THE SOCIALIST REPUBLIC OF THE UNION OF BURMA

THE MASTER PLAN SURVEY REPORT ON THE IRRAWADDY BASIN INTEGRATED AGRICULTURAL DEVELOPMENT

ANNEX F

RURAL DEVELOPMENT

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

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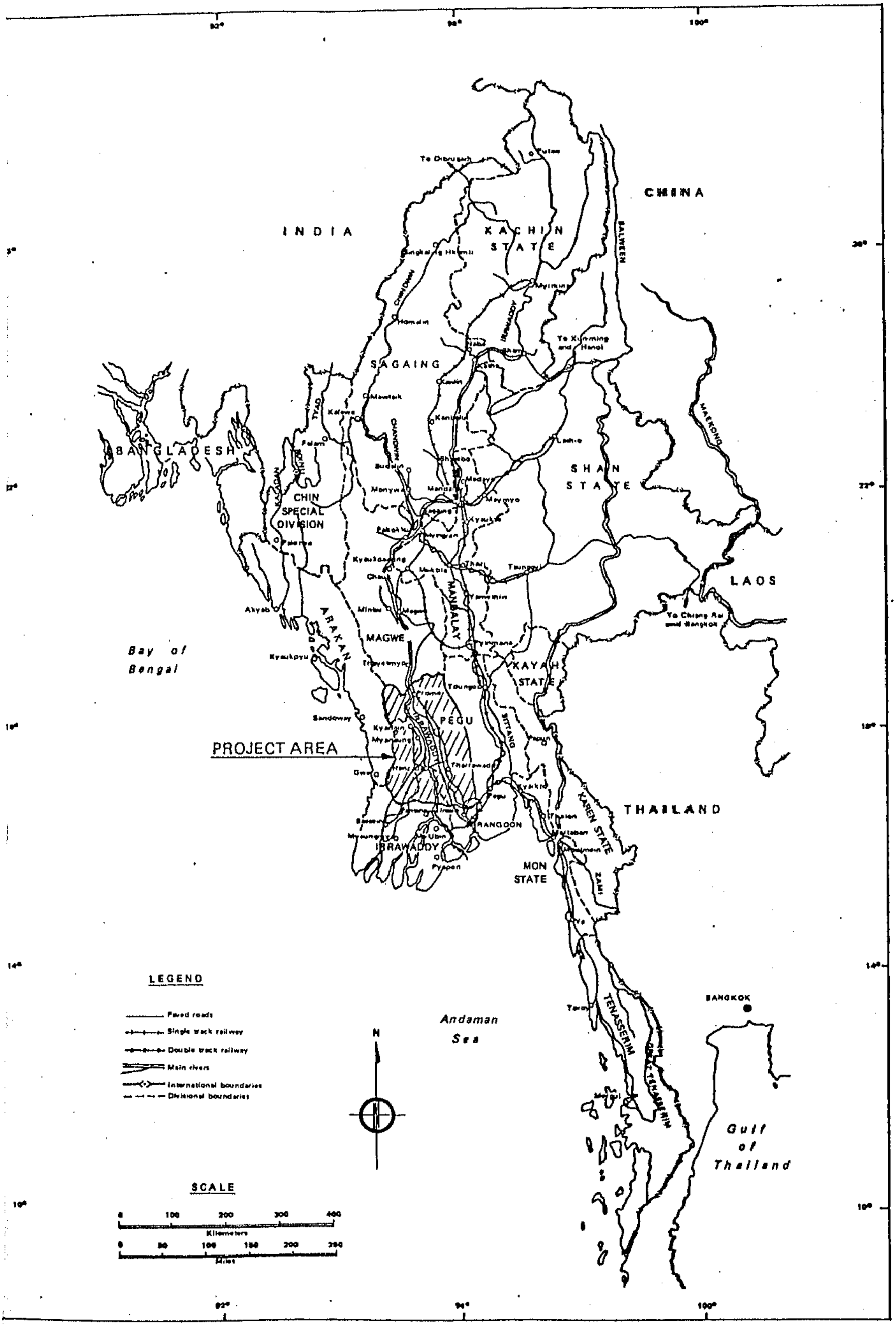

CHINA
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SAGAING
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MANDALAY
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Bay of Bengal
KAYAH STATE
PEGU
PROJECT AREA
THAILAND
RANGOON
IRRAWADDY
MON STATE
KAREN STATE
TENASSERIM
Andaman Sea
Gulf of Thailand
BANGKOK
LEGEND
Paved roads
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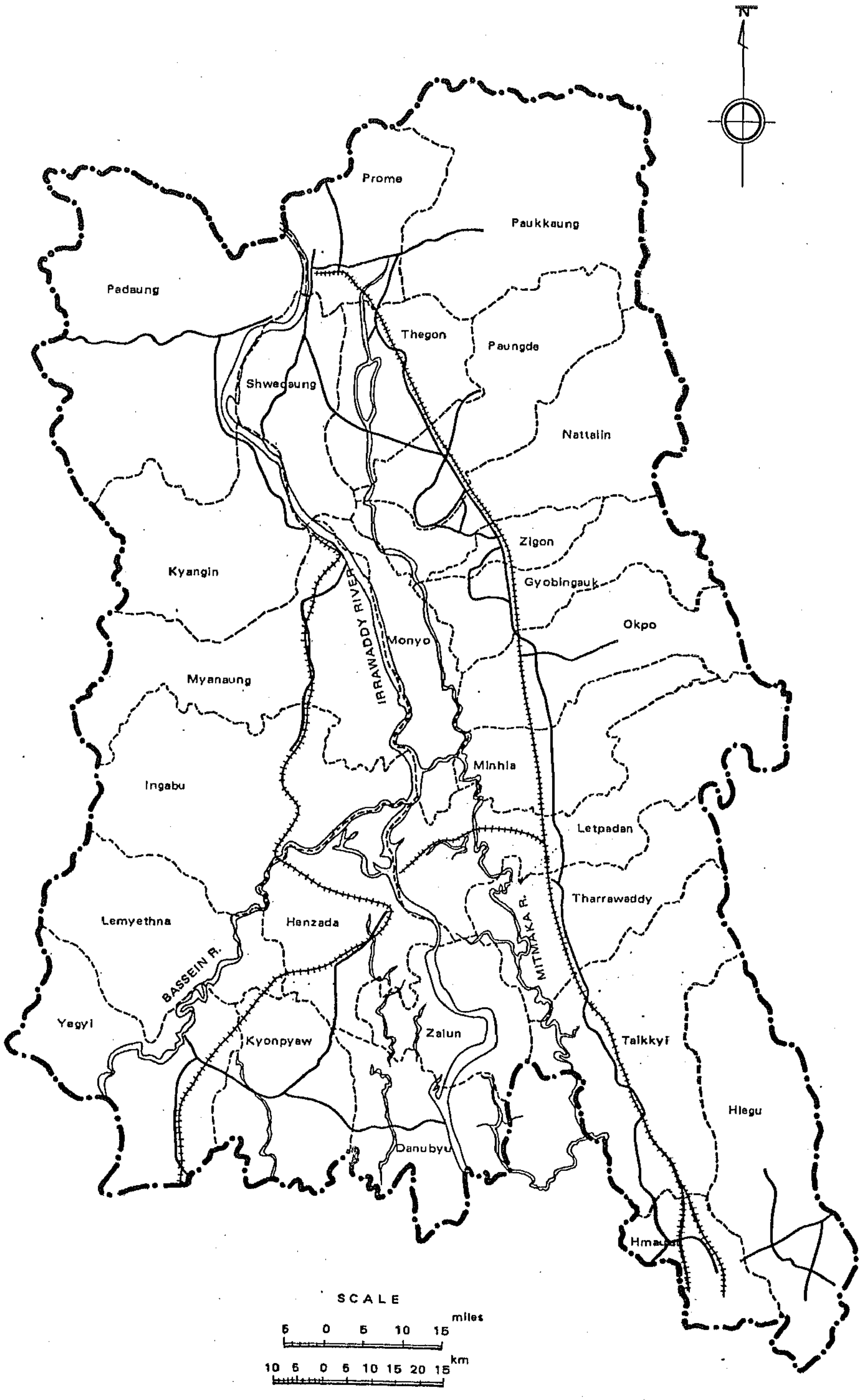
N
Prome
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Nattalin
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Kyangin
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Okpo
Monyo
IRRAWADDY RIVER
Myanaung
Minhla
Ingabu
Letpadan
Tharrawaddy
Lemyethna
Hanzada
MITMAKA R.
BASSEIN R.
Yegyi
Kyonpyaw
Zalun
Taikkyi
Hlegu
Danubyu
SCALE
miles
5 0 5 10 15
km
10 5 0 5 10 15 20 15

