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東南アジア各国における洪水予報の提言

Proposals of the Flood Forecasting and Warning Systems in the Countries of Southeast Asia

May, 1973

建設省土木研究所

Public Works Research Institute
Ministry of Construction, Government of Japan





The picture shows friendships of the participants
and the members of Hydrology Section of PWRI.

序 文

本報告は、日本政府主催の第4回洪水予警報セミナーにおいて各国研修生より出された各国における洪水予警報システムの提言等についてのレポートをまとめたものである。

東南アジア諸国は台風等により著しい洪水被害を受ける。E C A F E事務局が昨年度の台風委員会へ提出した報告によると21ヶ国を対象として1961年～1970年の10年間調べた結果、台風・サイクロンで受けた被害額は99億米ドルに達し、この金額は世界銀行が同時期に全世界に融資した累計額94億米ドルを上廻る額であり、事の重大さを示している。このうち68億米ドル（約2兆円）は台風の影響を受ける地域の被害である。

台風地域でG N Pの統計の得られる5ヶ国でみると年平均被害額はG N Pの0.53%に達していることがわかる。

台風地域にある8ヶ国にしばってもこの10年間には死者10,657人、被災人口1,670万人に及び、物的被害のみならず、人的被害も大きいことがわかる。

これらの被害を河川改修などによって防除するには、あまりにも莫大な資金が必要であり、日本政府も協力しているが、まだまだというところである。現実的な手段として被害を少しでも軽減するには、洪水予警報による住民の避難が大へん有効であろうと思われる。建設省では1969年より海外技術協力事業団の協力を得て、毎年一回、東南アジア各国より研修生を招き洪水予警報の集団セミナーを開催して来た。これまでに参加した国は韓国、台湾、フィリピン、ベトナム、ラオス、タイ、マレーシア、インドネシアなど8ヶ国に達し、参加者も約40人に及んでいる。

研修内容は洪水予警報の一般論として、システム概要、観測網、通信回線

設計、水文解析（電算機も含む）、公布、水防活動など多岐にわたる。また北上川、利根川、淀川、筑後川、木曽川などの洪水予警報システムの見学旅行は研修生にとって大好評であり、第3回からは京都大学防災研究所での講義も受けている。このように京都大学防災研究所は勿論、全建設省の努力の結晶として1972年度第4回研修も成功裏に終了した。土木研究所もこれら研修の一部を分担して来たので担当時間中に討論資料として、各国における洪水予警報システムの将来計画、提言、理想像を各研修生より提出してもらった。提出レポートは十分なものでもないし、この内容が直ちに実施できるものでもないが、これを一読すると各国の水文事情がわかり、各国の洪水予報に対する熱意をうかがうこともできる。

これを基礎にして、洪水予警報セミナーのよりよい発展が期待され、将来の国際技術協力に貢献する所が大きいと思われたので、各レポートに概要（日本文）を付して印刷し、大方のご批判をおおぐ次第である。

1973年4月

建設省土木研究所赤羽支所長

川 越 達 雄

Introduction

The reports in this book are presented by the participants of the fourth group seminar on the flood forecasting and warning systems held by OTCA and Ministry of Construction, Japan.

In the seminar, various kinds of procedures of flood forecasting and warning were explained and future plans, proposals or ideal procedures were discussed by the participants. They also exchanged their ideas and suggestions for future developments of the systems.

The successful forecasting requires more steps, that is, completion of observation network, hydrological analysis for operational use, financial supports and the international technical cooperation. It is, of course, each participant who promotes the establishment of the flood forecasting and warning system in his own country.

This book is printed as fruitful memories of the seminar, by the Public Works Research Institute, Ministry of Construction.

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1. Han River, Korea

LIM, CHOONG SOO

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概要：ハン川は韓国の4つの大河川のうちでも最大のもので、流域面積は26,200 km²、全国土の1/4に及ぶ。この流域には首都ソウルがあるのでこの川の洪水予報は大へん重要である。ここで行なわれる洪水予報の方法は水位－水位法が有効である。ハン川は北ハン川、南ハン川に分かれ、それぞれの上流チェオン－ピエオンとヨジュとで水位を測り流量を求め、流下時間だけずらせて、コアン（合流点）の流量とし、合流後さらに、流下時間を考慮してソウルの水位を予報する。

現在、新しい方法を日本の専門家チームが研究中である。この方法でテレメータによって予報時間を早めること、ソウルのみならず他にも予報地点を設けることが可能になるだろう。

1. Short Explanation on Major Rivers in Korea

Because of the high mountain range along the eastern coast which runs from north to south the major rivers flow toward the west or south.

Thus the four major rivers of Korea flow to the west or south.

The generals of those rivers are as follows.

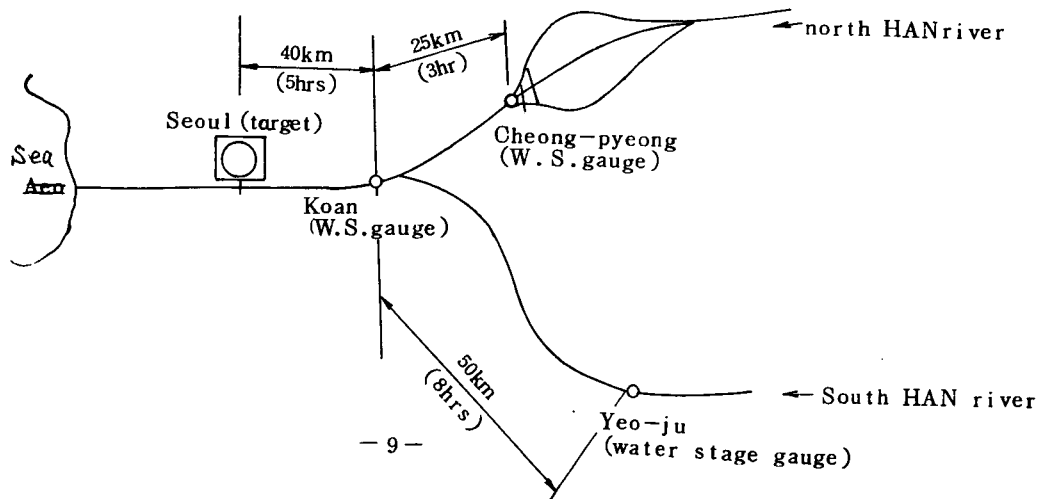
River	Catchment Area (km ²)	River Length (km)
HAN River	26,200	470
NAKTONG River	23,900	530
KEUM River	10,000	400
YEONGSAN River	3,000	120

2. Flood Forecasting Procedure

How to forecast on the HAN River was the target from the old time. Because the catchment area of the HAN river is more than one quarter of total territory of Korea.

Moreover the capital city Seoul is located aside this river.

The method which we have applied, so called "Stage to stage method", is as follows.



- (1) Observation of water stage at Cheong-pyeong (Hc).
- (2) Calculation of discharge rate at Cheong-pyeong (Qc) by rating curve.
- (3) Find traveling time from Cheong-pyeong to Ko-an (Tc-k) by the table which tabulated from the past record.
- (4) Find water stage at Yeo-ju (Hy) after finding traveling time.
- (5) Calculation of the discharge rate at Yeo-ju (Qy).
- (6) Calculation of the discharge rate at Ko-an (Qk) by adding Qc and Qy.
- (7) Calculation of water stage at Ko-an (Hk) by the same way.
- (8) Calculation of water stage at Seoul.
- (9) Find the traveling time by the table.

