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The Operational Pattern of the Dam and Weir Cascade on the Way Sekampung River

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ABSTRACT

Utilization of the water flow of the Way Sekampung River from upstream to downstream in a cascade (tiered) nature. Reservoir operation is a reservoir of *inflow* that enters the reservoir and the release of reservoir water to supply water needs downstream. Reservoir operational simulation is a reservoir water release modeling technique to supply downstream water needs based on the storage capacity and *inflow* into the reservoir. The principle of the reservoir operating pattern is to balance water availability and water demand, or what is known as the water balance. The derivative of the water balance is water allocation, where the *variable* amount and time of available water availability is not the same as water demand, so it is necessary to allocate between *demand* and *supply* of water using reservoirs.

Keywords:
Cascade
Operation pattern
inflow
Reservoir

1. Introduction

The construction of the Way Sekampung Dam and the construction of the Margatiga Dam are the use of the Way Sekampung River's water flow from upstream to downstream which is cascade in nature. To be able to take advantage of river flow optimally, the Batutegi Dam Cascade Operation Pattern, Way Sekampung Dam, Argoguru Weir, Margatiga Dam and Jabung Weir can be a solution in meeting domestic, agricultural and industrial water needs. The schematic can be seen in Figure 1.1 below.

2. Literature Review

2.1 . Reservoir Water Balance

There are actually two basic concepts used in hydrology, namely the concept of the *hydrologic cycle* and the concept of *water balance* (Sri Harto, 2009). Sudjarwadi (1989) states that the water balance concept *shows* a simple water mass continuity equation that provides a relationship between input, output, and changes in reservoirs.

Analysis of the water balance in the reservoir is carried out by formulating the problem into the following equation (Despa, 2020).

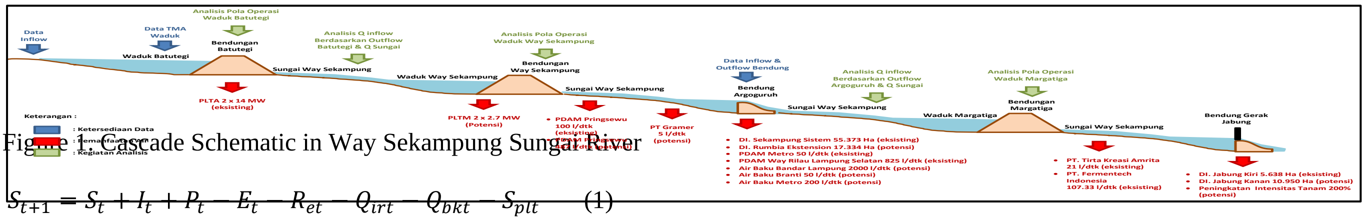

Figure 1. Cascade Schematic in Way Sekampung Sungai River

$$S_{t+1} = S_t + I_t + P_t - E_t - R_{et} - Q_{irt} - Q_{bkt} - S_{plt} \qquad (1)$$

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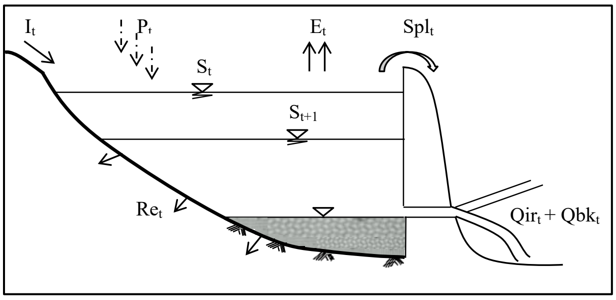


Figure 2. Reservoir Water Balance Schematic

3 . Theoretical basis

3.1 Reservoir Operation Simulation

Reservoir is a barrier that is built across the cross section of the river, causing water to be held and resulting in puddles (Garg, 1982). Rachmad Jayadi (2000) states that the regulation of the release of *multi-purpose* reservoir water can be done by operating a simulation method to set the reservoir release target, namely the *standard operating rule approach* as shown in Figure 3.1 below.

