Conjunctive Use of Spate Water and River Pumping Water in Twingyi Pump Irrigation Project

Presented by
Daw Nay Chi Win Maung
Junior Researcher at Hydro-Informatics Centre
AIRBM Project Component(1)

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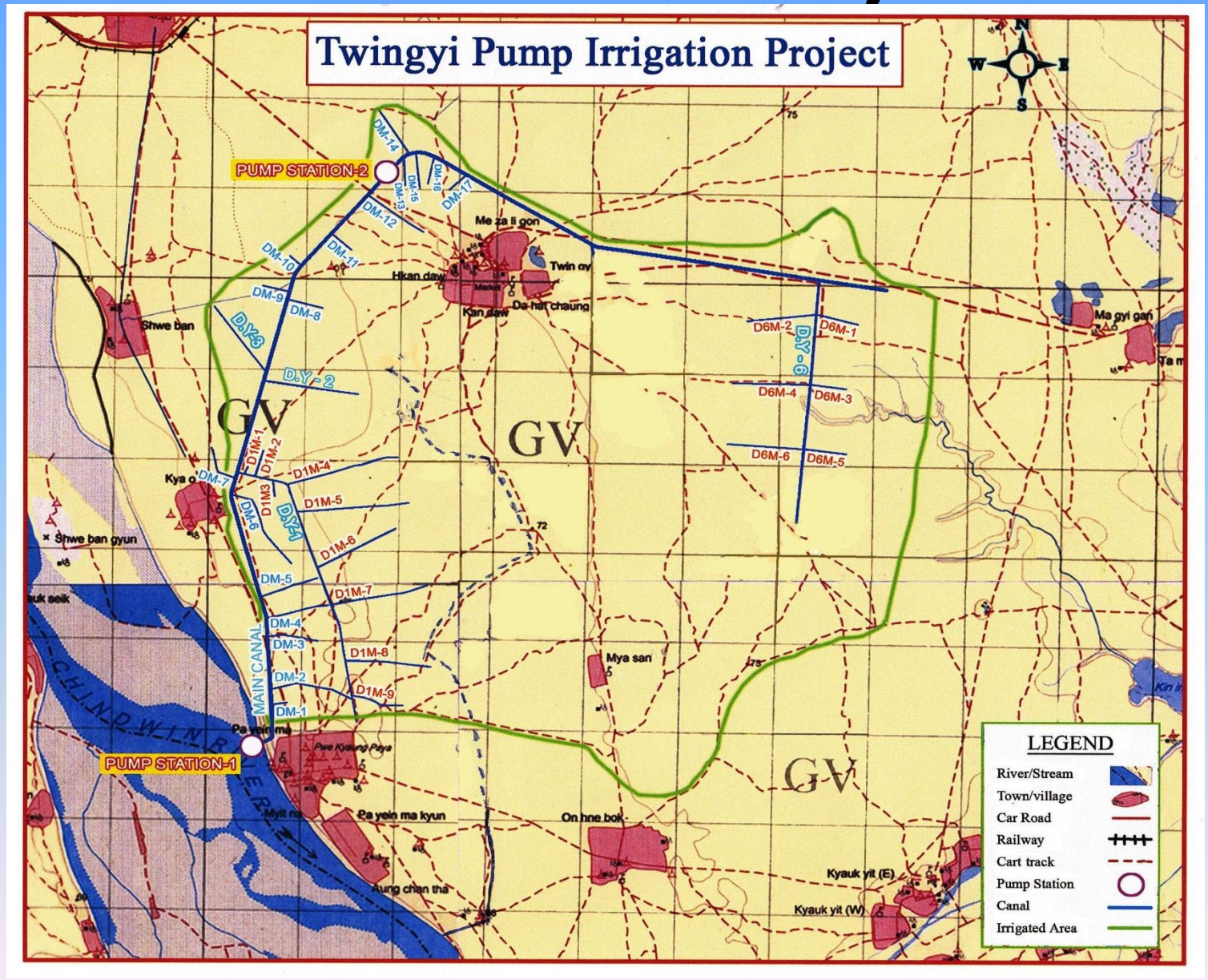
Introduction to Study Area



Objectives of the Study

- To maximize the crop yield from the cultivated area.
- To develop the conjunctive use of spate water and river pumping water
- To conduct the design of pump irrigation system for the irrigable area near Twingyi villages.
- To develop the spate irrigation system for the effective use of flood water in the rainy season.
- To develop suitable drainage design for controlling flood of the proposed irrigable area.

