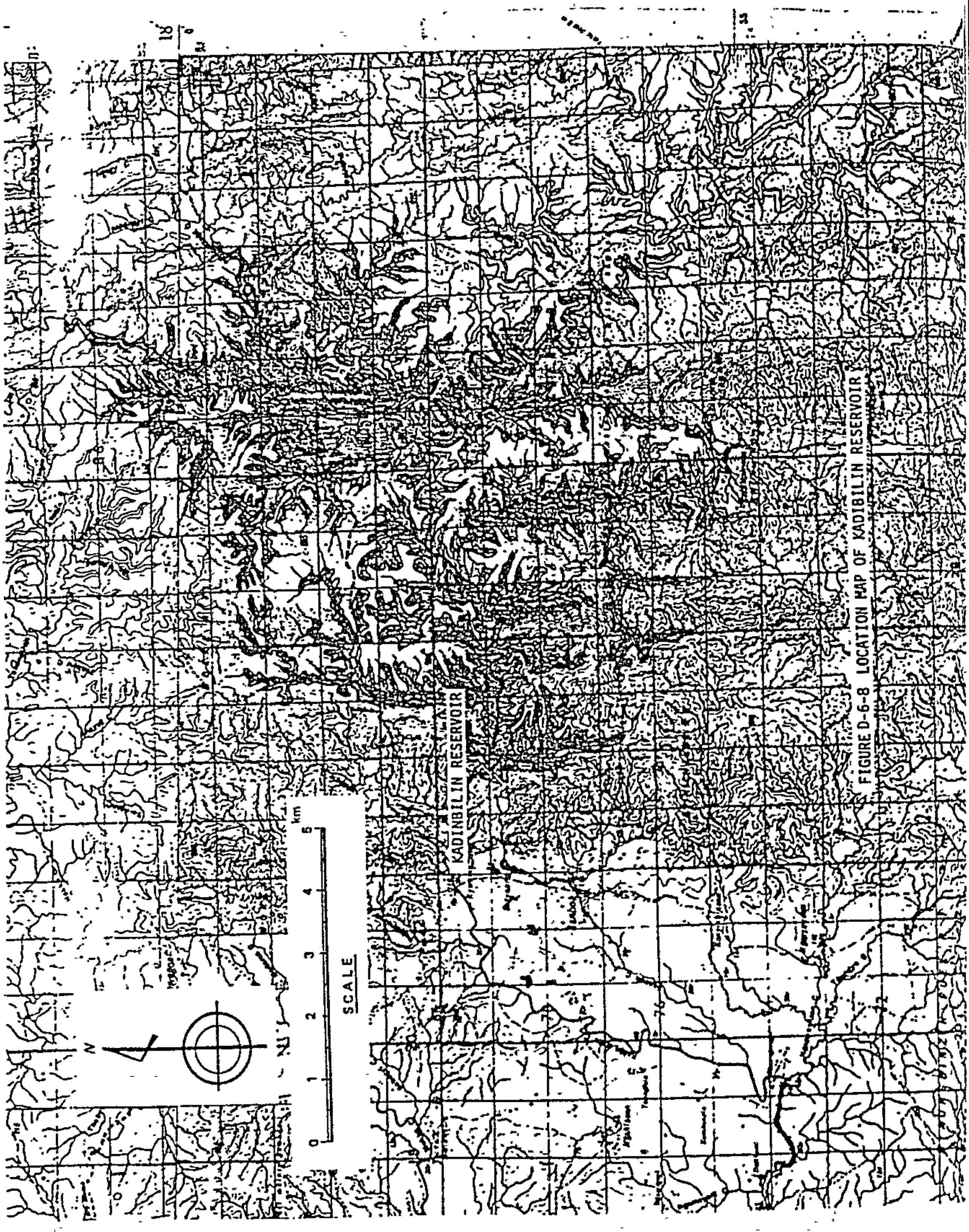


FIGURE D-6-8 LOCATION MAP OF KADIBILIN RESERVOIR

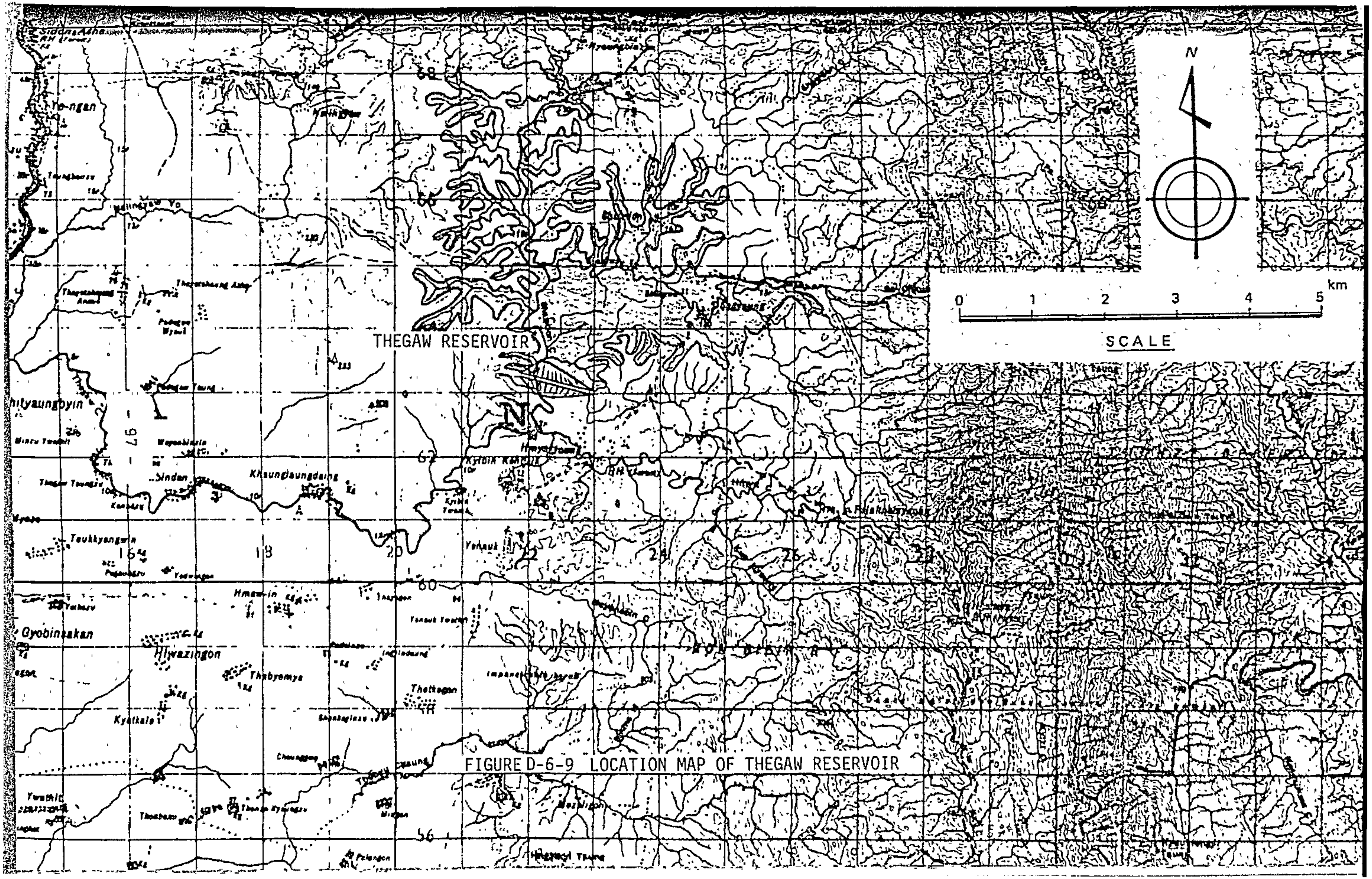


FIGURE D-6-9 LOCATION MAP OF THEGAW RESERVOIR

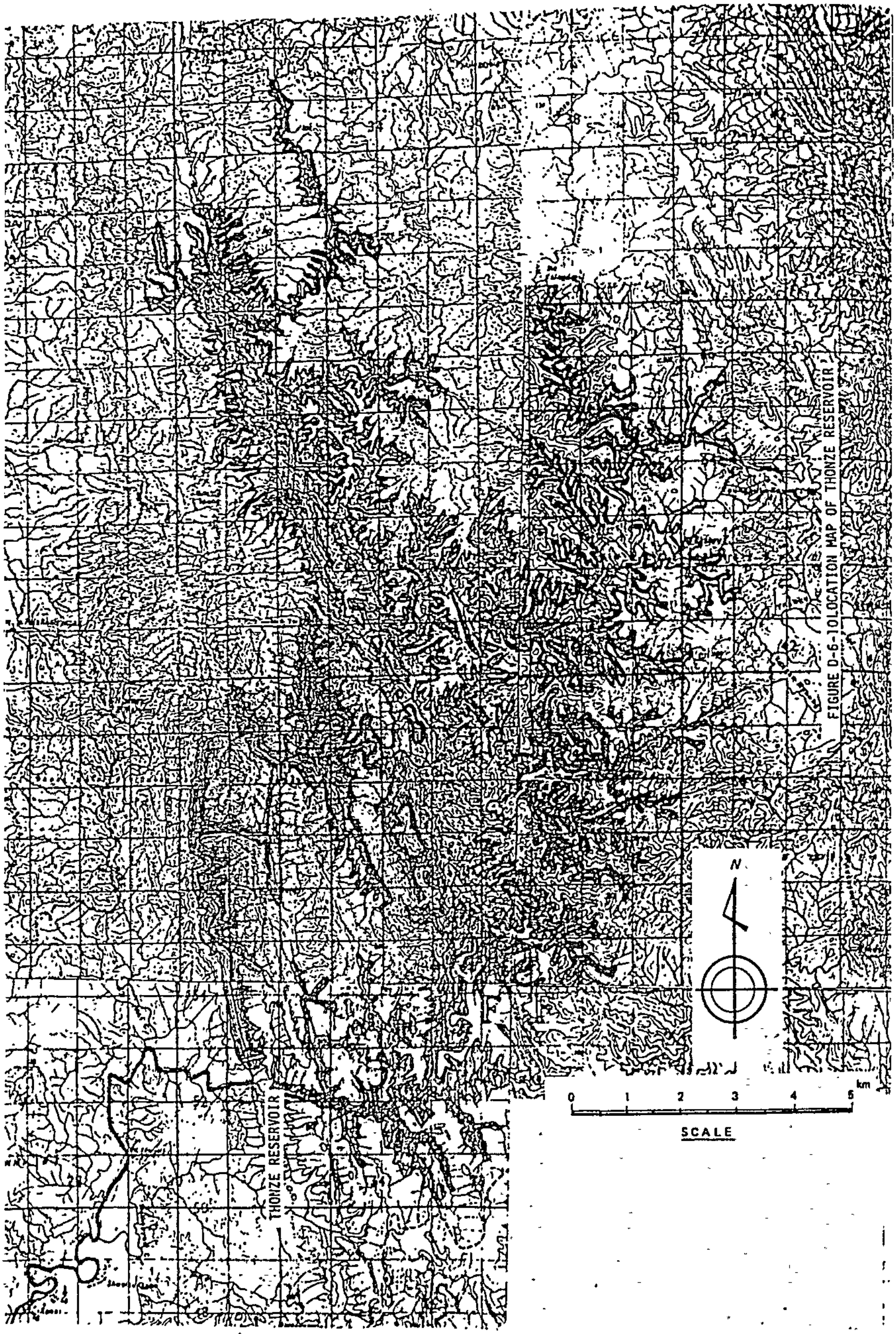


FIGURE D-6-10 LOCATION MAP OF THONZE RESERVOIR

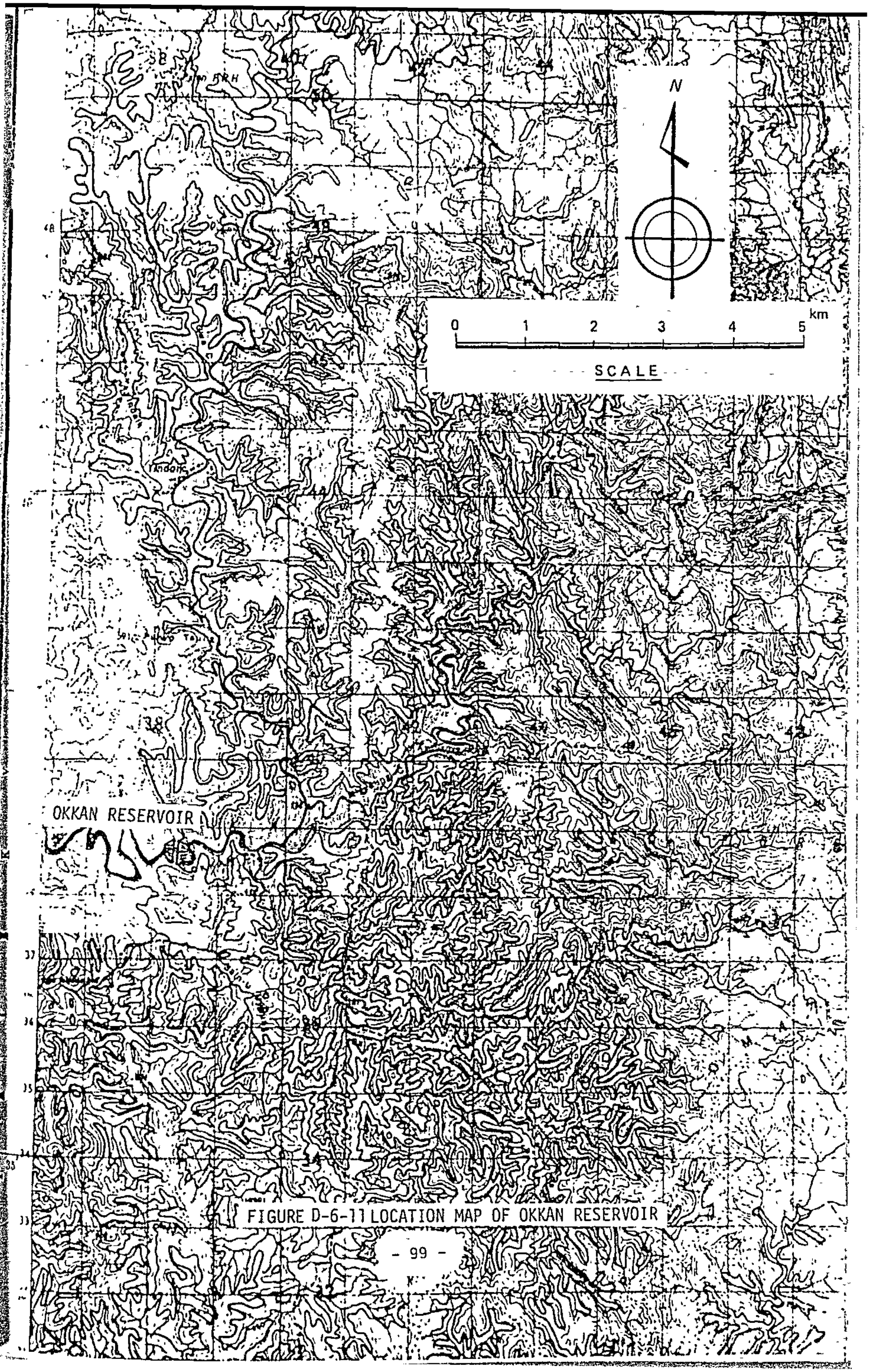