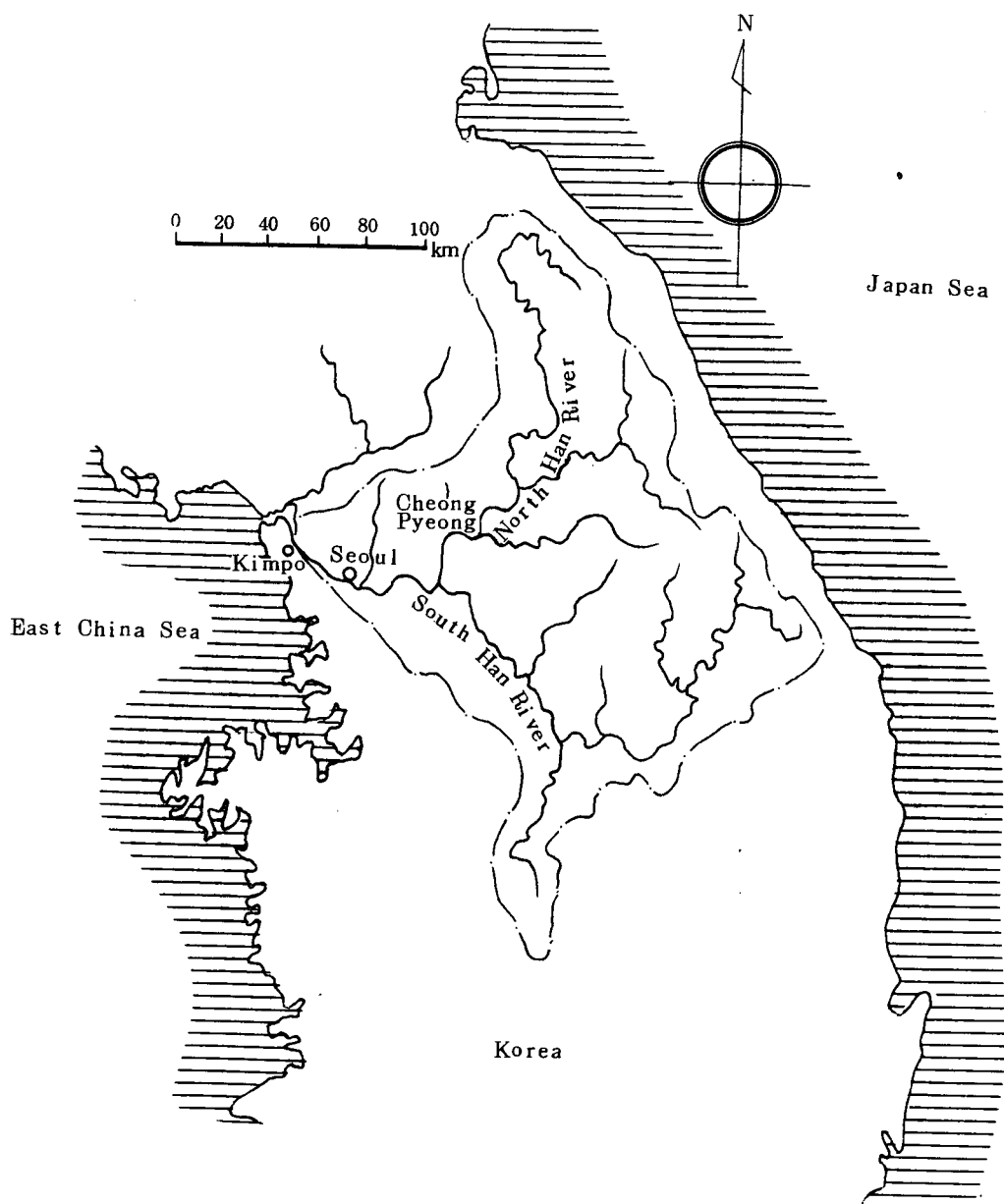
3. Future Plan

Now the new method is under study by Japanese experts and the new method is somewhat similar as the one applied in Tone river of Japan..

That is storage function method for sub-basins and routing for stage to stage with telemeterized system as a means of data transfer.

Two main requirement on this new method is more time advantage and forecasting on some another target point. (Not only Seoul)

The above is the brief future plan on Han river flood forecasting.



2. Abulog River, Philippines

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概要：アプログ川はルソン島北端の川で、長さ約100 km で、洪水の流出時間は約8～12時間である。下流は農地であって、堤防は実際上有効でない。この流域には非自記の雨量計・水位計があって、20年にわたり毎日の記録をとっている。観測所には観測人がいるので、洪水予報のためには通報を電話で行なうことができる。しかし、この流域にはラジオ・テレビの放送局がないので、ラジオ・テレビを使って予警報を周知せしめることはむづかしい。

将来テレメータ水位計・雨量計をつけてデータを収集し、貯留関数やタンクモデル等により流出計算が行なえるようになるとよい。

（討論）夜間に山間部に大雨が降ったらどうして検知するか。それには強雨警報器とか空港用レーダー等が有効となるであろう。

Short Explanation of a River Basin and a Proposed Flood Forecasting Procedure to be applied

I would like to present a river Basin, a very simple one, because it has only one major tributary. Owing to the fact that communication and highway facilities in the northern part of the Philippines is so poor today, there is no flood forecasting and warning system in the area so that when there is flood, disaster is to be expected immediately. Thus, due to the limited facilities and data, that we now have, the simplest and most appropriate method is proposed to be applied herein.

Geography of the Basin:

Length of the river is about 100 km from the mouth, and the slope longitudinally is generally mild, so that travel time is about 8 hrs. to 12 hrs. Upstream and west part is mountainous region. Western downstream area is a plain and a target area, for this is an agricultural region. Eastern part downstream is also a plain and a target area. River banks are practically not protected.

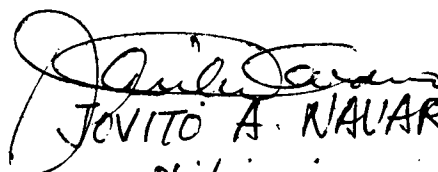
Data Available:

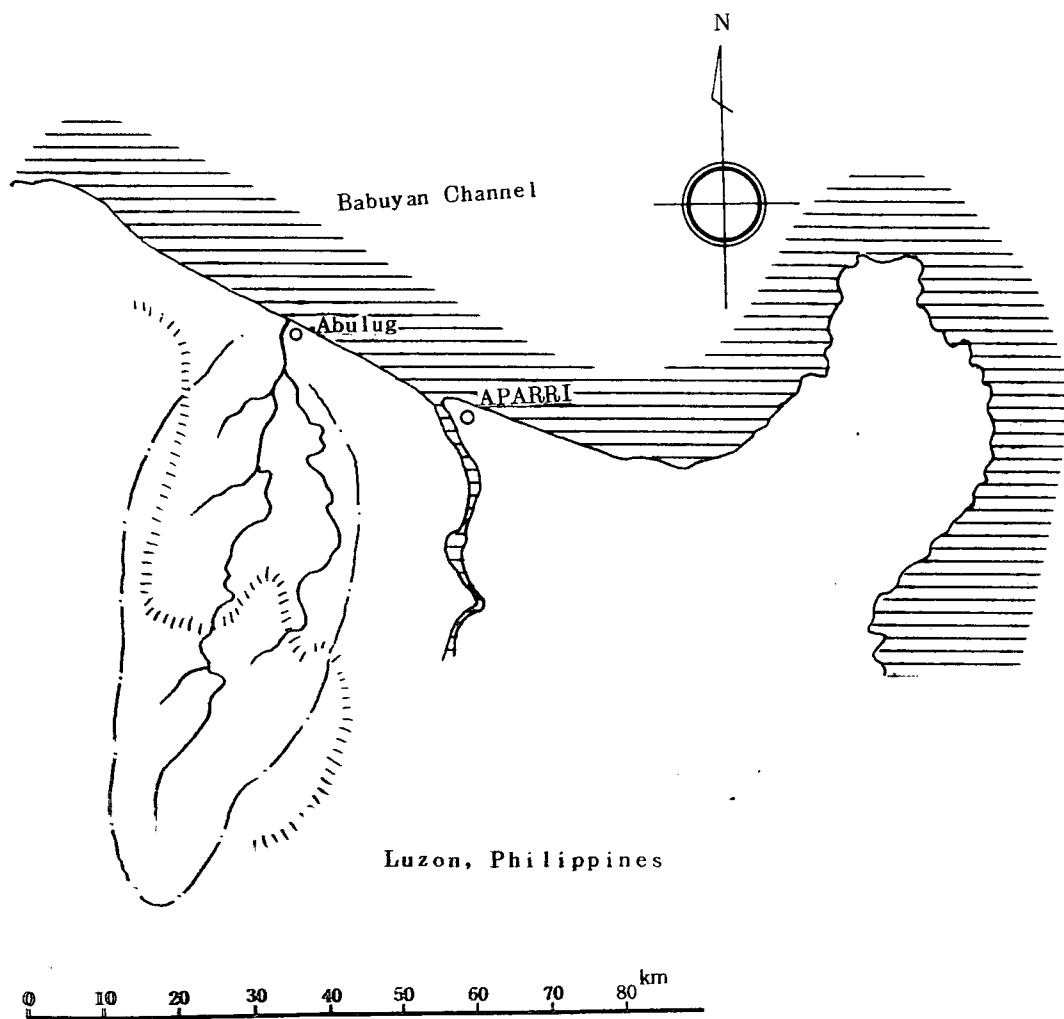
At the confluence upstream is a discharge, stage and rainfall station. Upstream are a number of non-recording rain gages maintained by a different agency. Downstream from the confluence are also quite a number of non-recording staff and rain gages. It must be noted that rainfall data are total daily amount and about 20 ya. record.

