clearance was carried out in the lowland areas due to its richness in commercial timber and easy access, while during the 1970's most of the logging and clearance was carried out on upland catchment areas which meant that slowly but perceptibly, water source areas are being progressively encroached upon. The effects of disturbances to these source areas are well documented in Malaysia. These include increased surface runoff and peakflow causing floods (Low & Leigh, 1972), erosion (Shallow, 1956; Douglas, 1969; Leigh & Low, 1973), siltation in river channels (Kenworthy, 1969; Burgess, 1971) and quality of water (Ho, 1973).

The total amount of surface water available in the form of precipitation is averaged at 2000 mm. per year. As the demand for this water by natural processes, such as evaporation, evapotranspiration and storage in the ground, is 70% of the total supply, based on the water balance studies in the Sg. Lui catchments (Low, 1971), the total available for streamflow which could be stored for domestic, agriculture and industrial uses could only be obtained from the remaining 30%. However, a significant number of river systems in the country are already polluted and cannot be used for potable, industrial and agricultural purposes. The effective amount would, therefore, be very much reduced and with increasing encroachment by land clearance, this amount in the years to come can possibly be obtained only from the relatively undisturbed upland catchment areas.

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The total quantity of water used for purposes other than the natural processes in Malaysia is estimated to be 5,000 million gallons per day in 1976 as shown in Table 2. By the year 2000, the volume is estimated to increase more than 100% to 11,800 million gallons per day and the water crises, which has already surfaced especially in industrial conurbations such as the Klang Valley, will emerge with greater intensity in the near future.

TABLE 2. ESTIMATED TOTAL WATER USED IN MALAYSIA.

USER	1976 CUSEC	%	2000 CUSEC	%
Irrigation	8,570	82.0	20,000	85.0
Mining	1,050	10.0	1,050	4.5
Domestic (rural & urban)	590	5.7	1,200	5.0
Industrial	120	1.1	1,000	4.0
Fish Habitat	100	1.0	250	1.0
Livestock and Poultry	20	0.2	100	0.5
	5,000mgd.	100%	11,800 mgd.	100%
Hydro-power (in-stream use)	10,800 cusec		30,000 cusec	

Source: C.L.Cheong (1978)

The above discussion indicates that water of usable quantity and quality is limited in relation to its many and varied uses despite the country being located in the humid tropical areas

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and should, therefore, have an unlimited quantity of water. However, the constant presence and frequency of droughts alternating with floods in various parts of the country shows that water of usable quantity and quality, present in the right place and at the right time, is not non-limiting. It is within this perspective that the research proposal is focused on the investigation of the effects of large scale forest clearance in watersheds so that sound principles of forest and water conservation and management could be formulated.

Conceptual framework

The aim of this research proposal provides a wide scope that is inextricably linked with the activities of watershed management. The term 'watershed' denotes the area bounded by the topographic divide of a particular river system. The management of this area so bounded by the divide is termed 'watershed management' and it usually connotes different meanings to different groups of people. In essence, the modern concept of watershed management includes development as well as conservation, use and protection of all watershed resources such as forest, land, water and the human population. These resources occur on flood-plains, in valleys and in hill or mountain areas. Watershed management, therefore, will involve the skills of art and science to manage these resources, juxtapositioning them so that they do not conflict with each other or threaten one another. It includes the most efficient use of all watershed lands within their capability to sustain crop production or other types of vegetation and provides the scope for drainage and irrigation, flood control, storage and use of water for municipal and industrial purposes, propagation

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of fish and wild-life and recreational purposes, without undue environmental deterioration.

Within this broad definition of watershed management two approaches could be taken either singly or in combination to study water resources. These are: (a) use of the total watershed as a contiguous unit of an open system whereby all inputs of mass and energy could be measured and relating these inputs to the outputs thereby evaluating the impact of human activities and the implications on water availability; and (b) use of representative and experimental basins which are much smaller units of a whole watershed to evaluate the effects of particular processes operating in them to forecast the required resource in the total watershed.

Both of these approaches have their advantages and limitations. In the former, all the natural resources such as forest, water, land and human communities could be evaluated in relation to one another. Important intangible factors such as the decision-making process or the legal process arising from human societies can be seen to operate more effectively in total watersheds than in representative or experimental watersheds, which by their definitions are more aligned to physical causal factors such as soil, geology or vegetation. Experimental basins are defined as basins which are relatively homogeneous in soil and vegetation and which have uniform physical characteristics while representative basins are basins selected on the basis of them being representative of a hydrological region. They are generally used for evaluating specific problems such as effects of forest clearance on water yield, as has been carried out in the Sungei Tekam Experimental basins, or sedimentation as a result of land clearance. In other words they are used in isolation to

other possible resources such as population or other forms of land use which also have a direct influence on (example, total water abstractions from) a watershed.

The investigations envisaged in the research proposal have been formulated into the two projects outlined in Appendix 1. The participating and/or contributing agencies in Malaysia are expected to be the (a) Drainage and Irrigation Department, (b) Geography Department of the University of Malaya, (c) Forestry Department, (d) Malaysian Meteorological Service, (e) Public Works Department, (f) Department of Environment, (g) Geological Survey of Malaysia, and (h) Malaysian Agricultural Research and Development Institute.

Appendix 1

Project Paper 1

ASSESSMENT OF SURFACE WATER RESOURCES FOR MANAGEMENT

Objective and Scope

The objective of this proposal is to investigate the present and future potential quantity and quality of surface water resources in Malaysia consequent to large-scale forest clearance/disturbance. The information obtained will provide the basis for assessing the scope and adequacy of surface water for potable consumption, power-generation, agricultural and industrial needs. It will also facilitate the identification of problem areas vulnerable to water crises and potential water source areas (termed vital source areas); formulation of guidelines to conserve these 'vital source areas' in watersheds for water supply; and finally evolution of appropriate measures for the rational development of watersheds.

Approach/Programme of Study

Whole watersheds as well as experimental/representative basins will be used in the study to achieve the above objectives based on a study programme as summarised in Figure 1.1

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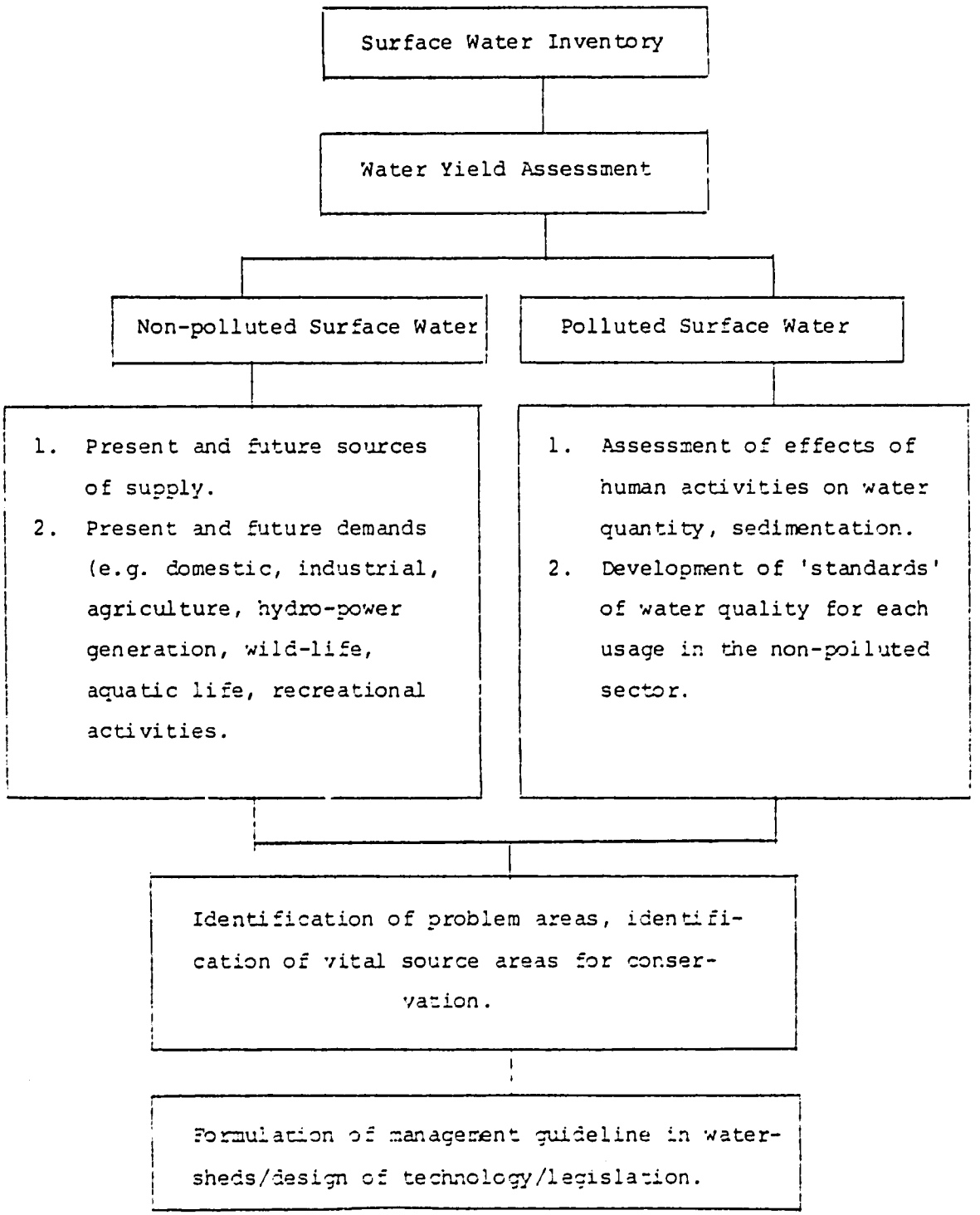
Figure 1.1. OUTLINE WATER RESOURCE STUDY PROGRAMME



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The whole project will be carried out in six phases over a period of five years. The first three phases will take two years while the last three phases will require a minimum of three years for successful completion.

Phase	Activity
1. Exploratory	Design of experimental and observational framework within the watershed concept.
2. Preparatory	Selection of sites and location.
3. Instrumentation	Installation of appropriate instruments and equipment on selected sites.
4. Evaluation	Data collection, analysis and calibration.
5. Management	Choice of management requirement for water conservation in problem areas.
6. Confirmatory	Evaluation of management practices used in Phase 5 to confirm or discard practices used.

Budget Requirements

a. Technical support and manpower

Most of the technical support will be provided by the various agencies involved in this project. Additional Project staff will be:

(i)	Project Manager ($2,305 x 12 x 5)	$138,300
(ii)	3 Research Assistants (preferably graduate students working towards a higher degree) ($860 x 12 x 5 x 3)	154,800
(iii)	4 Field Assistants ($400 x 12 x 5 x 4)	96,000
(iv)	1 driver ($250 x 12 x 5)	15,000
		459,600

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b) Equipment and Construction

i)	Construction of weirs and flow structures, including equipment for flow measurements, streamflow recorders, current meters, sediment samplers, neutron probes etc.	1,000,000
ii)	Glassware	5,000
iii)	Chemicals	5,000
iv)	Xerox materials, books etc.	3,000
v)	Miscellaneous	6,000
		$1,019,000

c) Travel Expenses/Operational Costs

Expenses for field trips, maintenance and operational costs	$ 100,000
Total:	$1,578,600

Duration of Project

The project would require a minimum of five years for completion.