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ABBREVIATION, MEASURES AND GLOSSARIES

AC	Agriculture Corporation
ADB	Asian Development Bank
AE	Assistant Engineer
AGM	Assistant General Manager
AFPTC	Agricultural and Farm Produce Trade Corporation
AMD	Agricultural Mechanization Department
APS	Advance Purchase System
Ave	Average
BAG	Bachelor of Agricultural University
BKT	Basket(s)
CIF	Cost Insurance and Freight
°C	Degree Centigrade
DAGM	Deputy Assistant General Manager
DG	Director General
DGM	Deputy General Manager
Dy	Deputy
EE	Executive Engineer
EL	Elevation
EPC	Electric Power Corporation
FC	Foreign Currency
FiD	Fishery Department
FERD	Foreign Economic Relations Department
FIC	Foodstuff Industries Corporation
FOB	Free on Board
FoD	Forest Department
F/S	Feasibility Study
FY	Fiscal Year from April to March
GM	General Manager
GNP	Gross National Product
GWH	Giga Watt Hour
HP	Horsepower

HWL	High Water Level
HYV	High Yielding Variety (of paddy)
Hz.	Hertz per second
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department
IDA	International Development Association
KV	Kilo Volt
KW	Kilo Watt
KWH	Kilo Watt Hour
LC	Local Currency
LDMC	Livestock Development and Marketing Corporation
LIV	Local Improved Variety
LWL	Lower Water Level
LV	Local Variety
MAF	Ministry of Agriculture and Forests
MD	Managing Director
MHD	Meteorological and Hydrological Department
MI 1	Ministry of Industry No. 1
M/P	Master Plan
MPF	Ministry of Planning and Finance
MT	Ministry of Trade
MW	Mega Watt
MWL	Mean Water Level
PD	Project Director
pH	Potential of Hydrogen
PPFC	People's Pearl and Fishery Corporation, MAF
PPM	Part(s) per Million
%	Percent
PSD	Planning and Statistics Department
SD	Survey Department, MAF
SLRD	Settlements and Land Records Department, MAF
TC	Timber Corporation, MAF
TEM	Township Extension Manager
TSP	Triple Super Phosphate

UCC	University Computer Center
UGCF	Union Government Consolidated Fund
VAHD	Veterinary and Animal Husbandry Department
VIB	Village Tract Banks
WPSD	Working People's Settlement Department

MEASURES

Length

mm	millimeter (s)
cm.	centimeter (s)
m	meter (s)
km	kilometer (s)
inch	25.4 mm
ft	foot (feet) = 12 inch = 30.48 cm
mile	5,280 feet = 1.609 km

Area

sq.cm	square centimeter (s)
sq.m	square meter (s)
sq.km	square kilometer (s) = 100 ha
ac	acre (s) = 4,047 sq.m
sq.mile	square mile = 2.59 sq.km = 640 ac
ha	hectare

Capacity

ℓ	litter
cu.m	cubic meter
MCM	Million Cubic Meter
cu.ft	cubic foot (feet) = 28.32 ℓ
cu.yd	cubic yard = 0.765 cu.m
AF	Acre Foot (feet) = 1,233.48 cu.m
Qt	Quart = 1/4 gl = 1.136 ℓ (UK) = 0.946 ℓ (US)
gl	gallon = 4.543 ℓ (UK) = 3.785 ℓ (US)

Note: UK: British Measure
US: US Measure

Weight

g	gram (s)
kg	kilogram (s)
ton	metric ton
oz	ounce = 28.4 g
lb	Pound = 16 oz = 0.454 kg

Others

cm/sec	centimeter per second
m/sec	meter per second
km/sec	kilometer per second
mile /hr	mile per hour= 1.609 km/hr = 0.447 m/sec
ft/second	feet per second
cu.m/sec	cubic meter per second
cfs/cu.sec	cubic foot (feet) per second = 0.0283 cu.m/sec
gl/sec	gallon per second = 4.543 ℓ/sec = 0.0757 ℓ/min

Glossaries

lakh	100,000
crore	10,000,000
viss	1.633 kg
Pyi	2,127 kg
basket	20.9 kg (paddy)
basket	34.0 kg (rice)
bag	75.6 kg (rice)
Chaung	River or Stream
Kyat	Unit of Local Currency (about 30 Japanese Yen)
In	Lake or Swamp area
Yoma	Mountain range
1 US$	6.44 kyats

SUMMARY

Burma has about 70,000 farm villages, and 28 million people covering 87% of the gross population live in rural areas, and are engaged in agriculture.

The living condition in these rural areas has some disparity compared with the urban areas like Rangoon. In this survey, Bogyigon village in Tharrawaddy was the objective township, and the survey aims to seek the way to fill some of these ill-balanced gaps by setting up Village Road Networks, improvement of Domestic Fuel Supply, and providing Simple Water Supply System.

I. PRESENT DESCRIPTION OF RURAL AREAS

I.1. Number of Farm Household and Population

The population in Burma as of 1978 counts 32.2 millions. About 28 million people covering about 87% of the population live in rural areas and are engaged in agriculture.

The villages count approximately 70,000 all over the country, and the average farm village consists of about 55 farm households, 350 inhabitants and 150 cattle.

According to 1975-76 statistics, the number of farm household counts 4,350 thousand.

I.2. Number of Farm Household by Farm Size

The average farm size is 5.4 acres per household, but households cultivating less than five acres cover 63%. However, this less-than-five-acres class occupies only 26% of the whole cultivated land, and this shows majority of the farm households is small scale.

This is because Burma Socialist Programme Party gave the right for cultivation to those who actually cultivate the land, and large scale farming was diminished. (Ref. to Table F-1)

TABLE F-1 FARM HOUSEHOLD CLASSIFIED BY SIZE (1975-76)

Size Class	Farm Household		Crop Land	
	Number $\times 10^3$	%	Acre $\times 10^3$	%
- 5	2,728.6	62.7	6,147.7	26.1
5 - 10	1,045.6	24.0	7,530.4	32.0
10 - 20	466.1	10.7	6,541.8	27.8
20 - 50	109.5	2.5	3,034.7	12.9
50 - 100	1.8	0.04	117.1	0.5
100 -	0.3	0.06	170.9	0.7
Total	4,351.9	100.0	23,542.6	100.0

Source: Report to the Pyithu Hluttaw 1978-79.

I.3. Living Condition

1) Domestic Water Supply

Domestic water, like drinking water, and manifold use water is mainly supplied from shallow wells, and is used for bathing, washing and cooking. The number of wells differ according to a scale of farm village, but generally, there are two or three common use wells per village. The villagers bathe and wash clothes around these common use wells. Therefore, the wells tend to be contaminated and prevention of epidemics problem or sanitary problem are numerous. Some of these wells are useless during the dry season, as their water table is lowered, and sometimes are dried up. On such an occasion, villagers must travel seeking for a well available to a nearby village. Drawing and delivering water to home is the work of housewives and children, and this is quite a heavy burden for them.

The data of water quality from these wells are not available, but most of the water is turbid, and raw water is not suitable for drinking.

Duty of domestic water per man in the rural area is about 27 litre (about six gallons) a day.

2) Electrification

Only three percent (3%) of the farm villages nearby urban cities are electrified. Most of the farm households use kerosene lamp for lighting.

3) Housing

Most of the farmhouses are high-floored house made of wood and bamboo. There is about 1.3 meter clearance between the ground and the floor. In general, housing lot is fairly large with barn and cattle shed. Farmers keep chickens, pigs, and cattle.

4) Village Road

Being narrow and without side ditches, village roads become muddy during the rainy season. Also, their function as a road is very low, because the passable width of the roads is not definite, and many of the roads are provided without any consideration for farming.