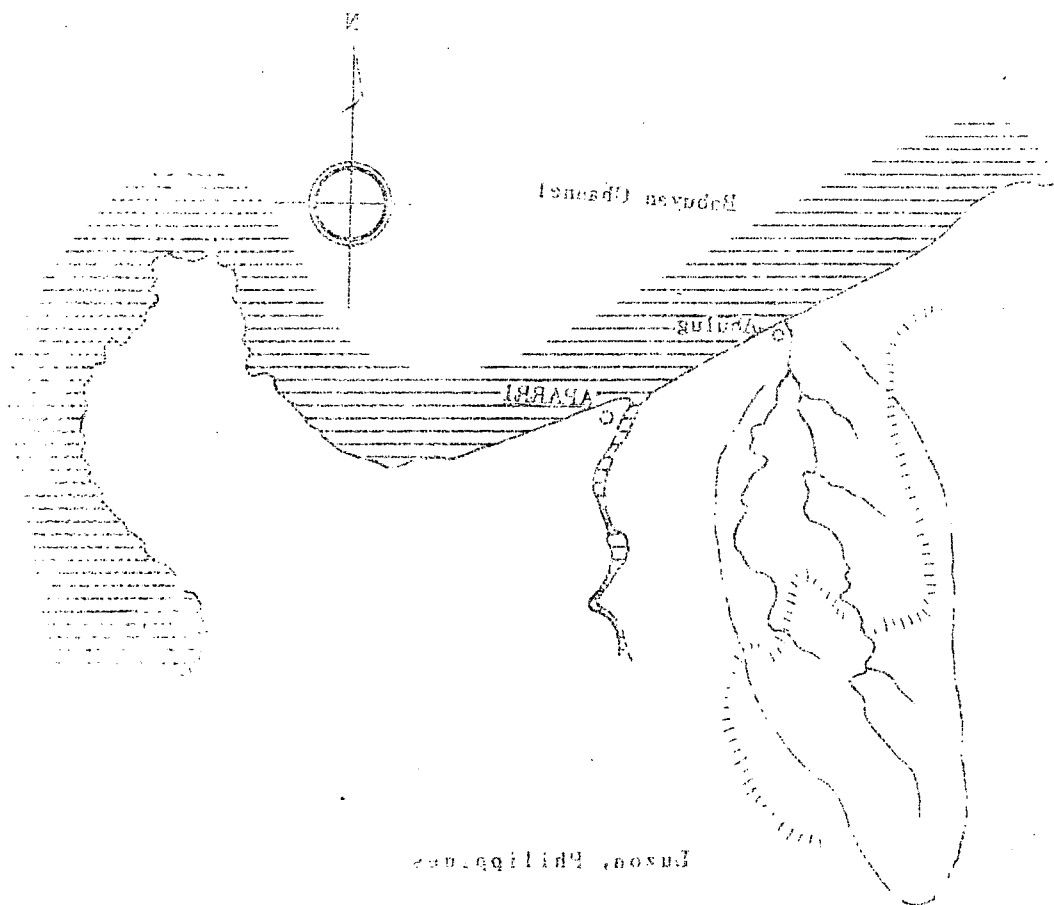
Proposed Method of Flood Forecasting and Warning:

Stage-discharge correlation method is being proposed to be applied throughout considering the limited equipment and facility now existing. As we are employing gage keepers, warning can be done by the telephone system. There is no radio and television station in the area so that warning is impossible to be done thru these media.

However, when self-recording rain and stage gages will be installed and if the telemetering system shall have been introduced storage-function or the tank model method will be appropriate. But suffice it to apply for the moment the stage-discharge relationship.


JOVITO A. NAVARRO
Philippines





0 10 20 30 40 50 60 70 80 90 100

3. Citanduy River Basin, Indonesia

WIKAMTO

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概要：チタンドウイ川流域はジャカルタの南東 7 0 0 km にあり，流域面積は 4,5 0 0 km²である。

下流部約 1 0 0 km は平野部を流れているが，中流 4 0 km はやや勾配が急で V 形の断面をしている。上流 1 0 0 km は山間部を流れる急流である。

ここを図のように 7 つの小流域に分けそれぞれに雨量計を置き，河道のチェックポイント A, B, C …… に水位計を置く。流域は流出計算を行ない，河道は洪水追跡によって洪水を予報する。

洪水予報にはテレメータが必要で，これら雨量・水位の観測所はテレメータ化しておかなければならない。

(討論) 図の G - K 間の分流をどのようにして計算するか。またその影響が上下流へどのように効くか。

Brief Description on Flood Forecasting
and Warning in Citanduy River Basin, Indonesia

Location: About 700 km south-east of Jakarta in Jawa Island.

Area: Catchment area 4,500 km².

Channel stream:

- 100 km from estuary flows along alluvium plain with a very flat shape and has a rectangular shape of cross-section.
- Next 40 km has a mild shape, with a "V" shape of cross section.
- Upper stream about 100 km flows along mountainous area with very steep slope.
- The river pours out its water to Indian Ocean.

Proposed forecasting system:

- Rainfall method will be applied for computation.

Tributary I down to dam (I)

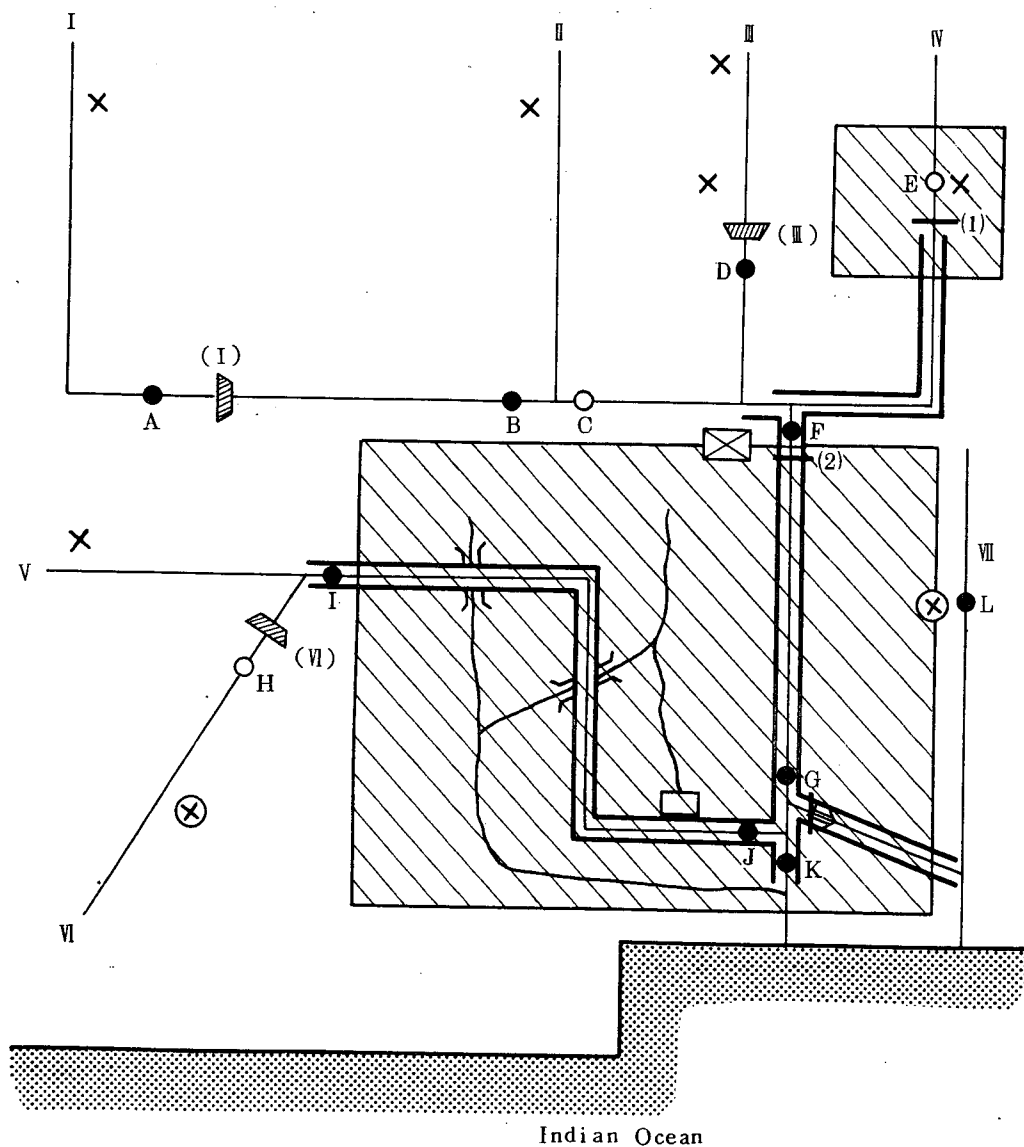
"	II	"	"	Confluence
"	III	"	"	dam (III)
"	IV	"	"	E point
"	V	"	"	Confluence
"	VI	"	"	dam (VI)
"	VII	"	"	L point.