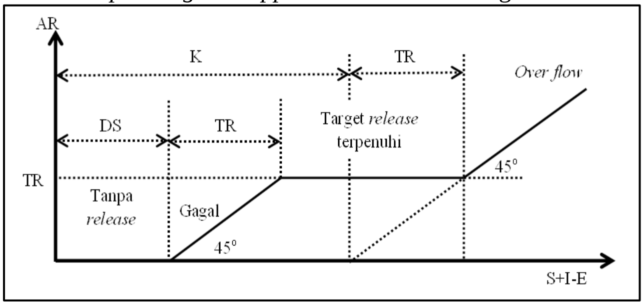
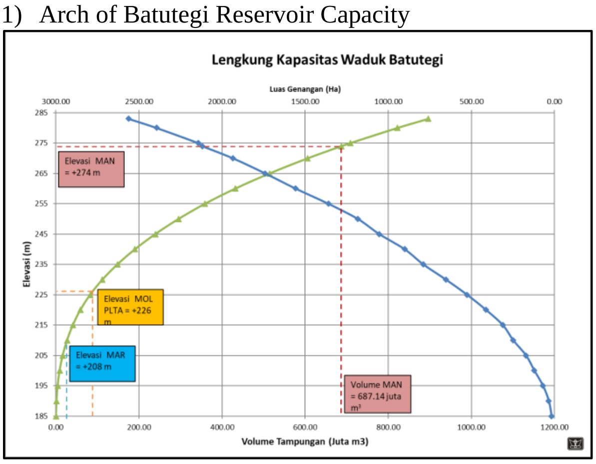