FIGURE D-6-11 LOCATION MAP OF OKKAN RESERVOIR

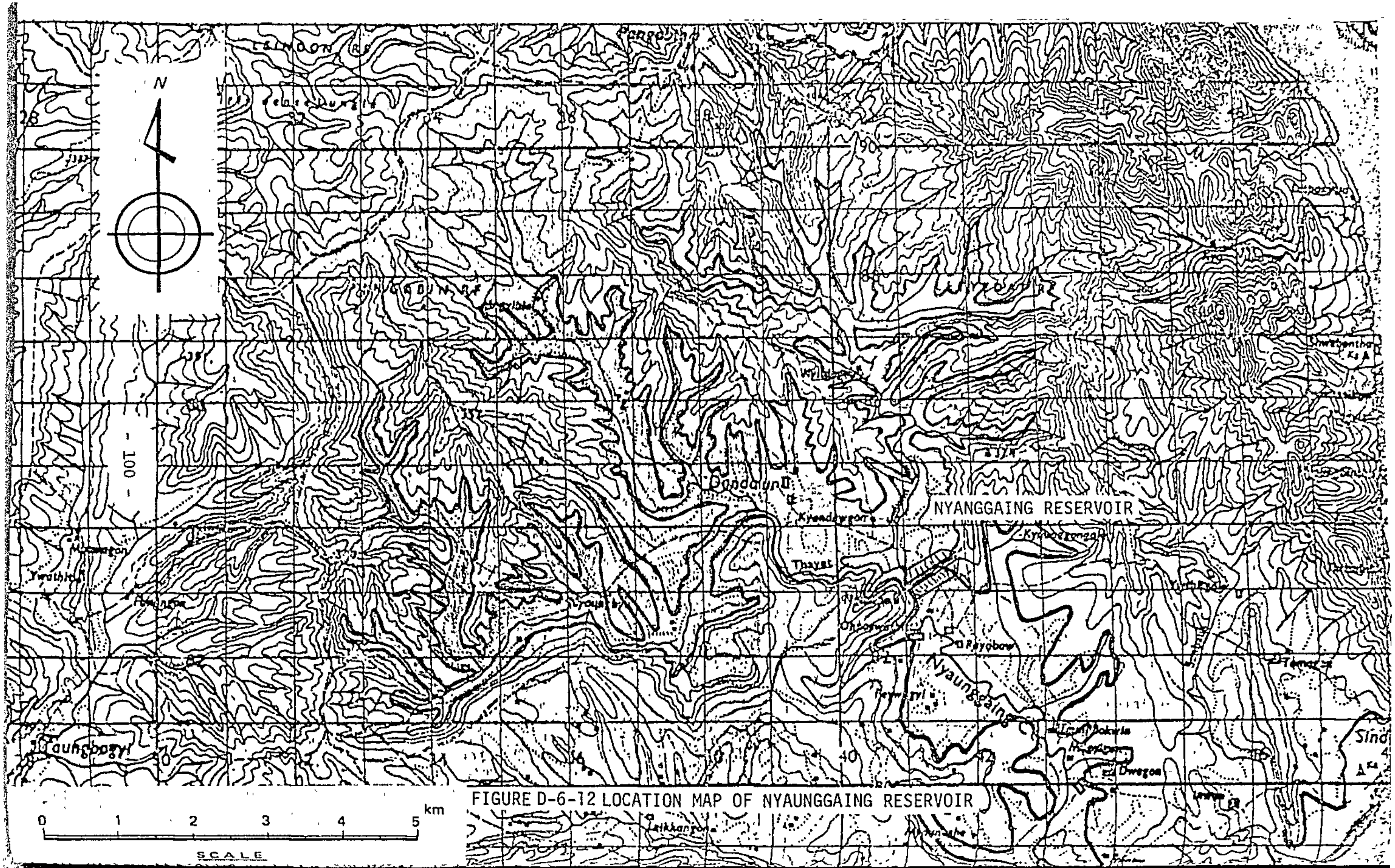
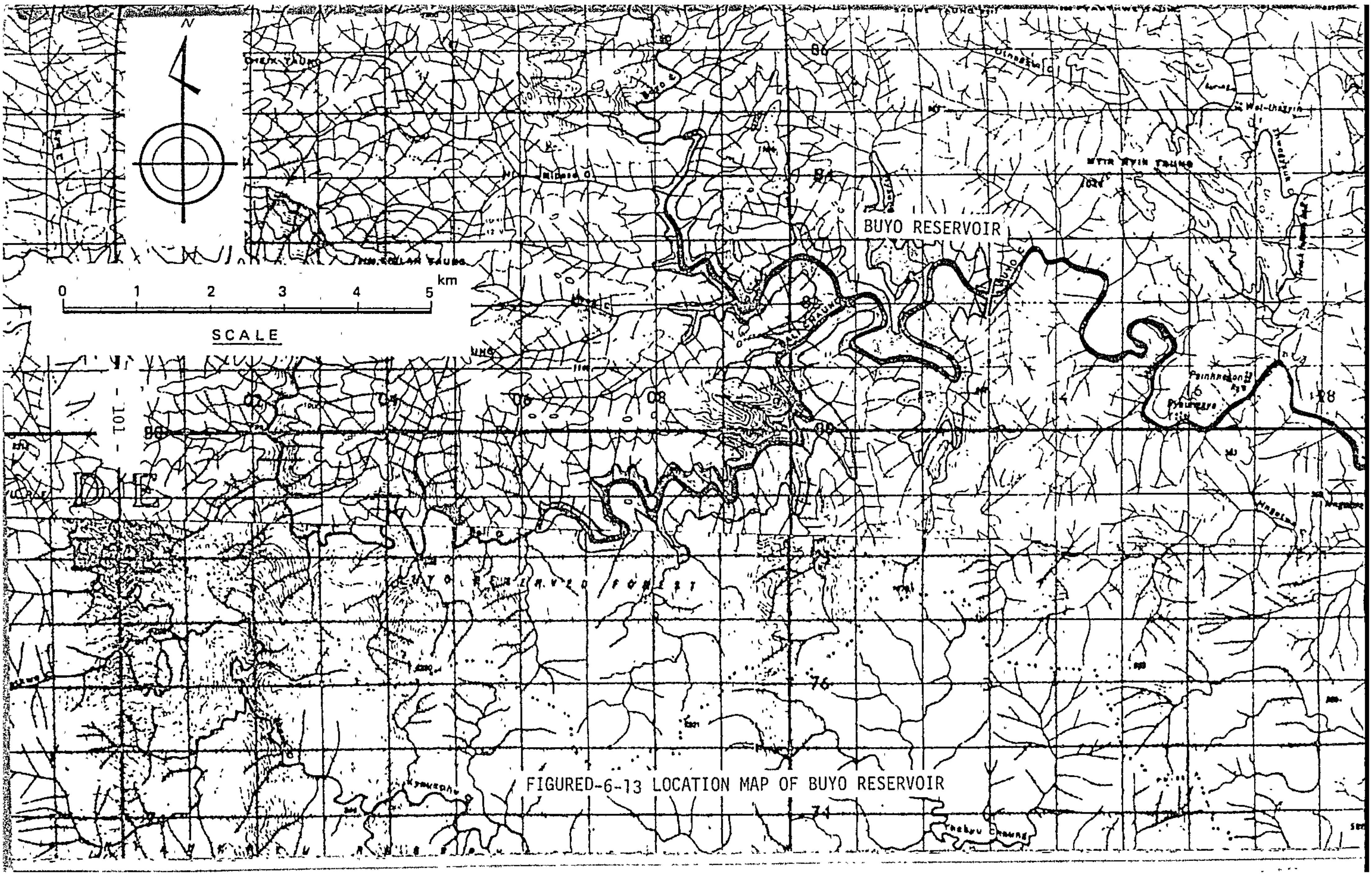


FIGURE D-6-12 LOCATION MAP OF NYAUNGGAING RESERVOIR



FIGURED-6-13 LOCATION MAP OF BUYO RESERVOIR

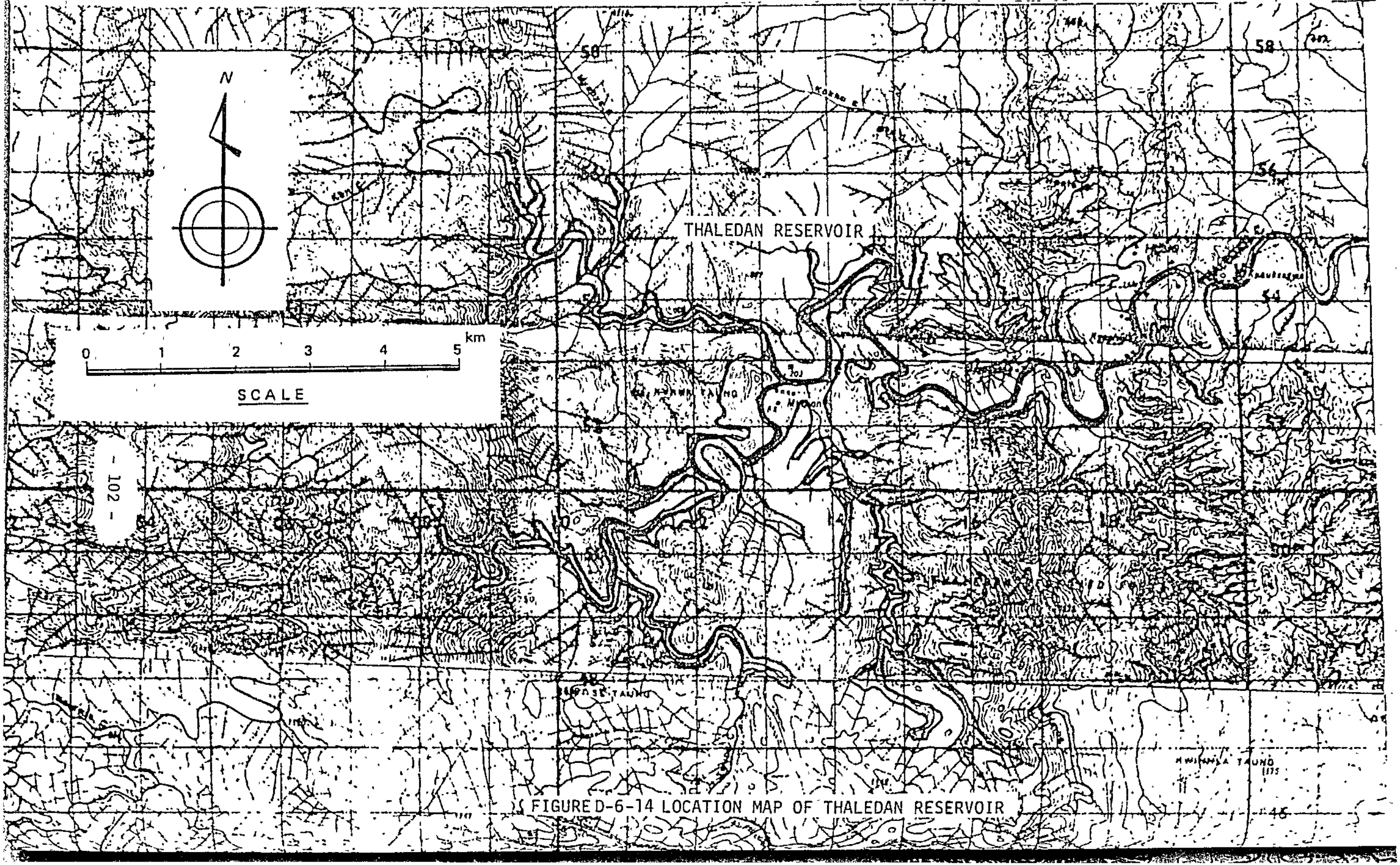
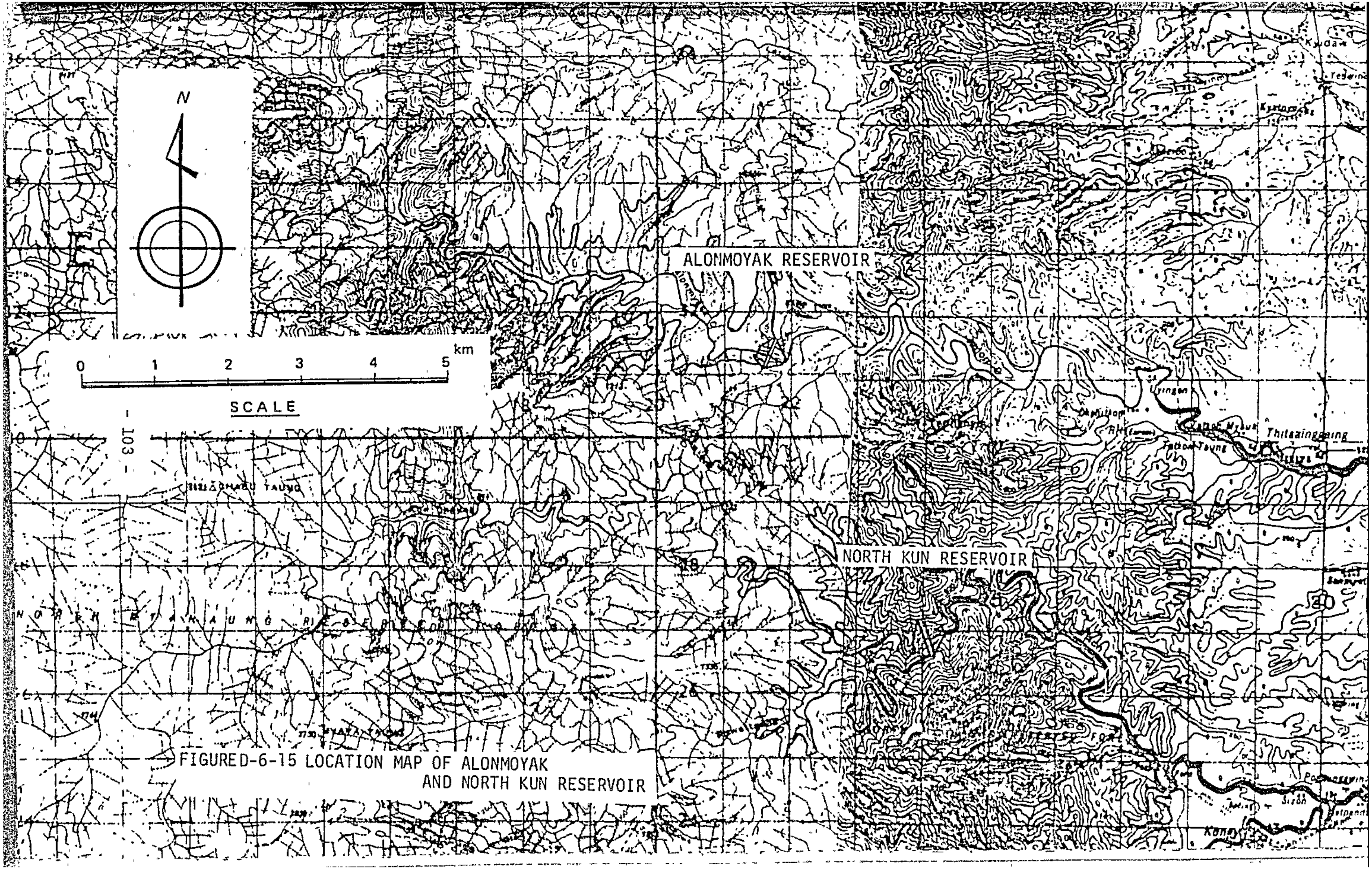