- Routing method will be applied for computation:

B = Outflow Dam (I) + routing

C = B + tributary II

F = (C + routing) + (outflow dam III + routing) + (E + routing)



-  Central office
-  rainfall recorder (existing)
-  rainfall recorder (proposed)
-  Water level gauge (existing)
-  Water level gauge (proposed)
-  Pumping station

-  Irrigation weir
-  flood control dam
-  diversion gate
-  dike+syphon
-  drainage ditch
-  paddy field related to this project

$G = F + \text{routing.}$

$I = \text{Dams (VI) outflow} + \text{tributary V.}$

$J = I + \text{routing.}$

Downstream of L = L + routing.

Complexity between points G, J and K will be eliminated by providing flood diversion with gate.

A little problem is about discharge calculation, because it will be influenced by tidal effect.

Communication system:

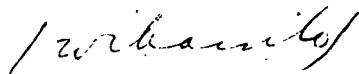
The aim of this forecasting is for flood control by means of operations of dams and flood diversion, so it's needed to get information of data as soon as possible.

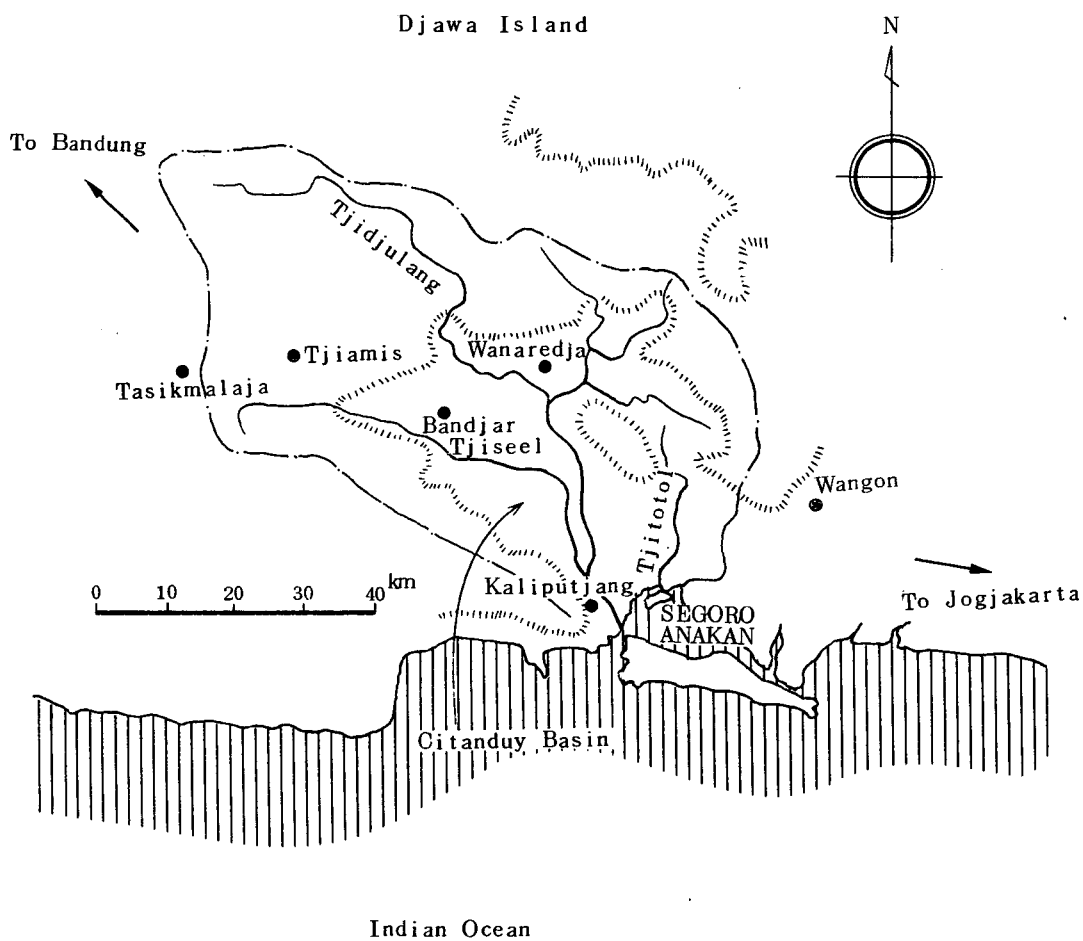
To satisfy this purpose, telemetring system is the most convenient. Proposed telemeter rainfall recorders are in tributary I, II, III, IV, V, VI and VII; each one set and for tributary IV and VII include for water level gauge. Another water level gauge that are needed are for point C and K.

Because of topographical condition, it may be needed one relay station.

Tokyo, 15 Mar. 1973

Participant from Indonesia





4. Kelantan River, Malaysia

LIEW SEE PENG

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概要：ケラントン川はマレイ半島の北東部にあり、西・南・東を山でかこまれていて北へ流れている。流域面積 $15,000\text{ km}^2$ で、長さは 250 km である。下流部だけが平野となっていて水田耕作が行なわれている。山岳地方には雨量計がないが、年雨量は $4,000\sim5,000\text{ mm}$ と推定され、北東モンスーンの吹く10月から1月中旬までに年雨量の $75\sim80\%$ が降る。

本河川には水位計が2カ所あるが、雨量計はほんのわずか平野部だけにしかない。マレーシア気象台は最近波長 10 cm の気象レーダーをコタバルに設置した。

洪水予報は平野部において洪水が来る前に人々を高台などへ避難させることを目的とする。そのためにははじめある支川流域に多くの雨量計において、レーダーエコーと雨量との関係を明らかにし、併せて、水位・流量をも観測して単位図を求める。このような調査を逐次各支川で行なう。図中のA、B、Cにおける流量を時差を考慮して加え、Dから下流は水位－水位法で洪水追跡を行なう。以上に3年かけ、4年目はシステム作り、5年目は改良と完成を目指す。

Flood Forecasting System for Kelantan River (Malaysia)

(A Proposal)

Until today, no efficient flood forecasting system exists for the Kelantan River. This short article is a proposal for a flood forecasting system for the Kelantan Basin. Owing to lack of data at hand, the statistics given are approximations only. It is requested that this proposal not be taken seriously as the actual situation might not warrant the working of the proposed system.

Geography of Basin:

The Kelantan River Basin is situated at the northeastern corner of the Malay Peninsula. The main river, Kelantan River and its tributaries rise in the mountain ranges in the west, south and east and drain northwards into the South China Sea. The length of the river is about 250 km and the basin area about 15,000 km². The only plain area is in the lower reaches of the river. Small pockets of plain area also exist along the sides of the river in its middle river reaches. It is in these plain area that rice cultivation are carried out. It is also these same plain areas that annual flooding occurs. Hence the need of a flood forecasting system.

Rainfall:

Due to the absence of data in the uninhabited upstream areas of the river and its tributaries, there is no way of knowing the annual amount of rainfall in the basin. However, a good estimate for the upstream area would be in the range of 4,000 mm to 5,000 mm. The meteorological

logical station at Kota Bahru which is situated at the mouth of the river recorded an annual average of about 3,050 mm of rainfall. Of this amount, 75 to 80 percent fall during the North-East Monsoon Period i.e. late October to mid January. The type of rainfall is continuous; sometimes lasting several days without pause.

Existing Facilities:

To my knowledge, there are only two river gauging stations; one at Gullimard Bridge which is a recording gauge, the other is a staff gauge at Kuala Kerai (see map). As for rain gauges, there are quite a few, but majority of them are in the lower reaches of the basin. As these rain gauges do not belong to one single agency, the maintenance of record is poor. In addition, the Malaysian Meteorological Service has lately installed a 10 cm weather radar at Kota Bahru.