Figure 3. Reservoir Standard Operating Rule Chart

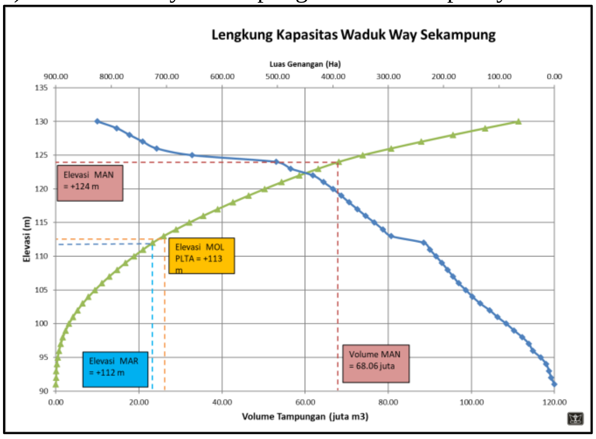
4 . Results and Discussion

4.1 Reservoir Storage

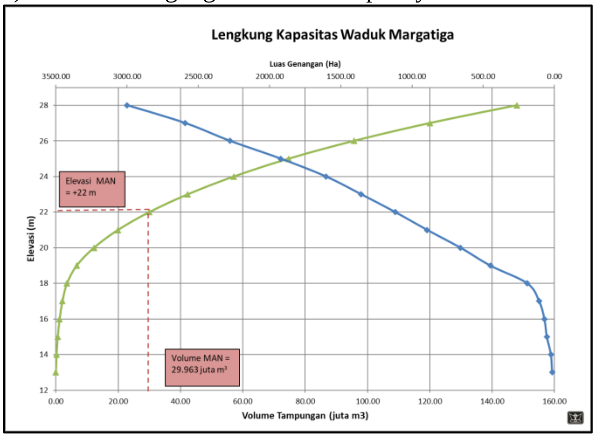
1) Arch of Batutegi Reservoir Capacity



2) Curve of Way Sekampung Reservoir Capacity

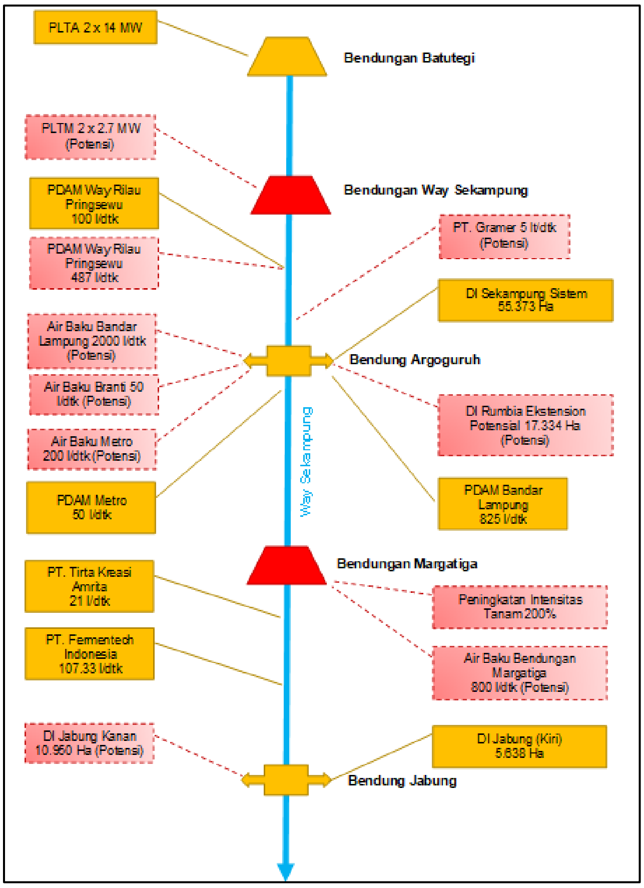


3) Arch of Margatiga Reservoir Capacity



4.2 Availability of Way Sekampung River Water

In the "Annual Water Allocation Plan (RAAT) for the Seputih Sekampung River Basin" (2021) and the Thesis for the Study of Water Management to Improve the Performance of the Batutegi Reservoir (2013), it is stated that the mainstay discharge in the Way Sekampung river can be divided into several segments based on water structures. which exists. The 1st segment is from the upstream of Way Sekampung to the Batutegi Dam (watershed area of 424 km^2), the 2nd segment is from the Batutegi Dam to the Way Sekampung Dam (watershed area of 346 km^2), the 3rd segment is from the Way Sekampung Dam to the Argoguruh Weir (watershed area of 1430 km^2), 4th segment from Argoguruh Dam to Margatiga Dam (watershed area 203 km^2), 5th segment from Margatiga Dam to Jabung Dam (watershed area 949 km^2) (RAAT 2020-2021). (Great R, 2013)



The discharge data recorded at the Argoguruh Weir from 1978 to 2020. Due to the construction of the Batutegi Dam (completed in 2002), this discharge can be divided into 2 (two) parts, namely as follows :) can be calculated, it is necessary to analyze (Martinus, 2020-1) the discharge data by converting the measured data into Argoguruh discharge data (DAS 1,776 km ^{2}), then calculating its flagship discharge.

1. Before until 2002

The discharge recorded at the Argoguruh Weir comes from a rain catchment area (DAS) of 2,200 km ^{2}.

The area of the Argoguruh watershed (including the Batutegi watershed) is 2,200 km ^{2}, while the Argoguruh watershed (without the Batutegi watershed) is 1,776 km ^{2}, so converting the recorded data into Argoguruh discharge data (for further analysis) is carried out by:

$$Q = Q_c \times 1776/2200 \qquad (2)$$

where : Q (Argoguruh dam discharge) and Q_c (Argoguruh dam recorded discharge).

2. After 2002

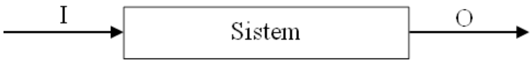
The debit recorded at the Argoguruh Dam comes from a watershed area of 1,776 km ^{2} plus the Batutegi outflow.

Because the recorded discharge at the Argoguruh Weir is affected by the outflow of the Batutegi reservoir, then:

$$Q = Q_c - outflow_{batutegi} \qquad (3)$$

a. Mainstay debit segment 1

Inflow Batutegi : S (change in storage volume) + Outflow recorded (Sri Harto BR, 1981).



Bulan		Debit	Rata-rata	Q40%	Q50%	Q60%	Q80%
Jan	1	m³/dtk	61,00	20,66	18,48	16,23	9,25
	2	m³/dtk	64,56	27,36	24,53	20,30	16,21
Feb	1	m³/dtk	77,44	31,73	27,87	24,55	18,85
	2	m³/dtk	70,38	34,27	28,05	26,17	18,63
Mar	1	m³/dtk	66,54	27,14	24,50	21,55	17,00
	2	m³/dtk	66,59	30,32	26,67	23,99	15,79
Apr	1	m³/dtk	66,18	28,15	26,82	23,82	16,68
	2	m³/dtk	65,10	27,84	24,62	22,91	14,91
Mei	1	m³/dtk	61,70	23,33	18,51	17,30	15,70
	2	m³/dtk	60,83	18,61	17,34	17,10	13,49
Jun	1	m³/dtk	57,96	16,33	15,11	14,94	6,40
	2	m³/dtk	56,16	13,84	10,91	10,78	4,61
Jul	1	m³/dtk	57,30	12,55	10,47	9,41	5,36
	2	m³/dtk	57,78	12,62	11,82	8,43	5,90
Agus	1	m³/dtk	56,47	8,54	8,01	7,20	4,33
	2	m³/dtk	56,10	9,26	7,92	6,43	4,15
Sep	1	m³/dtk	6,39	7,47	6,77	5,59	2,59
	2	m³/dtk	53,58	6,09	5,38	4,73	3,29
Okt	1	m³/dtk	5,96	6,37	5,39	4,87	1,91
	2	m³/dtk	5,74	5,70	4,91	4,15	1,74
Nov	1	m³/dtk	7,29	7,50	5,43	4,92	2,47
	2	m³/dtk	8,59	10,50	8,38	5,74	3,23
Des	1	m³/dtk	15,29	14,94	13,75	10,02	5,53
	2	m³/dtk	17,40	17,57	14,64	13,31	8,69
VOLUME TOTAL		MCM		547,20	479,17	424,05	283,32

b. 2 segment mainstay debit

The mainstay discharge that has been calculated is the mainstay discharge from the downstream of the Batutegi Dam to the Argoguruh Weir (watershed area of 1776 km ^{2}), so to calculate the mainstay discharge of segment 2 it can be calculated based on the comparison of the watershed area (346 km ^{2} / 1776 km ^{2}).