Crop Water Requirement

- Crop water requirement (ET_c) is the amount of water required to compensate the evapotranspiration loss from the cropped field.

$$\mathbf{ET_c = K_c . ET_o}$$

Where,

ET_C =Crop Evapotranspiration(mm / day)

K_C =Crop Coefficient

ET_O =Reference Crop Evapotranspiration (mm /day)

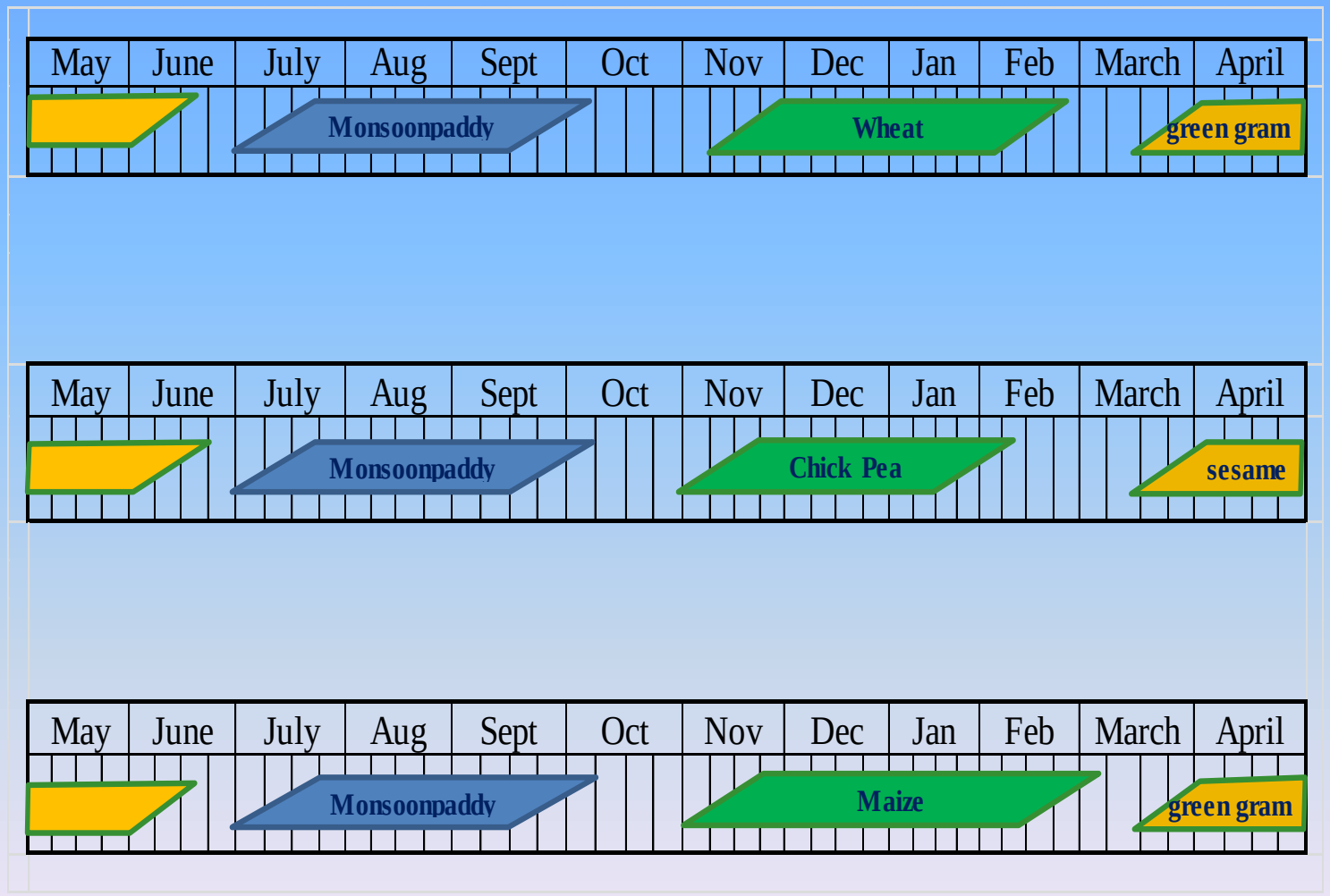
- The crop water requirement for Twingyi Pump Irrigation is calculated by CROPWAT 8.0 software.
- CROPWAT is a piece of software designed for the calculation of the right amount of water needed for the irrigation of crop field.
- It is based on FAO Penman-Monteith method which is recommended as the sole standard method.