12/-

Project Paper 2

CONSERVATION OF GROUNDWATER RESOURCES

Objective and Scope

The objective of this proposal is to investigate the status of present and potential quantity and quality of groundwater in different rock types consequent to forest clearance/disturbance. Such an objective will provide useful information for abstractions of groundwater for use in the domestic, agriculture and industrial sectors, particularly where surface water is inadequate.

Programme of study

The programme of work will be carried out in phases.

Phase	Activity
1. Location of groundwater sources.	This will include groundwater tracing, geophysical surveys (electrical, resistivity and seismic) for identifying aquifer profiles and water bearing zones.
2. Well construction and development.	Establishment of observation network within watersheds.
3. Pumping test and aquifer evaluation.	Evaluation of groundwater yield based on various rock types, including chemical, trace metals and radioactive elements analyses of borehole water samples.
4. Policy	Formulation of national groundwater policy.

Budget Requirements

a. Technical support and manpower

i)	Project Manager ($2305 x 12 x 5)	$138,300
ii)	Two Research Assistants, (preferably graduate students working towards a higher degree) ($860 x 12 x 5 x 2)	103,200
iii)	One Technical Assistant ($765 x 40 - 925) x 12 x 5.	55,500
iv)	2 Laboratory Assistants @ $8000/yr./5 yrs.	80,000
v)	2 Field Assistants @ $7000/yr./5 yrs.	70,000
vi)	1 Driller @ $6000/yr./5 yrs.	30,000
vii)	2 Assistant Drillers @ $5000/yr./5 years.	50,000
viii)	5 labourers (part-time) @ $6/day/2 yrs.	21,900
		$548,900

b) Equipment Requirement

i)	Groundwater tracing equipment/ instrument including geophysical equipment for electrical resistivity and seismometer, sedimentation equipment.	1,000,000
ii)	Construction of wells	500,000
iii)	Landrover	27,000
iv)	Glassware	5,000
v)	Chemicals	6,000
vi)	Xerox, books, publications, etc.	3,000
vii)	Miscellaneous	5,000
		1,546,000

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c. Travel Expenses

Expenses for fieldtrips for staff	$100,000
Total:	$2,194,900

Duration of Project

The project would require a period of five years for completion.

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MALAYSIAN
TECHNICAL PAPER
No. 3

ASEAN 79/COFAF.WW/Doc. 4

PROPOSED STUDIES ON SOIL EROSION AND CONSERVATION IN A WATERSHED

KUALA LUMPUR, MALAYSIA

3 - 7 SEPTEMBER, 1979

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PROPOSED STUDIES ON SOIL EROSION AND CONSERVATION IN A WATERSHED*

by

ZAKI GHAZALLI AND MOKHTARUDDIN MANAN**

Introduction

Soil erosion and conservation is an integral element of a viable watershed management program. Management strategies such as watershed rehabilitation, improved logging practices etc. should therefore be geared towards conserving the soil which often promotes the protection of other watershed resources such as water, wildlife and vegetation.

Teller (1977) presented a simple flow chart for the identification of impacts and effects due to forestry activities as shown in Fig. 1.

In this proposal efforts will be concentrated in the study of soil removal, which is an effect of logging activity.

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

** Malaysian Agricultural Research and Development Institute (MARDI) and University of Agriculture Malaysia respectively.

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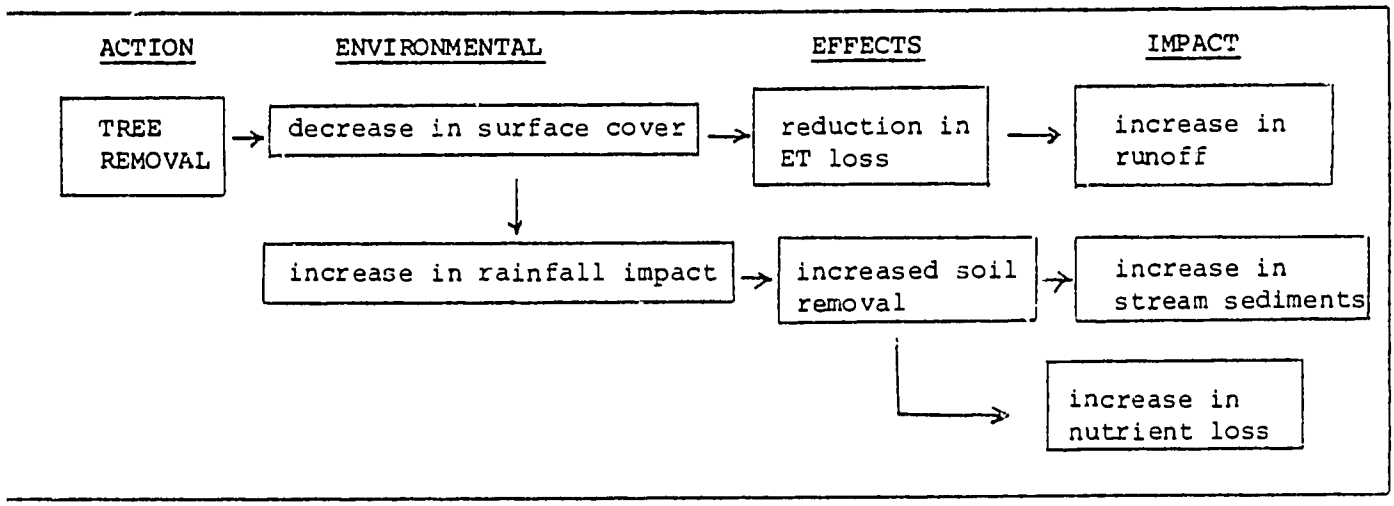

Fig. 1. Partial flow chart for logging impact identification (After Teller, 1977)

Background

Malaysia is situated in the tropical monsoon belt with an average annual precipitation of 2500 - 5000 mm and quite often of very high intensity. This, together with the highly erodible nature of most Malaysian soils, contributed to the severity of soil erosion. Soil erosion has been known to reduce soil productivity by removing the top soil and consequently causing the sedimentation of water-courses, flash floods and pollution of waterways. The major land development schemes in Malaysia cover a total area of 1.5 million hectares. The introduction and use of modern agricultural equipment, mechanical clearing and cultivation of land has to some extent resulted in the increase in erosion. Hunting Technical Services Ltd. (Anon, 1971) made an erosion study on

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two small adjacent catchments, one with forest cover and the other mainly under plantation crops (rubber and oil palm) for a period of 13 months. The results of this study indicated that the peak storm runoff per unit area of the catchment under plantation crops was about twice that from the jungle catchment while the soil losses were approximately 46 and 31 m^3/Km^2/annum for the catchment under plantation crops and jungle catchment, respectively. Shallow (1956) observed soil losses from three hilly catchments in the Cameron Highlands. They were 24.5, 488 and 732 m^3/Km^2/annum for catchments under jungle, tea and vegetables respectively. All these studies were done on established, matured trees and there was no indication of the critical period of soil erosion from the time of jungle clearing till the establishment of soil cover. However, a recent joint project between the Federal Land Development Authority (FELDA) and other agencies on "Sungai Tekam Experimental Basins" (Ling et. al., 1979) takes this into account, namely, to evaluate the runoff and soil losses from the stage of jungle clearing to the establishment of covers and perennial crops. Preliminary results of this study show that soil losses for the period of one year after land clearing were 79, 11 and 10 mt/ha/yr under the conditions of bare, legumes and natural vegetation covers respectively.

It is therefore obvious that large-scale conversion of forests to other forms of land use tends to be seriously destructive to the country's soil resources. On the other hand, there is ample evidence elsewhere showing that the transformation of forest to agricultural crops can be viable if proper conservation practices, such as good farming and mechanical means of erosion control, are adopted. Quantitative information on these is still lacking in this country. It is therefore imperative that research in soil erosion and conservation of watershed is urgently needed.

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Scope of the Project

The studies will consist of three sub-projects as summarized below.

Sub-project 1. Soil Survey and Land Evaluation

A soil survey and land evaluation of the major soil types at the reconnaissance level will be carried out in the selected watershed. Samples will be collected for the determination of dispersion ratio.

Sub-project 2. Monitoring of Soil Losses.

Monitoring stations will be established under various conditions in the watershed. These are:

a) Unlogged areas - the primary jungle which will be used as the reference.

b) Logged areas -

   i) Main or branch trunk roads.
   ii) Skid tracks.
   iii) Areas after selective cutting.
   iv) Completely cleared areas.

To evaluate the effect of slopes, a monitoring station will be established on each of three slope classes: gentle, steep and very steep. Within each monitoring station three runoff plots (5 x 10 cm) will be set up from which soil loss data will be collected. In order to relate soil losses to rainfall, each station will be equipped with

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an automatic rainfall and intensity recording raingauges. Samples of eroded soil and sediments will also be taken for analysis of mobile nutrients.

Sub-project 3. Soil Conservation Methods and Control

Two 5 to 10-acre sites in the watershed under forest and agro-forestry practice will be set aside for the purpose of soil management studies. These studies will include the methods of erosion control at various slope classes. The treatments are:

a) Biological control
   i) Use of cover crops (legumes or grass)
   ii) Use of mulching to reduce runoff
   iii) Bare surface

b) Mechanical control

Evaluation of the effectiveness of various types of bench terraces - level bench, sloping bench, reverse-slope terrace.

Equipment and Staff Requirements

Table 1 shows the equipment and staff requirements for this project.

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TABLE 1

Equipment and Staff Requirements Over Five Years

Items	Estimates
Sub-project 1. Reconnaissance Soil Survey and Land Evaluation at $1.50 per acre.	Total cost depends on size of watershed
Sub-project 2. Monitoring stations	
i) Primary jungle	
ii) logged areas - 3 stations	
a) Truck roads - 3 stations	
b) Skid Tracks - 3 stations	
c) Semi-logged areas - 3 stations	
d) Cleared areas - 3 stations	
Total number of runoff plots - 15 x 3 @ $2000	$ 90,000
iii) Maintenance of stations (with 10 labourers) (7x30x12x5x10)	$ 126,000
iv) Equipment	
- Automatic rainfall and intensity recording raingauges @ $2000 each (one per station)	$ 30,000
- Plastic wares for sampling of eroded soil and stream sediments	$ 6,000
v) Analysis of samples (sediment concn., mobile nutrients, etc) (50¢/sample, 320,000 samples per year)	$ 160,000
Sub-project 3. Soil Conservation Methods and Control	
i) 72 plots will be prepared @ $2000	$ 144,000
ii) Maintenance (16 labourers) (7x30x12x5x16)	$ 201,600
iii) 6 raingauges @ $2000	$ 12,000
Staff (Supernumary posts)	
i) Research Officer (1)	$ 60,540
ii) Research Assistants (2)	$ 77,400
iii) Junior Research Assistants (4)	$ 85,200
iv) Driver (1)	$ 15,000
Others: Landrover	$ 35,000
Travelling and Transport	$ 79,000
Short-training	$ 7,000
Miscellaneous	$ 10,000
Total estimate less soil survey	$1,138,740

Acknowledgement

The authors wish to thank Messrs. Soong Ngin Kwi of the Rubber Research Institute Malaysia and Leong See Ying of the Department of Agriculture, Malaysia, for their helpful suggestions during the preparation of this proposal.