Bulan		Debit	Rata-rata	Min	Q90%	Q80%	Q70%	Q60%	Q50%	Q40%
Jan	1	m³/dtk	26,19	1,63	4,11	4,44	11,37	12,08	12,97	15,28
	2	m³/dtk	28,55	2,08	3,03	4,21	10,10	15,89	18,91	24,72
Feb	1	m³/dtk	30,04	3,55	5,94	8,42	11,63	14,54	18,03	20,30
	2	m³/dtk	28,14	2,16	9,21	11,14	15,27	16,77	17,73	19,99
Mar	1	m³/dtk	29,46	4,73	6,99	8,33	11,92	13,32	19,73	22,06
	2	m³/dtk	21,60	1,64	6,31	7,28	9,16	11,38	12,46	17,66
Apr	1	m³/dtk	19,61	1,96	4,10	8,21	8,95	9,42	11,07	13,38
	2	m³/dtk	13,94	1,00	2,49	4,26	5,64	6,14	6,32	7,39
Mei	1	m³/dtk	20,46	0,09	2,20	3,14	3,43	3,62	4,74	8,06
	2	m³/dtk	9,77	0,98	2,33	3,39	4,11	4,92	5,69	6,69
Jun	1	m³/dtk	7,15	0,35	1,31	2,34	2,96	3,55	3,84	4,11
	2	m³/dtk	4,80	-	1,03	1,55	2,00	2,29	2,57	2,86
Jul	1	m³/dtk	4,96	-	0,28	0,88	0,97	1,40	1,96	2,39
	2	m³/dtk	5,78	-	0,20	0,53	0,98	1,29	1,99	2,82
Agus	1	m³/dtk	4,56	-	-	0,13	0,48	0,81	1,63	2,23
	2	m³/dtk	5,09	-	-	0,45	0,61	1,16	1,49	1,78
Sep	1	m³/dtk	6,55	-	-	0,45	0,76	1,29	1,42	1,49
	2	m³/dtk	6,76	-	0,18	0,58	0,71	1,00	1,43	2,17
Okt	1	m³/dtk	5,15	-	0,21	0,52	0,61	0,92	1,52	3,24
	2	m³/dtk	7,29	-	0,24	0,58	0,85	1,33	2,12	3,45
Nov	1	m³/dtk	7,99	0,05	0,34	0,49	0,95	2,25	3,37	3,91
	2	m³/dtk	10,36	-	0,98	1,86	2,00	2,29	3,14	4,29
Des	1	m³/dtk	12,35	0,44	0,89	1,78	2,68	3,70	5,32	7,11
	2	m³/dtk	18,28	1,30	2,89	3,78	4,54	5,32	8,68	12,95

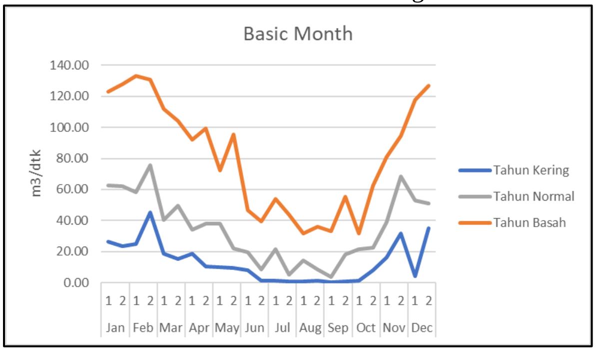
c. Mainstay debit segment 3

The mainstay discharge that has been calculated is the mainstay discharge from the downstream of the Batutegi Dam to the Argoguruh Weir (watershed area of 1776 km ^{2}), so to calculate the mainstay discharge of segment 3 it can be calculated based on the comparison of the watershed area (1430 km ^{2} / 1776 km ^{2}).