Proposed System:

The proposed system outlined below is aimed at warning the people of impending flood and flood peak. This would give those living in low-lying areas time to move to higher ground well before the arrival of flood. The control of flood by dams and retention basin is out of the question at the moment.

Due to lack of fund, the main instrument needed in the proposed system is the weather radar at Kota Bahru.

To start with many rain gauges must be placed in the upper reaches of the river and its tributaries. These rain gauges are required to derive the relationship between rainfall intensity and radar echo intensity. Once the relationship is obtained, the rain gauges can be moved to

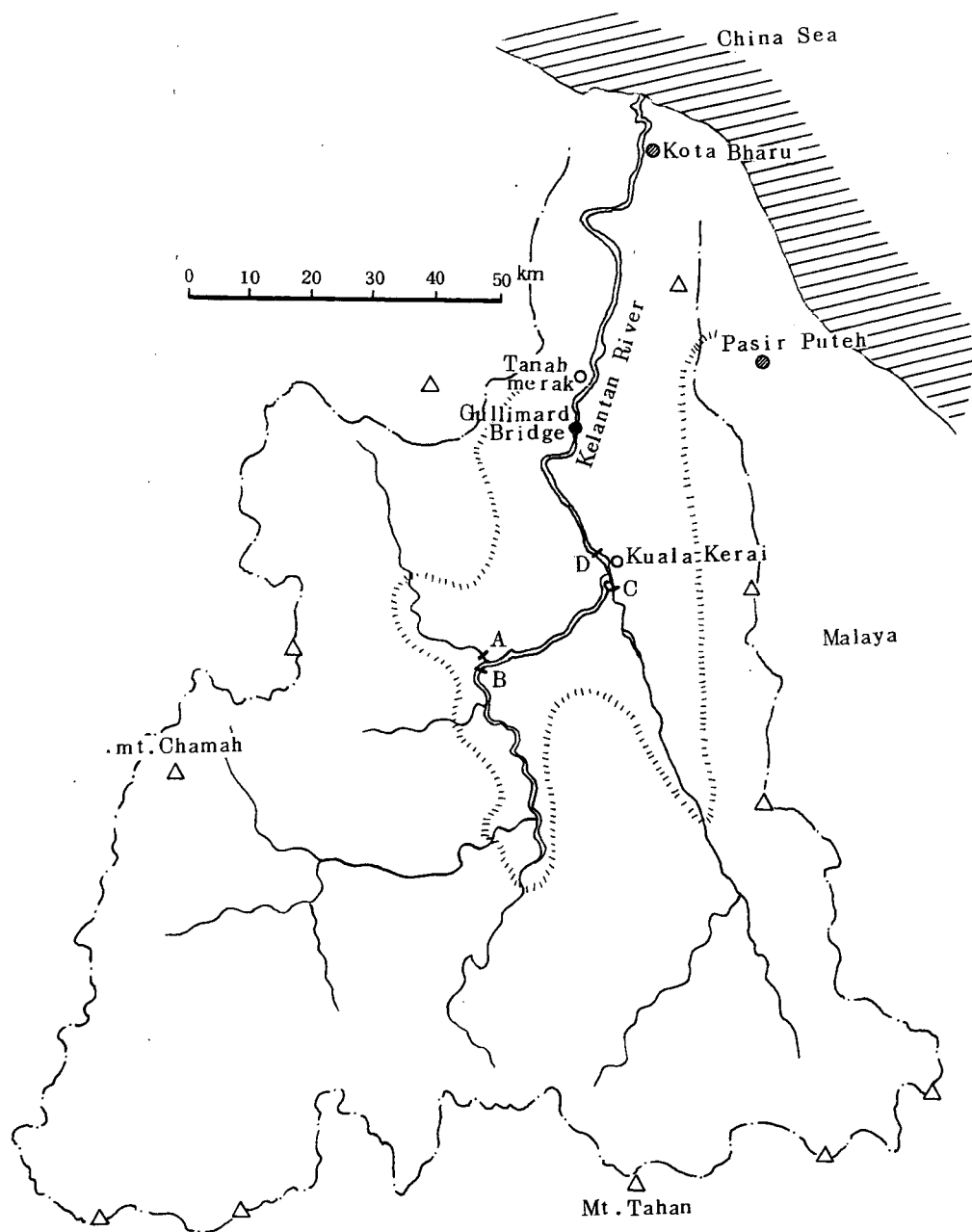
other experimental basins. Simultaneously, the stage reading at points A, B and C (see map) must be observed. These values would be used to derive the unit hydrographs for the respective tributaries. At the point D, the hydrograph there would be the arithmetic sum of the three hydrographs of A, B and C, with due consideration for the time lag. From D downwards, stage-stage relationship would be employed to forecast downstream hydrograph.

In the implementation of the proposed system, it is suggested that three years (actually only three monsoons periods) be spent in deriving the radar-rainfall relationship, unit hydrographs at A, B and C, and the stage-stage relationship for downstream regions. The system should be tried out in the fourth year and then revised and implemented in the fifth year.

Conclusion:

The proposed system seemed ideal for the time being. However in the actual implementation, many problems are bound to arise and many hurdles to overcome. In fact it is suggested that more detail planning be done on drawing board first before accepting the system.

By Liew See Peng



5. Mae Klong River, Thailand

PRASONG JITSERI

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Royal Irrigation Department,
Bangkok, Thailand.

概要：メクロン川はタイ国政府が第1回台風委員会に提出したタイにおける洪水予報のパイロットシステムが考えられている流域である。この川はタイ国西部にあり、カンチャナブリ市より上流で25,450 km²の流域面積である。上流流域は標高700～2000 mの山岳で、カンチャナブリ下流では平らな氾濫原となっている。この上流流域はクワエノイ、クワエヤイの2流域に分かれる。雨期は南西モンスーンの卓越する5月～10月で、大洪水は7月～10月に主として発生する。強い雨は、強いモンスーンと地形状態によって引き起こされる。山岳部分は人口が少ないので洪水予報の目標地点はカンチャナブリにおき、ここより下流の人口密度の高い地域に有効となるように考えられてある。

(討論) 第1にクワエノイ流域のシステム作りが考えられている。ここに現在雨量計が5個設置されてあるが、7個にしたい。日雨量から日流量を推定したいが有効雨量の算定はトライアルで求めている。