5) Energy Source for Living

Firewood and chaff are often used as energy source for living, but firewood obtainable has been decreasing in quantity recently. One farm household requires 2.5 ton/year of firewood, (Ref. to Annex H Forestry) and the nationwide requirement amounts to 3.9 million ton/year in Burma. However, national forest can supply only 0.1 million ton and 3.8 million ton is lacking. In order to meet the firewood demand, the forestry Department is planning a reforestation project in haste. This reforestation project, however, could not be a quick countermeasure in considering growing speed of trees reforested. Therefore, investigation for securing other fuel sources, such as enlarging usage of chaffs, is urgently required.

II. FARM VILLAGES IN PROJECT AREA

II.1. Number of Farm Villages and Population

The number of farm villages in the Project Area is 9,076, occupying about 13 percent of the whole villages in the country. (Ref. to Table F-2)

Population in these farm villages counts about 3,340 thousand, and more than 200 thousand people are thought to be engaged in agriculture. (Ref. to Table F-3)

TABLE F-2 NUMBER OF JURISDICTION AND AREA BY TOWNSHIP

Division / Township	Municipality (Town)	Village Tract	Village	Acreage ac	Acreage ha
Pegu					
1. Prome	7	40	272	194,820	78,842
2. Paukkaung	5	53	235	471,370	190,759
3. Padaung	5	38	210	619,509	250,709
4. Paungde	12	42	241	229,539	92,892
5. Thegon	4	43	348	191,917	77,667
6. Shwedaung	3	48	297	181,721	73,541
7. Tharrawaddy	8	48	262	255,290	103,313
8. Letpadan	4	49	330	367,413	148,688
9. Minhla	8	55	247	165,320	66,903
10. Okpo	6	54	243	259,506	105,019
11. Zigon	5	20	132	60,584	24,518
12. Nattalin	4	78	367	337,883	136,738
13. Monyo	5	37	207	158,076	63,972
14. Gyobingauk	10	49	271	190,079	76,923
Sub-total	86	654	3,662	3,683,027	1,490,484
Rangoon					
1. Hmawbi	4	42	212	124,367	50,330
2. Hlegu	5	73	206	441,849	178,812
3. Taikkyi	8	69	426	426,761	172,706
Sub-total	17	184	844	992,977	401,848
Irrawaddy					
1. Kyonpyaw	4	88	527	204,648	82,819
2. Yegyi	5	88	517	316,762	128,190
3. Henzada	20	103	894	242,365	98,083
4. Zalun	5	72	496	184,419	74,633
5. Lemyethna	3	41	284	255,388	103,353
6. Kyangin	3	30	234	284,537	115,149
7. Ingapu	3	73	661	402,047	162,705
8. Myanaung	6	58	507	383,561	155,223
9. Danubyu	16	63	450	185,184	74,942
Sub-total	65	616	4,570	2,458,911	995,097
Total	168	1,454	9,076	7,134,915	2,887,429

TABLE F-3 POPULATION IN THE PROJECT AREA

Division	Under 17 years	Over 18 years	Total
Irrawaddy (14 townships)	594,208	857,394	1,451,602
Pegu (9 townships)	627,523	875,812	1,503,335
Rangoon (3 townships)	180,094	206,933	387,023
Total	1,401,825	1,904,139	3,341,964

II.2. Rural Survey

Bogyigon Village on the left bank of the Irrawaddy river was selected as sample farm village in this rural survey.

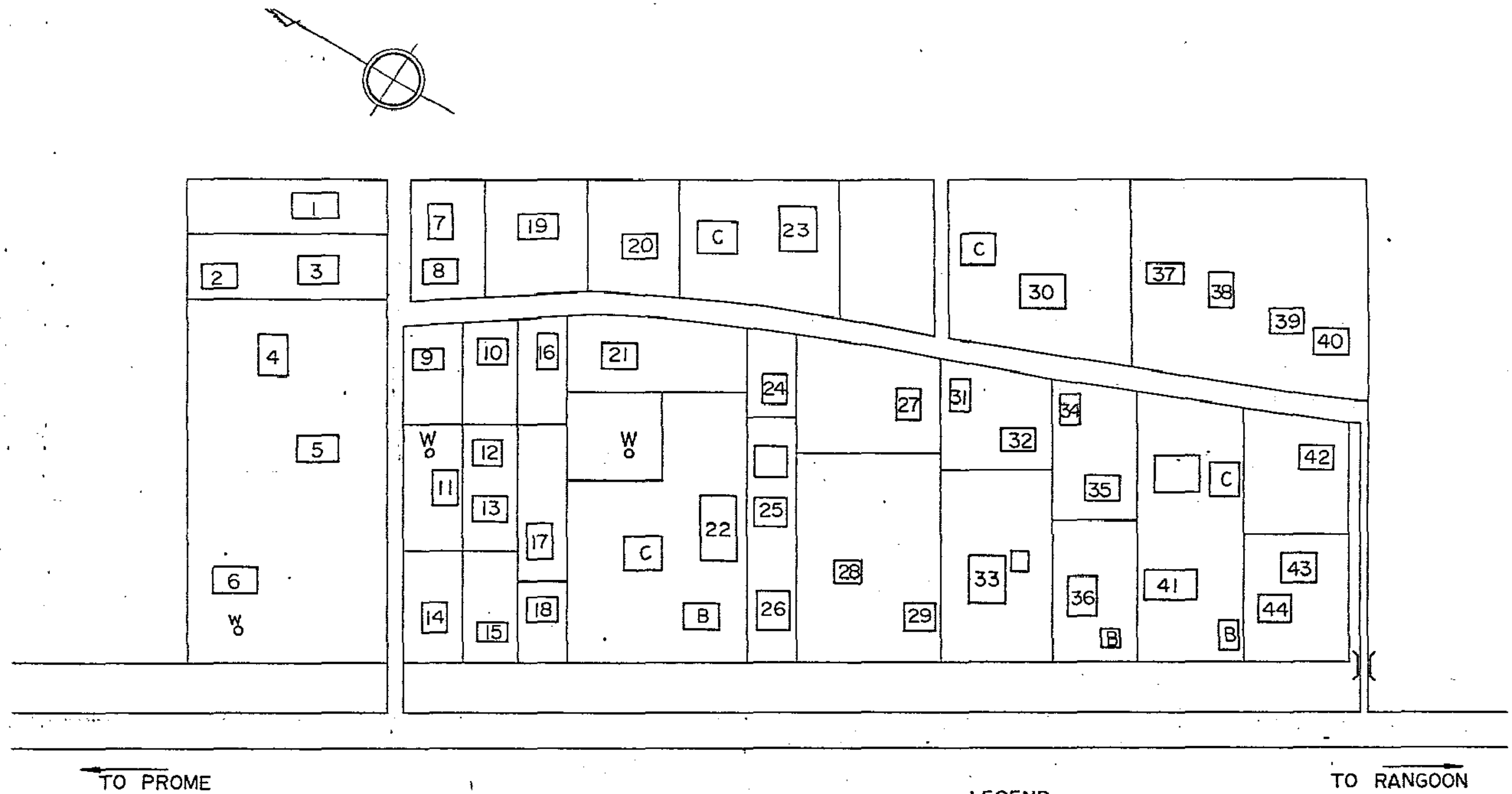
This farm village has 44 households *100% Farm household) and population as of 1979 counts 195. (Male; 95, Female; 100) Also, 100 cattle, four pigs and about 800 chicknes are kept in this village. (Ref. to Fig. F-1)

1) Domestic Water Supply

Domestic water in this village is supplied from three wells, and one of which has hand pump. (Ref. to Fig. F-2) But all of these wells become unavailable in dry season due to reducing of their water level. On such an occasion, villagers must travel more than 400 meters to draw water from the well in neighboring village. Such condition lasts from March to May for three months during the dry season. Some farmhouses use reserved rain water.