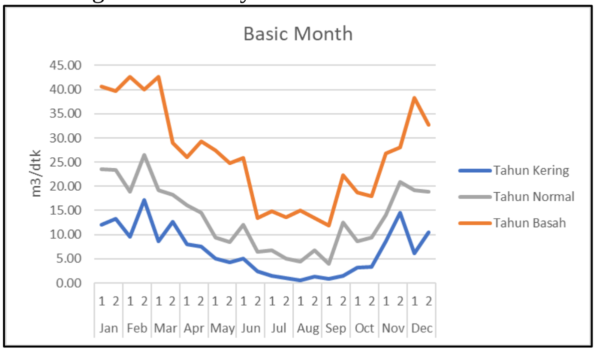
Bulan		Debit	Rata-rata	Min	Q90%	Q80%	Q70%	Q60%	Q50%	Q40%
Jan	**1**	**m^3/dtk**	108,26	6,74	16,98	18,34	46,98	49,92	53,60	63,14
	2	**m^3/dtk**	118,00	8,62	12,53	17,39	41,74	65,68	78,17	102,18
Feb	**1**	**m^3/dtk**	124,15	14,68	24,54	34,79	48,06	60,09	74,51	83,88
	2	**m^3/dtk**	116,29	8,91	38,08	46,05	63,11	69,31	73,29	82,63
Mar	**1**	**m^3/dtk**	121,74	19,55	28,87	34,44	49,28	55,06	81,56	91,17
	2	**m^3/dtk**	89,27	6,76	26,09	30,10	37,88	47,02	51,48	72,98
Apr	**1**	**m^3/dtk**	81,03	8,10	16,95	33,92	36,98	38,95	45,77	55,30
	2	**m^3/dtk**	57,60	4,14	10,30	17,63	23,31	25,37	26,12	30,54
Mei	**1**	**m^3/dtk**	84,57	0,38	9,10	12,97	14,18	14,97	19,59	33,32
	2	**m^3/dtk**	40,39	4,03	9,64	14,03	16,97	20,35	23,51	27,65
Jun	**1**	**m^3/dtk**	29,53	1,43	5,41	9,65	12,24	14,65	15,87	16,99
	2	**m^3/dtk**	19,84	-	4,27	6,39	8,26	9,45	10,60	11,82
Jul	**1**	**m^3/dtk**	20,50	-	1,16	3,66	3,99	5,79	8,08	9,89
	2	**m^3/dtk**	23,88	-	0,81	2,19	4,06	5,32	8,22	11,64
Agus	**1**	**m^3/dtk**	18,86	-	-	0,52	1,99	3,35	6,74	9,20
	2	**m^3/dtk**	21,02	-	-	1,86	2,54	4,80	6,15	7,37
Sep	**1**	**m^3/dtk**	27,08	-	-	1,86	3,14	5,34	5,88	6,17
	2	**m^3/dtk**	27,96	-	0,76	2,40	2,94	4,14	5,91	8,98
Okt	**1**	**m^3/dtk**	21,27	-	0,87	2,15	2,53	3,81	6,29	13,38
	2	**m^3/dtk**	30,15	-	0,99	2,38	3,50	5,51	8,75	14,25
Nov	**1**	**m^3/dtk**	33,03	0,23	1,41	2,02	3,94	9,30	13,94	16,16
	2	**m^3/dtk**	42,82	-	4,05	7,67	8,27	9,47	12,96	17,74
Des	**1**	**m^3/dtk**	51,05	1,80	3,68	7,36	11,07	15,28	21,97	29,37
	2	**m^3/dtk**	75,55	5,36	11,96	15,60	18,75	22,00	35,87	53,53

d. 4 . segment mainstay debit

The mainstay discharge calculation in segments 4 and 5 uses rain data which is converted into discharge data.



e. 5 . segment mainstay debit



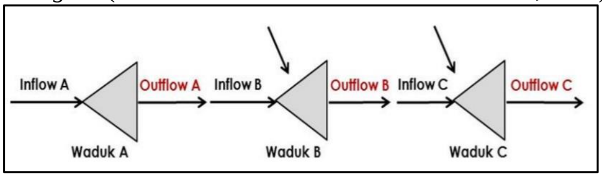
4.3 Cascade Reservoir Operation Pattern

The study of the Cascade Operational Pattern of the Batutegi Dam, Way Sekampung Dam and Margatiga Dam (2021), stated that reservoir operation is a reservoir for *inflow* that enters the reservoir and releases reservoir water to supply water needs downstream. Government Regulation Number 37 of 2010 concerning Dams Article 4 paragraph 2 states that " *The construction of dams is carried out for the management of water resources, which functions to supply raw water, irrigation, flood control and/or hydropower* ". (PP No. 37 on Dams, 2010)