Cropwat 8.0 (continued)

Input Data

- Climatic Data
- Crops Data
- Soil data

Crop pattern with various crops



Results of irrigation water requirement by CROPWAT 8.0

Irrigation water requirement (mm/dec)						
Year	monsoon paddy	wheat	chick pea	maize	sesame	green gram
2001	643	305.9	201.7	324.9	324.4	249.5
2002	409.4	262.9	166.9	276.5	312.4	280.5
2003	536.7	303.1	214	311.4	188	164.4
2004	413.2	337.6	231.6	352.4	173.6	170.2
2005	475.8	297.2	193.4	313.7	369.5	348.2
2006	392.4	328.1	200.5	320.5	194.9	171.2
2007	615.6	308.9	196	302.1	203.9	173.7
2008	**666.9**	309.1	218.2	312.6	299.5	266.5
2009	661.5	348.7	259.6	357.7	277.8	248.9
2010	453.6	300.4	213.7	302.7	272.3	252.5

- Maximum irrigation requirement = 666.9 mm/dec

Estimation of duty

Duty of water is the total volume of irrigation water required to mature a particular type of crop.

Irrigation efficiency, $E_p = E_a \times E_b \times E_c = 0.51$

Irrigation requirement at pump site = $\frac{Irrigation\ requirement}{irrigation\ efficiency}$

Volume of water one cusec running for one day

= 1 x 24 x 60 x 60= 86400 ft^3 = 2 acre –ft

Duty for irrigation = 2Acre-ft x $\frac{No.of\ base\ period}{Depth\ of\ water}$

Estimation of duty(Continued)

Crops	maximum irrigation requirement		Base period (days)	IR at pump site (ft)	Duty for irrigation (Acre/cusec)
	mm	ft			
monsoon paddy	666.9	2.19	100	4.29	46.63
wheat	348.7	1.14	120	2.24	107.02
chick pea	367.3	1.20	100	2.36	84.67
maize	357.7	1.17	125	2.30	108.67
sesame	369.5	1.21	110	2.38	92.58
green gram	348.2	1.14	100	2.24	89.31