Participant: Thailand
Name: Prasong Jitseri

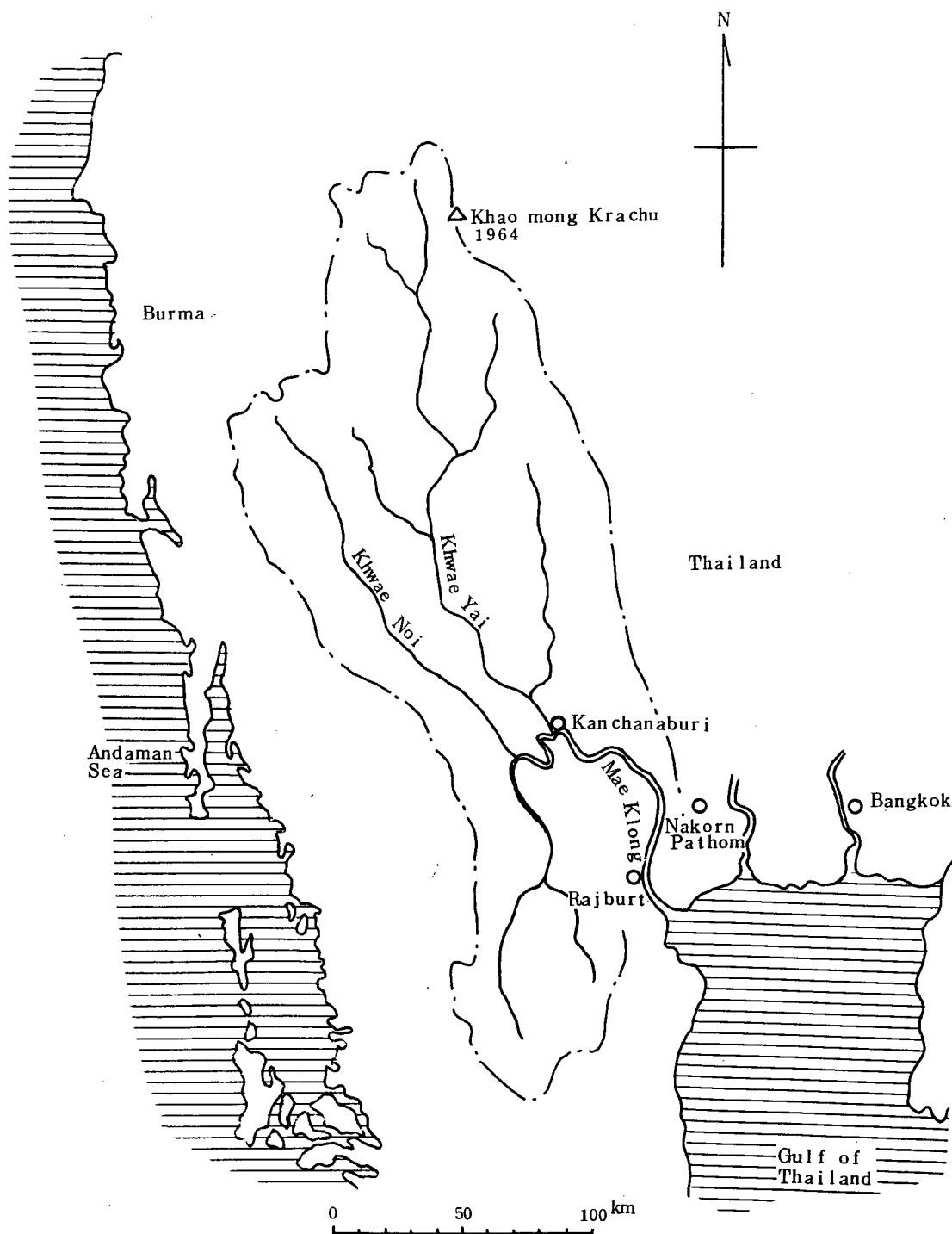
Mae Klong River Basin

The Mae Klong River basin was selected by the Thai Government for establishing a pilot flood forecasting and warning system which were adopted in the first session of Typhoon Committee held at Bangkok in December, 1968.

The Mae Klong River basin is located in the Western part of Thailand, the river basin can be divided into two parts, above Kanchanaburi City comprising 25,450 Km² in areas, it contains rugged mountains ranging in elevation from 700 to 2,000 meters, and below Kanchanaburi city is characterized by low-lying flood plain.

There are two big tributaries named Khwae Noi and Khwae Yai rivers joined together at Kanchanaburi and forming the Mae Klong River. This river starts to rise in early May with the beginning of rainy season brought by south west monsoon which prevails up to the end of October or early November. Big flood of Mae Klong River basin generally occurred during the period of July to October associated with heavy storm rainfall, and the heavy rainfall are caused by strong monsoon conditions and orographic conditions of the basin.

In the mountainous region, there are no important developed areas for the present. However, along the lower reach of the river from Kanchanaburi city, developed land with dense population stretches Southward embracing many important cities. Where the inhabitants often suffered from flood. So Kanchanaburi was therefore selected as a basic target station where flood forecasting system are to be issued as a first priority.



6. Mekong River, Laos

MALAYTHONG SINGKEO

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Tel: 2406

概要：メコン川はその源をチベットの山脈に発し、ホアコン、ルアン普拉バン、ヴィエンチャン、タケク、サバンナケット、パクセ、コーンの諸州を
通ってカンボジャ、ヴェトナムを過ぎて南シナ海に注ぐ。長さ 4 0 0 0 km
流域面積 8 0 0,0 0 0 km²に及ぶ大河川である。

洪水予報は人命財産に及ぶ被害を軽減するのに大へん役立つから重要である。本セミナーで論じられた方法はすべて完全な作業態勢と器材と十分なデータがなければいけないが、わがラオスではそれらは全く望めず、極くわずかの雨量計と水位計があるだけである。このような状態でどのようにしたら洪水予報が十分行なえるであろうか。

(討論) Bandith の報告と共に次のような討論を行なった。洪水予報の方法は幾つかある。

- ① 雨量の観測に重点をおく方法：テレメータ雨量計が山岳地方に設置できなければ、レーダを用いるとよい。
- ② 統計的方法：相関の高い因子を選び出し、回帰曲線による方法と、周期分析などが有効であろう。

Tokyo, 14th March, 1973

Explanation about the outline of Mekong River basin in Laos and introduce some of my hope to satisfy on the task of flood forecasting and warning in my country.

To: Dr. Takeo Kinoshita, Head Section of Hydrology, Public Works Research Institute, Ministry of Construction at Tokyo in Japan.

Dear Sir

I have to honor to inform you that a short explanation concerning the outline of Mekong River basin and introduce some of my hope to satisfy on the task of flood forecasting and warning in the Mekong River and its tributaries in future by applying my knowledge I learned from this course in Japan.

The outline of Mekong River basin

The Mekong River rises in the Mt. TIBET (Red China) it reaches to the Provinces Houakhong, Luang Prabang, Vientiane, Thakhek, Savanna-khet, Paksé, Khone and empties into the China sea by passing Cambodia and south Viet-Nam it is joined by a number of tributaries such as the Nam Tha, N. bèng, N. Ou, N. Seuang, N. Khane, N. Lick, N. Ngum, N. Ngiep, N. Sane, N. Kading, Sé bangfai, Sé bang hieng and Sédane.

The mainstream has an extension over 4,000 km. The total of the mainstream and tributaries combined is about 12,000 km.

The Mekong River basin covers an area of 800,000 km² and embraces five areas each presenting different topographic mountainous area and plain area and these five major basins are divided into a

number of sub-basins.

The flood forecasting procedure

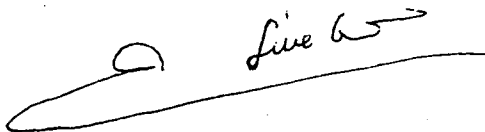
The flood forecasting knowledge is very useful and very interesting to reduce the flood damage and to protect the people and property from floods.

According to my knowledge I learned from this course all methods and all systems of flood forecasting can be applied only in the case of completed the component part of works, equipments, instruments and enough data.

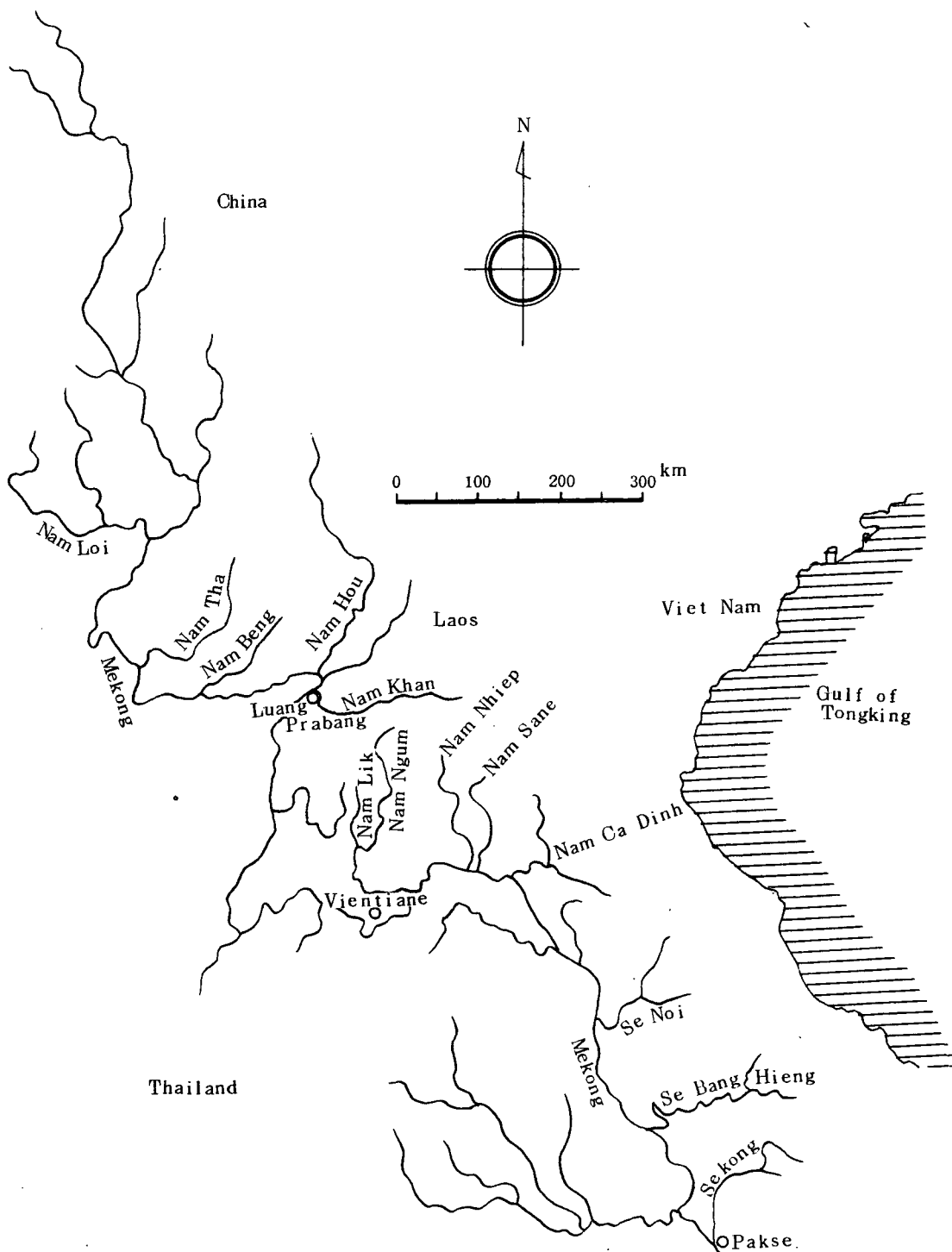
For the case of Laos my country we don't have enough the component part of works, equipments, instruments, the lack of data there are only few rain gauge and water stage gauging station in the River basin, in this case how can to apply and to satisfy on the task of flood forecasting after returned to our home. So if my dear Dr. would be kind enough to suggest or recommend some methods wherein I can do some sort of flood forecasting, considering the limited data that we now have I will appreciate it very much.