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No. 4

ASEAN 79/COFAF.WW/Doc. 5

PROPOSED STUDIES ON THE EFFECTS OF LANDUSE CHANGES ON SOIL FERTILITY

KUALA LUMPUR, MALAYSIA
3 - 7 SEPTEMBER, 1979

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PROPOSED STUDIES ON THE EFFECTS OF LANDUSE CHANGES ON SOIL FERTILITY*

by

TAN KOK YEANG, SYED SOFIE SYED OMAR,
TAN PENG YEW**

INTRODUCTION

In Malaysia, agriculture development through forest exploitation and clearance has been and is the current prime economic developmental strategy in alleviating rural poverty and overcoming problems of land pressure, unemployment and under-employment. The encroachment into the delicately balanced tropical forest ecosystem can cause considerable changes to the environment. The consequences of such environmental change have been well documented (Nye and Greenland, 1960; Soepadmo, 1973; Leigh, 1973; Richards, 1977).

An important aspect of Landuse change affecting the environment is the accelerated changes in soil fertility. The clearing of large tracts of tropical forest for crop production disrupts its natural nutrient balance. The felling and subsequent burning of the felled forest destroy much of the organic matter in the vegetation and in leaf litter accumulated on the ground. Burning also results in the loss of organic carbon and nitrogen in the vegetation and litter, but the mineral nutrients are returned to the soil as ash. Part of the ash may be washed away by the first rainstorms that fall on the bare ground after clearing and there will be some further loss of nutrients through leaching. In addition,

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

** Federal Land Development Authority (FELDA) Agricultural Services Corporation.

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clearing and burning leave the land bare of the protective canopy of vegetation, thus exposing it to erosional hazards resulting in the loss of nutrients through leaching and in the loss of the fertile top soil. The drastic landuse change may cause the soil physical characteristics to deteriorate, thus affecting the soil water regime.

The change in soil fertility is fairly well understood qualitatively. However, there is little information, particularly in Malaysia, on the progressive changes in soil fertility when a tropical forest ecosystem is converted to an agro-ecosystem.

The purpose of the study is to quantify and evaluate the soil fertility changes when a tropical forest is converted to an agricultural holding and to evolve a set of management techniques for the maintenance of soil fertility.

SCOPE AND METHODOLOGY

Location

The study is to be conducted at the Sg. Tekam Experimental Basin, located to the north of the Jengka Triangle in Central Pahang of Peninsular Malaysia. The Basin details are described in the Sg. Tekam Experimental Basin Annual Report No.1.

Land Management

Catchment A and B are both classified as operational catchments and are scheduled for conversion to oil palm and/or cocoa in 1980 after

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the initial period of calibration (Figure 1). Catchment C is to be retained in its natural forested state to serve as a control catchment.

The land clearing will follow the normal FELDA practice termed the 'conventional method' (Balakrishnan and Lim, 1976). It consists of the following sequential operations: underbrushing, manual felling, major burning, manual pruning, stacking and reburning. Should there be a delay in felling or burning or owing to a very poor burn, the 'partial mechanization method' will be employed. In this method, the pruning and stacking are carried out mechanically by bulldozers. The time schedule for the various activities in the land clearing operation is summarised in Appendix 1.

Immediately after the area has been pruned, stacked and reburned, leguminous covers at the rate of 5 lb. per acre will be planted in Catchment B While natural covers will be allowed to establish in Catchment A.

Field plantings of oil palm and/or cocoa are scheduled to commence in October, 1981. The maintenance of the crops will follow the standard FELDA practice.

Soil Fertility Study

The field studies involve investigations into the various aspects of soil fertility changes at different stages of land development, viz.,

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(a) uncleared forest;

(b) felling and burning, and

(c) immature plantation crop.

Uncleared Forest

In order to study the accelerated soil changes it is necessary to quantify the nutrient status in the natural tropical forest ecosystem. The following baseline studies are envisage:

(a) the nutrient content of each of the soil horizons, both the total amount and amount readily available to the plant,

(b) the quantity and nutrient composition of the litter on the soil, and

(c) the nutrient composition of the forest vegetations.

In addition, the dynamic processes involvedin the nutrient cycle of the forest ecosystem will also be examined. These include:

(a) the litter production and mineralisation,

(b) the nutrient contribution through rainwash, and

(c) the nutrient losses through runoff and percolation.

The above investigations will provide baseline information for subsequent comparison.

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Felling and Burning

The clearing and burning disrupts the complete nutrient cycle in the forest ecosystem. The effects of forest clearing and burning will be quantified and evaluated as follows:

(a) the nutrient contribution of the ash, and

(b) the nutrient losses through increase runoff, percolation and erosion.

Immature Plantation Crop

Finally, the nutrient balance in the agro-ecosystem that follow will be similarly evaluated as that of the forest ecosystem.

The variables for measurement and the methods used are summarised in Appendix.2.

IMPLICATIONS OF STUDY

While land development aims to raise the economic well being of the farmers, it is important to note that sustained crop production and the consequential economic return can only be achieved through proper management of soil resources. Farmers, plantation managers and landuse planners have to understand the delicate processes of environmental change in an agro-ecosystem derived from a tropical forest ecosystem. Therefore, the study would have the following implications:

(a) Quantification of the soil changes at different stages of land development will illustrate objectively the impact of human activity on soil fertility.

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(b) A better understanding of the progressive soil fertility changes would enable better management of soil resources by plantation managers and extension workers.

ESTIMATED COST

The estimated cost for the investigation comprises of:-

(1)	Soil Laboratory equipment, glassware	=	M$100,000
(2)	Field sampling equipment and tools	=	10,000
(3)	Labour cost	=	20,000
(4)	Analysis cost - chemicals and salaries of laboratory technicians	=	120,000
	TOTAL		M$250,000

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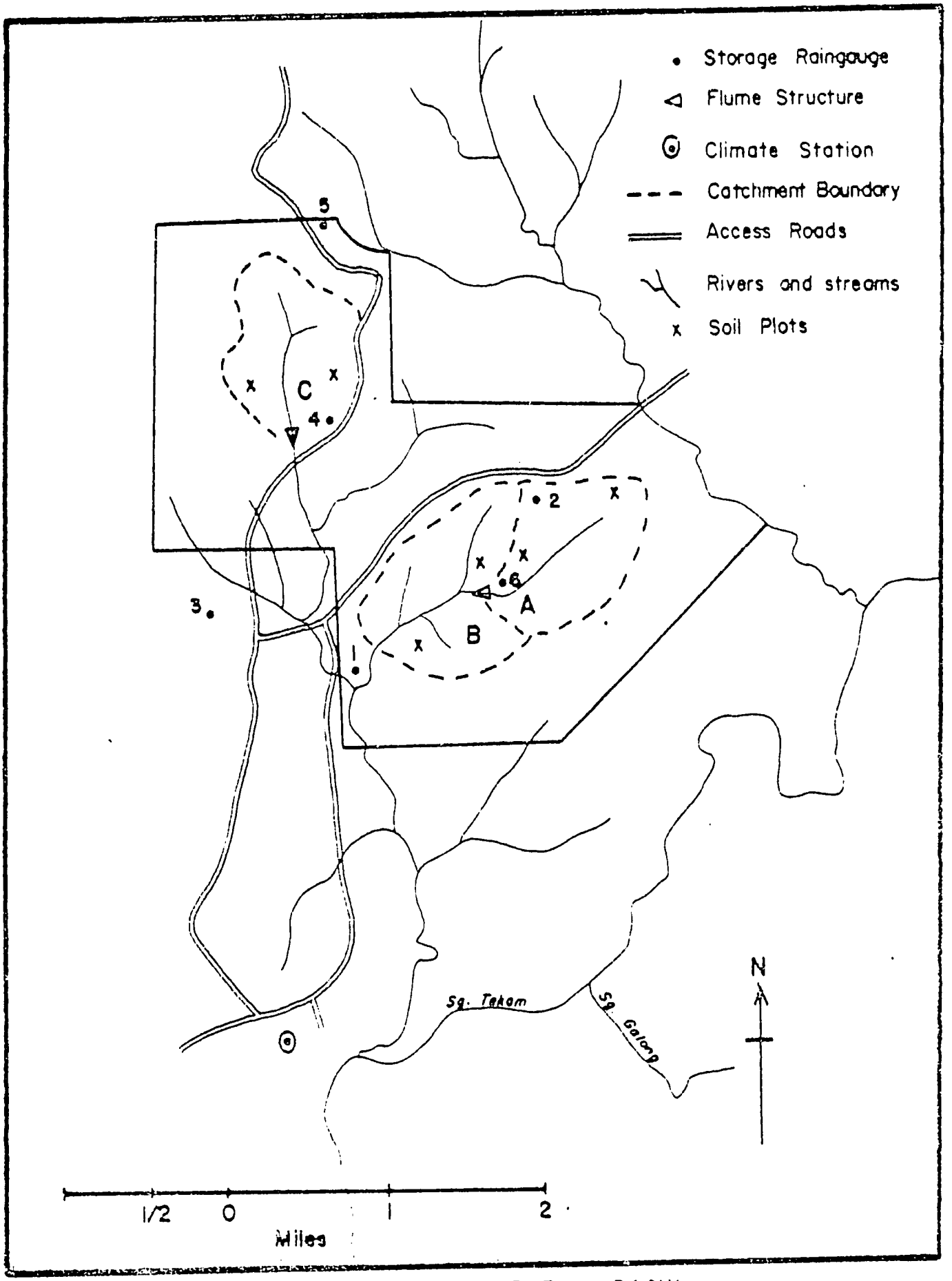
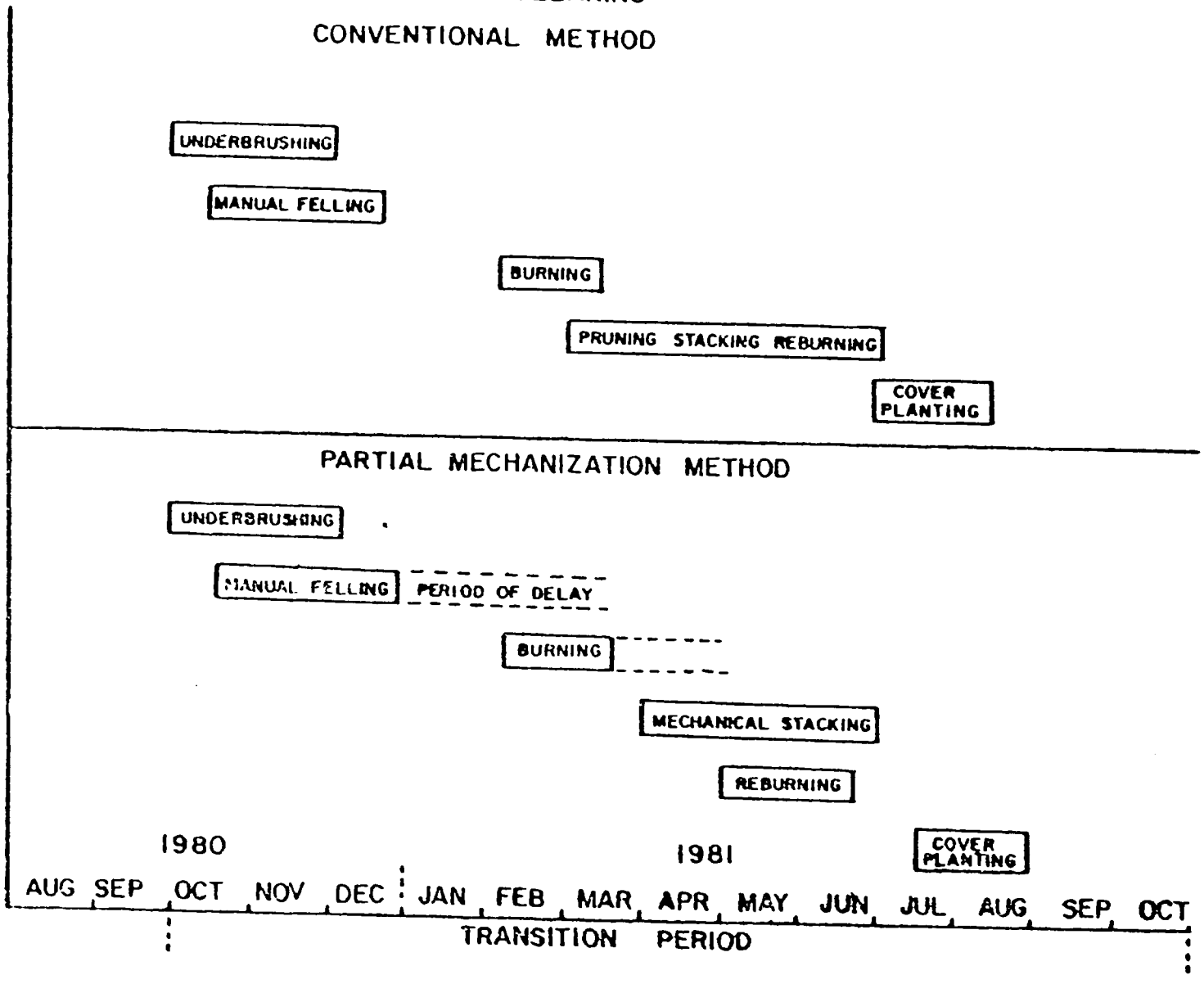