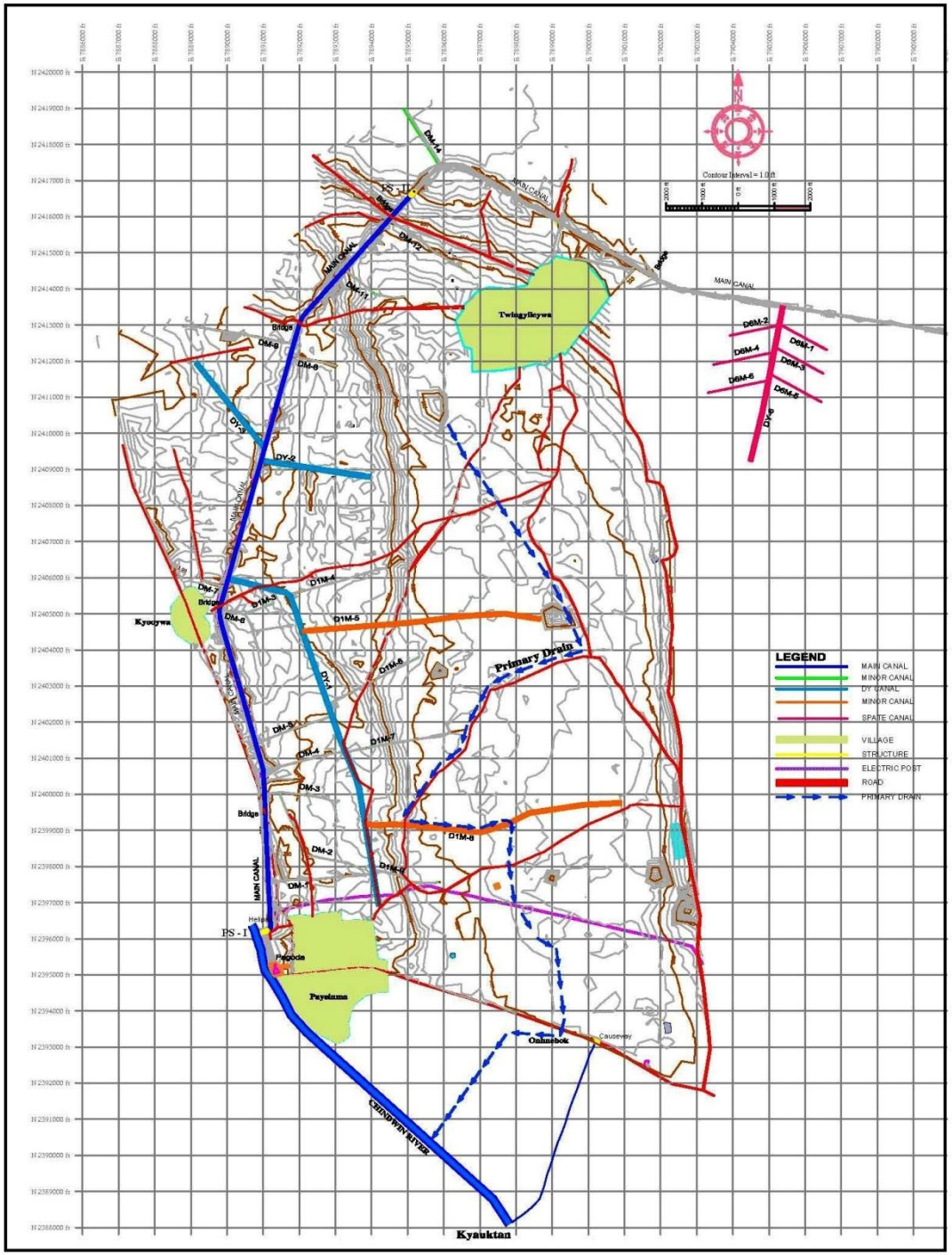
∴ Duty of water = 46.67 Acre/ cusec (Take 50 Acre/ cusec).

∴ The duty of water for pump irrigation for 12 hour water supply is taken as 25 Acre/cusec.

Estimation of duty(Continued)

- The duty of water for spate irrigation is different from that of pump irrigation.
- Since spate irrigation use only the flood water, the sum of raining days during the raining season is considered for the calculation of duty.
- The sum of raining days from May to October (6months) for the year of 2001 to 2010 is 37.7days.
- Thus, the average raining day for 1month is 6.28 days.
- The duty of water for spate irrigation system for 6.28 raining day = 50 x 6.28/30

  = 10.38 acre/cusec
- Therefore, duty of water for spate irrigation is taken as 10 acre/cusec



Canal Alignment of Twingyi Pump Irrigation Project

Design of Irrigation Canal

- In this study, irrigation canals designs are conducted according to Manning's formula.
- Design discharge (cusec)= Irrigable area $\times$ 1.2/ duty

For main canal,

Design discharge = 5000 x 1.2 / 50 = 240 cusec

Note: Design discharge is usually adopted 15 to 20 percent larger than the discharge at the month of maximum demand. So, add 20 percent for maximum demand and design discharge for main canal becomes 240 cusec.

Design of Pump Irrigation System

Name	Width (B)	Depth (D)	n	Bed Slope (S)	Side slope (z)	Area (A)	Wetted Parameter (P)	Velocity (V)	Design Discharge (Q= A.V)
	(ft)	(ft)				(sq ft)	(ft)	(ft/s)	(cusec)
Main Canal RD(0-101+00)	10.000	5.500	0.025	1/3000	1.5	100.375	29.831	2.447	245.590
Main Canal RD(101+00 - tail)	8.000	5.500	0.025	1/3000	1.5	89.375	27.831	2.371	211.943
DY 1	5.500	3.500	0.025	1/2000	1.5	37.625	18.119	2.169	81.593
DY 2	5.000	2.500	0.025	1/2000	1.5	21.875	14.014	1.791	39.182
DY 3	3.250	2.000	0.025	1/2000	1.5	12.500	10.461	1.498	18.719
DM 1	3.000	1.750	0.025	1/2000	1.5	9.844	9.310	1.380	13.582
DM 2	3.000	1.750	0.025	1/2000	1.5	9.844	9.310	1.380	13.582
DM 3	2.250	1.500	0.025	1/2000	1.5	6.750	7.658	1.221	8.244
DM 4	2.500	1.750	0.025	1/2000	1.5	8.969	8.810	1.345	12.064
DM 5	2.500	1.750	0.025	1/2000	1.5	8.969	8.810	1.345	12.064
DM 6	2.500	1.750	0.025	1/2000	1.5	8.969	8.810	1.345	12.064
DM 7	2.500	1.750	0.025	1/2000	1.5	8.969	8.810	1.345	12.064