2) Village Road

The road networks provided around the village. The road width is 4.5 m (about 15 ft) at its widest part, and 3 m at its narrowest part. Being muddy as it has no side ditches, acutally passable



LEGEND

1-44; House
B ; Barn
C; Cattle Shed
W; Common Use Well

FIGURE F-I PRESENT SITUATION OF THE BOGYIGON VILLAGE

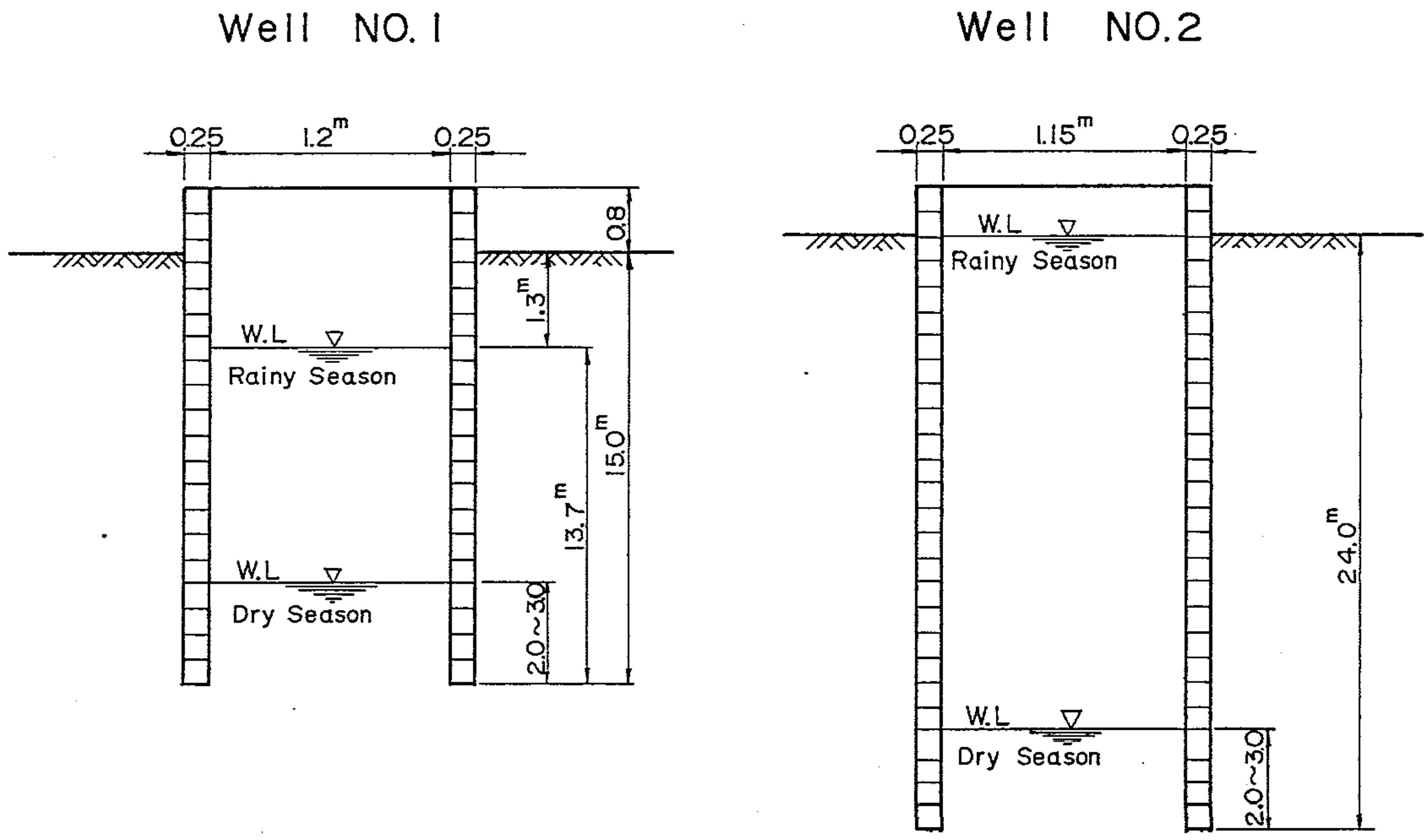


FIGURE F-2 COMMON USE WELLS

width of the road is narrowed down to 0.7 - 1.5 m (about 2.5 - 5 ft).

3) Fuel for Living

Farmers use kerosene lumps for lighting. As for fuel, they collect firewood in the mountains about 30 km (about 20 miles) away from the village after getting permission of Forestry Department. They use cattle to haul firewood.

III. RURAL DEVELOPMENT PROJECT

III.1. Simple Water Supply Project

One of the three wells in Bogyigon village with hand pump was set up in 1959. These wells are of common use, but as learned from Figure F-1, they are inconveniently located for common well. Epidemics prevention problem and sanitary problem could be also pointed out, because they are common wells and villagers get water for bathing, washing, cooking from these wells.

These wells, being shallow wells and unusable during a dry season due to lowered water table, should be converted to deep wells. First, submerged pump should be set up and, the water is pumped up to water supply tower, and delivered through a delivery pipe (Ref. Figure F-3). Pumpingout test is required in order to practice the method. The delivery pipe is provided along the road, and several outlets are located where they could be publicly used. Sanitary problem, as well as women's labour for drawing water will be improved by the conversion of a shallow well to a deep well.

Present duty of water consumption is 27 litres per capita a day, but considering the increase of population and water consumption in future because of improved water works, the average water supply per capita would increased to 65 litres a day.

The average water supply:

for drinking	65 ℓ/man/day x 195 capita	=	12.7 cu.m
for livestock	45 ℓ/head/day x 100 head	=	4.5 cu.m
		Total	17.2 cu.m

Daily peak water requirement: 17.2 cu.m x 1.5 = 25.8 cu.m

Peak water requirement per hour: 25.8cu.mx1/24x1.5=1.6cu.m/hr

Delivery capacity: 1.6 cu.m/60 = 26.6 ℓ/min

Lift: 50 m

Cost estimation is shown in Table F-4.

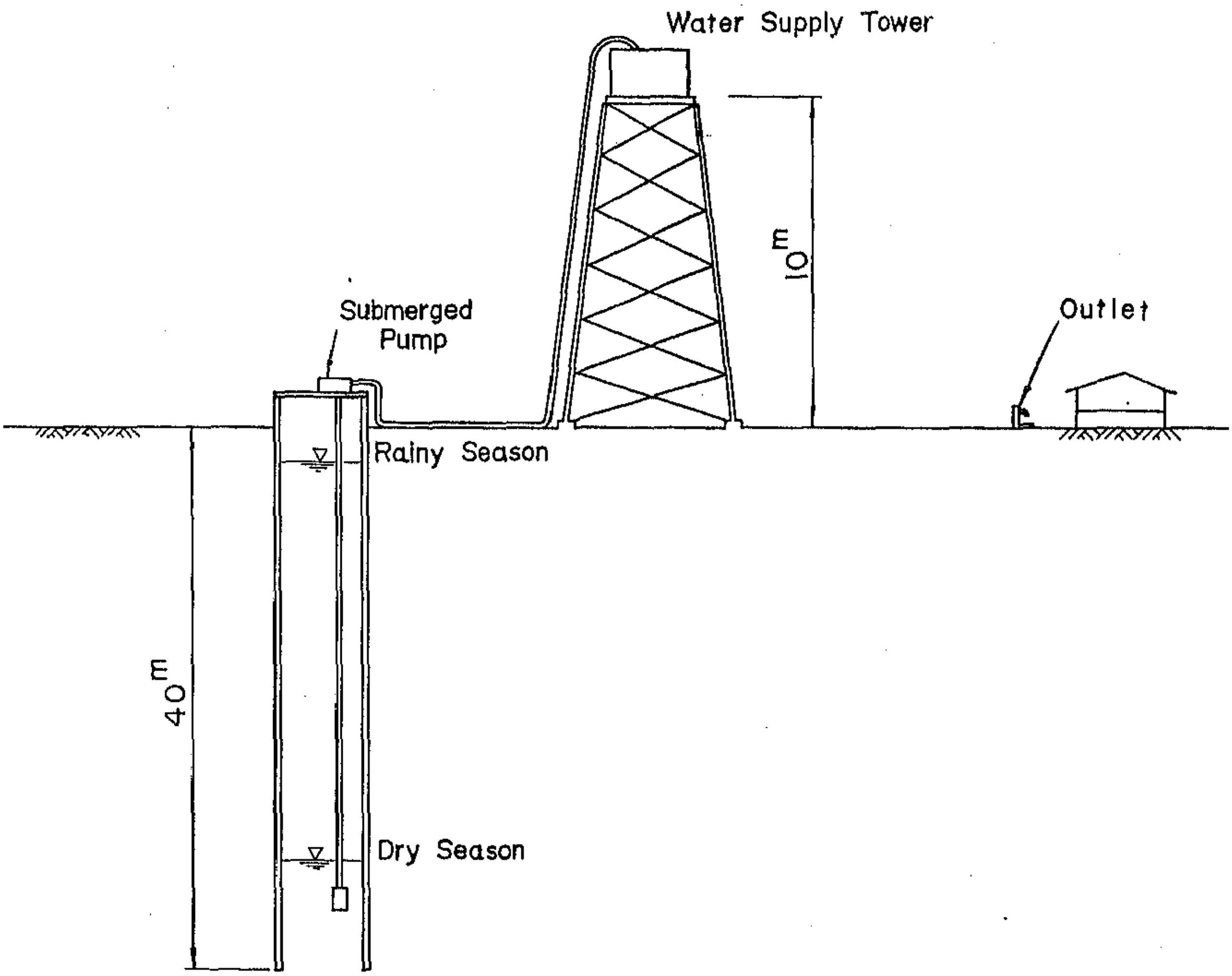


FIGURE F-3 WATER SUPPLY SYSTEM

TABLE F-4 COST ESTIMATION OF SIMPLE WATER SUPPLY SYSTEM

(Unit: Kyats Thousand)