FIG. 1 SG. TEKAM EXPERIMENTAL BASIN.

TIME SCHEDULE FOR THE MAJOR ACTIVITIES
IN FOREST CLEARING



Appendix 2

VARIABLES FOR MEASUREMENT

Climatic Variables

(i) Rainfall

(ii) Maximum and Minimum Temperatures

(iii) Solar Radiation

(iv) Wind Velocity at 2 m

(v) Evaporation

Soil Physical and Chemical Variables

(i) Mechanical Analysis

(ii) Bulk Density

(iii) pF Characteristics

(iv) Organic Carbon

(v) Total Nitrogen

(vi) pH H_2O

(vii) Exchangeable Ca, Mg, K, Na

(viii) Total Ca, Mg, K

(ix) Soluble P

(x) Total P

Stream-Water Variables

(i) Daily Stream Discharge

(ii) Total Sediment

(iii) Suspended Sediment

(iv) Dissolved Sediment

(v) Cations: Ca, Mg, Na, K

(vi) Anions: SO_4 NO_3, Cl, P_2O_5

Biological Variables

(i) Amount and Composition of Litter

(ii) Rate of decomposition of Litter

(iii) Biomass of forest

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MALAYSIAN
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No. 5

ASEAN 79/COFAF.WW/Doc. 6

PROPOSED MONITORING OF METEOROLOGICAL PARAMETERS AND STUDIES OF CLIMATIC VARIATIONS IN A WATERSHED

KUALA LUMPUR, MALAYSIA
3 - 7 SEPTEMBER, 1979

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PROPOSED MONITORING OF METEOROLOGICAL PARAMETERS AND STUDIES OF CLIMATIC VARIATIONS IN A WATERSHED*

by

TUNG NAM PING**

Introduction

Climate is commonly conceived as part of the natural environment. Any human interference to the natural environment will affect the localised climate. Recently the Malaysian Meteorological Service has noted some localised climatic variation, such as the variation in the frequency and intensity of the afternoon thunderstorm activities causing variation in the rainfall pattern, variation in the temperature gradient, variation in the evaporation rate, just to mention a few. Hence there is a need to study in greater depth, how and to what extent the human activities in and around the watershed, such as clearing of forested land for agricultural development and settlement, highway construction, mining, logging but to name a few, affect the localised climate. Such studies are not only useful in helping the decision-makers in their planning, development and management of water resources and forested watershed, but also provide valuable contributions to the World Climate Programme which was proposed by the World Meteorological Organization. The purposes of of the World Climate Programme are to provide the means to foresee possible future changes of climate and to aid countries in the application of

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* Paper presented at the ASEAN Workshop on Watershed Conservation and Management Research Programme, Kuala Lumpur, 3-7 September, 1979.

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climatic data and knowledge to the planning and management of all aspects of man's activities. Therefore this proposal for monitoring of meteorological parameters and studies of climatic variations in and around a watershed is consistent with the objectives of the World Climate Programme.

To study the changes in climatic conditions, Malaysian Meteorological Service (MMS) proposes to set up a network of stations with automatic recording instruments in and around the selected watershed.

The meteorological parameters which MMS plans to monitor are:-

i) rainfall
ii) temperature
iii) solar radiation
iv) evaporation
v) relative humidity
vi) wind

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Project Description

Project Inputs

Technical Support

For the collection of basic data, automatic recording instruments are preferable in this project. Technical aid in equipment and instrumentation will be needed.

Project Staff

Senior Meteorologist-in-charge

A senior meteorologist with sufficient experience in administration and data management and analysis is necessary. He will be responsible for the overall planning, implementation and coordination of the meteorological aspects of the project.

Experimental officer

An experimental officer of sufficient experience in instrument handling is necessary. His responsibilities are as follows:-

i) to set up meteorological instruments.

ii) to perform regular inspection and to maintain the meteorological instruments.

iii) to perform minor repairs and corrections to the instruments when necessary.

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iv) to assist the Senior Meteorologist-in-charge in simple data analysis.

v) any other job as assigned by the Senior Meteorologist-in-charge.

Meteorological assistant

Three meteorological assistants will be required. Their responsibilities will be:-

i) to collect and change the charts regularly.

ii) to extract data from the charts.

iii) to compile the data according to the format designed by the Senior Meteorologist-in-charge.

iv) to assist experimental officer as and when necessary.

Technical consultant (3 months)

A short term technical consultant will be required at the initial stage of project implementation. His input will be:-

i) to advise on the selection of sites for location of stations.

ii) to advise on the selection of appropriate meteorological instruments.

iii) to provide guidelines to the type of analysis required for climatic studies in the watershed conservation and management.

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Equipment

At least 12 stations with automatic recording instruments will be required for the collection of climatic data in the proposed watershed. Assuming that the chosen watershed has an area of 700 sq. miles, this gives the station network a density of about one station per 60 sq. miles.

Project Outputs

It is hoped that at the end of the project, sufficient data would have been collected, and analysis could be carried out to conclude in one way or another the long or short term ~~effects~~ of forest conservation or deforestation on meso-scale climate. The findings should provide good guidelines in the planning and management of the other watersheds in the ASEAN regions.

End of Project Status

It is hoped that the monitoring of the meteorological observations could be continued even after the project has ended.

Implementation Plan

Project implementation should be carried out in four phases, namely:-

i) selection of site

ii) selection, purchasing and installation of meteorological instruments

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iii) collection and verification of data

iv) analysis of data and presentation of findings.

Estimates of Costs (5 years)

Office accomodation and clerical staff will be provi by MMS.

Project Staff Emolument

	M$	
Senior Meteorologist-in-charge ($2800x120 - 3280)	182,400	
Experimental Officer ($1500x12x5)	90,000	
Three Meteorological Assistants ($1000x12x5x3)	180,000	
Driver ($350x12x5)	21,000	
Short-term Consultant (3 months) ($8000x3)	24,000	
Allowances for financial assistance (part time)	6,000	
Overtime allowance for Experimental Officer, Meteorological Assistants and Driver	8,000	511,400

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Travel and Subsistence	M$	
Field trips	10,000	
Airfare for Consultant	8,000	
Subsistence for Consultant (for 3 months)	9,000	27,000
Equipment, Services and Supplies		
12 automatic recording stations (Instruments, clearing forest, fencing etc.)		660,000
One Land Rover		40,000
Lease of Computer and Service		20,000
Supply and Materials (Stationery, charts, batteries, spares etc.)		40,000
Maintenance and Service		20,000
Miscellaneous		25,000
TOTAL		M$1,343,400

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ANNEX L

PROPOSAL FOR AN ASEAN WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME

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PROPOSAL FOR AN ASEAN WATERSHED CONSERVATION AND MANAGEMENT RESEARCH PROGRAMME

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I. PROGRAMME BACKGROUND AND DETAILED DESCRIPTION

A. Background

Throughout the ASEAN region, increasing pressure for arable land has steadily decimated the valuable forest resources of the countries concerned. Ultimately, it is envisaged that the region's forest resources will be confined mainly to the hilly and mountainous areas which are essentially watersheds with vital conservation functions. However, vast areas of devastated land, which also have vital watershed functions, already exist in all ASEAN countries, except Singapore. It is inevitable that much of the remaining forested land will have to be managed for multiple use, including timber production and also that concerted efforts will have to be made to rehabilitate much of the devastated land.

Human activity, such as logging, land clearance for agriculture, shifting cultivation, etc., in watersheds will increase soil erosion, run-off, siltation of water courses and other deleterious downstream effects. Because of the very critical interdependence between the forest and the water resources, it is imperative that in the overall management and harvesting of the former, maximum care must be taken so as not to adversely affect or impair the quality, availability and productive potential of the latter. At the same time the cost of timber harvesting which involves heavy expenditure on equipment, forest road construction etc, must be kept within economical limits. It is equally imperative that positive action be taken to restore the productivity of the presently devastated land.

To-date, unfortunately, there is scant knowledge and experience on the long-term effects of soil/water changes as a result of human activities and land-use changes. There is, therefore, an urgent and critical need to appraise the situation and to draw up and implement a comprehensive programme of

studies that will have direct applications in the overall conservation, management and development of the watersheds in the region.