FIGURE D-6-14 LOCATION MAP OF THALEDAN RESERVOIR



FIGURED-6-15 LOCATION MAP OF ALONMOYAK AND NORTH KUN RESERVOIR

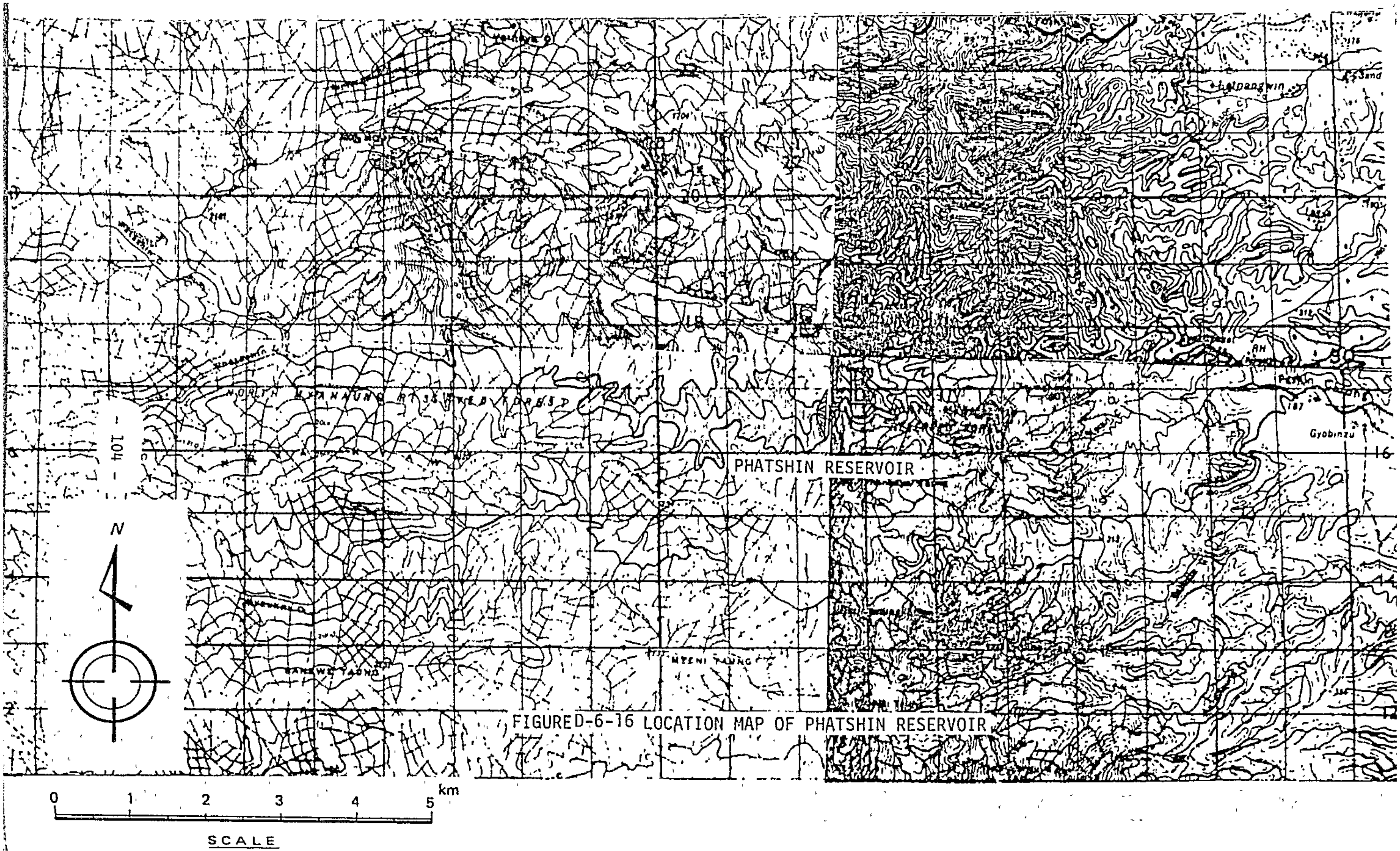


FIGURE D-6-16 LOCATION MAP OF PHATSHIN RESERVOIR

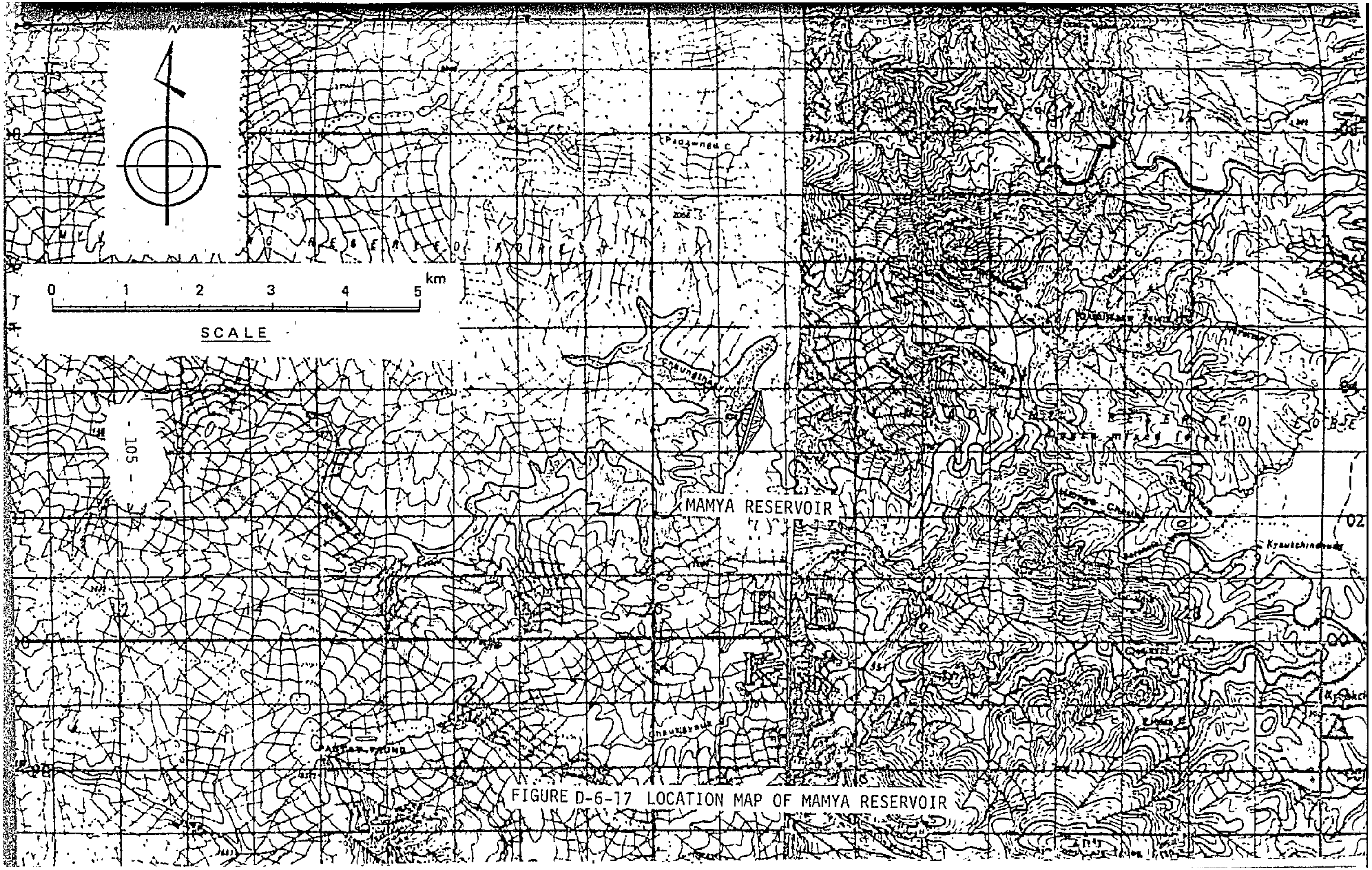
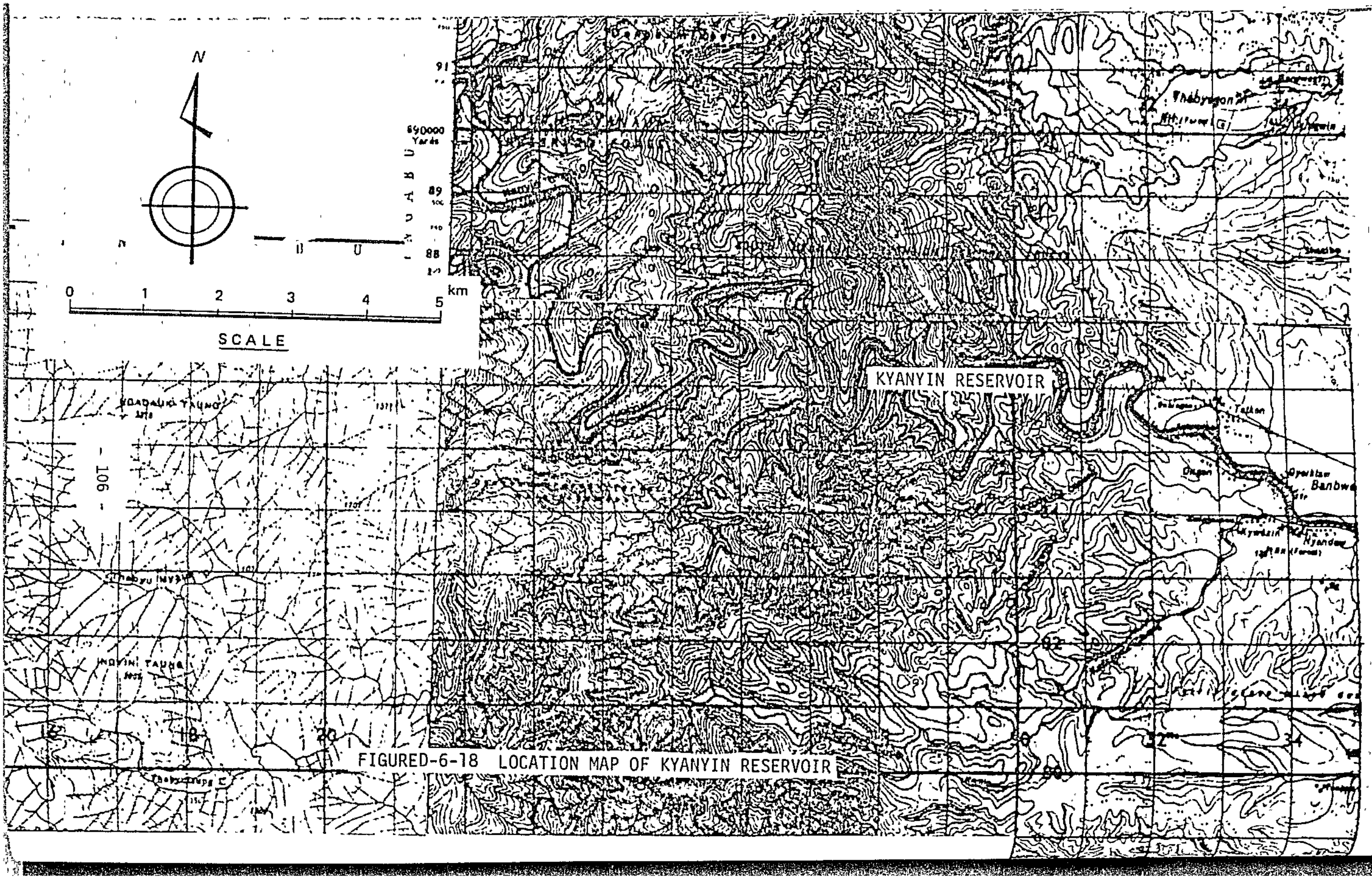
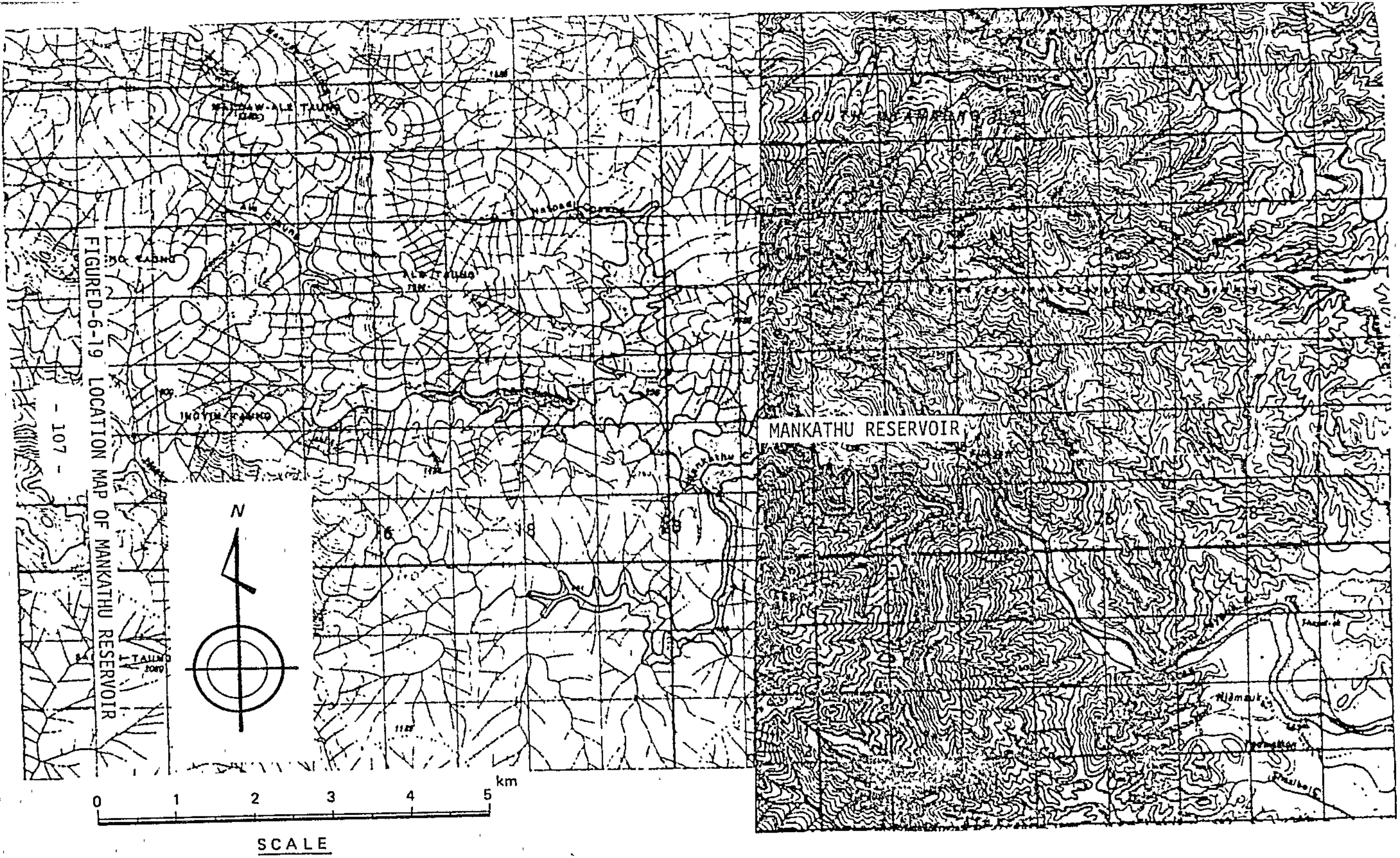