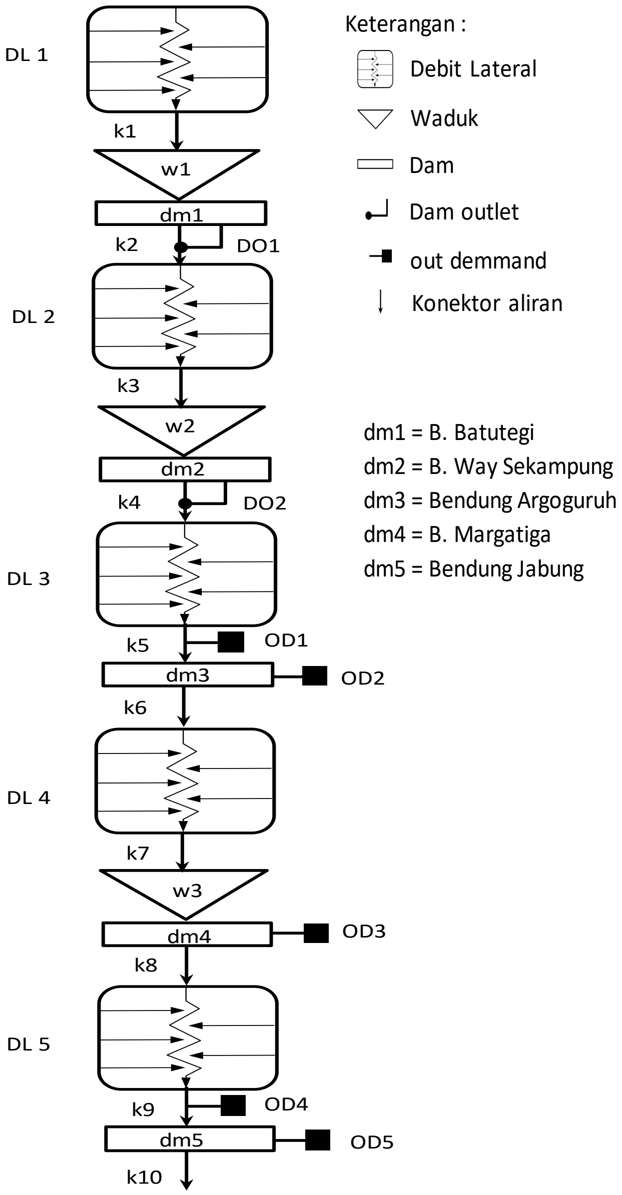
Regulation of the Minister of Public Works and Public Housing Number 27/PRT/2015 concerning Dams Article 47 paragraph 3 states " *The reservoir operation pattern shall at least contain procedures for removing water from the reservoir in accordance with the conditions of the volume and/or elevation of the reservoir water and the water demand and river capacity in the reservoir. downstream of the dam* " (Permen PUPR on dam No. 27). This reservoir operation is carried out every 1 (one) year, where the water discharge released by the reservoir must be in accordance with the provisions so that its elevation (Martinus, 2020-2) is maintained according to the plan. In one year the operation of the reservoir consists of 24 periods in which each operating period is carried out every (half) month, according to the *inflow* and *outflow* required in the operation of the reservoir.

1) Reservoir Operational Simulation

Reservoir Operation Module 2017, by the Center for Natural Resources and Construction Education and Training - Directorate General of Natural Resources - Ministry of PUPR Chapter IV explains that " *The basic equation for simulating the water balance in reservoirs is a function of input, output and reservoir storage* ". (Directorate General of Natural Resources, 2017)



Reservoir operational simulation (Name, 2015) is a reservoir water release modeling technique to supply downstream water needs based on the storage capacity and *inflow* into the reservoir. The operational simulation in question is a function of *inflow* (water availability), *outlow* (water demand), and reservoir capacity. *Inflow* and *outflow* for cascade reservoir operations are different from single reservoirs. The concept of reservoir operation is as shown in the following scheme.



The explanation of the above scheme is as follows:

Code	Symbol	Information
DL		It is a code for Lateral Debit, which is an *inflow discharge* originating from the water catchment area of an area itself.
k	↓	Is the code of the Flow Connector, the flow connector in this case describes the Way Sekampung River itself
w		Reservoir is the code for a reservoir, which is an artificial container formed as a result of the construction of a dam
dm		Is the code of a dam or weir, namely a building in which there is an instrument for regulating the discharge output.
DO		Is the code of the *Dam Outlet* , namely the discharge discharge from the reservoir which in the end the discharge returns to the downstream river, in this case what is included in the *Dam Outlet* is the discharge for hydropower needs
OD		Is the code of *Outflow Demand* , which is the intake discharge for which the water is considered depleted or does not return to the river, in this case what is included in *Outflow Demand* is the debit for raw water and irrigation needs.