Spate Irrigation System

- Spate irrigation – diversion of floodwater through hydraulic structures and canals to spread water over the agricultural lands and is the most cost effective solution for irrigation, especially in the dry zone.
- Spate irrigation is a type of water management that is unique to arid and semi-arid regions.
- The objective is to divert the maximum possible amount of water from the river to the fields, during the very limited spate period-a few hours or a few days.
- The simplest method of estimating mean annual runoff is to apply a runoff coefficient to the mean annual rainfall over the catchment.

MAR = k . MAP

Where, MAR=mean annual runoff (mm)

MAP=mean annual precipitation (mm)

k =runoff coefficient

Spate Irrigation System (Continued)

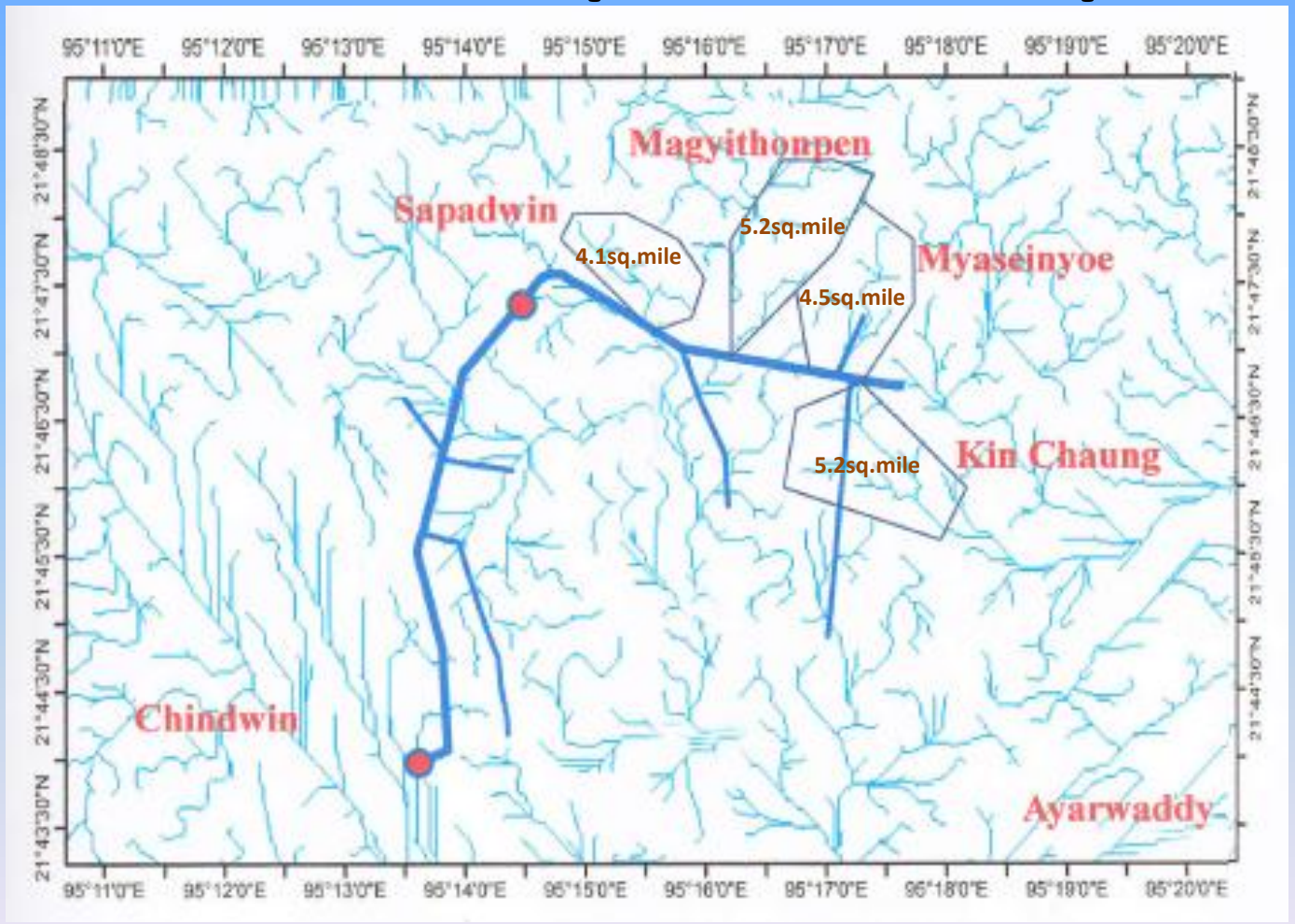


Fig: Watershed of Twingyi Pump Irrigation Project

Spate Irrigation System

- Spate irrigation water resources management plan would ensure supply of water for irrigation and thus would improve the quality of life in the area and ultimately leads to sustainable development.
- In spate irrigation system, flood water from the Spardaw creek, Mya Sein Creek, Magyi thone Pen Creek and Kin Chaung Creek will diverted to the irrigation field at the downstream of the Pump Station II (PS II). .
- The annual runoff coefficient is assumed 0.22 or 22%. The mean annual rainfall of this area is 29 inches.

$$\text{Mean annual runoff} = \text{runoff coefficient} \times \text{mean annual prcipitation}$$

$$\text{Mean annual yield} = \text{mean annual runoff} \times \text{Catchment area}$$

$$\text{Potential irrigable area} = \frac{\text{mean annual yield}}{\text{required depth of water for paddy}}$$

Spate Irrigation System (Continued)