FIGURE D-6-17 LOCATION MAP OF MAMYA RESERVOIR



FIGURED-6-18 LOCATION MAP OF KYANYIN RESERVOIR



FIGURED-6-19 LOCATION MAP OF MANKATHU RESERVOIR

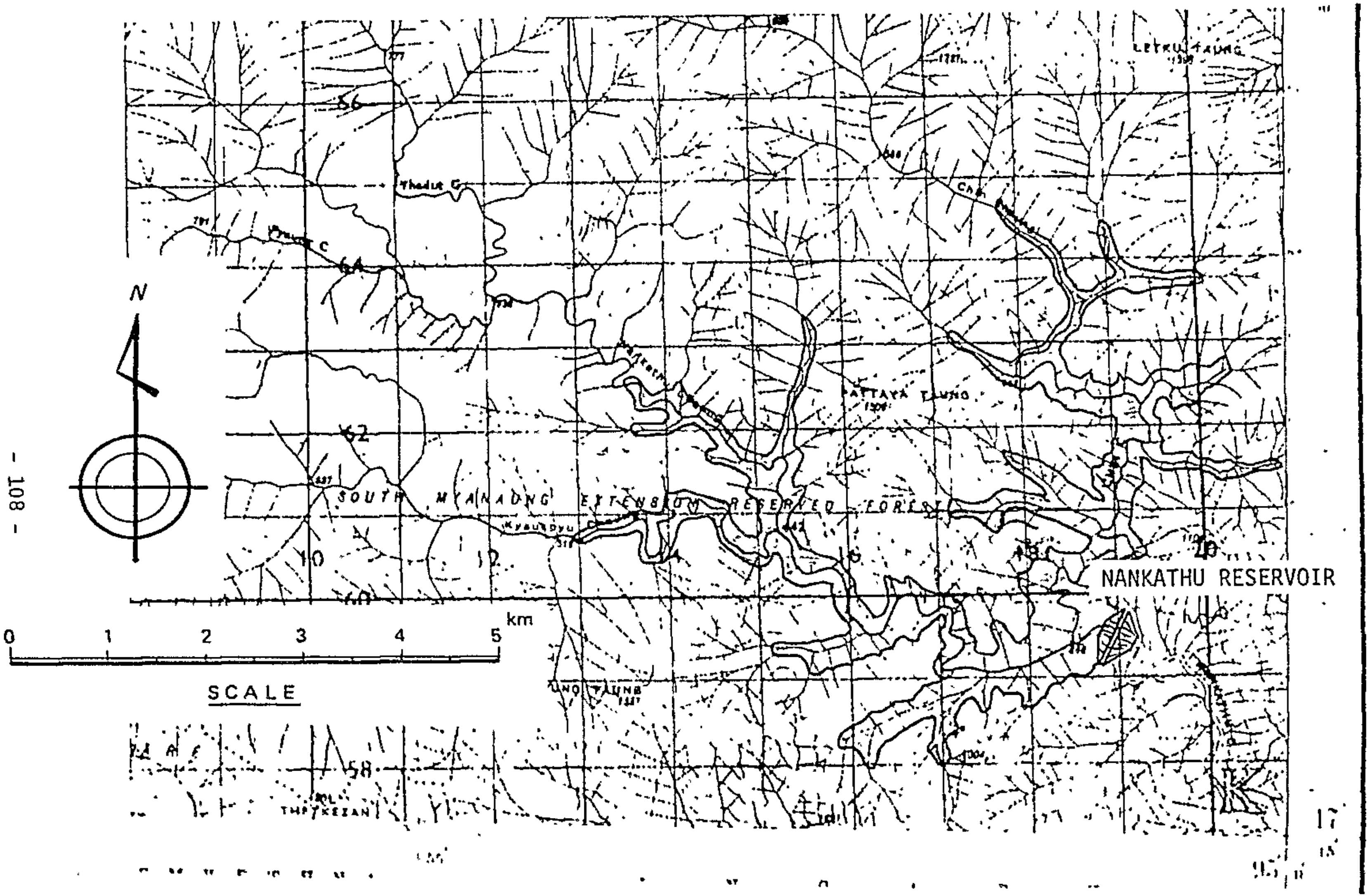


FIGURE D-6-20 LOCATION MAP OF NANKATHU RESERVOIR

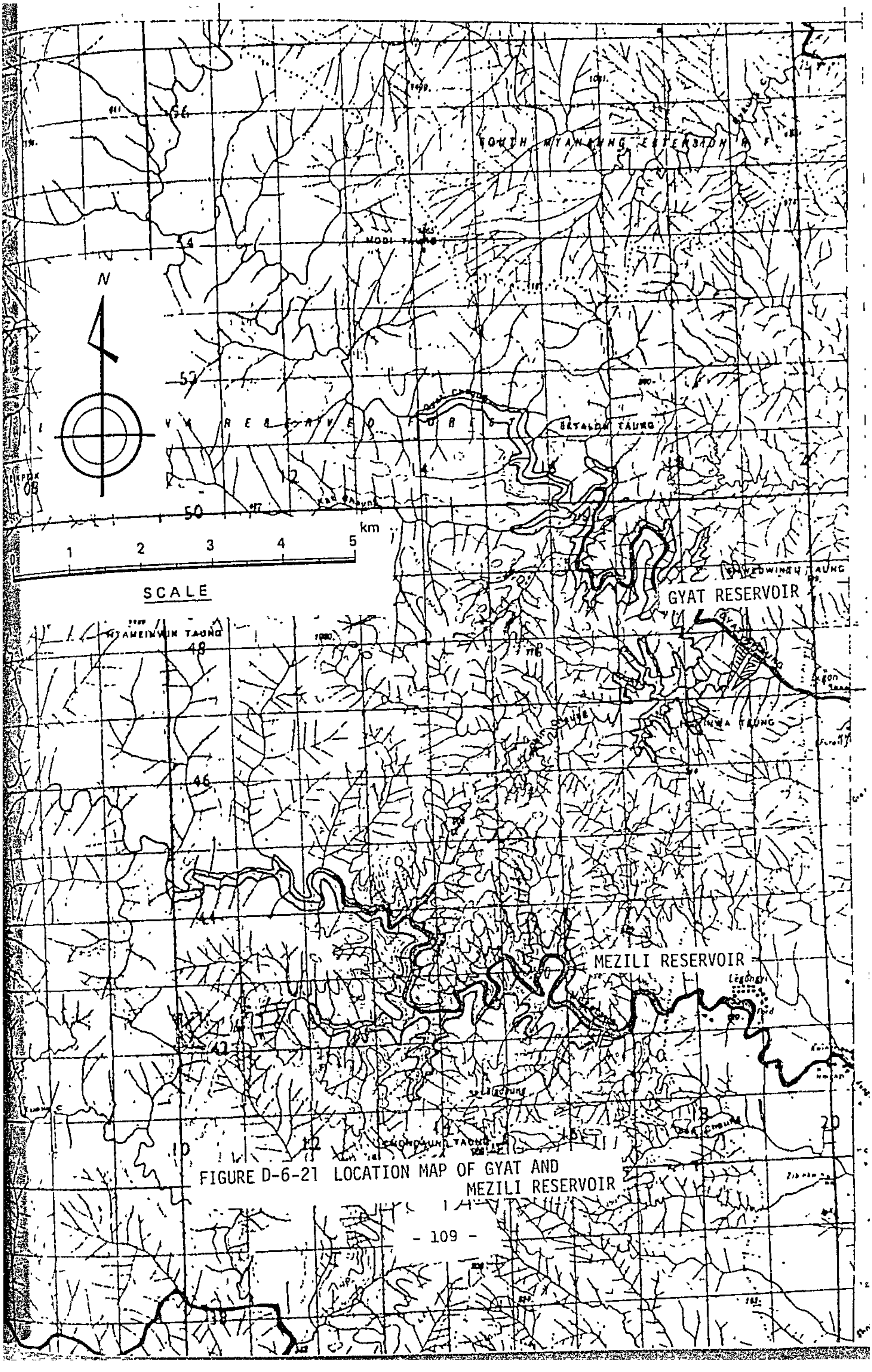
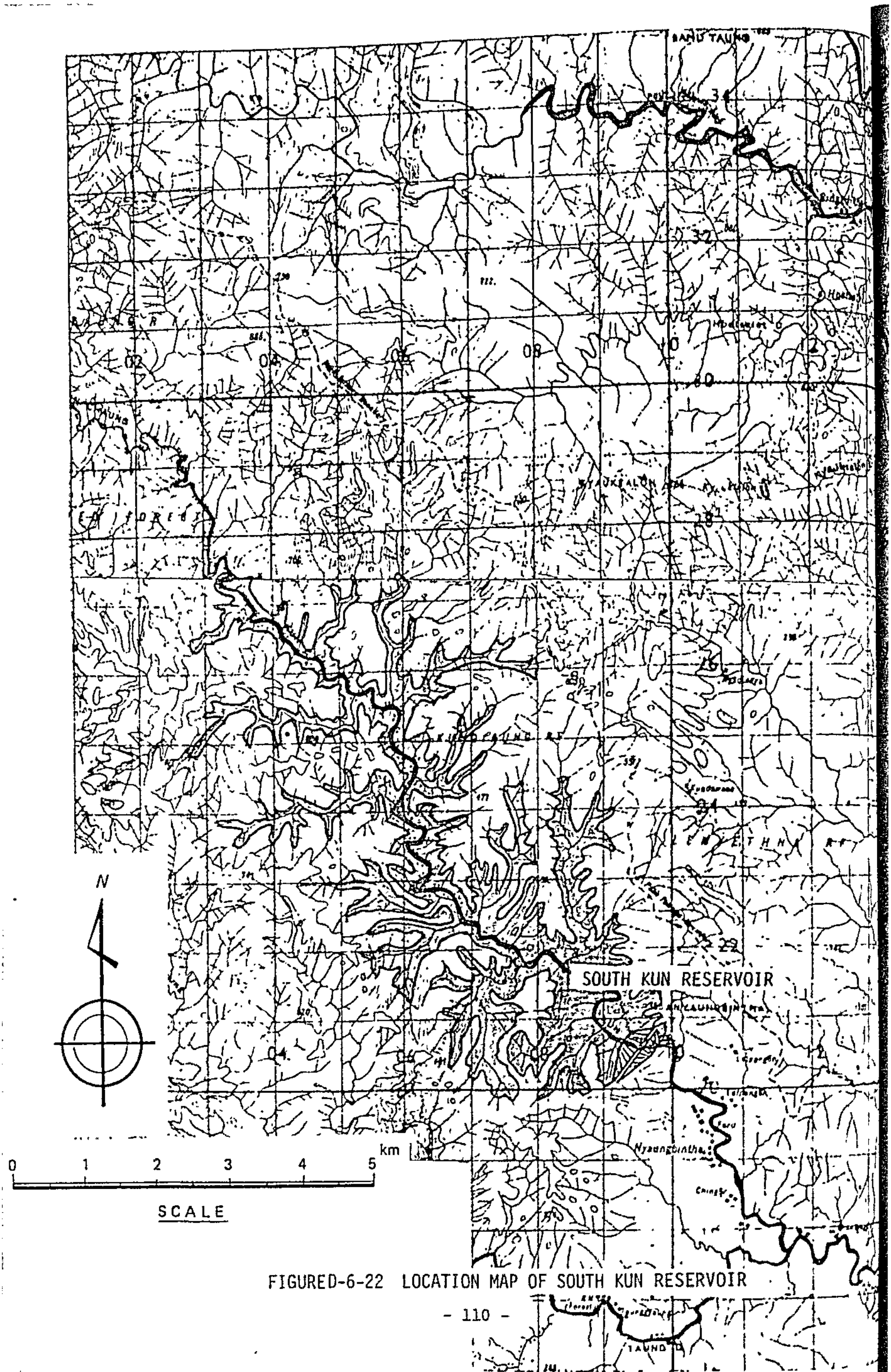


FIGURE D-6-21 LOCATION MAP OF GYAT AND MEZILI RESERVOIR



FIGURED-6-22 LOCATION MAP OF SOUTH KUN RESERVOIR

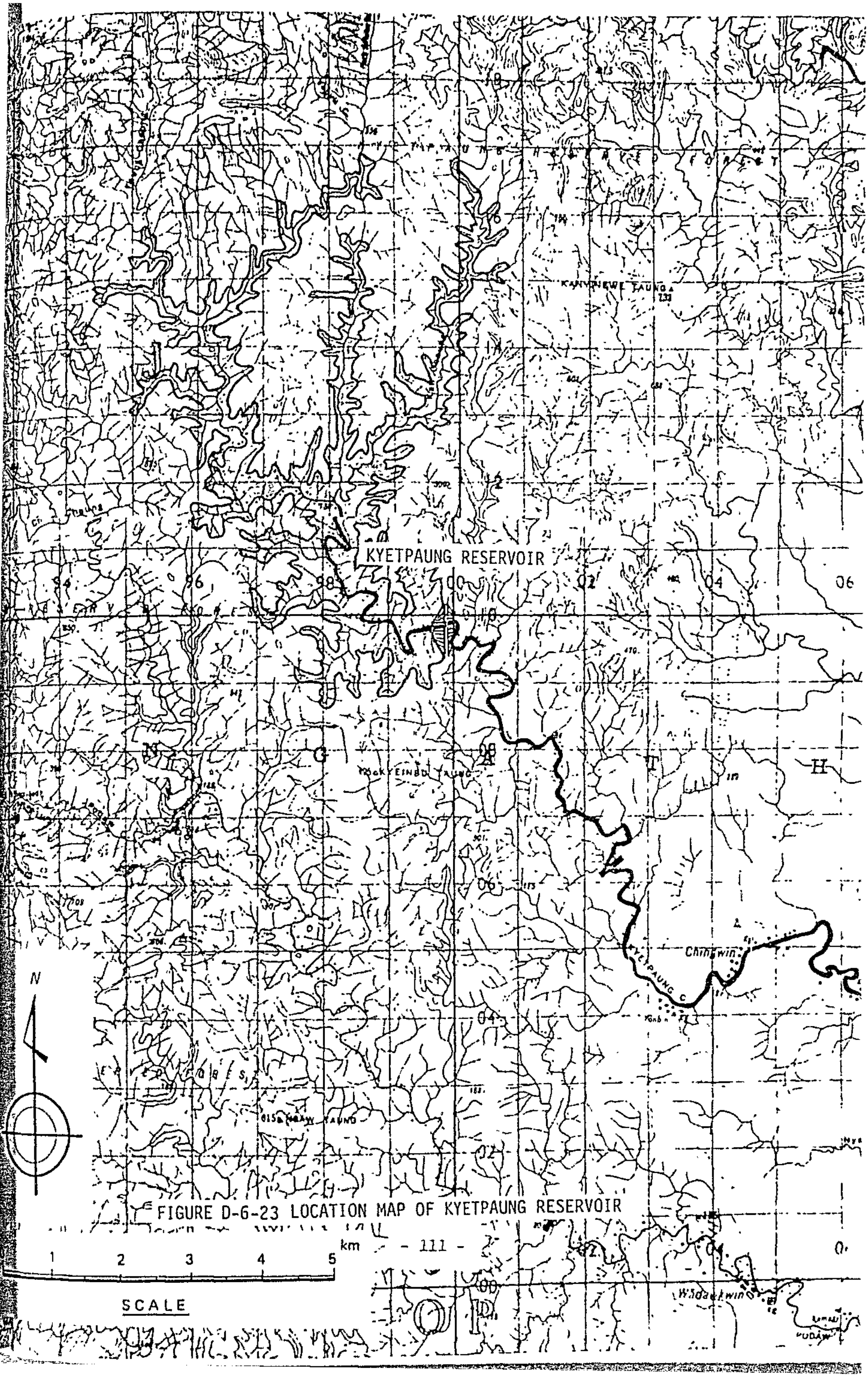


FIGURE D-6-23 LOCATION MAP OF KYETPAUNG RESERVOIR

VI-4. Reservoir Operation

A reservoir operation study according to the irrigation scheme was made on the basis of gravity irrigation method by using rainfall, river discharge, and reservoir storage water. The operation rule was established to use the rainfall on the field first, then the river discharge and finally the storage water for supplying the shortages.

The reservoir water should be stored in depending upon run-off from the catchment area of the reservoir and not depending in principle upon run-off from the other catchment areas by trans-basin.

The irrigation plan was studied for the proposed 23 dams in the Survey Area, but the reservoir operation computation for these dams should be made independently on the basis of one irrigable area of the respective dams, which could successfully irrigate.

The computation method applied herein to satisfy the above conditions is described below as a procedure with the following input data to be repeated for obtaining the most effective reservoir operation program available for water utilization.

a) Catchment area of a reservoir (sq.km)
b) Catchment area of a diversion dam (sq.km)
c) Annual mean rainfall (mm)
d) Estimated reservoir capacity (MCM)
   (Estimated by topographical conditions at the proposed dam site)
e) Full water surface area of reservoir when meeting the above requirement d) above (sq.km)
f) Height between the river bed and the full water surface level in the reservoir (m)
g) Rainfall ratio of the respective years to the annual mean rainfall adopted for computation
h) Rainfall ratio of the respective months to the annual rainfall

i) Evaporation from the water surface of the reservoir (mm/day)
j) Names of crops to be grown in the irrigable area
k) Daily water requirements of the above crops on the basis of monthly mean value (mm/day)
l) Water retaining capacity of the soils (mm)
m) Crop-wise irrigation acreage (ha)
n) Irrigation efficiency

The first processing electronic computer was used for carrying out the above fully and complicated computation. The programme applied to the said computation includes five blocks as shown in Fig. D-6-24.

The contents of the respective five blocks are described as follows:

1) The first block

Data reading and their conversion are carried out; the input data include the above items from a) to n). The determination of reservoir capacity is considered as one of the aims at carrying out the reservoir operation study. In this study, however, both the H-A curve and H-V curve for the respective dam sites were developed from the reservoir model discusses in paragraph VI-5 due to detailed topo-maps being unavoidable, and then the water depth and the water surface area in optional storage amount of water were estimated. In other words, the data for dam sites were estimated by interpreting the existing one-inch maps, shown as a), b), d), e) and f).

The rainfall data were taken by c), g), and h) as inputs. Since the reservoir operation study was made on the monthly basis, the rainfall in the objective month was obtained by c), g), h). Furthermore, the study made in paragraph III-1

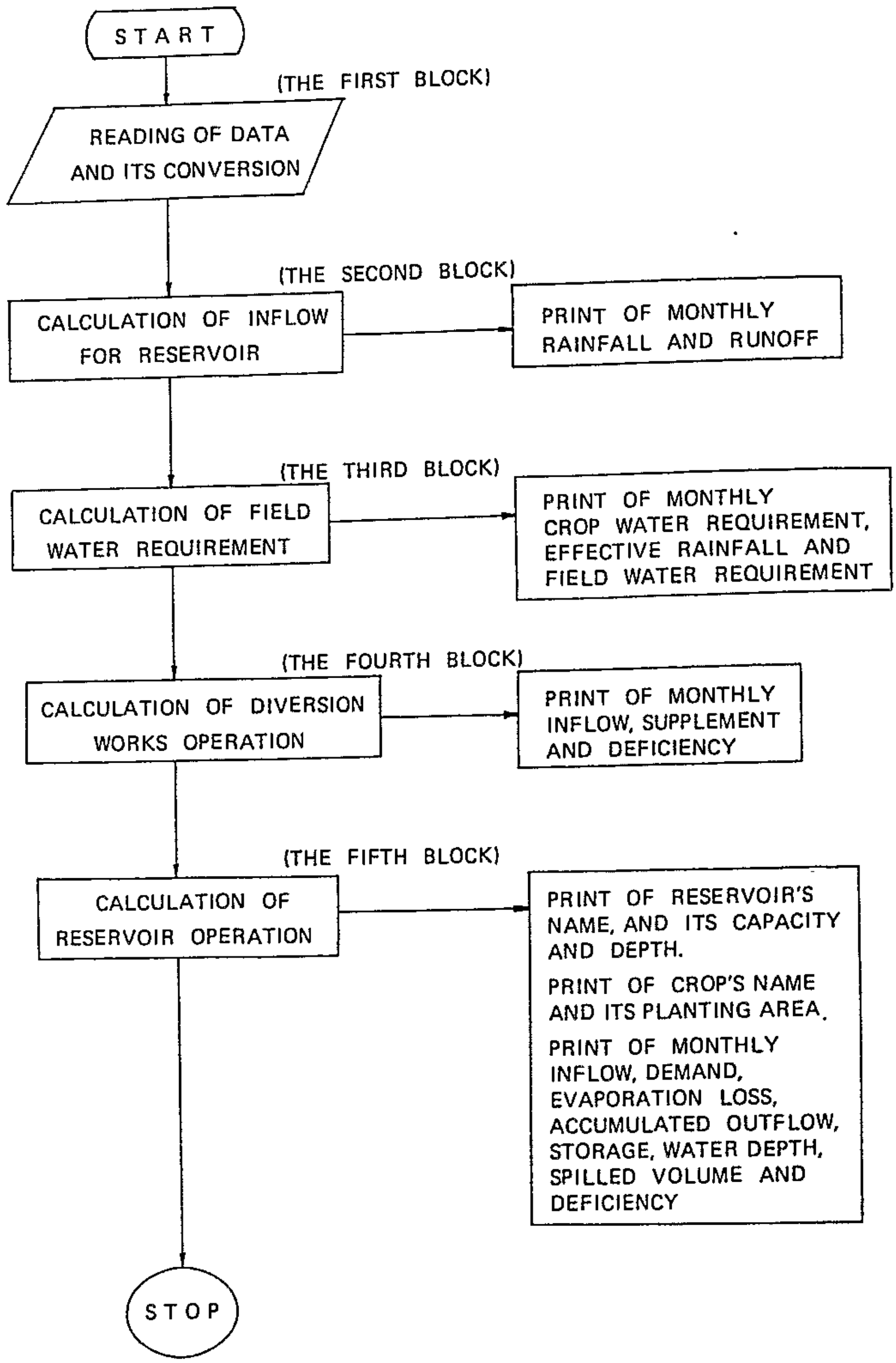


FIGURE D-6-24 GENERAL FLOW CHART OF RESERVOIR OPERATION found that there would be a little correlations among the annual rainfalls recorded at 19 gauging stations in the Project Area; however, the monthly mean rainfall distribution at every station had two patterns as shwon in Fig. D-3-4.