A. Batutegi Dam
1. Incoming Debit
   Incoming discharge from the catchment area (DTA) of the Batutegi Dam (DL 1 = lateral discharge 1) through the rivers upstream (k1 = flow connector 1) → input parameter: mainstay discharge watershed area (DAS) of the Batutegi Dam
2. Batutegi reservoir reservoir (W1) → input parameter : data of the Batutegi reservoir storage curve)
3. Outgoing _
   a. Outflow to fulfill hydropower needs (DO 1 = *Dam Outlet* 1) , the water will return to the river system (k2 = flow connector 2) → input parameters: Hydropower discharge requirements
   b. Reservoir release to supply Watershed (DAS) Way Sekampung Dam , water enters the river system (k2= Flow Connector 2)

B. Way Sekampung Dam
1. Incoming Debit
   a. Incoming discharge from the discharge of the Batutegi Dam through the Way Sekampung River (k3 = flow connector 3) → input parameter: output discharge of Batutegi Dam
   b. Incoming discharge from the Way Sekampung Dam catchment area (DL 2 = lateral flow 2) via the Way Sekampung River (k3 = flow connector 3) → input parameter: mainstay discharge from the Way Sekampung Dam Watershed (DAS)
2. Way Sekampung reservoir reservoir (W2) → input parameters: Way Sekampung reservoir reservoir curve data)
3. Outgoing _
   a. The discharge discharge is for the fulfillment of the hydropower and hydraulic power pump (PATH) needs of PDAM Pringsewu (DO 2 = *Dam Outlet* 2) , the water will return to the river system (k4 = flow connector 4) → input parameters: PLTA and PATH discharge

requirements

b. Reservoir release to supply the Argoguruh Watershed (DAS) , water enters the river system (k4= Stream Connector 4).

C. Argoguruh Weir

1. Incoming Debit
   a. Incoming discharge from the Way Sekampung Dam discharge via the Way Sekampung River (k4 = flow connector 4) → input parameter: Way Sekampung Dam output discharge
   b. Incoming discharge from the Argoguruh Dam Catchment Area (DL 3 = lateral flow 3) via the Way Sekampung River (k5 = flow connector 5) → input parameter: mainstay discharge from the Argoguruh Watershed (DAS)
2. Outgoing _
   a. for meeting water needs (OD 1 = *Outflow Demand*) , → input parameters:
      - PDAM Pringsewu raw water needs 100 liters/second (existing)
      - Pringsewu PDAM raw water needs 487 liters/second (potential)
      - Industrial raw water needs of PT. Gramer 50 liters/second (potential).
   b. for meeting water needs (OD 2 = *Outflow Demand*), → input parameters:
      - The need for irrigation water in the Sekampung Irrigation Area System is 55,373 Ha (existing: Planting Period I and Planting Period II)
      - The need for irrigation water in the Sekampung Irrigation System is 55,373 Ha (scenario 1: Planting Period I, Planting Period II and Planting Period III)
      - Irrigation water needs Sekampung irrigation system 55,373 Ha + Rumbia Extension irrigation area 17,334 Ha (scenario 2: Planting Period I and Planting Period II)
      - Irrigation water needs Sekampung irrigation system 55,373 Ha + Rumbia Extension irrigation area 17,334 Ha (scenario 3: Planting Period I, Planting Period II and Planting Period III)
      - PDAM Metro raw water needs 50 liters/second (existing)
      - PDAM South Lampung raw water needs 825 liters/second (existing)
      - PDAM Bandar Lampung raw water needs 2000 liters/second (potential)
      - Branti raw water needs 50 liters/second (potential)
      - Metro raw water needs 200 liters/second (potential)
   c. Water that runs off the Argoguruh Weir and supplies it to the Margatiga Watershed (DAS), the water enters the river system (k6= Stream Connector 6).

D. Margatiga Dam

1. Incoming Debit
   a. Incoming discharge from the Argoguruh weir runoff through the Way Sekampung River (k6 = flow connector 6) → input parameter: Argoguruh weir runoff discharge
   b. Incoming discharge from the catchment area (DTA) of the Margatiga Dam (DL 4 = lateral flow 4) via the Way Sekampung River (k7 = flow connector 7) → input parameter: mainstay discharge from the Margatiga River Basin Area (DAS)
2. Margatiga reservoir reservoir (W2) → input parameter : data of Margatiga reservoir reservoir storage
3. Outgoing _
   a. Benefits of raw water for Margatiga Dam 800 liters/second(Potential)
   b. Reservoir release to supply Jabung Watershed (DAS), water enters the river system (k8= Flow Connector 8)
   c. to meet water demand (OD 4 = *Outflow Demand*), → input parameters:
      - Industrial raw water needs of PT. Tirta Kreasi Amrita 21 liters/second (existing)
      - Industrial raw water needs of PT. Fermentech Indonesia 107.33 liters/second (existing).