Description	F.C	L.C	Total
Digging	-	25	25
Equipments	12	8	20
Engineering Fee etc.	2	5	7
Preparation	1	3	4
Tax and Transportation	6	-	6
Total (1)	21	41	62
Contingency (2) (15% of 1)	3	6	9
Price Escalation (20% of 1 + 2)	5	9	14
Grand Total	29	56	85

Note: See Appendix F-1 page 1

When this Water Supply Project will be practiced in 9,076 villages in the Project Area, total project cost is following;

$$85^{x10^3 Kyats} \times 9,076^{vilalges} = 771,460^{x10^3 Kyats}$$

say 772 Million Kyat.

III.2. Village Road Improvement Scheme

The present village road, as it was mentioned before, varies in road width, and height of the road is at the same level as the ground level. Therefore, it becomes muddy and loses its function in the rainy season.

In this scheme, the road width will be determined and the mud problem during the rainy season will be improved by increasing the height of road and providing earth ditches on each side of the road for convenience of the villagers' transportation.

The passable road width should be designed at 3.0 m, and the simple pavement would be made with laterite which is available in the Project Area. (Ref. Figure F-4)

Cost estimation is shown in Table F-5.

TABLE F-5 COST ESTIMATION OF VILLAGE ROAD

(Unit: Kyat)

Description	F.C	L.C	Total
Materials	-	4,750	4,750
Engineering Fee etc.	-	713	713
Preparation	-	475	475
Total (1)	-	5,938	5,938
Contingency (2) (15% of 1)	-	891	891
Price Escalation (20% of 1 + 2)	-	1,365	1,365
Grand Total	-	8,194	8,194

Note: See Appendix F-1 page 2

When this Proejct will be done in 9,076 villages in the Project Area, total project cost is calculated as follows;

$$8.194^{x10^3 Kyats} \times 9,076^{villages} = 74,369^{x10^3 Kyat}$$

say 75 Million Kyats.

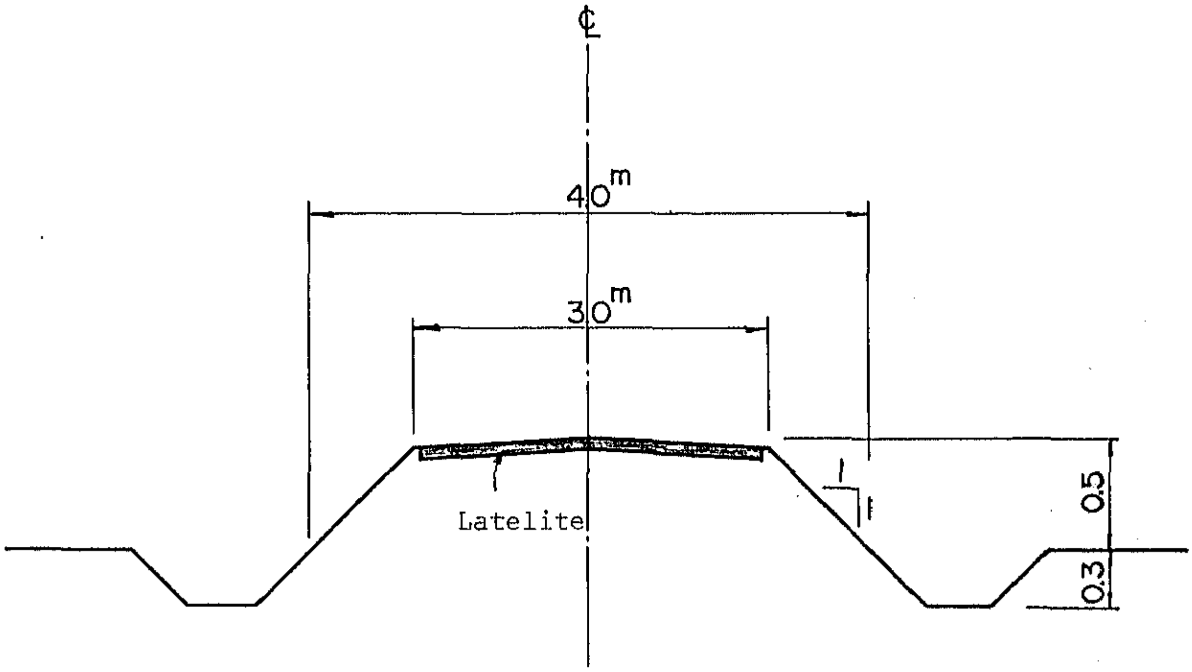


FIGURE F-4 VILLAGE ROAD

III.3. Domestic Fuel Supply Project

Main fuel for living is firewood and chaffs in Burmese villages, but increase in consumption of firewood has been reducing forest resources. Apparently, reduction of firewood resources is furthered. On the other hand, livestock such as cattle, buffaloes, pigs and poultry are kept at every farm village in Burma, and feces of cattle and buffaloes are used as compost and farmyard manure, though the utilization is not so high. Other than compost and farmyard manure, these livestock feces could be used as fuel source. The availability has already been proved in various countries. Therefore, the use of feces as fuel could be also a countermeasure to cope with the reduction of firewood resources in the country.

1) Theory of Methane Gas Generation

Livestock feces have high organic matter contents, and are an ideal material for methane gas production. Methane gas generation is a reaction that organic matter is decomposed into gas such as methane under high anaerobic condition through two stages of reactions as follows. (Ref. to Fig. F-5)

The first stage is a liquefaction process called oxidative fermentation, through which compricated organic matters are decomposed into soluble and small molecular weight matter, then further decomposed into lowgrade fatty acid. The second stage is the process that the low-grade fatty acid is decomposed into methane by methane bacteria. Liquefaction and gasification proceed at the same time in methane fermentation. Therefore, if livestock feces are applied for methane fermentation, both methane gas energy and organic fertilizer which is maturated and liquefied are available in the same process.