On the other hand, a very few stations provided observation records for more than 20 years, as shown in paragraph III-1, and several lackings of the records were found that these long-term observation under the situation, for the annual rainfall in a certain area, the observation records available at the most closest station were adopted, and if the lacking found on the data, the records observed at the second closest station were adopted for the data of that area.

The monthly rainfall was assumed to repeat itself with the same pattern year by year at the constant ratio to the annual rainfall.

This computation method applied here is aimed at enabling to make smooth study of reservoir operation in general on the basis of the limited data available. Further study on the respective dams would require the more detailed computation on reservoir operation of each reservoir.

Regarding evaporation from the water surface of the reservoir, item i) above, the following procedures were taken for estimation due to lack of observed data; the month-wise daily mean evaporation from the water surface, which was obtained by substituting the value estimated by the evaporation-pan measurement into conversion equation, was used as input data in multiplying the number of days for each month so as to have estimated monthly evaporation.

The value of h) corresponding to j) was obtained by the same treatment as made in computation of i) on the values computed by using the equation cited in paragraph VI-3.

The value of l), m), and n) were computed by the equation cited in paragraph VI-3 and used as inputs.

2) The second block

The month-wise inflow to reservoir from its catchment area was computed in this block.

The related run-off discharge was estimated by using the results obtained in paragraph VI-2, computed from the monthly basis estimated rainfall (A) by the following equation:

$R \leq 200$ mm	$RA = 0\ 0$
$200 < R \leq 1{,}200$ mm	$RA = 0.3R - 60$
$1{,}200 < R$	$RA = 0.5R - 300$

If it is taken by index for optional month, the monthly effective rainfall for the said optional month (qi) is computed by following equation.

$$q_1 = RA_1$$
$$qi = RAi - RAi{-}1 \ (2 \leq i \leq 1a)$$

Based on the above, the run-off discharge of the respective month (Qi) is obtained as;

$$Qi = qi \times (\text{catchment area}) \quad (MCM)$$

3) The third block

The third block programme could compute the crop-wise field water requirements. The effective rainfall was essentially required for computation.

The estimated effective rainfall was used to make a comparison with water requirements. When the effective rainfall exceeds the water requirements, the irrigation water would be applied sufficiently only by rainfall. But when the water requirements exceed the effective rainfall, the supplemental water is required by amount computed by the following equation:

$$WRQ = 1.0 \times 10^{-5} \times FWRi \times AiR/RL\bar{o}s$$

Where, WRO: Crop-wise supplemental water requirements

FWR: Net water requirement per unit acreage

AiR: Irrigable area (ha)

$RL\bar{o}s$: Irrigation efficiency

i: index to show optinal month

4) The fourth block

The diversion dam operation was computed in this block the water available for diverting was estimated by multiplying the monthly specific discharge from the reservoir (computed in the second block) by catchment area of the diversion dam.

When taking this monthly diversion water available by QDi,

$$QDi \leqq WRQI$$

Furthermore, the surplus discharge QDSi could be expressed by:

$$QDSi = QDi - QDRi$$

This would be discharge through dam to the downstream. The beneficial areas in future downstream from the dam were not taken into consideration in this computation.

On the other hand in case of $QDi < WRQi$, the water shortage would take place by $QDDi = WRQi - QDi$.

This amount of water should be released from the main dam. Therefore,

$$QDRi = QDi$$

5) The fifth block

The reservoir operation was computed in this block under the condition that the reservoir was at full surface water of water in its initial status. The factor to increase the storage water is an inflow (QiNi), while the factor to reduce the storage water is evaporation from water surface (VETi) and release from dam (QDDi).

The monthly variation of reservoir storage water was expressed as follows by taking water storage as Vi and its initial amount as VIi;

$$Vi = VIi + \sum_{i=1}^{i=n} (QiNi - QDDI - VETi)$$

But in case of Vi > VIi taking place on the way of computation, in effective discharge should be made through the spillway. In such case, substitution should be made as Vi = VIi.

Also, in case of Vi < 0 taking place, the water shortage was expected to occur in the said month and the amount in short should be expressed and substitution should be made as Vi = 0.

Further computation should be proceeded in neglecting the scale of water shortage to have occurred.

The reservoir operation study was carried out according to the above rule

VI-5. Model Analysis of Reservoir

The dimensions of proposed reservoirs can be turned into a specific model for digitally analyzing, by the following procedures.

The reservoir can be approximated by the triangular pyramid illustrated in Fig. D-6-25. The estimated reservoir capacity in terms of topographical conditions is taken by Vo and the water surface area with Vo is expressed as Ao. When the height from the river bed to the reservoir water surface is taken by Ho, the reservoir capacity Vo can be obtained by the following equation (Refer to Fig. D-6-25).

$$Vo = \frac{1}{3} AoHo = \frac{1}{3} BoLoHo \text{ ----- } (1)$$

And, when the optional height is taken by H, the stored water V with H is obtained by;

$$V = \frac{1}{3} AH = \frac{1}{3} \cdot \frac{1}{2} BLH \text{ -------- } (2)$$

Since the shapes of Vo and V are in resemblance, the following relationship can be obtained:

$$\frac{H}{Ho} = \frac{B}{Bo}, \frac{H}{Ho} = \frac{L}{Lo} \text{ ----------- } (3)$$

From the above equations (1), (2) and (3), the values of optional H and A can be expressed as;

$$H = Ho \cdot \sqrt[3]{\frac{V}{Vo}} \text{ ---------------- } (4)$$

$$A = Ao \cdot \sqrt[3]{\left(\frac{V}{Vo}\right)^2} \text{ --------------- } (5)$$

The computation for reservoir operation can be made in using the data on stored water, inflow and outflow, and evaporation from the water surface.

The values of A and H in any stored water in an optional month can be computed by the above equation of (4) and (5).

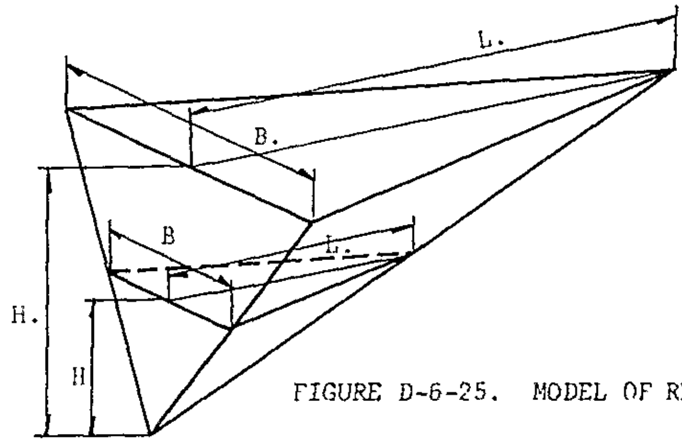


FIGURE D-6-25. MODEL OF RESERVOIR

VI-6. Computation on Reservoir Operation

Under the conditions prescribed in the previous paragraphs up to VI-5, the computation on reservoir operation was made for 23 proposed reservoirs of the planned irrigation projects.

The said computation was carried out in aiming at irrigating the areas as large as possible by the limited water resources along with the direction to generate higher benefit with target cropping intensity of 170 percent.

The scale of the respective reservoirs was determined in taking into account number of years for storage carry-over and shortage in irrigation water. The years for storage carry-over will closely affect the estimation of dam construction costs.

In the country such as Japan which has rainfall in any seasons of the year, the necessary amount of water can be secured in increasing the reservoir operation efficiency with the carry-over years shortened; whereas in the countries with the monsoon zones such as the Southeast Asia which has rainfall only in the rainy season, the carry-over years should be taken around three to five years for the effective use of limited available water in the rainy season.

Under the situation, the carry-over years for the proposed dams in the Survey Area were taken by about five years in due consideration on the data of the existing dams in the country, difficulty in securing the water sources in the dry season in the Survey Area as well, and considerably low cost of earth works which will enable to construct large-scale embankments.

The shortage amount in irrigation water was principle out of consideration for the computation because it would be a negative factor for assuring the stable supply of farm products and the stable life of farmers in the service areas.

The trial estimation of the crop-wise growing acreages is made on the basis that in the rainy season, the whole irrigable area would be cropped with paddy, and in the dry season, about 10 percent of the irrigable area would be cropped with paddy and about 60 percent with general crops according to the soil types. The above cropping ratio could vary with change of the demand-and-supply programme. In other words, the irrigation water ratio of paddy to general crops was set by 3:1.

The study through the above revealed that the estimated irrigable areas to be commanded by the 25 proposed dams including North and South Nawin Irrigation Projects would be about 350 thousand ha (about 40 percent of the existing paddy fields sown). (Refer to Table D-6-2).

The details of the computation on reservoir operation of the Okkan reservoir are discussed in Appendix D-4.(Ref. to Fig. D-6-25(a))

VI.7. Pilot Land Consolidation Project

The Irrigation Project, generally takes several years from commencement to completion with major facilities such as dam, irrigation and drainage systems and on-farm facilities. After completion of the irrigation project, the farmers concerned will be allowed to

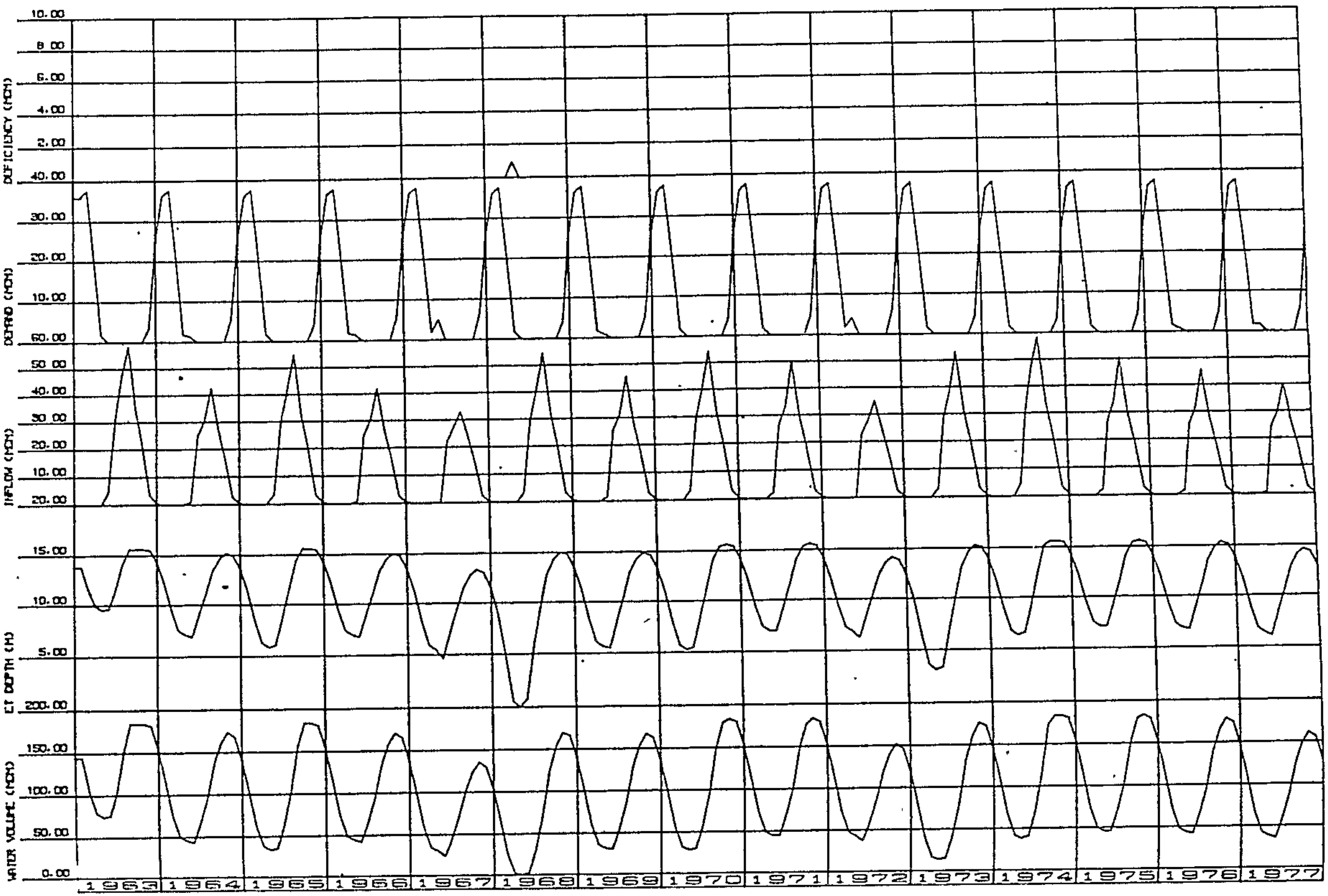


FIGURE D-6-25(a) RESULT OF RESERVOIR OPERATION OF OKKAN DAM

TABLE D-6-2 PROPOSED IRRIGATION PROJECT

Sr. No.	Name of Project	C.A (sq.km)	Resoirvoir Area (ha)	Storage* Capacity (MCM)	Dam H (m)	Dam L (km)	Dam FWSL (m)	Irrigable Area (ha) Paddy (Wet)	Paddy (Dry)	G.Nuts (Dry)	Beans (Dry)
1.	Wegyi	525		306.2	42	1.3	54	33,000	3,000	10,000	10,000
2.	Taunyo	545		130.0	35	1.1	75	18,900	900	5,700	5,700
3.	Bawbin	260		107.0	43	1.5	75	13,000	1,000	4,000	4,000
4.	Gamon	95	470	47.0	30	1.8	75	4,500	100	1,400	1,200
5.	Minhla	80	340	34.0	30	1.2	85	8,000	400	2,100	2,000
6.	Kadinbilin	154		110.0	36	0.3	63	19,000	1,600	5,600	5,600
7.	Thegaw	90		80.0	25	1.6	51	12,900	1,000	4,000	4,000
8.	Thonze	250		221.5	32	1.4	67	39,500	3,100	12,000	12,000
9.	Okkan	205		194.0	28	0.4	59	31,000	3,000	10,000	9,000
	Sub-total							179,800	14,100	54,800	53,500
10.	Nyaungging	80		30.0	19	0.8	61	1,400	700	400	300
11.	Buyo	330		89.0	49	0.6	139	4,900	2,500	1,200	1,200
12.	Thaledan	540	880	59.0	23	0.4	75	2,500	1,200	600	700
13.	Alonmoyak	120		66.0	67	0.5	137	8,000	800	2,000	2,000
14.	North Kun	75	300	45.0	49	0.7	150	5,300	100	1,700	1,600
15.	Phatashin	55		29.0	47	0.6	212	3,000	100	1,000	1,000
16.	Mamya	90		47.0	81	0.9	265	8,500	500	2,500	2,500
17.	Kyanyin	490		85.0	55	1.2	75	16,400	900	4,500	4,400
18.	Mankathu	110		99.0	68	0.8	150	16,700	1,700	5,000	5,000
19.	Nankathu	115		88.0	65	0.7	135	20,000	1,500	6,000	6,000
20.	Gyat	95		80.0	55	1.1	75	20,000	2,000	5,500	5,500
21.	Mezili	80		70.0	55	0.7	75	19,000	1,500	5,400	5,400
22.	South Kun	90		90.0	48	1.1	58	19,400	1,400	6,500	6,500
23.	Kyetpaung	80		10.6	33	0.8	70	2,000	100	600	600
	Sub-total							147,100	15,000	42,900	42,700
	Total							326,900	29,100	97,700	96,200
24.	South Nawin	640		354.0	41.5	5.1		25,300			
25.	North Nawin	592	3,158	359.0	35.1	1.6		39,200			
	G. Total							391,400			

convert their present rainfed farming to the irrigated farming, and thereby the farmers will have get various knowledge on modernized farming like water management selection of crops with irrigation, farm mechanization and so on.