No	Name	Catchment area (square mile)	Mean annual yield (Acre-ft)	Potential irrigable area (Acre)
1	Sapardaw Creek	4.1	1390.72	324.18
2	Magyithone Pen Creek	5.2	1763.84	411.15
3	Mya Sein Creek	4.5	1526.4	355.71
4	Kin Chaung Creek	5.2	1763.84	411.15
Total		19	6444.8	1502.29

Spate Irrigation System (Continued)

- Total potential irrigable area by spate irrigation system is 1502.29 Acre (Say 1500 Acre)
- Spate (flood water) from drainage channel will supply to the irrigation canal during short flood period.
- Therefore, drainage water will supply the irrigation canal during short flood period lasting for a few hours or a few days.
- Design discharge for main canal = 1.2irrigable area/duty

  = 1.2 x 1500/10 = 180 acre/cusec

Design of Spate irrigation canal

Name	Width (B)	Depth (D)	n	Bed Slope (S)	Side slope (z)	Area (A)	Wetted Parameter (P)	Velocity (V)	Design Discharge (Q= A.V)
	(ft)	(ft)				(sq ft)	(ft)	(ft/s)	(cusec)
Spate main canal	6.500	5.500	0.025	1/3000	1.5	81.125	26.331	2.306	187.111
DY 6	6.250	5.000	0.025	1/2000	1.5	68.750	24.278	2.670	183.535
D6M1	3.500	2.750	0.025	1/2000	1.5	20.969	13.415	1.793	37.592
D6M2	3.500	2.750	0.025	1/2000	1.5	20.969	13.415	1.793	37.592
D6M3	3.500	2.750	0.025	1/2000	1.5	20.969	13.415	1.793	37.592
D6M4	3.500	2.750	0.025	1/2000	1.5	20.969	13.415	1.793	37.592
D6M5	3.000	2.250	0.025	1/2000	1.5	14.344	11.112	1.577	22.620
D6M6	3.000	2.250	0.025	1/2000	1.5	14.344	11.112	1.577	22.620

Design of Hydraulic Structure

- According to the topography of the study area and hydraulic requirement of canal system, various types of hydraulic structures are provided in the canal.
- In this study, head regulators will regulates water at the junction of drainage channels and irrigation canals. In the design of the opening size of the head regulators, orifice formula is used
- $V = C_d\sqrt{2gh}$