The natural resources of the ASEAN countries, such as forests, soil and water, share some very common characteristics because of the close geographical proximity of these countries. In fact, with respect to forest resources, it is usual to refer to most of the forests found in the ASEAN countries collectively as the Tropical Rainforests since the countries have very similar forest vegetation and rainfall patterns. Another feature common to ASEAN countries is that currently all the member countries have their own development plans which are invariably agro-based and involve the conversion of forest lands to agricultural development and settlement which have an important effect on the soil and water balance of the land. A third feature common to ASEAN countries is the widespread and extensive problem of shifting cultivation, which has reduced vast areas of formerly rich natural forests to an unproductive and unstable status.

Therefore, a watershed conservation, management and development research programme on a regional basis, with the objective of formulating sound conservation, management and development prescriptions compatible with reduced impairment to the productive potential of soil and water, will be of immense benefit to the ASEAN countries. It would also be of great benefit to ASEAN member countries to aim for coordination of all these research activities through the establishment of a regional research centre.

B. Scope of the Programme

1. Justification

An ASEAN Watershed Conservation and Management Research Programme can have various objectives and can be amply justified.

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These objectives and the justification will become apparent with a brief survey of the scale and dimension of the resource problems in the five ASEAN countries which will enable watershed management to be given shape and form and to be viewed in the proper perspective.

In Peninsular Malaysia, forests covered 74% of the total land area in 1958, but by 1976 only 55% or about 7.2 million ha. out of the total area of 13.2 million ha., was left. In Sabah, the 1971 forest inventory figures showed that 86% (6.00 million ha.) of the land was forested of which more than 22% have been logged over or disturbed by shifting cultivation. For Sarawak, by 1975, only about 75.6% (9.3 million ha.) out of the total land area of 12.3 million ha. was classified as under permanent forests and other forests. With the launching of the Third Malaysia Plan, where land clearance for agriculture and settlements will continue at an accelerated rate, it is estimated that most lowland forests within Malaysia would have disappeared in the mid-1980's. Meanwhile, the boundary which was arbitrarily taken to delineate the "productive" forests from the "protective" forests, has been pushed upwards from the 330 m (1,000 ft.) to the 990 m (3,000 ft.) contour. Logging in these high elevation forests has generally been identified as the reason for the heavy sedimentation and more frequent flooding experienced downstream.

The situation is also true in the Philippines although the form of forest exploitation is different. The very fast forest destruction in the Philippines is primarily due to the widespread practice of shifting cultivation and secondarily to exploitative logging, fires and other causes. Only about 30% of the total land area of the country (30 million ha.) are under forest cover. About 5 million ha. of Philippine watersheds are grassland and about 66,000 ha.of the remaining forest cover are being destroyed

annually. The hydrologic behaviour of 1.4 million ha. of watersheds in the Philippines are considered critical. These watersheds continue to be the major sources of accelerated soil erosion, flash flooding and related hydro-physical deteriorations that are affecting multi-million dollar infrastructure projects, productive agricultural lands and other ecological imbalances over a wide spectrum of land scenes.

It is estimated that Indonesia has about 20 million hectares (200,000 sq. km.) of unproductive land consisting of lalang fields and bare lands which are in a critical condition and are the source of erosion. These critical lands will increase every year by 1 to 2% if no management and protection measures are taken. In Java in particular, and in other places outside Java in general, the total forested areas serving as protection agents for the upper river regions are beneath the minimum requirements (about 20% of the area). This will endanger the management of water, soil and the environment. Due to population pressures, the need for land for seasonal agricultural cultivation seems to be urgent. The need for fuelwood makes the cutting of trees difficult to control. This land has a vital protection function and should be covered with permanent vegetation. In Kalimantan, West Irian and part of Mollucas, Sumatra and Sulawesi, much of the forest land have been approved for logging.

In Thailand, it is estimated that only about 39% of the total land area is still forested. Forest land clearings in the lowlands and shifting cultivation in the mountainous areas are the causes of deforestation. It is estimated that about 40% of watershed areas have been degraded by shifting cultivation. The accelerated rate of agricultural development, settlement schemes, mining and highway construction have also resulted in a considerable loss of the national forest reserves.

Although there is hardly any forest left in Singapore, there are many critical watersheds which are vital for water supplies. The Ministry of Environment's dynamic programme to plant trees and shrubs is an indication of the country's positive conservation and management policy to protect the watersheds.

2. Objectives of the Programme

General Objectives:

The long-term objectives of the Programme are to enable ASEAN Member Countries:

(a) To upgrade technical expertise and to improve technology for the conservation, management and development of watersheds;

(b) To apply appropriate technology for watershed conservation, management, development and multiple-use so as to ensure a sustained yield of socio-economic benefits; and

(c) To optimise the utilisation and application of the limited expertise and resources available in individual ASEAN member countries for the collective benefit of the region as a whole through close co-operation and co-ordination of the activities in watershed conservation, management and development.

Specific Objectives:

The immediate and specific objectives of the Programme are to assist ASEAN Member Countries:-

(a) To develop appropriate criteria for the identification and classification of watersheds;

(b) To determine the extent of these watersheds;

(c) To conduct research aimed at the formulation of sound principles and guidelines for watershed conservation, management and development;

(d) To develop appropriate technology for the conservation, management and development of watersheds for protection and/or production;

(e) To investigate the feasibility of multiple-use, with particular reference to timber production in watersheds;

(f) To effect close co-operation and co-ordination of the watershed management and development activities; and

(g) To appraise and develop appropriate legislative guidelines for the conservation, management and development of watersheds.

3. Structure

The Programme comprises four main projects with components in all participating ASEAN Member Countries. It involves the establishment of regional and country infrastructural facilities necessary for project implementation and coordination and encompasses integrated techno-economic research to optimise conservation, management and development of watersheds as well as studies on socio-economic and institutional implications of watershed conservation, management and development. The Programme

will be operated essentially as a network coordinated by the regional centre.

4. Duration

The Programme is essentially long term but the specific projects involving technical assistance under the ASEAN-US Devleopment Co-operation Programme will initially be for five years. However, such projects may be extended by mutual agreement, if deemed necessary.

5. Location

The Programme will be implemented in all participating ASEAN Member Countries. The ASEAN Centre for Watershed Management and Development to be established for monitoring and coordinating the implementation of project components approved for the respective participating countries will be located in Malaysia. Country Centres will be established in participating countries to facilitate implementation, monitoring and coordination of projects located in the countries concerned as well as to liaise with the regional centre.

C. Detailed Programme Description

The Programme comprises four main projects, namely:-

Project No. 1

ASEAN Centre for Watershed Management and Development (including Country Centres).

Project No. 2

Integrated Research Studies on the Management of Forested Watersheds.

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Project No. 3

Integrated Research Studies on the Development and Management of Non-forested Watersheds.

Project No. 4

Integrated Studies on Social, Economic, Technical and Institutional Profile of Watershed Conservation, Management and Development.

Project Inputs, Project Outputs, End-of-Project Status and other relevant details of the projects constituting the Programme are described in Appendices 1 to 4.

2. PROGRAMME ANALYSIS

The Programme is recognised to be of high priority by the ASEAN Member Countries, particularly those where pressure for land has brough about deforestation and the inevitable need to develop watersheds for socio-economic purposes. Many of these watersheds, however, have a multitude of critical functions and should therefore be developed and managed by sound and appropriate technologies to minimise detrimental impacts on natural resources, environment and other development projects.

In addition to appropriate technologies applicable to unique local conditions and circumstances, the conservation, development and management of watersheds for sustained socio-economic benefits also require accurate, relevant and timely information on the natural resources and characteristics of the watersheds. ASEAN Member Countries possess the basic technical expertise and skills necessary for the acquisition of such information but needs assistance to accelerate the process and to develop the necessary appropriate technologies. The Programme would provide the means to attain these goals and ultimately enable ASEAN Member Countries to upgrade their technical

capability and to become completely self-reliant in the application of sound and appropriate technologies for watershed conservation, development and management.

At the completion of the Programme, the information collected as well as the knowledge and experienced gained with U.S. technical assistance will be compiled and synthesised into documents for dissemination to ASEAN Member Countries. They will provide a firm basis for the development of comprehensive, sound and long-term strategies, programmes and guidelines for the proper conservation, development and management of the watersheds in the respective countries to ensure that such watersheds continue to produce the optimal benefits to the peoples of the ASEAN region. Needless to say, such appropriate technologies could also be transferred beneficially to other countries outside the ASEAN region which have similar background and conditions.

Detailed analyses of the technical, financial, social and economic aspects of the Programme are given under the various projects described in Appendices 1 to 4. A summary of the total cost of the Programme is shown in Table 1.

3. IMPLEMENTATION PLANS

The Programme will be implemented as soon as agreement is reached between ASEAN and the United States. Details of the implementation plans for each of the four projects are described in Appendices 1 to 4.

4. EVALUATION ARRANGEMENTS FOR THE PROGRAMME

Project implementation will be reviewed and evaluated periodically by a Steering Committee comprising country coordinators to determine the effectiveness and general applicability of the progress achieved as

reported by the Technical Working Group comprising the Director of the ASEAN Centre for Watershed Management and Development, country project leaders, and other relevant technical experts.

The Programme as a whole will be reviewed and evaluated by the Sub-Committee on Forestry of the Committee on Food, Agriculture and Forestry of ASEAN Economic Ministers, which is responsible for programme policy and guidelines and project priority.

TABLE 1

Summary of Total Cost (US $1,000) of ASEAN Conservation and Management Research Programme

Project No.	Project Title	year 1	2	3	4	5	Total
1	ASEAN Centre for Watershed Management and Development (including country centres)	3571	721	721	721	721	6,455
2	Integrated Research Studies on the Management of Forested Watersheds.	11392	4392	3416	3324	3324	25,848
3	Integrated Research Studies on the Development and Management of Non-forested Watersheds.	7475	2475	2475	2475	2475	17,375
4	Integrated Studies on the Social, Economic, Technical and Institutional Profile of Watershed Conservation, Management and Development.	605	495	440	-	-	1,540
	TOTAL	23043	8083	7052	6520	6520	51218

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APPENDIX 1

PROJECT NO.1 ASEAN CENTRE FOR WATERSHED MANAGEMENT AND DEVELOPMENT

1. PROJECT BACKGROUND AND DETAILED DESCRIPTION

1.1 Background

Watersheds are complex and dynamic ecosystems which include not only bio-physical, but also sociological, institutional and human components. Although some of these components may appear to be common to all the ASEAN countries, considerable differences in specific characteristics do occur. Many of the problems encountered in watershed management and development also appear to be common to ASEAN countries, but the specific circumstances leading to the problems, and the solutions to these problems may be quite different for each individual country. However, the one feature truly common to all ASEAN countries is the dearth of reliable, quantitative information and experience needed to develop effective, sound and long-term strategies for watershed management and development.

To overcome this critical problem, comprehensive project proposals (see Projects 2, 3 and 4) have been prepared for implementation in the various ASEAN countries. However, it is vital that these project proposals be very closely coordinated to optimise the benefits to the region as a whole accruing from the activities carried out in the various individual member countries. The results of these activities must also be synthesised to form the bases for evolving and operationalising sound, long-term strategies for watershed management and development for the region. It is proposed that an ASEAN Centre for Watershed Management and Development (ACWMD) be established to ensure that these vital functions are effectively and efficiently carried out.