Strengthening of the agricultural extension system by adequate staffing is an indispensable factor to lead the irrigation projects to success. The extension workers providing a full knowledge and techniques of irrigated farming will give the farmers concerned a guidance and education. The agricultural development inevitably requires those three major factors of good opportunity, good earth and good human resources as well as growing plants essentially require sunshine, water and fertilizer. The Project has provided with these major factors for successful development.

Needless to say, about quantity, however, quality is a problem in human resources. In other countries, in most cases that substantial results could not obtained from agricultural development even after completion of physical development, the farmers concerned could be found to have insufficient knowledge and techniques to successfully execute the agricultural development works in the Projects.

Farmers' education is more effective in being given through field training than by teaching in classrooms. For accomplishment of this purpose, it would be necessary to provide with pilot land consolidation projects or demonstration farms to show the farmers what the future farming would and should be. If these pilot farms can be arranged along with the heavy traffic roads such as national highway, not only local farmers but other farmers passing there through can directly observe the actualities of irrigated farming, land consolidation and other moden farming techniques. Also, these farms will serve to call farmers' interest to modernized farming prior to training given in a training center.

These farms can be used as experimental farms for applied research of the seeds to be bred in Hmawbi Extension Farm and used as seed farms for distributing quality seeds to the farmers. The farmers would be able to practise seed-renewal at proper time and introduce new varieties smoothly. (Refer to Annex C, Agriculture).

Six Pilot Land Consolidation Projects (Pilot Farm) to meet the above requirements could be provided in the Survey Area.(refer to Fig. D-6-26 ∿ Fig. D-6-32) so that the extension workers and/or representative farmers could be trained for difusing their gained knowledge and techniques to the local farmers. These extension activities would allow the Project to have quick yield. Under these considerations, the pilot farm schemes should be implemented prior to execution of irrigation schemes.

The components to be involved in the pilot schemes are as follows:

1) Civil works -- Construction of irrigation/drainage facilities and land consolidation works with on-farm facilities.

2) Architectural works -- Construction of training center building, warehouses, shelters for farming equipment, drying-storage houses, office building, research center buildings, etc.

3) Provision of machinery and equipment -- Farming machines research/experimental equipment, meteorological equipment, surveying equipment, office equipment and devices.

Each of pilot scheme farms should have about 1,000 ha (about 3,000 acres) with water source exclusively serving for the purpose. The land consolidation should be carried out to allow the year-round irrigation available, and it is desirable implement the land consolidation for the whole planned area.

However, when a total execution of the scheme might reduce the cost, a staged development would be taken up to implement the construction works for on-farm irrigation/drainage facilities for a part of the planned area, first and the land consolidation works could be made later on. In such case, the irrigation/drainage layout should be made on conditions that the land consolidation works would be implemented in the said area in future. This is very important to avoid duplicating investment to be incurred by rearranging the irrigation/drainage facilities to meet the condition after land consolidation.

1) Shape of plots

The plots should be formed in rectangular so as to raise the operation efficiency of farming machines. The plot size would be determined in depending upon the following factors:

a) Related farmers' sowing acreage.
b) Operation efficiency and capacity of farming machines to be used.
c) Construction cost in variable topographical conditions and dip of the farm lands, and d) water management.

The average acreage sown per farmer in the Survey Area is 1.6-2.0 ha (4 - 5 acres), and exchange and consolidation of these farm lands should be made for effective farming works.

Machine operation in straight will increase the working efficiency; thereby the plot shape should be designed so as to reduce the turning frequency of the farming machine. The test run conducted in Japan clarified that the most reasonable ratio of length of run and width of the farm land is 5:1. (Refer to Fig. D-6-33).

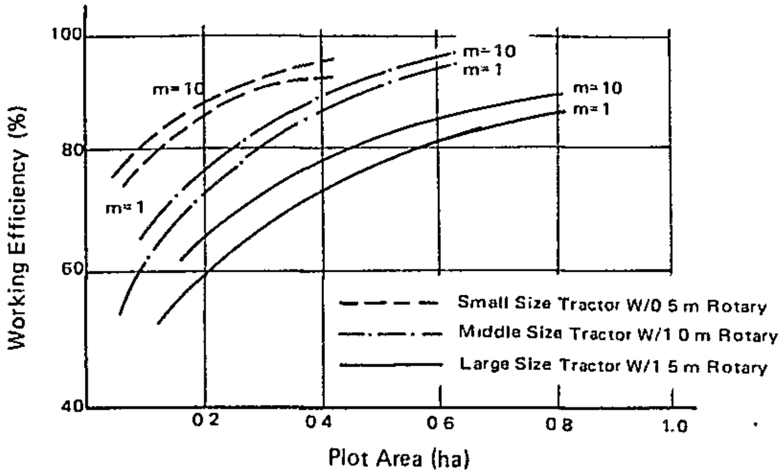


FIGURE D-6-33 PLOT AREA, RATIO OF LONG SIDE TO SHORT SIDE (m) AND WORKING EFFICIENCY

The degree of the farm land inclination sometimes may be an important factor for determining the plot size, but in the Survey Area, the land slope will not affect to determine the plot size because most of the farm land has a gentle slope. However, it should be noted that the larger width of the plot will increase the construction by increase in hauling distance and earth-moving volume of equipments for its works.

Heavy equipment such as bulldozers for earth-moving are commonly used for land levelling and this is because the most reasonable hauling distance ranges from 30 to 60 m for efficient machine operation. In considering various factors, the width of the plot should be arranged within 45-90 m.

The size of irrigation block as a unit of irrigation service depends upon the farmers' technical level of water management and the extent of irrigation facilities available. The large size of the block covers larger number of related farmers and requires more complicated water management techniques; contrarily, the smaller size of the block increase the number of on-farm diversion facilities, which will cause the construction cost higher and the water management of the main canals more complicated, although water control at on-farm level would become easy technically.

From the above studies and various examples in other countries, it is recommended to provide on unit of irrigation block for covering the farm lands sown by five to ten farm households. Hence, the plot size will be determined by about 1.0 ha (about 2.5 acres) with 200 m length of run and 50 m width, and one block should include 10 plots of the above. (Refer to Fig. D-6-34).

Every plot should provide a turn-out and an outlet in order to facilitate on-farm level water management. The farm roads with 3.0 m width (about 10 ft) and 0.5 m height from the field surface would be constructed along the farm ditches, and planned with laterite paving materials so as for the traffics to be avoided even in the rainy season.

The farm drains would be provided in between the farm roads for reducing the farm land losses. When the farm drains are constructed along the farm roads, accessing to the farm plots will be available only by one side of the farm road. This will cause some inconveniency to the farmers in their farming works. The land consolidation works, once implemented in a certain area, would not be repeatedly carried out there within 50 years at least. The farm ditches to be provided on both sides of the farm roads will make it easy for the farmers to do the water management.

In the low-lying flat lands with heavy clayey soils and comparatively high groundwater table, under drain works should be constructed; however, since the provision of its works need much construction cost, simple under-drains without drain pipes are recommendable to be provided for the time being to save the cost. And these simple under-drains should be replaced with its under-drains therein, when the farmers' income increases to be or the expenditure for such construction works.

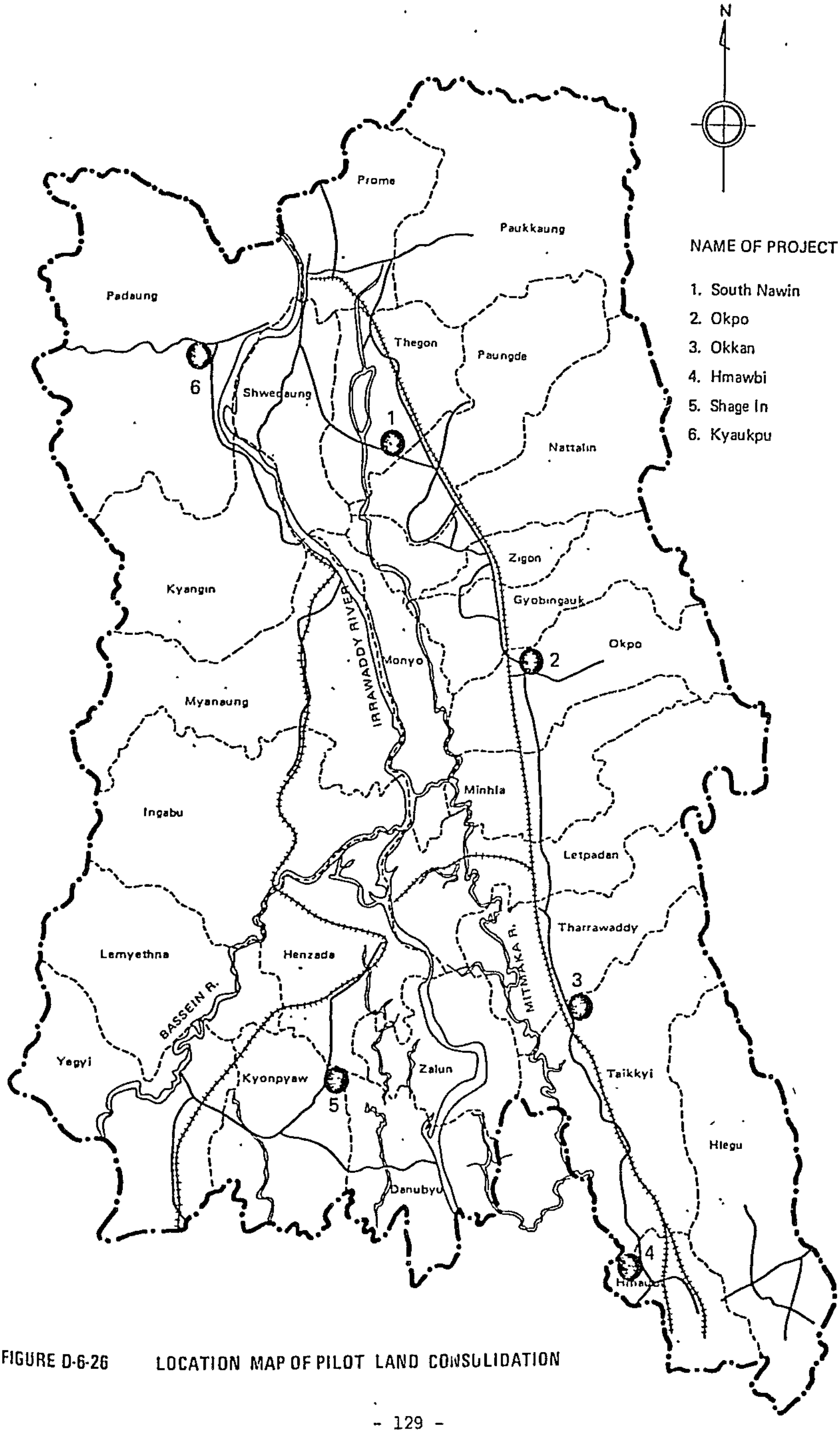
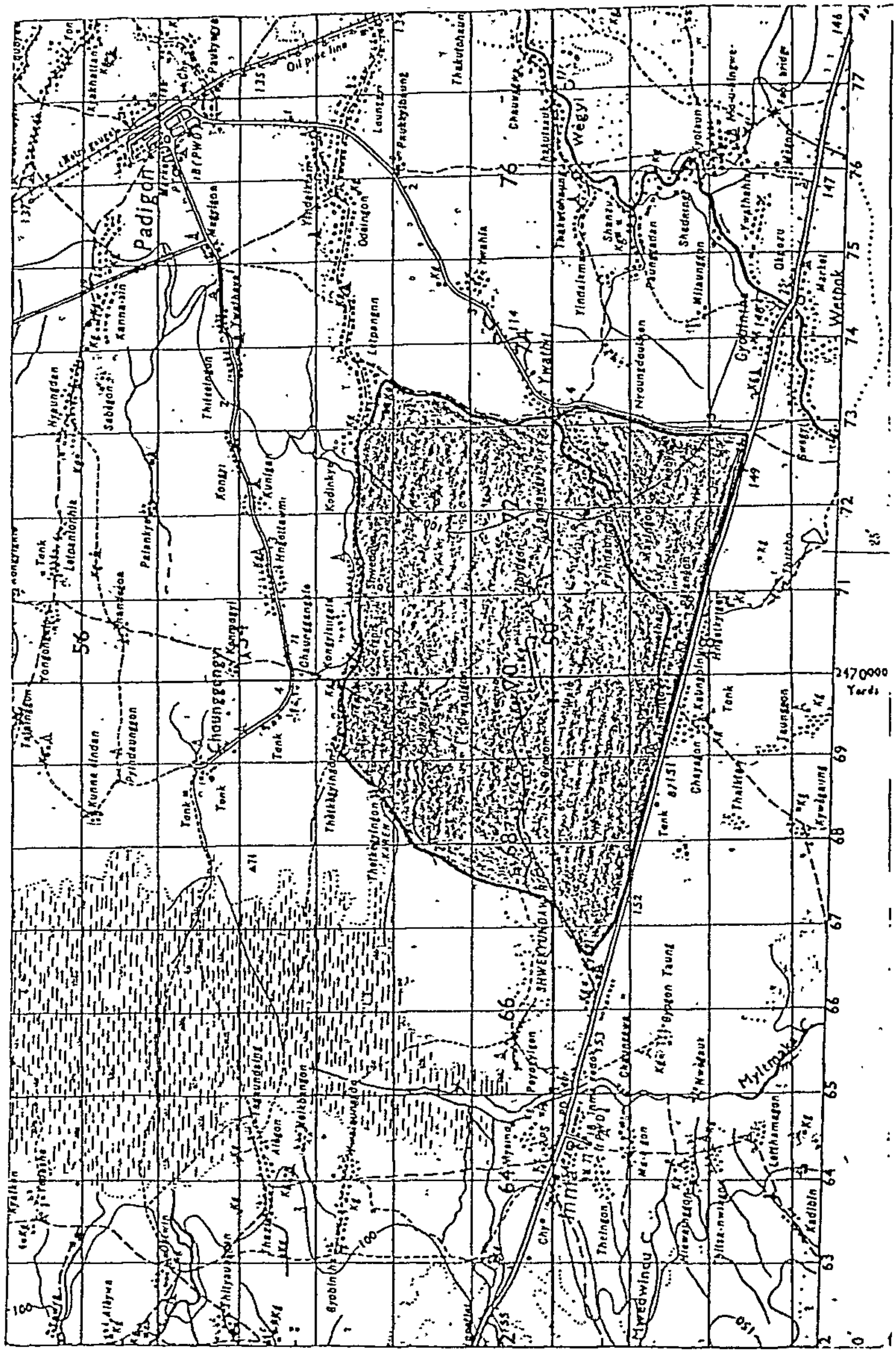
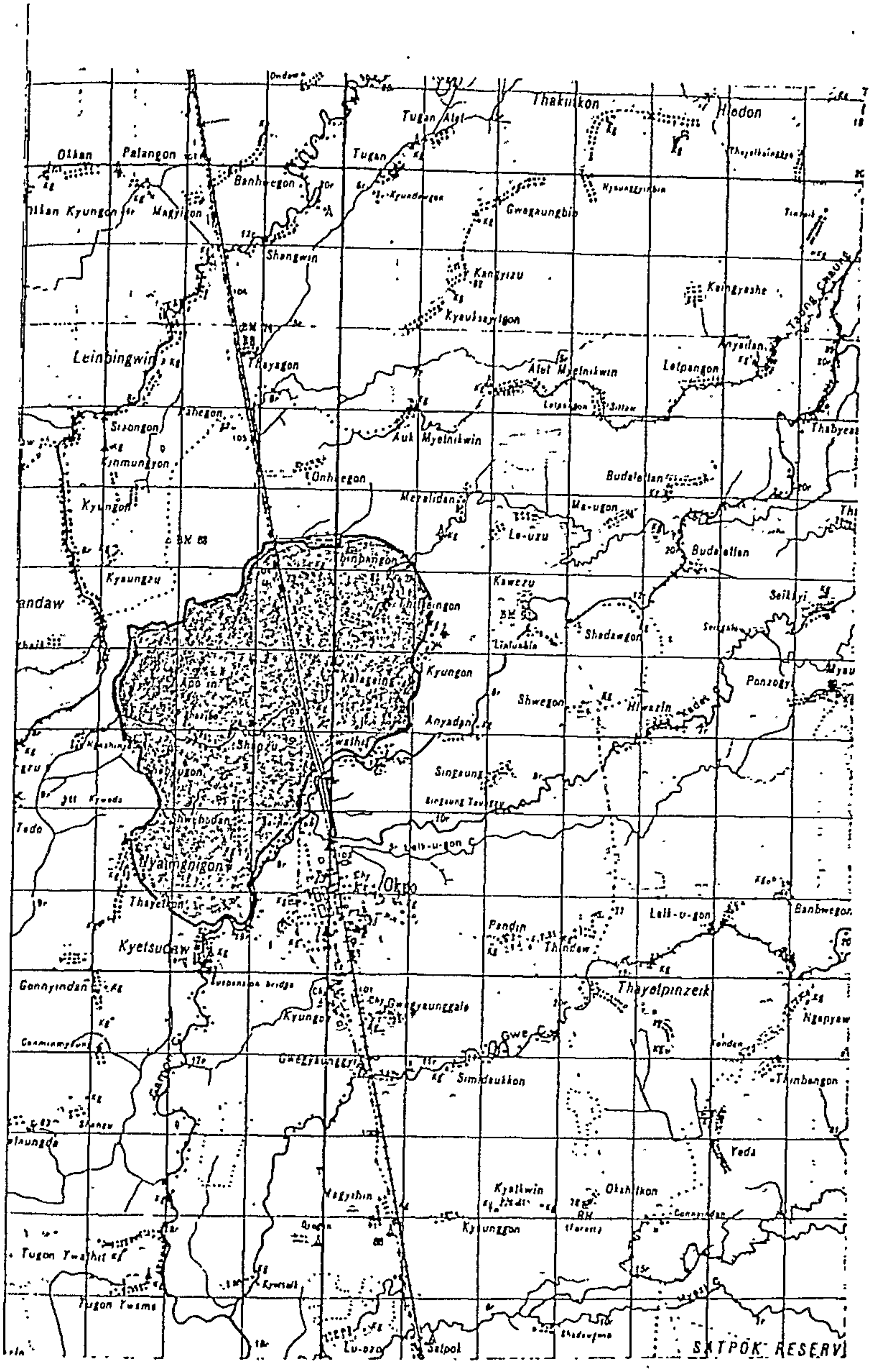