2) Necessary Condition for Methane Fermentation

a) Temperature

Middle-temperature fermentation (30 - 40°C) and high-temperature

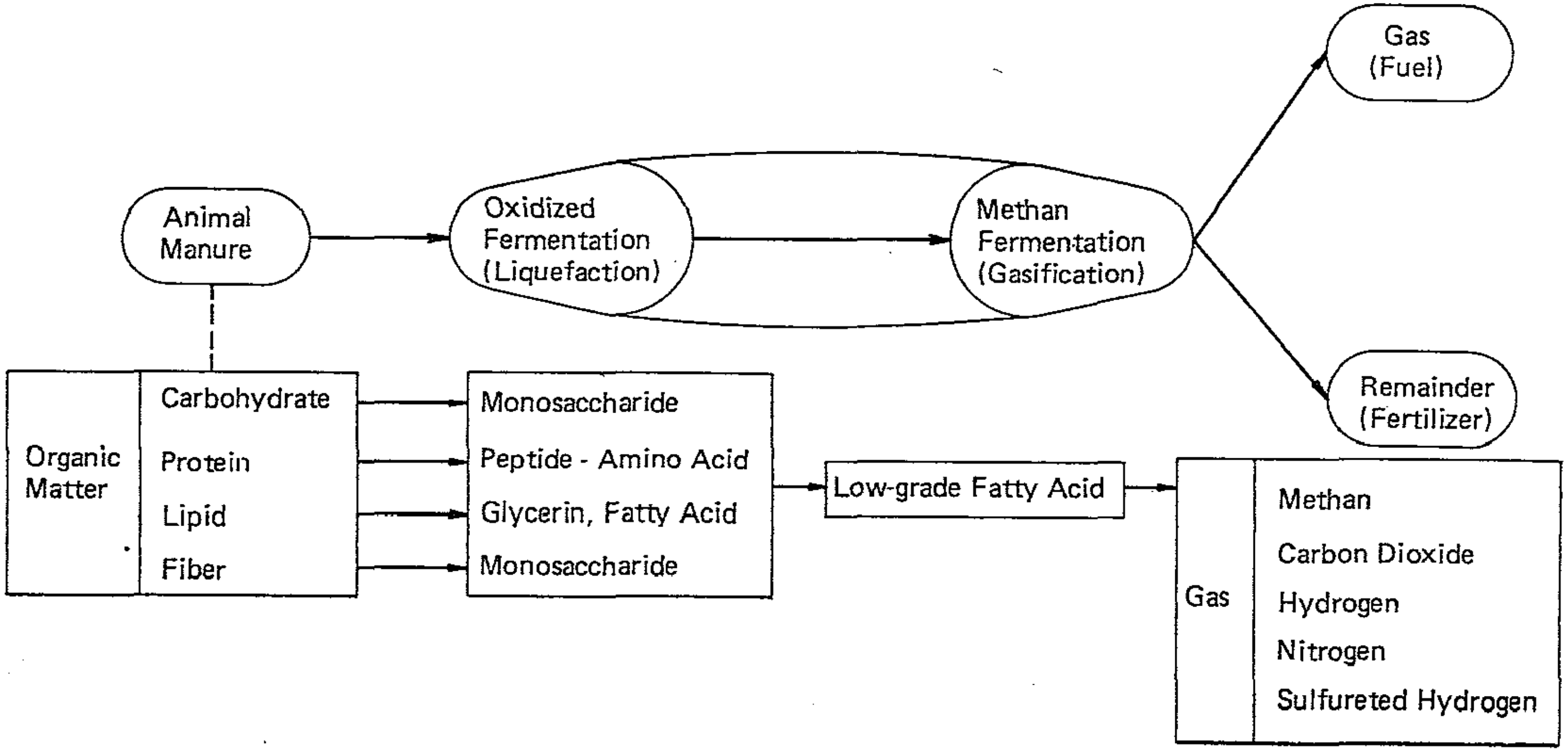


FIGURE F-5 FERMENTATION OF ANIMAL MANURE fermentation (50 - 54°C) are available for methane fermentation. Failure to keep these ranges of temperature will extremely reduce gas production. (Ref. Figure F-6) And it should be noted that sudden change of temperature more than 5°C is harmfull to methane bacteria. Thus, temperature is an important factor for methane fermentation. As learned from Figure-6, high-temperature fermentation has greater treatment capacity, but in case of livestock feces, middle-temperature fermentation around 35°C would be more appropriate in Burma considering economy, and easy operation and maintenance.

b) pH

The most suitable pH for the bacteria concerned in methane gas production is pH 7.0 - 7.5, and gas production is reduced out of range of pH 7.0 - 7.5.

c) Ingredients of Input Organic Matters

The best nitrogen content ratio in organic matter is organic matter/total nitrogen = 10 ∿ 20/1. Also, 1/100 phosphorus content in organic matters is required. The ingredients of livestock feces almost satisfy these requirements.

d) Stirring

The effect of stirring methane fermentation tank would be as follows:

i. to unify temperature in the tank,
ii. to heighten the contact probability of organic matter with fungi,
iii. to exclude products (methane gas) and obstructs (hydrogen sulfide) from the liquid and to promote fermentation, and
iv. to shatter the scum.

3) Organic Matter Loading and Gas Production

Methane gas is available daily by putting the organic matter

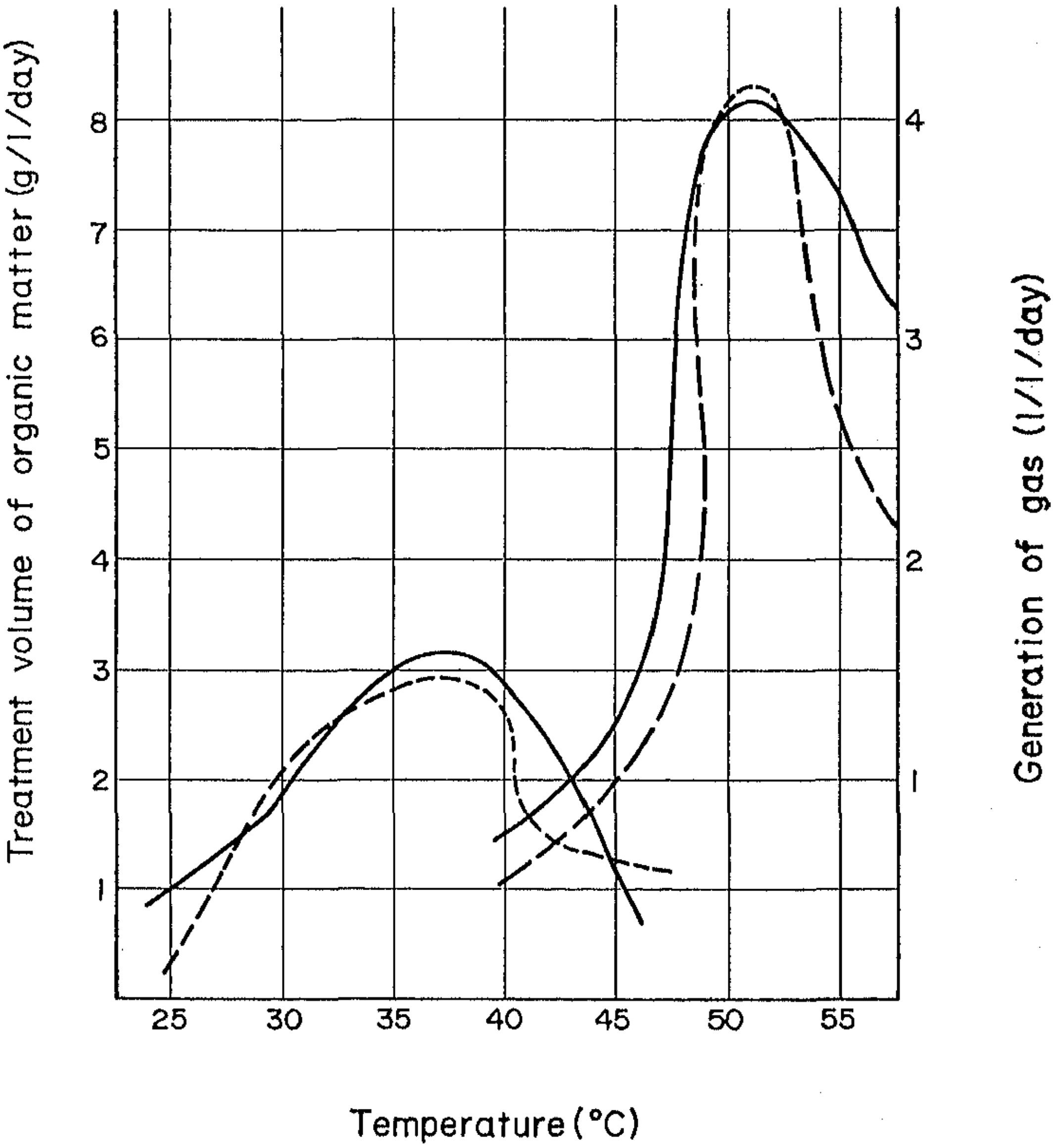


FIGURE F-6 SUITABLE TEMPERATURE FOR METHANE FERMENTATION successively day after day into the fermentation tank in which naturally methane fermented sludge from river or swamp is cultivated as a seed by adding animal manure little by little. For successful fermentation, it is better to put the organic matter (animal manure) daily. The organic matters loading is a measure that shows how much organic matter should be put per cu.m in the tank a day. It is shown by the unit organic matter kg/tank cu.m/day. Generally, middle-temperature fermentation requires that of 2 - 3 kg/cu.m/day, 5 - 6 kg/cu.m/day in case of high-temperature fermentation. The gas production is 300 - 700 ℓ (methane content 50 - 80%) per 1 kg of organic matter. Orhanic matter loading of 2 - 4 kg/cu.m/day is appropriate in case of livestock feces. The gas production of one kilogramme for organic matter is about slightly less than 100 ℓ in case of cattle's feces, 400 ℓ in case of pig's, and 300 ℓ in case of chicken's. Cattle feces show the highest methane content in the gas, then pig and chicken follow. The content of methane ranges from 50 - 80% (Ref. Table F-6). Most of the ingredients other than methane is carbon dioxide, and it might be considered that methane and carbon dioxide consist nearly 100 percent of the ingredients, and small amount of water steam, hydrogen and hydrogen sulfide complete the whole ingredients. Hydrogen sulfide is a corrosive gas, and it requires desulfurization when metalic apparatus is used.