1.2 Scope of the Project

The Project shall establish, support and operationalize the ASEAN Centre for Watershed Management and Development for the region and Country Centres for participating ASEAN Member Countries. The regional office of the ACWMD shall be located in Malaysia while Country Centres shall be located on site, wherever possible, to facilitate implementation, monitoring and coordination of project components in the respective countries.

The Project is intended to be long-term but the U.S.-assisted phase will be for a duration of five years with an option for extension if deemed necessary and is mutually agreeable.

The objectives of the ACWMD are:-

(a) To promote, institutionalize, coordinate and strengthen regional cooperation in watershed conservation, management and development among ASEAN countries.

(b) To operationalize and support a regional network designed to pool and promote the optimal use of the limited manpower and financial resources in watershed conservation, management and development research;

(c) To initiate and/or support research, training and extension/development projects for evolving effective watershed management strategies;

(d) To evolve common standards/criteria/ guidelines for the identification/ classification of ASEAN watersheds;

(e) To evolve effective conservation, management and development guidelines for ASEAN watersheds;

(f) To evolve methodologies and strategies for systematic data generation, storage, retrieval and analysis for ASEAN watershed conservation, management and development;

(g) To initiate and strengthen international linkages on effective watershed conservation, management and development;

(h) To generate funds to support research, training and extension/development projects on ASEAN watershed conservation, management and development; and

(i) To document and evaluate watershed management orientations, policies and strategies in the ASEAN region.

1.3 Detailed Project Description

1.3.1 Project Inputs

(a) Technical Support

Technical support/expertise for ACWMD shall come from ASEAN Member Countries. However, necessary but currently unavailable technical expertise/manpower shall come from outside

sources, such as foreign consultants, or through manpower training and staff development which shall be accorded priority to ensure effective transfers of expertise and technology to ASEAN personnel.

(b) Manpower Training

A manpower training and staff development programme shall be formulated and implemented to meet the necessary requirements of ACWMD. A survey of ASEAN expertise on watershed conservation and management should be conducted as soon as possible to determine additional expertise or technical support required from foreign consultants and ultimately from staff from ASEAN Member Countries.

(c) Field and Laboratory Equipment

Experimental sites shall be obtained from government lands and field laboratories either from national government offices, universities or other agencies. The bulk of the equipment for ACWMD shall be acquired as part of the Project.

1.3.2 Project Outputs

The establishment and operationalization of ACWMD will institutionalize watershed conservation, management and development among ASEAN Member Countries and focus attention on the urgent need for such activities.

1.3.3 End-of Project Status

The ACWMD, which is expected to be firmly established and fully operational by the end of the U.S.-assisted phase of the Project, shall be a contuining regional institution for technological research and development designed to promote and enhance the continued optimal use of watershed resources in the ASEAN region. The ACWMD shall be a source of expertise and guidance to ensure well developed, productive and protective watershed ecosystems in the region.

2. PROJECT ANALYSES

2.1 Technical Analysis

The Centre (ACWMD) aims to institutionalize all current and future watershed conservation, management and development research designed to promote a network of well developed, productive and protective watershed ecosystems in the ASEAN region. It cannot be over-emphasized that watersheds and their resources are vital components for socio-economic and institutional development in any country. Watersheds also act as physical barriers to stave off serious environmental and ecological imbalances and extremities. Consequently, appropriate technology and strategy for proper use of watershed resources in the light of current and future constraints and developments have to be developed. The ACWMD will ensure that technologically, watershed resources (physical, institutional, technical, etc.) are optimally used and developed to enhance the productive and protective values of watershed ecosystems and harmonized with the maintenance of environmental quality and ecological stability in the region.

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2.2 Financial Analysis and Plan

Table 1 shows a capsulized five-year budget for ACWMD. The budget is for a period of five years for both the regional and country centres. It is envisaged that as soon as ACWMD is approved and adopted by ASEAN Member Countries, a continuing source of funds shall be identified and institutionalized from amongst the ASEAN Member Countries or from external sources.

2.3 Social Analysis

The functions of ACWMD include three major components: research, management/development and extension. All these major functional components are expected to generate far-reaching social benefits not only for individual countries, but also for the ASEAN region as a whole.

Through research, necessary basic and applied data are generated which will form the bases for evolving viable, realistic and beneficial strategies for well developed and managed watersheds. In order that the benefits of well developed and managed watersheds will permeate to the greater mass of the common people, an intensive extension service will be necessary. In short, in the process of operationalizing the major functions of ACWMD, direct and beneficial multiplier benefits will be generated for the welfare of society in individual ASEAN Member Countries in particular, and in the ASEAN society in general.

2.4 Economic Analysis

The direct economic benefits that will be derived from a well managed and developed watershed depends on the intensity

or magnitude of development or management activities imposed on the watersheds. It cannot be over-emphasized that the potential economic benefits that could be derived from efficient use and development of watershed resources are tremendous. In addition to the direct economic benefits is the promotion of indirect values such as stable and protective watershed ecosystems and good environmental quality.