FIGURE D-6-26 LOCATION MAP OF PILOT LAND CONSOLIDATION



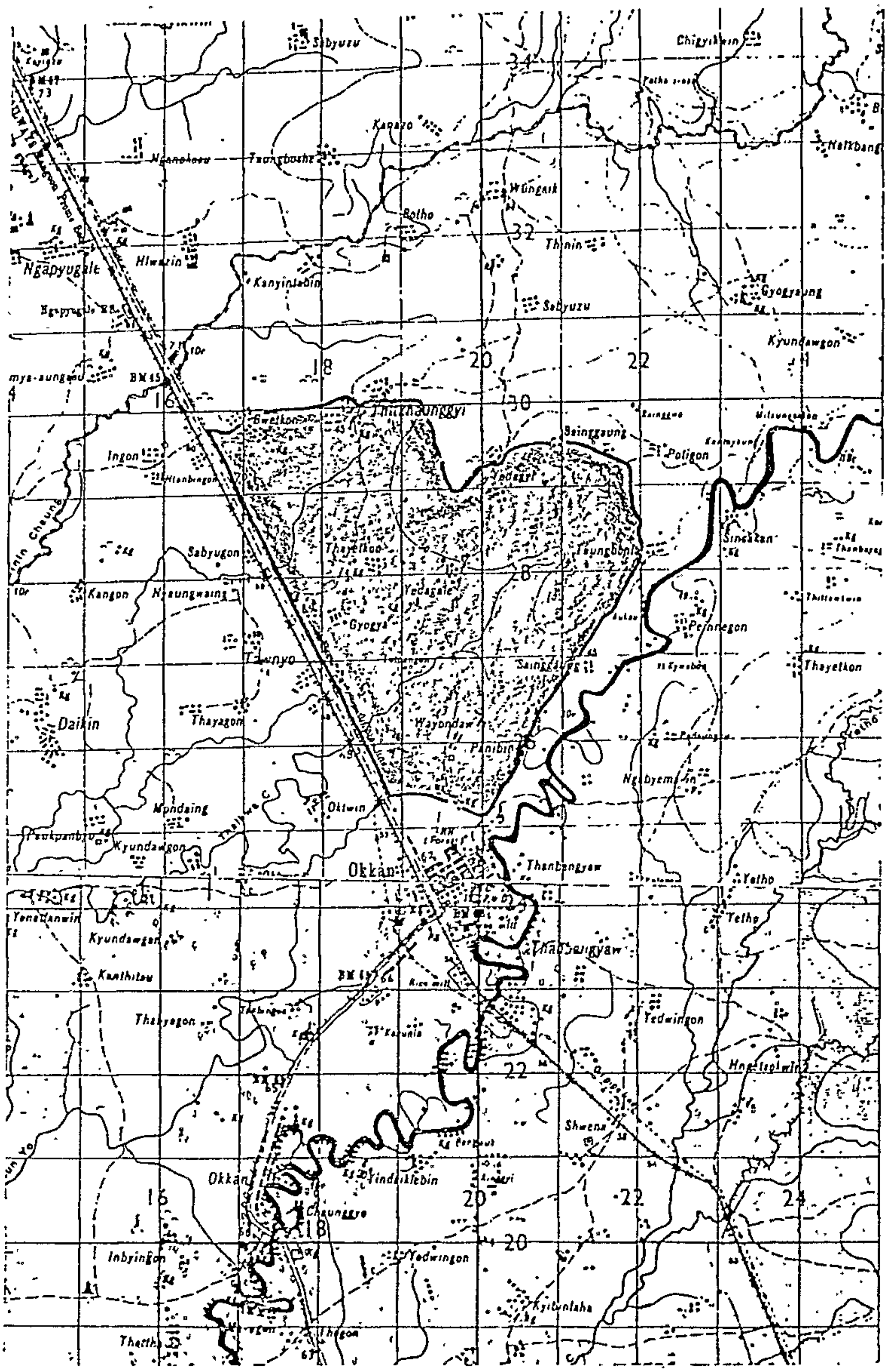
LOCATION: THEGON TOWNSHIP

FIGURE D-6-27 PILOT LAND CONSOLIDATION PROJECT (SOUTH NAWIN)



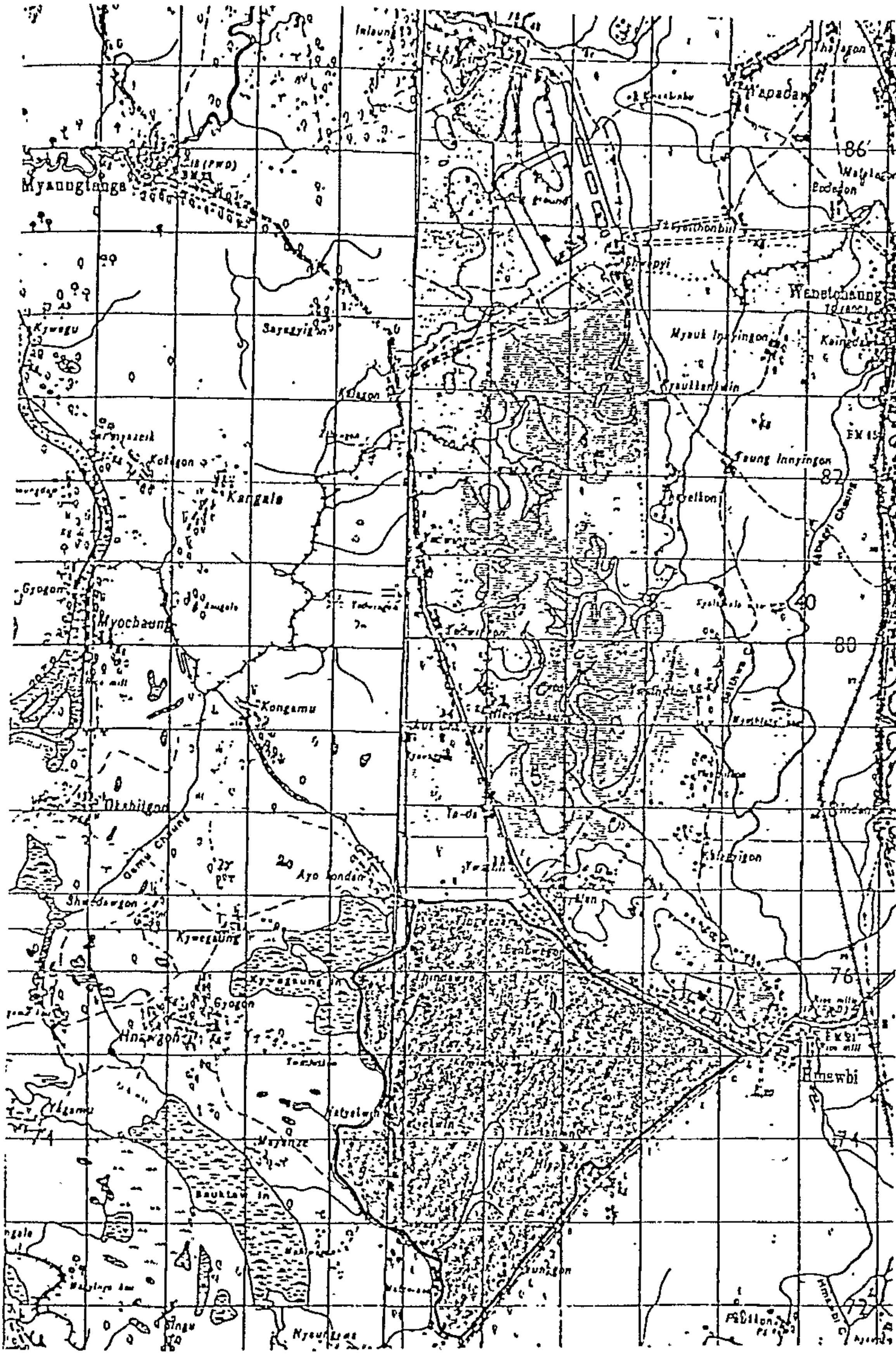
LOCATION: OKPO TOWNSHIP

FIGURE D-6-28 PILOT LAND CONSOLIDATION PROJECT (OKPO)



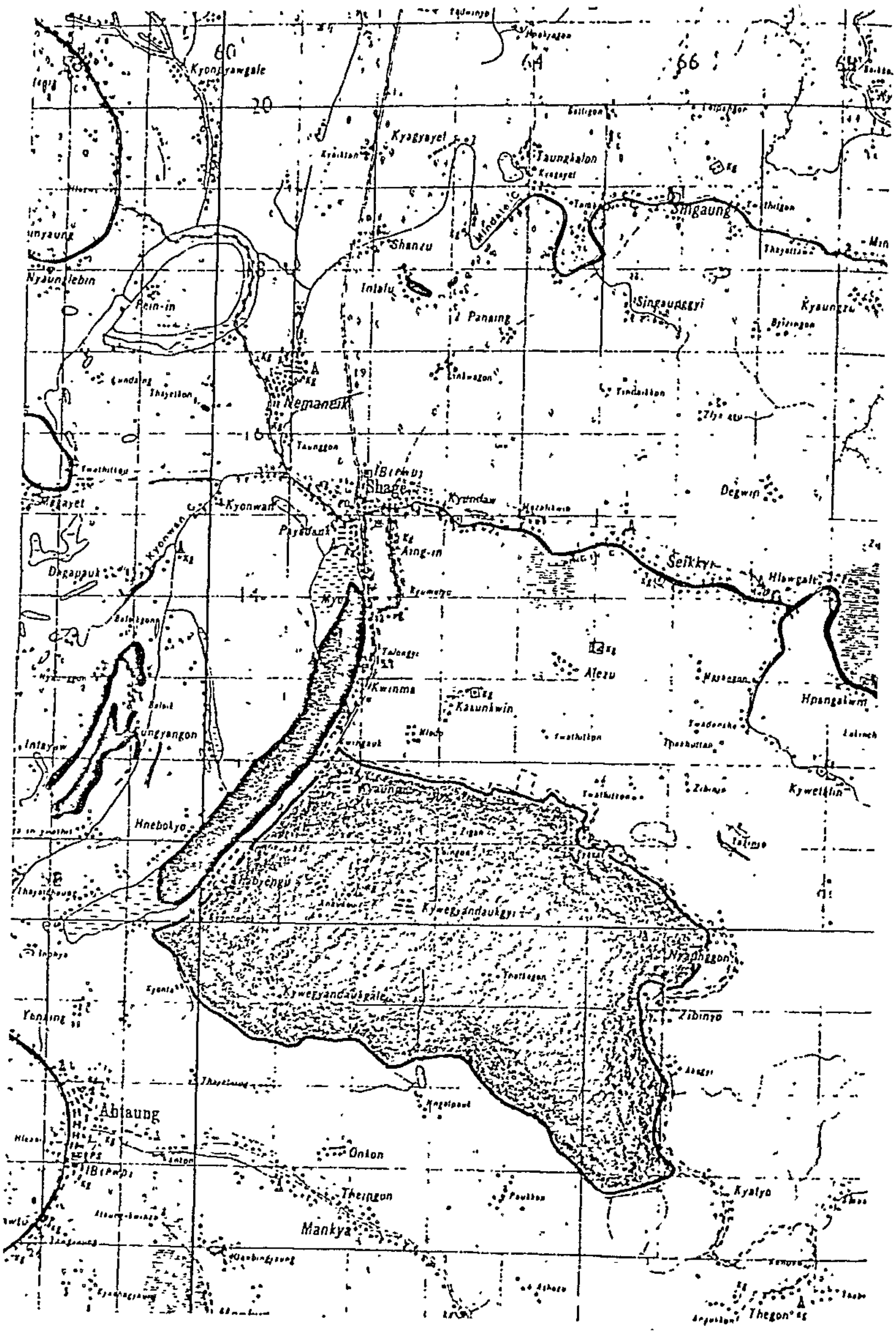
LOCATION : TAIKKYI : TOWNSHIP

FIGURE D-6-29 PILOT LAND CONSOLIDATION PROJECT (OKKAN)



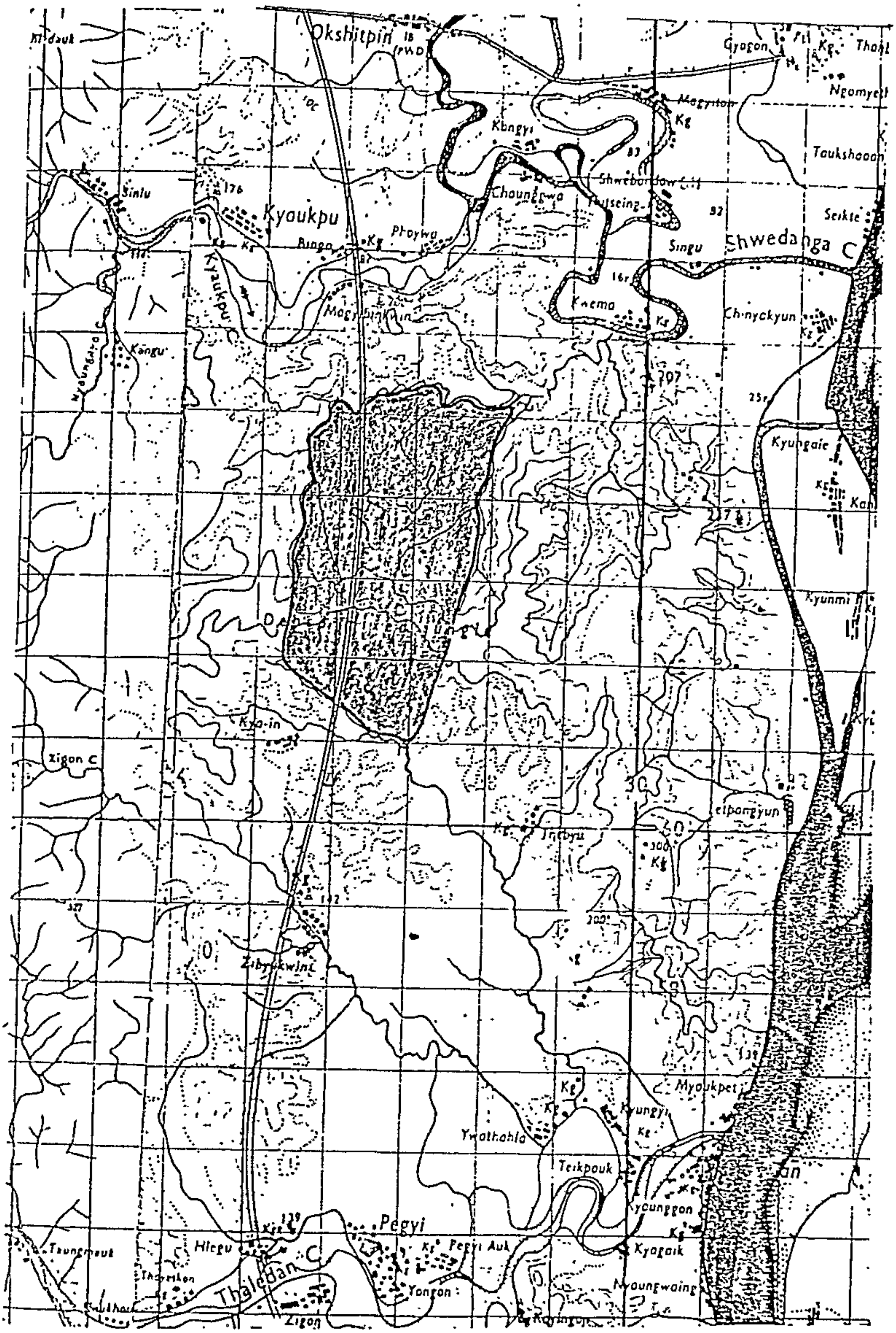
LOCATION : HMAWBI TOWNSHIP

FIGURE D-6-30 PILOT LAND CONSOLIDATION PROJECT (HMAWBI)