I beg therefore, to send by this report my hearty greetings and to express my sincere regard and respect to you.

Sincerely yours,

A handwritten signature in dark ink, appearing to read 'Singkeo', with a long horizontal line extending to the left.

Mr. MALAYTHONG Singkeo
(Laos)



7. Nam Ngum River, Laos

BANDITH VONGPHETH

Direction of Hydraulic and Navigation Office,
Ministry of Public Works.
Vientiane, Laos, B.P. 481.
Tel: 2755

概要：ナムグム川はヴィエンチャン市の下流 75 km でメコン川に注ぐ。この川はラオス・ベトナム国境のトランニン高原に源を発し、全長 400 km、流域面積 16,500 km² の河川である。流域は(a)ナムグム本流流域 8,460 km²、(b)右支川のナムリク流域 4,000 km²、(c)両川合流以下の流域 4,040 km² に分けられる。

ナムグム川はヴィエンチャン市付近の人口密度の高い地域と水田地帯を流れるので、バンケウンからメコン合流点までが予報対象域となる。洪水は①ナムグム川上流に降った雨によるもの、②メコン川の洪水がこの川を逆流して来たもの、の2種に分けられる。

この川の流域には水位計・雨量計は幾つかあるが洪水予報は行なわれていない。ナムグム本流流域、ナムリク流域に雨量計をつけ、雨量より流量を計算し、合流した後は水位－水位法によって洪水追跡を行なうのがよいと思われる。

(討論)ナムグム川に完成されたダムの放流量をテレメータで送るようにすると大へんよく洪水予報ができるであろう。

Tokyo, 14-3-73

Dear Doctor

and

Dear Representative of the OTCA

I have the honour to present to you my short explanation about one of the tributaries of the Mekong River. The name of the river is "NAM NGUM RIVER".

Description

Nam Ngum River joins the Mekong river about 75 km downstream of Vientiane city. It's original is in the Tran-Ninh Plateau near the border of Laos and Southern part of North Viet-Nam. The total length of the river is 400 km. The catchment area is 16,500 km². This area is divided into three sub-basins:

- a) The main river sub-basin upstream has the catchment area: 8,460 km².
- b) NAM LIK basin, on the left side of Nam Ngum basin covers 4,000 km².
- c) From the junction of Nam Ngum and Nam Lik downstream to the boundary and this part of the tributary covers 4,040 km².

Target Area of Flood

The Nam Ngum is flowing through a densely populated area, along paddy fields and close to Vientiane city. The target area from Bane Keun to the mouth of the river, because of the flat character of the

river bed, is 75 km long. This area is often flooded because of two factors:

- One is caused by heavy rainfall in the upstream area of the tributaries, NAM NGUM and NAM LIK.
- Second is caused by the flooding of the Mekong river, which results in the Mekong water streaming up through the tributary.

Flood Forecasting

There are several water gage stations and rain gage stations have been installed along the river. However, flood forecasting has not been done for this river. It is to be recommended that water gages and rain gages on the NAM NGUM and NAM LIK basins to be installed before the junction. The rain method will be available for these areas. And from the junction to the mouth of the river flood routing or stage to stage method will be used.

Conclusion

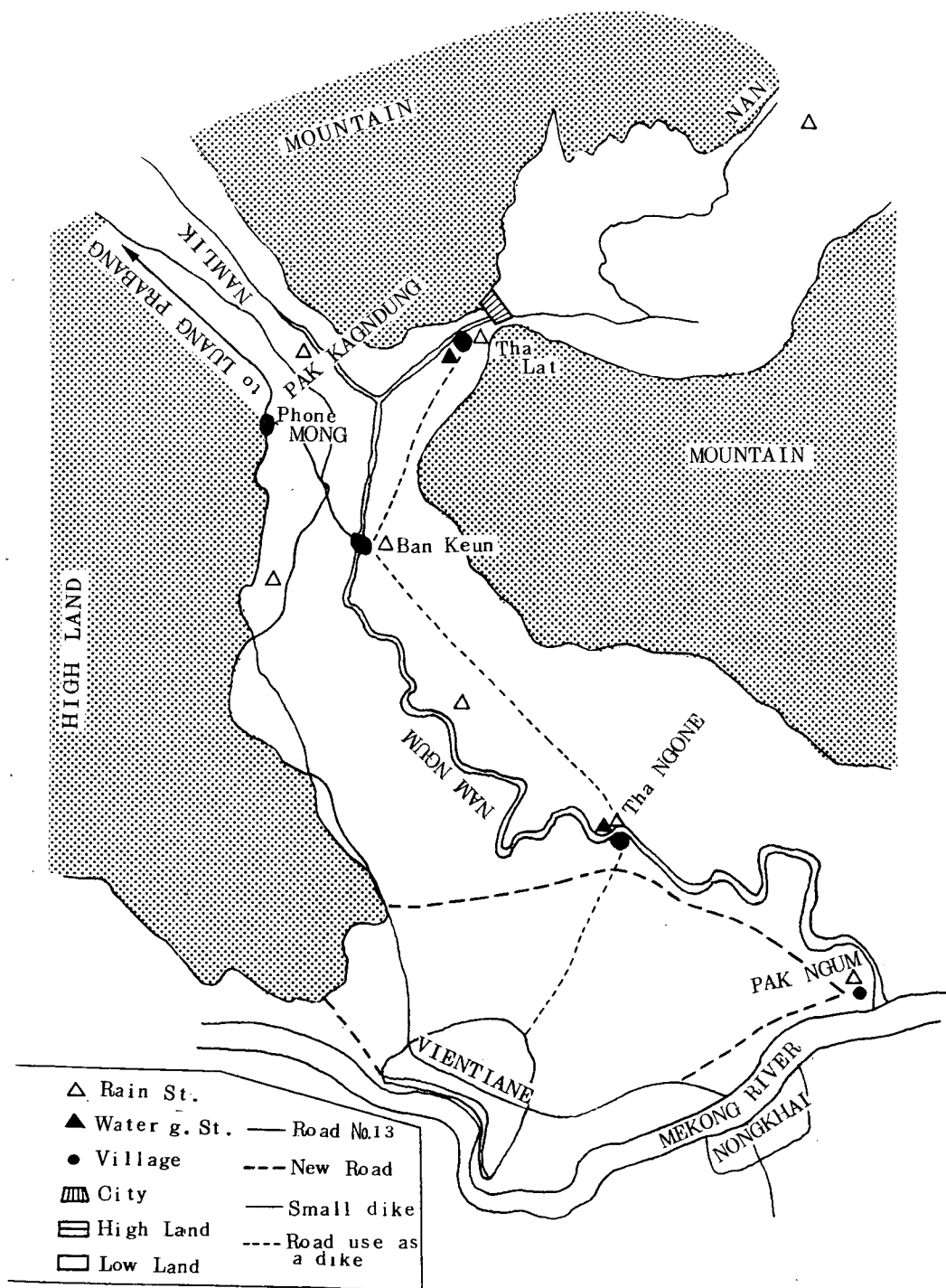
I hope the methods and example given from this course will increase my knowledge, my experiences in my country after all of them will be trying to use for difference rivers in Laos.