The calorie value of methane gas is 9,500 kcal/cu.m and methane gas produced from livestock feces has about 4,750 - 7,600 kcal/cu.m (methane content 50 -80%). Sometimes methane gas could be explosive, depending on the mixing rate with the air.

4) Usage of Methane Gas

Methane gas from livestock feces has about 6,000 kcal/cu.m, and this fuel could be a substitute for firewood and chaffs. For example, assuming that pig feces excretion is 2.5 kg/head, organic matter content is 20 percent, and gas production is 400 ℓ per one

TABLE F-6 TEMPERATURE, LOADING AND GAS PRODUCTION FOR METHAN FERMENTATION OF ANIMAL MANURE

Livestock	Tempera-ture	Organic matter loading (kg/cu.m/day)	Number of staging (day)	Gas pro-duction (ℓ/organic matter kg/day)	Methane gas content (%)
Milk Cow	23.3	1.69		76.4	52
	23.3	2.59		103.8	64
	35.0	1.56	10 - 30	154.7	59
	35.0	2.75		144.5	57
	35.0	1.6 - 4.8		337.0	60 - 80
Pig	32.5	1.9	10	252.7	58 - 61
	32.5	1.9	15	419.1	
	32.5	3.8	10	402.7	
	32.5	3.8	15	447.8	
	35.0	3.2	10	483.6 - 638.6	59
	36 - 37	4.65	20	360 - 400	71 - 82
Chicken	23.3	2.20		102.4	32
	23.3	3.57		66.4	48
	35.0	2.21		263.9	22
	35.0	3.90		212.3	49
	32.5	1.9	10	303.3	52 - 48
	32.5	1.9	15	359.8	
	32.5	3.8	10	304.1	
	32.5	3.8	15	279.2	

kilogramme of organic matter, feces of five pigs are sufficient in order to acquire one cubic meter gas a day. Capacity of the fermentation tank will be one cubic meter if organic matter loading is designed at 2.5 kg/cu.m/day. But, actual capacity of the fermentation tank becomes about 1.2 cu.m, because a space for accumulating gas is required on the top. The storing days in the fermentation tank will be 20 - 27 days, as feces are diluted with washing water to 1/3 - 1/4 consistency. The required calorie per Burmese household a day is not certain, but according to a data of Japanese household, about 0.7 cu.m/day of methane gas for single Burmese household is estimated.

Therefore, feces from four pigs will be sufficient according to the above estimation.

Similarly, cattle feces excretion is 30 kg/day, gas production acquired from one kilogramme of organic matter is about 100 ℓ; therefore, methane gas acquired from a cow is calculated as follows:

Organic matter	30 kg/head/day x 0.2 = 6 kg
Gas production	6 x 100 ℓ = 600 ℓ/head

Thus, in case of cattle, 1.2 heads are sufficient in order to acquire 0.7 cu.m gas for a household per day.

Cattle have advantages over pigs in breeding, because their breeding number is greater than that of pigs, feces are easily get, and a fewer cattle acquire the same amount of calorie from their feces compared with those of pigs.

5) Application of Methane Gas as Fuel to Farm Villages

When the above mentioned theory is applied to Bogyigon village, it will be as follows:

Required methane gas

0.7 cu.m x 44 household = 30.8 cu.m/day

Number of livestock necessary for producing 30.8 cu.m of Methane gas

In case of cattle -- 30.8 cu.m ÷ 600 ℓ = 51 cattle (head)

In case of pig ----- 30.8 cu.m ÷ 200 ℓ = 164 pigs (head)

At present, 100 cattle, four pigs and 800 chickens are kept in Bogyigon village, so domestic fuel of the village could be almost managed by methane gas using cattle feces only. Also, as this method is available with a simple equipment, this is applicable not only to farm village but also nation wide L.D.M.C. farms for nursing piglets and chicks required heating. And it has the possibility of supplying electricity. Feces that are through the methane fermentation decompose 40 - 50 percent of the organic matter, but they are useful as fertilizer, because ingredients such as nitrogen, phosphoric acid and potassium are maintained.

6) Methane Gas Fermentation Tank

A tank which is made of bricks and mortared would be easily constructed as a fermentation tank. The gas produced from such a tank does not have high pressure, therefore, it is desirable that the delivery area is within 30 m. The scale of the tank would be required as follows for the use of three farmhouses in the neighborhood:

Requirement of gas

0.7 cu.m x 3 household = 2.1 cu.m/day

Number of cattle required

2.1 cu.m ÷ 600 ℓ = 3.5 head

Input feces amount

3.5 capita x 30 kg = 105 kg

Content of organic matter

105 kg x 0.2 = 21 kg

Organic matter loading per cu.m of tank

3 kg/cu.m/day

Capacity of fermentation tank

21 ÷ 3 = 7 cu.m

The capacity is 7 cu.m per tank, but actually capacity around 8.5 cu.m (H 1.5 x B 2.4 x W 2.4) tank is required, because there must be a space for gas accumulation on the upper portion of the tank (Ref. to Fig. F-7). 14 fermentation tanks such as shown on the Figure F-7 are required at Bogyigon village. Cost estimation is shown in Table F-7.

TABLE F-7 COST ESTIMATION PER METHANE FERMENTATION TANK

Description	F.C.	L.C.	Total
Digging	-	288	288
Materials	185	1,397	1,582
Sub-total (1)	185	1,685	1,870
Engineering Fee etc. (5% of 1)	9	84	93
Preparation (5% of 1)	9	84	93
Tax and Transportation (10% of 1)	18	-	18
Total (2)	221	1,853	2,074
Contingency (15% of 2)	33	277	310
Price Escalation 1/ (20% of 2 + 3)	50	426	476
Grand Total	304	2,556	2,860