3. IMPLEMENTATION PLAN

The Project will be implemented as follows:-

```
                          YEAR

0            1            2            3            4            5....N

XXXXXXXXXXXXX
     A
             XXXXXXXXXXXXXXXXXXXXXXXXXXX
                          B
                                       XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                                                    C
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A - Establishment of contacts for institutional and government support for ACWMD.
- Formation of Steering Committee and Technical Working Group from ASEAN Member Countries.
- Formation of administrative set-up for ACWMD
- Fund generation for ACWMD

B - Facilities construction
- Project identification
- Project prioritizing
- Project implementation

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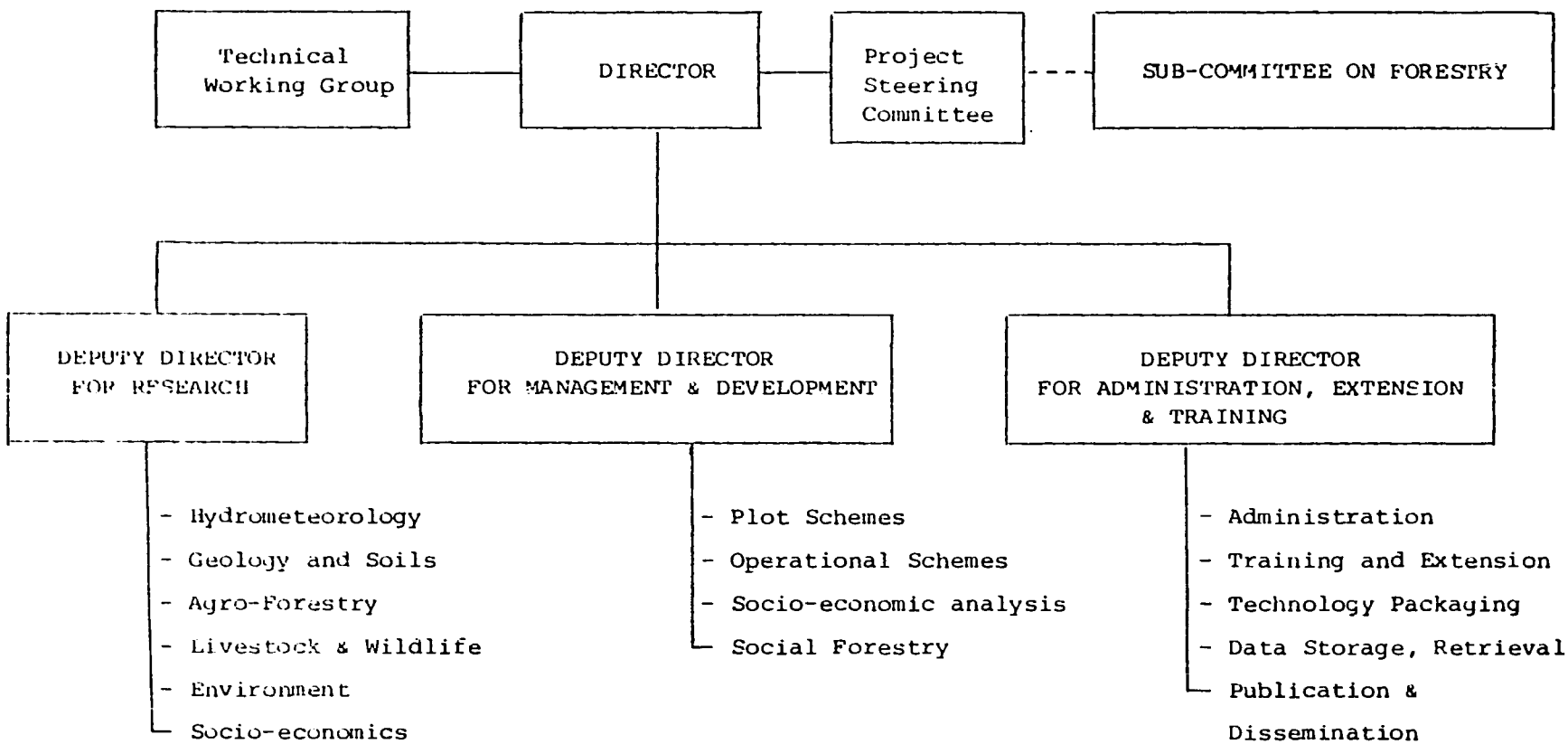
C - Data/output collection, collation, analyses, storage, retrieval
- Technology development
- Technology transfer

4. EVALUATION ARRANGEMENTS FOR THE PROJECT

A Steering Committee shall evaluate the progress and annual reports of ACWMD. This Committee shall comprise a representative from each participating ASEAN Countries and a representative from the United States. The Committee shall report to the ASEAN Sub-committee on Forestry.

Figure 1 shows the proposed organization chart for ACWMD.

FIGURE 1. PROPOSED ORGANIZATION CHART OF ASEAN CENTRE FOR WATERSHED MANAGEMENT AND DEVELOPMENT



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Tabel 1

Summary of Five-Year Budget for ACWMD

(US $1000)

ITEMS	YEAR 1	2	3	4	5	Total
A. Capital Costs						
a. Buildings and Equipment	1600	-	-	-	-	1600
b. Transport/Vehicle	50	-	-	-	-	50
Sub-total	1650	-	-	-	-	1650
B. Operating Expenses						
a. Personnel Services (including salaries, wages and honoraria)	205	205	205	205	205	1025
b. Supplies and Materials	15	15	15	15	15	75
c. Operating/Maintenance	30	30	30	30	30	150
d. Regional meetings, symposia etc.	130	130	130	130	130	650
e. Training Courses	150	150	150	150	150	750
f. Contingencies	60	60	60	60	60	300
Sub-total	590	590	590	590	590	2950
Total for ACWMD	2240	590	590	590	590	4600
Total for 4 Country Centres	1331	131	131	131	131	1855
TOTAL FOR ALL CENTRES	3571	721	721	721	721	6455

APPENDIX 2

PROJECT NO.2 INTEGRATED RESEARCH STUDIES ON THE MANAGEMENT OF FORESTED WATERSHEDS

1. PROJECT BACKGROUND AND DETAILED DESCRIPTION

1.1 Background

Throughout the ASEAN region, increasing pressure for arable land has steadily decimated the valuable forest resources of the countries concerned. Ultimately, it is envisaged that the region's forest resources will be confined mainly to the hilly and mountainous areas which are essentially watersheds with vital conservation functions. In spite of these functions, however, it is inevitable that some of these areas will have to be managed for multiple use, including timber production, in the long run.

Logging in such hilly areas by mechanised means will increase soil erosion, run-off, siltation of water courses and other deleterious downstream effects caused by activities associated with logging road construction and felling and removal of timber from the forest. Because of the very critical inter-relationship between the forest and the water resources, it is imperative that, in the overall management and harvesting of the former, maximum care must be taken so as not to adversely affect or impair the quality, availability and productive potential of the latter. At the same time the cost of timber harvesting which involves heavy expenditure on equipment, forest road construction etc, must be kept within economical limits. There is, therefore, a need to balance these requirements. To-date, unfortunately, there is scant knowledge and experience on the long-term effects of soil/water changes as a result of different management regimes,

logging using different mechanised systems and the subsequent development of the logged-over areas. There is, therefore, an urgent and critical need to appraise and evaluate the impact of forest management and development on other watershed resources and the environment by means of a comprehensive and integrated programme of studies that will have direct relevance to the overall conservation and management of forested watersheds.

1.2 Scope of the Project

1.2.1 Aspects

The proposed Project will cover the following aspects of forested watershed management:-

(a) determination and application of different cutting regimes;

(b) application of different logging systems;

(c) application of different methods of extraction and transportation of logs; and

(d) subsequent development and management of the logged-over areas.

The impacts of these activities on soil conservation and erosion, water balance and quality, nutrient cycling, regeneration, wild-life, climatic variables as well socio-economic variables will be studied and quantified.

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1.2.2 Objectives

The objectives of the Project are to assist ASEAN Member Countries:-

(a) To develop appropriate methodology for monitoring and quantifying the impact of human manipulation of forested watersheds;

(b) To conduct research aimed at the formulation of economically and environmentally sound principles and guidelines for the management of forested watersheds;

(c) To develop appropriate technology for the management and exploitation of forested watersheds for the optimal benefits of the people; and

(d) To investigate the feasibility of multiple-use of forested watersheds with particular reference to timber-production and non-timber benefits.

1.2.3 Structure

The Project consists of five main component studies on:-

(a) Forest management, development and protection;

(b) Conservation and management of water resources;

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(c) Soil erosion and conservation;

(d) Effects of land use changes on soil structure and fertility; and

(e) Effects of land use changes on meteorological parameters.

1.2.4 Duration

The Project will essentially be long term. However, the integrated studies will be implemented initially for five years with technical assistance under the ASEAN-US Development Co-operation Programme.

1.2.5 Location

Despite the many similarities in the nature of forested catchments in the ASEAN Member Countries, there are equally many disimilarities in the specific characteristics of these watersheds as well as in the social and institutional frameworks. Therefore, it is proposed that this Project be located in all the participating ASEAN Member Countries, except possibly, Singapore. All the country projects will be closely co-ordinated by the ASEAN Centre for Watershed Management and Development.

1.3 Detailed Project Description

1.3.1 Project Inputs

(a) Technical Support

The main activities of the proposed integrated studies will be carried out by researchers and workers from ASEAN Member Countries. However, it is envisaged

that technical assistance in the form of short-term foreign consultants will be required in the fields where local expertise is not available, eg. logging and forest engineering studies, etc.

(b) Manpower training

A manpower training programme will form an important part of this Project to ensure that local expertise is developed in the respective fields. Such training should, where possible, be conducted under conditions similar to the conditions which the trainees will normally work. In this respect, the proposed network of research projects within the ASEAN region will be able to fulfill, in part at least, this vital function. The integrated studies approach will also enable training to be provided for a wide range of disciplines as well as foster interaction and understanding amongst disciplines involved in watershed activities.

(c) Field and Laboratory Equipment

Appropriate equipment will be required for conducting studies in timber harvesting, extraction and transport as well as for studying the impact of forest harvesting, management and development on other watershed resources and the environment. The major items would be machinery for alternative logging and extraction systems and weirs, flow structures, and recorders for assessing the impact of forestry activities on other parameters.

A summary of the total cost of such equipment is shown in Table 1.

1.3.2 Project Outputs

The Project will provide quantitative information on the impact of various human activities on the environment, particularly on the soil and water characteristics and balance, in various types of forested watersheds in the ASEAN countries. This will enable the development of sound long-term strategies and programmes for the management of various types of forested watersheds to ensure the continued supply of benefits, both tangible and intangible, from these forested watersheds to the peoples of the region.

Another important output of the Project will be the provision of training opportunities in a wide spectrum of disciplines for developing the expertise of ASEAN nationals and appropriate technology geared to ASEAN conditions. The provision of such opportunities under conditions similar to those encounted by the trainees in their own local environments will be particularly effective and beneficial.

1.3.3 End of Project Status

At the termination of the U.S.-assisted phase of the Project, a set of recommendations and guidelines on the management and development of forested watersheds under various environments and their various impacts will be drawn up. These recommendations and guidelines, together with the results and experiences obtained from the Project will be compiled into a

document and published for dissemination to all the ASEAN Member Countries.

The Project itself will hopefully be expanded to cover other parts of the region and other aspects of forest management and development indicated by the results obtained from the Project at that point. It is anticipated that the various ASEAN Government agencies, in continued collaboration and co-operation with one another, will undertake this expansion.

2. PROJECT ANALYSES

2.1 Technical Analysis

The various components of the integrated studies will be analysed on a national as well as regional basis. The quantification of the impact of human manipulation of the range of forested watersheds in the region on the various environmental variables will provide the technical basis for the development of sound, long-term strategies and programmes for the management of forested watersheds. This will be a very significant contribution towards the long-term watershed management and development programmes of the respective ASEAN Member Countries.

2.2 Financial Analysis

The estimated total cost of the Project is shown in Table 1. It is proposed that the budget for the initial period of five years be funded under the ASEAN-US Development Cooperation Programme.

2.3 Socio-economic Analysis

The socio-economic impacts of human manipulation of forested watersheds will be identified and quantified. In particular, studies to quantify intangible benefits of forests will be attempted. These will form an important component of the overall cost-benefit evaluation of watershed management and development.

3. IMPLEMENTATION PLAN

The project will be implemented as follows:-

ACTIVITY	YEAR 0	1	2	3	4	5
1. Selection & Survey of study area	XXXXXXXX					
2. Establishment of infrastructure and gauging station		XXXXXXXX				
3. Calibration		XXXXXXXXXXXXXXXXXX				
4. Monitoring & data collection		XXXXXXXXXXXXXXXXXXXXXXXXXX				
5. Manipulation of watersheds		XXXXXXXXX..... (Subsequent management after initial manipulation)				
6. Data processing and analysis		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
7. Preparation & presentation of findings					XXXXX	

4. EVALUATION ARRANGEMENTS FOR THE PROJECT

The progress and achievements of the Project shall be reviewed and evaluated periodically by a Steering Committee comprising country coordinators based on reports by a Technical Working Group comprising the Director of the ACWMD, country project leaders and other relevant technical experts.

Table 1

Summary of Five-Year Bu

for the Project

(US $ 1000)

ITEMS	YEAR 1	2	3	4	5	Total
A. Capital Costs						
a. Logging Equipment	1005	-	-	-	-	1005
b. Construction of Weirs and Soil Laboratory	295	-	-	-	-	295
c. Field/Laboratory Equipment	381	36	-	-	-	417
Sub-Total	1681	36	-	-	-	1717
B. Operating Expenses						
a. Personnel Services (includes salaries, Wages and Honoraria)	252	252	252	252	252	1260
b. Supplies and Materials	145	210	15	4	4	378
c. Operations and Maintenance	491	480	489	479	479	2418
d. Training	20	20	20	20	20	100
e. Contigencies	259	100	78	76	76	589
Sub-Total	1167	1062	354	331	331	4745
Total per Country	2848	1098	354	831	831	6462
GRAND TOTAL FOR 4 COUNTRIES	11392	4392	3416	3324	3324	25848

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PROJECT NO. 3 INTEGRATED RESEARCH STUDIES ON THE DEVELOPMENT AND MANAGEMENT OF NON-FORESTED WATERSHEDS

1. PROJECT BACKGROUND AND DETAILED DESCRIPTION

1.1 Background

Watersheds of most countries in the ASEAN region have been and are continuously being encroached upon, resulting in serious degradation of bio-geophysical resources. As a result, large areas of watersheds have become very unstable and virtually unproductive ecosystems. To compound the problem, these same areas continue to be the major sources of accelerated soil erosion and related hydro-physical problems that are ruining expensive irrigation, other infrastructures, productive agricultural lands and a balanced ecology over a wide spectrum of land scenes.

The problems that beset watersheds are expected to continue because of anticipated population increases. An increased population will certainly bring about an accelerated occupancy of watershed areas with their concomitant degradation repercussions. Compounding the population problem is the physical land area constraint. A greater number of people will have to make do with the same land base. Unless effective development and management strategies for the watersheds are evolved and operationalized, the deteriorating conditions of these ecosystems will continue to upset the socio-economic as well as environmental and developmental efforts of ASEAN countries.

There is, therefore, an urgent need to check the continuing degradation of most ASEAN watersheds. Effective management and development strategies have to be evolved and operationalized to restore, improve or harness the productive as well as protective

values of watersheds. Hopefully, economic prosperity in the countryside in close harmony with resources conservation (soil, water, forage, timber, etc.) and environmental stability could be promoted.

These integrated research studies will address pressing problems affecting ASEAN watersheds through an integrated, coordinated, applied and participative approach.

1.2 Scope of the Project

The Project shall undertake integrated studies on the development and management of non-forested watersheds in the ASEAN region, combined with the research component in the operationalization of an income-generating watershed farm.

These integrated studies shall last up to five years subject to extension if deemed necessary. However, the operationalization of the income-generating watershed farm shall be continuing.

The objectives of this Project are:

1. To evaluate the impacts of deforested watersheds on the various components of the environment (soils, water, climate, animals, etc.)

2. To evaluate the impacts of deforested watersheds on the socio-economic and institutional structures of ASEAN Member Countries.

3. To evolve strategies to restore and harness the productive and protective potentials of deforested watersheds in the ASEAN region.

4. To develop and operationalize an income-generating and integrated watershed farm.

5. To evolve strategies for sustained public involvement in the beneficial use, development and management of watershed resources.

1.3 Detailed Project Description

1.3.1 Project Inputs

(a) Technical Support

Technical expertise/support to operationalize the Project shall come from participating ASEAN countries particularly those which have the necessary experience and skills. Technical assistance will only be sought if it is unavailable within the region.

(b) Manpower Training

Specialists available in each ASEAN country shall train their own staff for the Project. In addition, training of Project participants such as villagers, farmers, students, etc. may be undertaken. An annual Seminar/Workshop to discuss the progress and direction of the project

shall be conducted. The researchers from ASEAN countries shall also liase amongst themselves and coordinate their activities.

(c) Field and Laboratory Equipment

Field laboratories/experimental sites shall be obtained from each participating ASEAN country. Necessary field and laboratory facilities and materials shall come from the Project funds.

1.3.2 Project Outputs

The project hopes to operationalize an income-generating and integrated watershed farm geared towards harnessing the productive and protective values of the watersheds to promote socio-economic prosperity in the countryside in close harmony with the promotion of environmental stability. In addition, basic and applied scientific data on the impacts of forest denudation on the various environmental components, socio-economic and institutional structures of each ASEAN country will be generated. Furthermore, sound strategies for sustained public involvement in the beneficial use, development and management of watersheds will be evolved.

1.3.3 End-of-Project Status

The Project is intended to be continuing and income generating. It is expected that the productive and protective values of the afforested watershed will be enhanced. At the same time, environmental stability will be promoted.

2. PROJECT ANALYSES

2.1 Technical Analysis

The project hopes to develop a productive and protective integrated watershed farm in close harmony with the promotion of environmental quality and ecological stability. It is envisaged that the marginal productive and protective conditions of many deforested watersheds can be improved through the imposition of viable land-use alternatives and management strategies.

2.2 Financial Analysis and Plan

Table 1 shows a summary of the five-year budget for the Project.

2.3 Social Analysis

A well-developed watershed which incorporates both the productive and protective components as well as environmental quality will benefit society as a whole. It is anticipated that an integrated watershed farm will spur a just, fair and equitable sharing/distribution of the benefits of a well-developed natural resource.

2.4 Economic Analysis

The Project is an income-generating venture. It is expected that the economic viability of the Project will yield a commensurate rate of return. There will also be indirect protective values generated from a well-managed watershed ecosystem. In addition, the scientific data generated from the Project should provide the necessary technical inputs in evolving viable management and development strategies for deforested watersheds in the ASEAN region.

3. IMPLEMENTATION PLAN

The following is a five-year implementation plan for the Project:-