  Where, C_d = orifice coefficient

  A_o= Area of the orifice (ft^2)

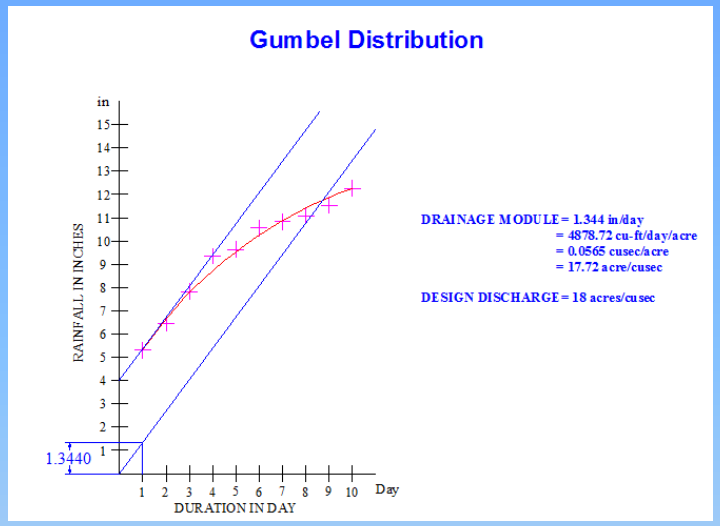
  H = head difference (ft)

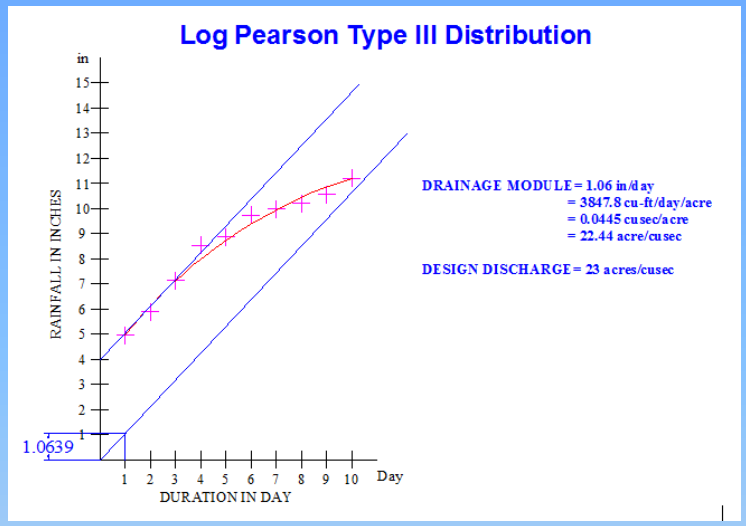
  Q = Discharge (cusec)

Estimation of Drainage Module

- Drainage module is needed to consider for the design discharge of the drainage system.
- The design capacity, or drainage modulus is based on the amount of rainfall which may cause undesirable flooding during critical phases of rice growth in periods lasting 1,2,3,4,5 or more (n) days.
- It is expected to occur once in 1,2,3,4,5….10 or more (T) years.
- For calculation of Drainage module, flood frequency analysis methods are used.
- In flood frequency method, the observed data of the past flood is used to predict the future flood of the particular probability or return period.
- In this study Gumbel's distribution method, Log normal distribution method and Log Pearson Type III distribution method are used.
- The daily rainfall data from 2001 to 2010 of Monywa station are analyzed in rainfall frequency analysis.