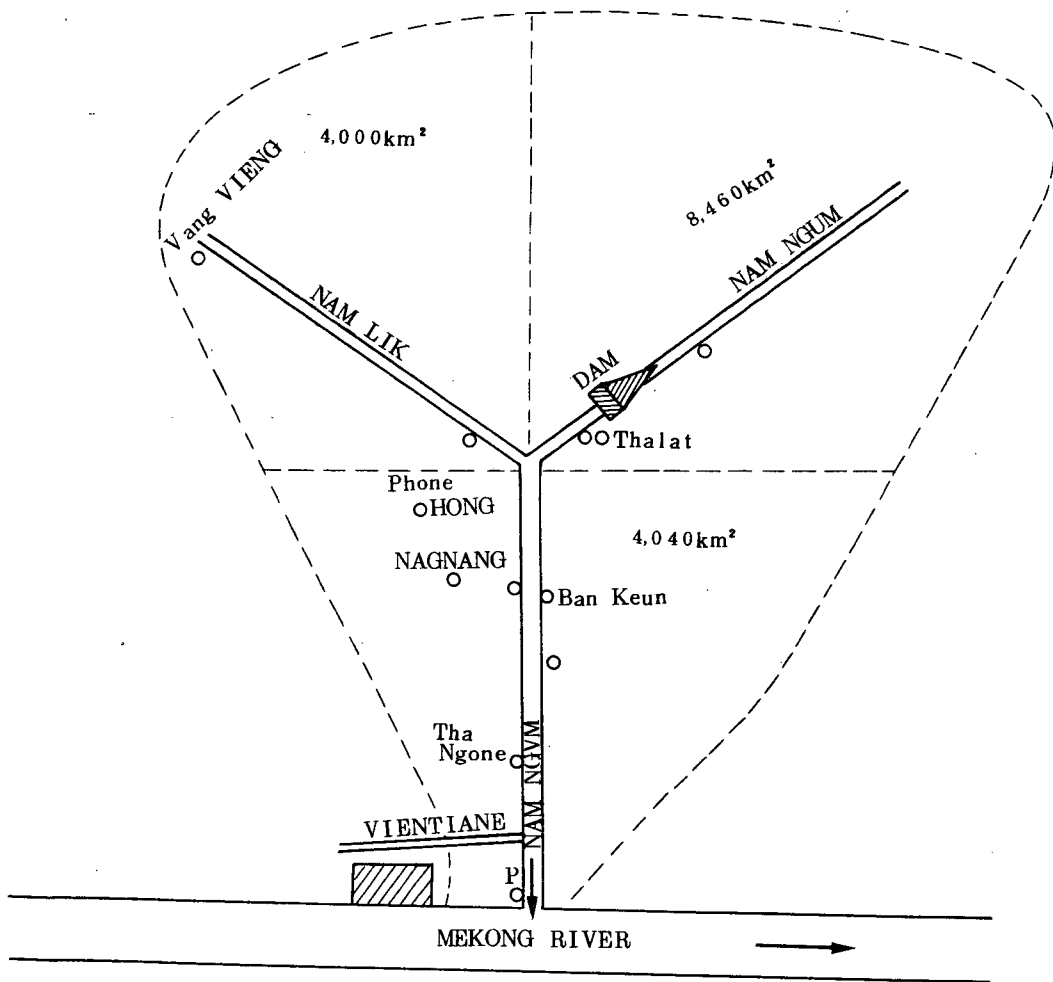
Very thankful to Mr. Doctor Kinoshita, to OTCA and Ministry of Construction who organize this interesting and useful course. I hope in the future my country will get benefit from this course and will be able to forecast any kind of floods.

Many thanks and respectfully

BANDITH VONGPHETH

From: Direction of Hydraulic and Navigation Office,
Ministry of Public Works, Vientiane/Laos.





8. Appendix

List of Annual Maximums of Water Stage
and Discharge of Mekong River

1960 - 1971

付録 メコン川年最大水位・流量表

Données Hydrologiques du Bassin
du Mékong au Laos

HYDROLOGIC DATA MEKONG RIVER
BASIN IN LAOS

I./ Superficie du bassin versant

Drainage Area.

L. Prabang :	268,000 Km ²
Vientiane :	299,000 Km ²
Paksé :	545,000 Km ²

II./ Discharge in cubic meters per second, calendar Year :

Debit en mètre cube par seconde année civil :

ANNEE 1960

L.P	(Maxi :	18,300 m ³ /sc	17.19 m	18 AG
	(Mini :	880 m ³ /sc	2.61 m	25 AP
VT	(Maxi :	18,200 m ³ /sc	11.34 m	20 AG
	(Mini :	815 m ³ /sc	0.12 m	28 AP
PS	(Maxi :	42,200 m ³ /sc	12.75 m	25 AG
	(Mini :	1,060 m ³ /sc	0.12 m	14 Mai

ANNEE 1961

L.P	(Maxi :	17,000 m ³ /sc	16.09 m	8 Sept
	(Mini :	1,000 m ³ /sc	3.00 m	25 March

VT	(Maxi :	18,300 m3/sc	11.17 m	10 Sept
	(Mini :	1,040 m3/sc	0.17 m	25 March

PS	(Maxi :	44,700 m3/sc	13.22 m	27 Sept
	(Mini :	1,360 m3/sc	0.38 m	1er AP

ANNEE 1962

L.P	(Maxi :	16,000 m3/sc	15.50 m	23 AG
	(Mini :	1,010 m3/sc	2.94 m	7 AP

VT	(Maxi :	15,400 m3/sc	10.30 m	26 AG
	(Mini :	1,070 m3/sc	0.12 m	29 March

PS	(Maxi :	34,800 m3/sc	11.14 m	7 AG
	(Mini :	1,380 m3/sc	0.39 m	7 AP

ANNEE 1963

L.P	(Maxi :	16,200 m3/sc	15.60 m	26 Jul
	(Mini :	976 m3/sc	2.82 m	2 AP

VT	(Maxi :	15,800 m3/sc	10.47 m	11 AG
	(Mini :	920 m3/sc	0.12 m	6 AP

PS	(Maxi :	39,500 m3/sc	12.16 m	12 AG
	(Mini :	1,160 m3/sc	0.24 m	14 AP

ANNEE 1964

L.P	(	NEANT
	(	NEANT

TV	(	NEANT
	(	NEANT

PS	(	NEANT
	(	NEANT

ANNEE 1965

L.P	(Maxi :	12,700 m3/sc	14.32 m
	(Mini :	1,030 m3/sc	3.00 m
VT	(Maxi :	12,800 m3/sc	9.14 m
	(Mini :	1,100 m3/sc	0.17 m
PS	(Maxi :	28,100 m3/sc	9.66 m
	(Mini :	1,570 m3/sc	0.51 m

ANNEE 1966

L.P	(Maxi :	25,200 m3/sc	22.36 m
	(Mini :	1,090 m3/sc	3.15 m
VT	(Maxi :	21,300 m3/sc	12.70 m
	(Mini :	1,160 m3/sc	0.27 m
PS	(Maxi :	NEANT	
	(Mini :	NEANT	

ANNEE 1967

L.P	(Maxi :	11,700 m3/sc	14.12 m	23 AG
	(Mini :	938 m3/sc	3.17 m	28 Mar
VT	(Maxi :	12,900 m3/sc	9.17 m	24 AG
	(Mini :	1,080 m3/sc	0.39 m	31 Mar
PS	(Maxi :	32,100 m3/sc	10.61 m	25 Sept
	(Mini :	1,550 m3/sc	0.55 m	11 AP

ANNEE 1968

L.P	(Maxi :	13,700 m3/sc	15.43 m	16 AG
	(Mini :	850 m3/sc	2.90 m	31 Mar

VT	(Maxi :	14,700 m3/sc	10.16 m	18 AG
	(Mini :	954 m3/sc	0.24 m	25 Mar.
PS	(Maxi :	40,400 m3/sc	12.08 m	9 Sept
	(Mini :	1,400 m3/sc	0.46 m	30 Mar

ANNEE 1971

VT	(Maxi :	23,000 m3/sc	12.51 m
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