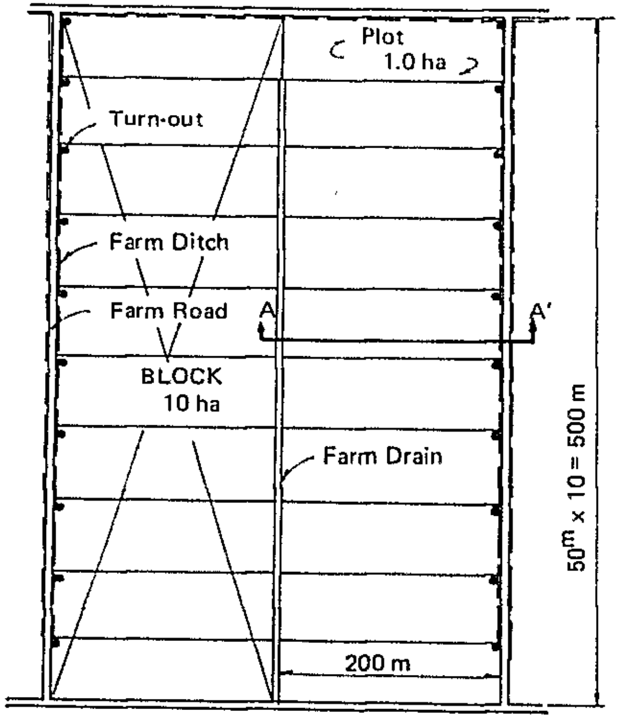
LOCATION: KYONPYAW TOWNSHIP

FIGURE D-6-31 PILOT LAND CONSOLIDATION PROJECT
(SHAGE IN)

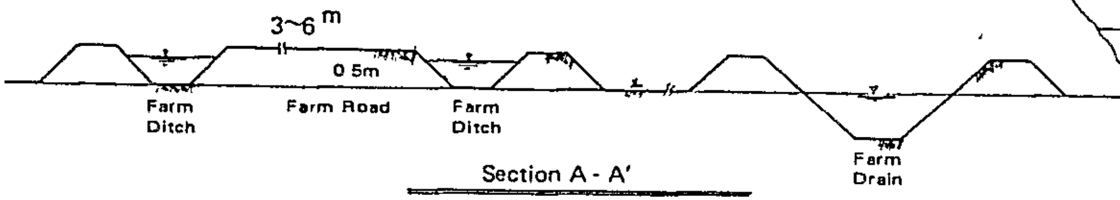


LOCATION : PADAUNG TOWNSHIP

FIGURE D-6-32 PILOT LAND CONSOLIDATION PROJECT (KYAUKPU)



Typical Plan of Block



Section A - A'

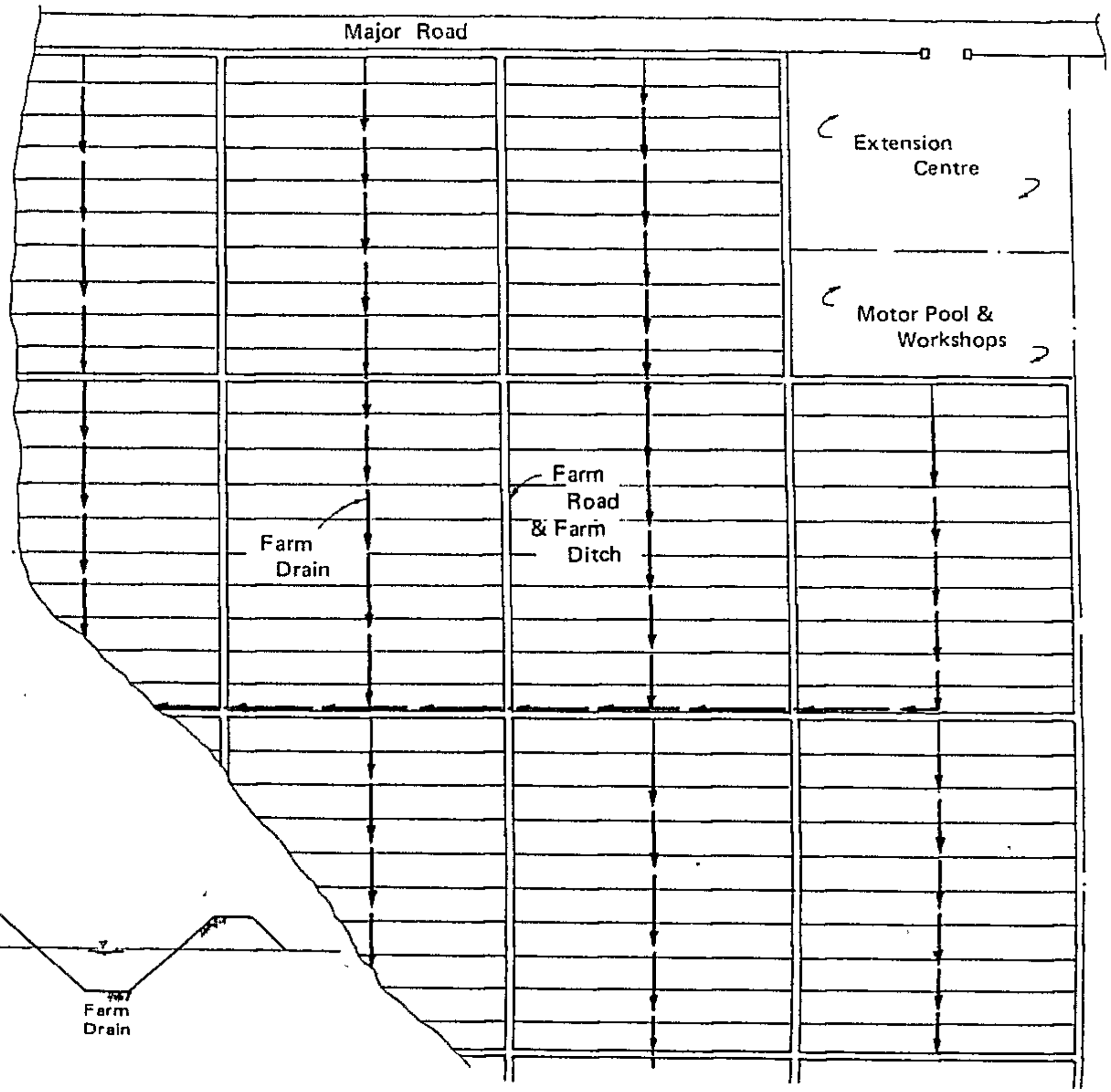


FIGURE D-6-34 TYPICAL LAYOUT OF LAND CONSOLIDATION

VII. COST ESTIMATE

VII-1. Work Volumes

The volumes of every kind of works to be required for the Project were estimated on the basis of the interpretation on the one inch map (scale: 1:63,360).

Embankment volumes of dam body was estimated by the following equation which had been derived from the actual results of earth dam construction in the past.

$$V = \frac{1}{2} B.H(Lh + Lb) + \frac{1}{6}(m + n).H^2.(Lh + 2Lb)$$

Where; V = Embankment volume of dam body (cu.m)

B = Width of dam crest (m)

H = Dam height (m)

Lh = Length of dam crest (m)

Lb = Length of river bed (m)

m = Slope of upper stream (1 : m)

n = Slope of down stream (1 : n)

The results obtained from the above estimation are shown in Table D-7-1. The work volumes other than dam construction were estimated by measurement on the one inch map. (Ref. to Fig. D-6-36)

VII-2. Estimate of Construction Cost

1) Reservoir-Irrigation Project

The unit costs adopted in the estimation were based on those used in the South Nawin Irrigation Project in 1979. The price escalation was estimated at annual rate of eight percent.

Construction period was taken six years, including one year for final design and five years for civil works. The annual basis cost allocation is shown as follow. In the said estimate, therefore, the price escalation was calculated by 36 percent in total.

	1st	2nd	3rd	4th	5th	6th	Total
Allocation	5%	15%	20%	20%	25%	15%	100%
Rate	1.08	1.17	1.26	1.36	1.47	1.59	1.36

The financial costs for the respective irrigation schemes are shown in Table D-7-2. The cost per hectare for the dam projects located on the left bank of the Irrawaddy river is smaller than those on the right bank. This is because the irrigable areas commanded by each scheme on the right bank are smaller than those on the left bank and the reservoir areas on the right bank, forming a V-valley, are expected to have smaller storage efficiency against their dam height.

On the other hand, the proposed dams located on the left bank present a plate-shape reservoir, therefore, their storage efficiency is expected to be larger compared with their dam height.

As far as the irrigation schemes are concerned, the group of proposed dams on the left bank should be constructed first. However, the dams at Kadinbilin, Thegaw, Thonge, and Okkan among the proposed dams on the left bank show a smaller construction costs per hectare than those of others.

In due consideration of the various factors, the priority was given to the following dam construction schemes:

Priority	Name of Project	Project Cost* (US$/ha)
A	Wegyi, Taunyo, Kadinbilin, Thonze, Okkan, and Thegaw	Less than 3,000 US$/ha
B	Not belong to Projects of Classes A and C	3,000-5,000 US$/ha
C	Gamon, Phatshin, Mamya and Kyetpaung	More than 5,000 US$/ha

Note: * including price escalation

2) Pilot Land Consolidation Project

The cost estimate for the pilot land consolidation projects was made on the basis of the data used for the estimate in the South Nawin Irrigation Project. The project cost of this Project will have a total amount of 54.3 million kyat per place. (Refer to Appendix D-9).

TABLE D-7-1 EMBANKMENT VOLUME OF PROPOSED DAM

	B (m)	H (m)	L_1 (m)	L_2 (m)	m	n	Embankment Volume ('000 cu.m)	Dam Type
1. Wegyi	6	42	1,300	80	3.5	3.0	2,964	E
2. Taunyo	6	35	1,100	80	3.5	3.0	1,796	E
3. Bawbin	6	43	1,500	60	3.5	3.0	3,446	E
4. Gamon	6	30	1,800	60	3.5	3.0	2,039	E
5. Minhla	6	34	1,200	60	3.5	3.0	1,782	E
6. Kadinbilin	6	36	300	80	3.5	3.0	687	E
7. Thegaw	6	25	1,600	80	3.5	3.0	1,318	E
8. Thonze	6	32	1,400	60	3.5	3.0	1,826	E
9. Okkan	6	28	300	60	3.5	3.0	387	E
10. Nyangging	6	19	800	100	3.5	3.0	442	E
11. Buyo	6	49	600	120	2.7	2.2	1,753	R
12. Thaledan	6	23	400	150	3.5	3.0	439	E
13. Alonmoyak	6	67	500	60	2.7	2.2	2,385	R
14. North Kun	6	49	700	100	2.7	2.2	1,882	R
15. Phatashin	6	47	600	60	2.7	2.2	1,392	R
16. Mamya	6	81	900	60	2.7	2.2	5,699	R
17. Kyanyin	6	55	1,200	120	2.7	2.2	3,775	R
18. Mankathu	6	68	800	100	2.7	2.2	3,960	R
19. Nankathu	6	65	700	120	2.7	2.2	3,403	R
20. Gyat	6	55	1,100	120	2.7	2.2	3,512	R
21. Mizili	6	55	700	200	2.7	2.2	2,866	R
22. Sough Kun	6	48	1,100	100	2.7	2.2	2,619	R
23. Kyetpaung	6	33	800	100	3.5	3.0	1,269	E

Note: E in the item "Dam Type" means Earth Fill Type dam and R. Roch Fill Type dam

TABLE D-7-2 COST ESTIMATE OF IRRIGATION PROJECT

Name of Irrigation Project	Main dam	Diversion dam	Irrigation & Drainage	Land Consoli-dation	Sub-total	Preparatory Works (10%)	Management & Engineering (15%)	(I) Total	(II) Contin-gency (15%)	(I+II) Total	Escalation (36%)	Grand Total (M.Kyat)	Per ha (Kyat/ha)	Per ha (US$/ha)
1. Wegyi	65,738	-	135,300	92,400	293,438	29,343	44,015	366,79[illegible]	55,004	421,800	[illegible]	575	17,304	[illegible]
2. Taunyo	39,833	6,931	77,490	52,920	177,174	17,717	26,576	221,467	33,133	254,600	91,400	346	18,364	2,843
3. Bawbin	76,428	15,878	53,300	36,400	182,006	18,200	27,300	227,506	34,094	261,600	93,400	355	27,308	4,240
4. Gamon	45,221	7,226	18,450	30,240	101,137	10,113	15,170	126,420	18,880	145,300	[illegible]1,700	197	43,376	6,798
5. Minhla	39,522	9,199	32,800	22,400	103,921	10,392	15,588	129,901	19,399	149,300	53,700	203	25,375	3,940
6. Kadinbilin	15,237	10,717	77,900	53,200	157,054	15,705	23,558	[illegible],317	29,383	225,700	80,300	306	16,105	[illegible],500
7. Thegaw	29,230	-	52,890	36,120	118,240	11,824	17,736	147,900	22,100	169,900	61.100	231	17,907	2,781
8. Thonze	40,497	6,642	161,950	82,600	291,689	29,168	43,753	[illegible]	54,690	419,300	15[illegible]	570	14,430	2,240
9. Okkan	8,582	6,002	127,100	86,800	228,484	22,848	34,272	[illegible],604	42,796	328,400	1[illegible]7,600	446	14,397	2,234
10. Nyangging	9,802	-	5,740	3,920	19,462	1,946	2,913	24,327	3,573	27,900	9,100	37	26,424	4,104
11. Byyo	43,658	-	20,090	13,720	77,468	7,746	11,620	96,834	14,466	111,300	39,700	151	30,51[illegible]	4,785
12. Thaledan	9,734	-	10,250	7,000	26,984	2,698	4,047	33,729	4,971	38,700	13,300	52	20,800	3,230
13. Alonmoyak	59,400	-	32,800	22,400	114,600	11,460	17,190	143,250	21,450	164,700	58,300	223	27,675	4,328
14. North Kun	46,871	-	21,730	14,840	83,441	8,344	12,516	104,301	15,599	119,900	43,100	163	30,754	4,776
15. Phatshin	34,668	-	12,300	8,400	55,368	5,536	8,305	69,209	10,291	79,500	29,500	108	[illegible],000	5,590
16. Mamya	141,940	15,160	34,850	23,800	215,750	21,575	32,362	269,687	40,413	310,100	110,900	421	49,529	7,691
17. Kyanyin	93,522	-	67,240	45,920	206,682	20,668	31,002	258,352	38,748	297,100	[illegible]	404	24,634	3,825
18. Mankathu	98,628	15,388	68,470	46,760	229,246	22,924	34,386	286,556	42,944	329,500	116,500	448	26,826	4,166
19. Nankathu	84,755	27,683	82,000	56,000	337,908	33,790	50,686	422,384	63,316	485,700	174,300	460	23,000	3,571
20. Gyat	87,470	-	82,000	56,000	225,470	22,547	33,820	281,837	42,263	324,100	115,[illegible]	440	22,000	3,416
21. Mezili	71,380	9,250	77,900	53,200	211,730	21,173	31,759	264,662	39,638	304,300	109,[illegible]	413	21,737	3,375
22. South Kun	65,228	9,705	79,540	54,320	208,793	20,879	31,318	260,990	39,110	300,100	10[illegible]	408	21,031	3,266
23. Kyetpaung	28,144	16,064	8,200	5,600	58,008	5,800	8,701	72,509	10,791	83,300	2[illegible]	[illegible]	56,500	8,773

Ngamoyeik Reservoir Irrigation Project

Ngamoyeik Reservoir Irrigation Project in Hlegu Township has specific features other than the reservoir irrigation projects along the Myitamaka or the Irrawaddy River as below:-

(1) A submerging arable land is estimated at as much as about 7,500 hectares. A number of houses will be also submerged after provision of the reservoir.

(2) No adequate dam site is found in respect with topography as well as geological conditions.

(3) Available information is limited to establish significant reservoir plan.

Despite the above disadvantages, a preliminary calculation was conducted and its result is as below:-

Name of Project	Catchment area (sq.km)	Storage Capacity (MCM)	Dam H (m)	Dam L (m)	Irrigable Area (ha)	Project Cost (Million Kyat)	Unit Cost (Kyat/ha)
Ngamoyeik	455	375	15	2,900	34,000	*	*

Note: * can not estimate because of lack of the data like fundation treatment.

FIGURE D-6-35 LOCATION MAP OF NGAMOYEIK RESERVOIR