```
                                 Y  E  A  R

0          1            2           3           4            5.....N

XXXXXXXXXXXX
     A
           XXXXXXXXXXXXXXXXXXXXXXXXX
                      B
                                     XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
                                                    C
```

A - Project area location
  - Staff recruitment
  - Formation of administrative set-up
  - Logistics/preparation

B - Research identification/implementation
- Facilities construction
- Project implementation

C - Data monitoring, collation, analysis
- Report preparation and presentation.

4. EVALUATION ARRANGEMENTS FOR THE PROJECT

The progress and achievements of the Project shall be reviewed and evaluated periodically by a Steering Committee comprising country coordinators based on reports by a Technical Working Group comprising the Director of the ACWMD, country project leaders and other relevant technical experts.

Table 1

Summary of Five-year Budget

(US $1000)

ITEMS	YEAR 1	2	3	4	5	Total
A. Capital Costs						
a. Buildings/shed	250	-	-	-	-	250
b. Transport/Equipment	500	-	-	-	-	500
c. Farm implements	250	-	-	-	-	250
Sub-total	1000	-	-	-	-	1000
B. Operating Expenses						
a. Personnel Services (including salaries, wages and honoraria)	250	250	250	250	250	1250
b. Supplies and Materials	100	100	100	100	100	500
c. Operating/ Maintenance	100	100	100	100	100	500
d. Contingencies	45	45	45	45	45	225
Sub-total	495	495	495	495	495	2475
TOTAL PER COUNTRY	1495	495	495	495	495	3475
TOTAL FOR 5 COUNTRIES	7475	2475	2475	2475	2475	17375

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APPENDIX 4

PROJECT NO. 4 INTEGRATED STUDIES ON THE SOCIAL, ECONOMIC, TECHNICAL AND INSTITUTIONAL PROFILE OF WATERSHED CONSERVATION, MANAGEMENT AND DEVELOPMENT

1. PROJECT BACKGROUND AND DETAILED DESCRIPTION

1.1 Background

One of the important components of a watershed is the local community which is recognized as a determinant factor in the success of any watershed conservation, management and development programme. Current issues concerning the degradation of ASEAN watersheds are traceable to social, economic, technical and institutional set-ups in the watershed communities. It is, therefore, essential that these factors be investigated as they affect watershed conservation, management and development programmes.

1.2 Scope of the Project

The Project shall include data collection, collation, evaluation and documentation of current and projected social, economic and institutional parameters that may influence the systematic and overall conservation, management and development of ASEAN watersheds. The interactions of the three named parameters with economic, hydrologic, social, as well as ecological considerations shall be emphasized.

The objectives of the Project are as follows:-

(a) Identify and evaluate the social, economic, technical and institutional constraints placed on the conservation, management and development of watersheds;

(b) Document and evaluate the public's perceptions, attitudes and involvement in watershed conservation, management and development;

1.3 Detailed Project Description

1.3.1 Project Inputs

(a) Technical Support

ASEAN Member Countries shall provide the necessary technical support for the Project. The Project shall be headed by an ASEAN expert to be chosen from the Project participants. Consultants may be required when local expertise is not available.

The Project shall be staffed by a project leader, research assistants, research aides, and contractual personnel.

(b) Manpower Training

Before the start of data collection, researchers and supporting members shall receive training/briefing on the implementation and execution of the Project by the Project leader and consultants.

(c) Field and Laboratory Equipment

Studies under this Project shall be conducted within ASEAN watersheds and shall use office and laboratory facilities of the Government research agencies, universities or private offices selected for the Project in the participating ASEAN country. Equipment and research facilities not available shall be procured for the Project.

1.3.2 Project Outputs

The major outputs from this research Project shall be:-

(a) Documentation of the public's perceptions, attitudes and involvement in watershed conservation, management and development;

(b) Codification of management alternatives/ terminologies, criteria or standards;

(c) Documentation of watershed land use policies; and

(d) Development of institutional arrangements for the conservation, management and development of watersheds in ASEAN countries.

It is recognised that these variables are not directly and easily quantifiable in terms of monetary benefits. However, these expected outputs are basic but major information and are necessary to effect successful conservation, management and development of watersheds in ASEAN countries.

1.3.3 End-of-Project Status

At the end of the Project, the objectives are expected to be attained. However, more scientific information related to the Project may be needed so that extension of the studies may become inevitable. Studies which warrant continuation shall be identified and initiated by the ASEAN Centre for Watershed Management and Development. Regional consultation and cooperation among ASEAN researchers shall be maintained.

2. PROJECT ANALYSES

2.1 Technical Analysis

Social, economic, technical and institutional characterization of watershed conservation, management and development in ASEAN countries shall be documented to serve as basic guide in operationalizing local watershed communities towards the conservation, management or development of the watershed.

The output from this Project are basic and necessary in evolving and strengthening management capabilities and strategies for watersheds in the ASEAN region.

2.2 Financial Analysis and Plan

A summary of the three year budget for the Project is shown in Table 1. The long-term financial implications of the findings of the Project will be a major topic of project analysis and evaluation.

2.3 Social Analysis

From the data generated, guidelines will be prepared and tailored toward social, economic and technical upliftment of the watershed communities. Organizations of local communities can be encouraged to work on watershed conservation, management and development projects with strategies geared towards their own improvement.

2.4 Economic Analysis

With a greater number of persons involved in the conservation, management and development of watershed resources, greater success is expected, and hence damage amounting to millions of dollars within the watershed ecosystems (above and below the common drainage) can be tremendously minimized. The savings from damage and rehabilitation costs will contribute to the economic progress of the community.

3. IMPLEMENTATION PLAN

The Project shall be implemented according to the following schedule:-

```
                 Y  E  A  R
O            1            2            3
XXXXXXXXXXXXXX
      A
             XXXXXXXXXXXXXX
                   B
             XXXXXXXXXXXXXXXXXXXX
                      C
                          XXXXXXXXXXXXXX
                                 D
```

A - Personnel recruitment, training and field assignment
- Arrangements for office and equipment
- Facilities procurement

B - Project implementation

C - Data collation and analysis

D - Data evaluation and preparation and presentation of final report.

4. EVALUATION ARRANGEMENTS FOR THE PROJECT

The progress and achievements of the Project shall be reviewed and evaluated periodically by a Steering Committee comprising country coordinators based on reports by a Technical Working Group comprising the Director of the ACWMD, country project leaders and other relevant technical experts.

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Table 1

Summary of Three-Year Budget

(US $1000)

ITEM	YEAR 1	YEAR 2	YEAR 3	Total
A. Capital Costs	20	5	-	25
B. Operating Expenses				
a. Personnel Services (including salaries, wages and honoraria)	36	36	36	108
b. Operations/Maintenance and other services	38	38	38	114
c. Supplies, materials and equipment	16	11	6	33
d. Contingencies	11	9	8	28
Sub-total	101	94	88	283
Total per country	121	99	88	308
TOTAL FOR 5 COUNTRIES	605	495	440	1540

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ANNEX M

JOINT PRESS RELEASE

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WORKSHOP ON
WATERSHED CONSERVATION AND MANAGEMENT
RESEARCH PROGRAMME

JOINT PRESS RELEASE

1. An ASEAN Workshop on Watershed Conservation and Management Research Programme was held at Genting Highlands on 3 - 7 September, 1979. The Workshop was sponsored by the United States Government under the ASEAN-US Development Cooperation Programme with the aim of finalising the design for the proposed ASEAN Watershed Conservation and Management Research Programme.

2. The Workshop was declared officially open by Encik Muhammad Jabil, Director General of Forestry, Peninsular Malaysia, on behalf of Y.B. Datuk Arshad Ayub, Secretary General of the Ministry of Agriculture and concurrently Chairman of the National Committee on Food, Agriculture and Forestry. The Workshop was attended by 25 delegates and 18 observers from Indonesia, the Philippines, Thailand and Malaysia.

3. Encik Muhammad Jabil, leader of the Malaysian delegation and Mr. Eduardo Llapitan, leader of the Philippines delegation were elected Chairman and Vice-Chairman of the Workshop respectively.

4. The Workshop was held in three sessions with a field trip. Country Reports, Technical and Project Proposals outlining the problems in Watersheds and ongoing measures and proposals for research in watersheds were presented by the respective delegations. The delegates were taken to Tekam and Jengka

to visit the ongoing studies in the Sungei Tekam Experimental Basins and the Jengka Forest Hydrology Project.

5. The Workshop agreed to recommend the incorporation of the following projects in the proposed ASEAN Watershed Conservation and Management Research Programme to be submitted for U.S. consideration:

Project No. 1	ASEAN Centre for Watershed Management and Development.
Project No. 2	Integrated Research Studies On the Management of Forested Watersheds.
Project No. 3	Integrated Research Studies on the Development of Non-Forested Watersheds.
Project No. 4	Integrated Studies on the Social, Economic and Institutional Profile of Watershed Conservation, Management and Development.

6. The Workshop further agreed to recommend the location of the ASEAN Centre for Watershed Management and Development in Malaysia and to assign Malaysia as the first Chairman of the Programme Steering Committee.

7. The delegates expressed their gratitude and appreciation at the close of the Workshop to Malaysia for the warm hospitality and excellent arrangements and to the United States for funding the Workshop.

8. The Workshop was held in the traditional spirit of ASEAN cordiality and solidarity.

September 7, 1979.