Estimation of Drainage Module





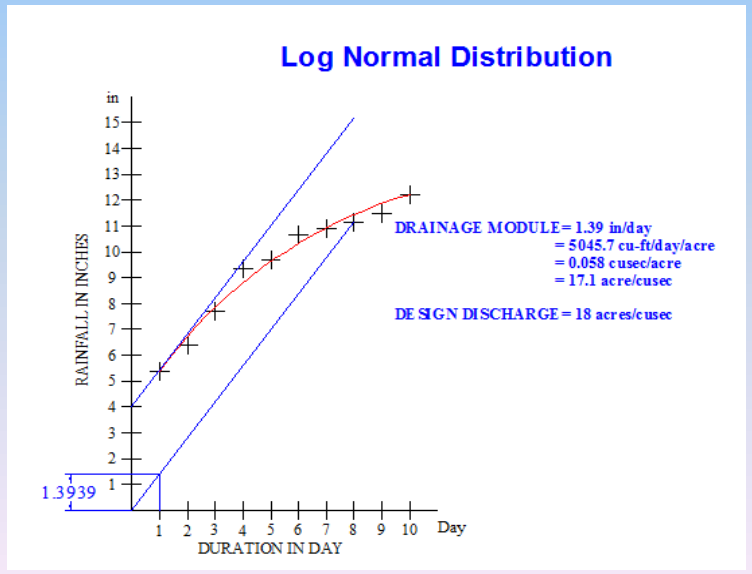


Fig: Rainfall Frequency Duration Curve

Estimation of Drainage Module

Log Normal Distribution Method					
Drainage of Excess Water in the Field, D_m = 1.39 "/day					
Duration (day)	Cumulative Rainfall (in)	Cumulative Drainage (in)	Water in The Field(in)	Water Level	
				Initial Depth (in)	Total Depth (in)
1	5.3745	1.39	3.9845	2	5.9845
2	6.3660	2.78	3.5860	2	5.5860
3	7.6967	4.17	3.5267	2	5.5267
4	9.3666	5.56	3.8066	2	5.8066
5	9.6662	6.95	2.7162	2	4.7162
6	10.6371	8.34	2.2971	2	4.2971
7	10.9065	9.73	1.1765	2	3.1765
8	11.1502	11.12	0.0302	2	2.0302
9	11.5007	12.51	-1.0093	2	0.9907
10	12.2346	13.9	-1.6654	2	0.3346
The amount of water that can be temporaily stored without harming the rice plant is 4" above normal level of 2" which amounts to 6" inches.					
Duration of flooding, more than allowable depth will not be greater than six days for paddy-resistance.					

Summary for Calculated Drainage module of Twingyi Pump Irrigation Project

Method	Design Discharge (in/day)	Design Discharge (acres/cusec)
Gumbel Distribution Method	1.344	18
Log Normal Distribution Method	1.39	18
Log Pearson Type III Distribution Method	1.06	23

- It is found that the design discharge of the proposed study is 18 acre/cusec according to Log Normal Distribution Method.
- For the crop yield, the maximum total depth of water that can retain in the field is 6 inches with initial storage depth of 2 inches and allowable temporary storage of 4 inches depth of rainwater and this amount of water will not stay in the field more than 6 days.
- According to the estimation of water level in the rice field, it can be concluded that there is no amount of water that will stay in the field more than 6 days.

Design of drainage system

Discharge = Area/drainage module

Design of drainage channel is carried out according to Manning's formula.

Name	Width (B)	Depth (D)	Bed Slope (S)	Side slope (z)	Area (A)	Wetted Parameter (P)	Velocity (V)	Design Discharge (Q= A.V)
	(ft)	(ft)			(sq ft)	(ft)	(ft/s)	(cusec)
0+00	15	4	1/2000	1	76	26.314	2.254	171.324
73+30 - 177+00	20	4	1/2000	1	96	31.314	2.346	225.234
177+00 - 294+00	30	4.1	1/1800	1	139.81	41.597	2.630	367.741

Discussion and Conclusion

- The purpose of this study is to conduct pump irrigation system and spate irrigation system for water supply to crop fields and drainage system for the control of flood in the rainy season.
- CROPWAT 8.0 Software is used in the estimation of crop water requirement and irrigation water requirement.
- In this study, duty of water for pump irrigation canal is estimated as 25 Acre/cusec for 12 hour water supply and that of spate irrigation system is 10 Acre/cusec.
- The potential irrigable area for spate irrigation system is 1500 Acre and it is estimated by using mean annual rainfall and runoff coefficient.
- In spate irrigation system, head regulator will regulate water for the irrigation water requirement and the design of head regulator is conducted according to Orifice Formula.

Discussion and Conclusion (Continued)

- Drainage System is necessary thing for the protection of flood.
- Drainage module is calculated by Gumbel's Distribution method, Log Normal Distribution method and Log Pearson Type III Distribution Method.
- The calculated design discharge for the drainage system is 18 Acre/cusec according to Log Normal Distribution Method.
- All of the irrigation canals and drainage channels are designed according to Manning's formula.

“ THANK YOU VERY MUCH FOR YOUR ATTENTION"