Note: 1/ 8% annum
See Appendix F-1 page 3

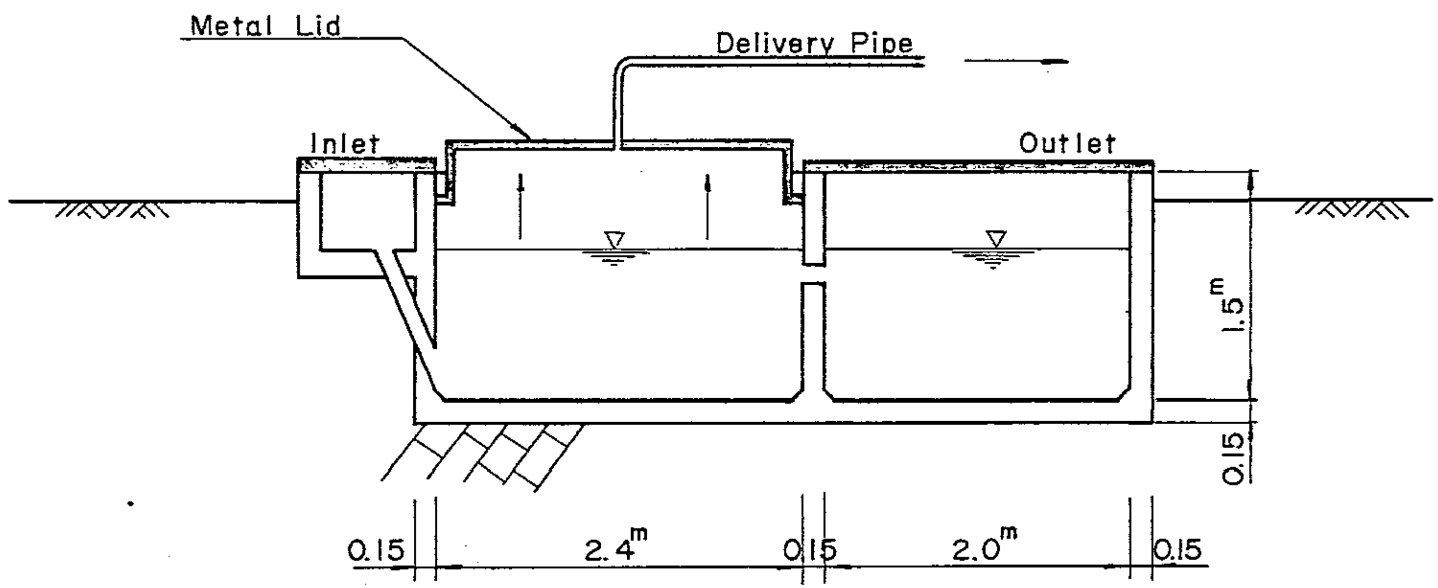
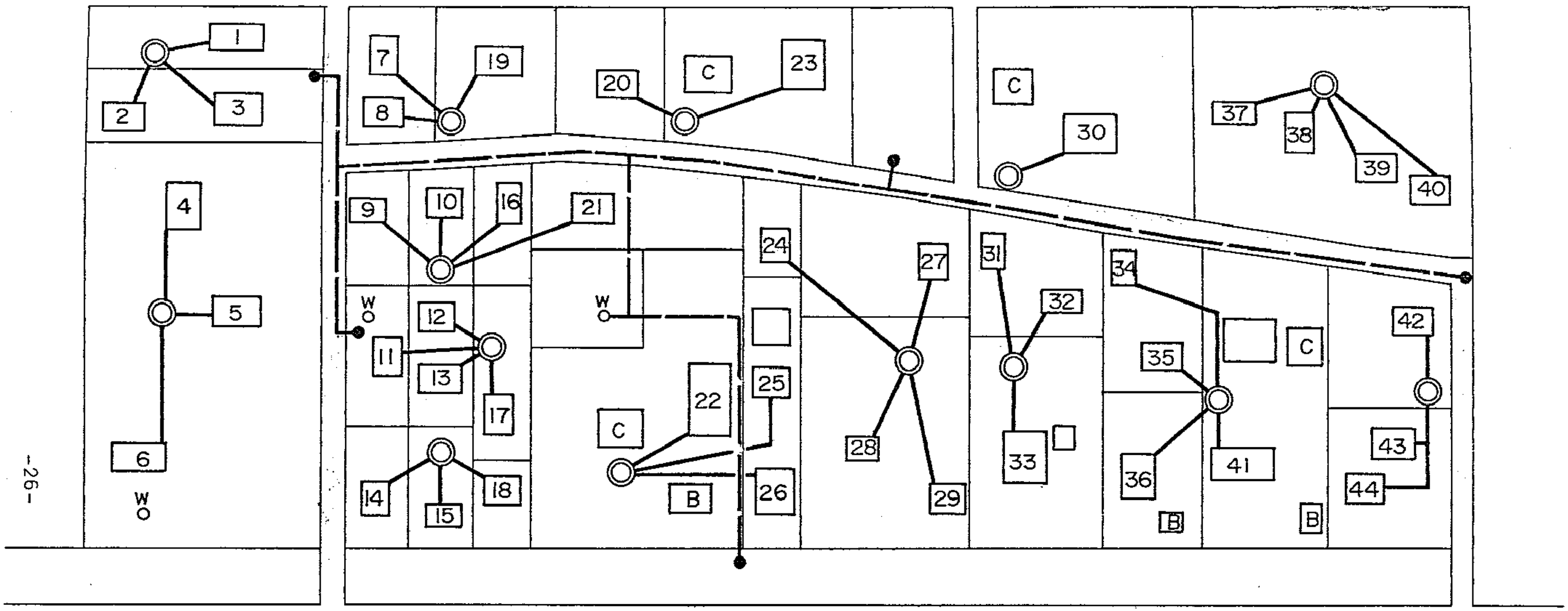


FIGURE F-7 TANK OF METHANE FERMENTATION



LEGEND

1 – 44:	House	● :	Outlet
B :	Barn	– – – :	Delivery Pipe
C :	Cattle Shed	——— :	Delivery Pipe for Gas
W :	Common Use Well	◎ :	Methane Fermentation Tank

FIGURE F-8 PLANNING FIGURE AFTER CONSOLIDATION

APPENDICES

Appendix F-1 COST ESTIMATIONS

COST ESTIMATION OF SIMPLE WATER SUPPLY SYSTEM

(Unit: Kyat Thousand)

Description	Quantity	F.C	L.C	Total
Digging	16m	-	25	25
Submerged Pump	1	12	-	12
Water Supply Tower	1	-	7	7
Delivery	336	-	1	1
Outlet	5	0.3	-	0.3
Sub-total (1)	-	12.3	33	45.3
Engineering Fee etc.	(15% of 1)	2	5	7
Preparation	(10% of 1)	1	3	4
Tax and Transportation	(50% of 1)	6	-	6
Total (2)		21.3	41	62.3
Contingency (3)	(15% of 2)	3	6	9
Price Escalation 1/	(20% of 2+3)	5	9	14
Grand Total		29.3	56	85.3

Note: 1/ 8% per annum

COST ESTIMATION OF VILLAGE ROAD ($L=372^m$)

(Unit: Kyat)

Description	Quantity	F.C	L.C	Total
Compaction	652 m^3	-	4,300	4,300
Cutting	67 m^3	-	450	450
Sub-total (1)		-	4,750	4,750
Engineering Fee etc.	(15% of 1)	-	713	713
Preparation	(10% of 1)	-	475	475
Total (2)		-	5,938	5,938
Contingency (3)	(15% of 2)	-	891	891
Price Escalation 1/	(20% of 2+3)	-	1,365	1,365
Grand Total		-	8,194	8,194

Note: 1/ 8% per annum

COST ESTIMATION PER METHANE FERMENTATION TANK

(Unit: Kyat)

Description	Quantity	F.C	L.C	Total
Digging	36^{m^3}	-	288	288
Bricks	38^{m^2}	-	1,368	1,368
Concrete	0.1^{m^3}	-	29	29
Delivery	30^{m}	85	-	85
Portable Range	3	100	-	100
Sub-total (1)		185	1,685	1,870
Engineering Fee etc.	(5% of 1)	9	84	93
Preparation	(5% of 1)	9	84	93
Tax and Transportation	(10% of 1)	18	-	18
Total (2)		221	1,853	2,074
Contingency (3)	(15% of 2)	33	277	310
Price Escalation 1/	(20% of 2+3)	50	426	476
Grand Total		304	2,556	2,860

Note: 1/ 8% per annum

ESTIMATION OF PRICE ESCALATION RATE

	Project Name	Allocation 1st year	2nd	3rd	4th	5th	Disbursement Schedule 1st year	2nd	3rd	4th	5th	Total	Average Price Escalation
	Feed Mill Plant	5%	70%	20%	5%	-	2,374	38,893	11,967	3,490	-	56,724	19%
Animal Husbandary	Cattle Breeding Center	10%	80%	10%	-	-	327	3,063	412	-	-	3,802	16%
Animal Husbandary	Pasture Land Development	10%	70%	20%	-	-	443	3,629	1,117	-	-	5,189	17%
Animal Husbandary	Pig and Poultry Breeding Center	30%	60%	10%	-	-	1,276	2,985	536	-	-	4,797	13%
Animal Husbandary	Slaughter House	5%	60%	30%	5%	-	2,961	41,571	22,384	4,027	-	70,943	20%
	Stuck Silo	25%	25%	25%	25%	-	310,853	363,698	391,675	422,760	-	1,488,986	20%
Fishery	Introduction of Grass Carp Spawns	10%	30%	30%	20%	10%	55	192	207	149	80	683	25%
Rural Development	Simple Water Supply System	25%	25%	25%	25%	-	161,099	188,486	202,985	219,095	-	771,665	20%
Rural Development	Village Road	"	"	"	"		15,495	18,129	19,524	21,073	-	74,221	20%
Rural Development	Methane Fermentation Tank	"	"	"	"		75,730	88,604	95,420	102,993		362,747	20%

Note: 8% per annum of price escalation rate is applied.

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