E. Jabung Weir

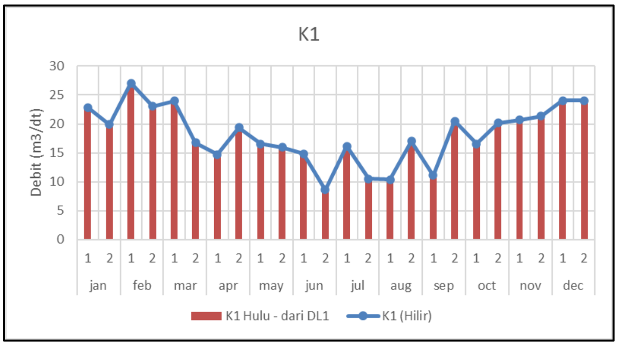
1. Incoming Debit
   a. Incoming discharge from the exit of the Margatiga Dam via the Way Sekampung River (k8 = flow connector 8) → input parameter: output discharge of the Margatiga Dam
   b. Incoming discharge from the Jabung Catchment Area (DTA) (DL 5 = Lateral discharge 5) via the Way Sekampung River (k9 = flow connector 9) → input parameter: mainstay discharge from the Jabung Watershed (DAS)
2. Outgoing _
   a. for meeting water needs (OD 5 = *Outflow Demand*), → input parameters:
      - The need for irrigation water for the Jabung Kiri Irrigation Area is 5638 Ha (existing: Planting Period 1)
      - Irrigation water needs of Jabung Kiri Irrigation Area 5638 Ha (scenario 1: Planting Period I and Planting Period II)
      - Irrigation water needs of Jabung Left Irrigation Area 5638 Ha + Right Jabung 10950 (scenario 2: Planting Period 1)
      - Irrigation water needs of the Left Jabung Irrigation Area 5638 Ha + Right Jabung 10950 (scenario 3: Planting Period 1 and Planting Period II).

2) Cascade Reservoir Simulation

In conducting the simulation (*Zulmiftahul* , 2020) the cascade reservoir, after determining the scenario as described above, it is also chosen for the mainstay discharge conditions that occur in wet, normal or dry years.

A. Discharge into Batutegi Dam

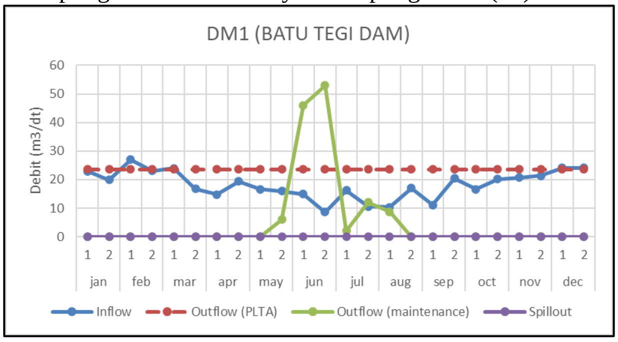
Incoming discharge from the Batutegi Dam Catchment Area (DL 1 = Lateral discharge 1) through upstream rivers (k1 = flow connector 1)



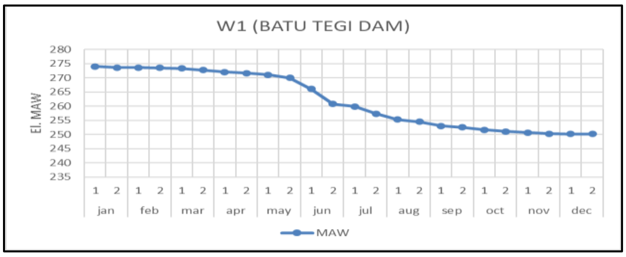
Graph of discharge into Batutegi Reservoir

B. Outflow Settings on the Batutegi Dam.

The incoming discharge from the Batutegi Dam catchment area (DL 1 = lateral discharge 1) through the rivers upstream (k1 = flow connector 1) is accommodated in the Batutegi dam reservoir (W1) and outflow arrangements are made according to the hydropower needs (DO1) and supplying the Way Sekampung Dam via the Way Sekampung River (k2).



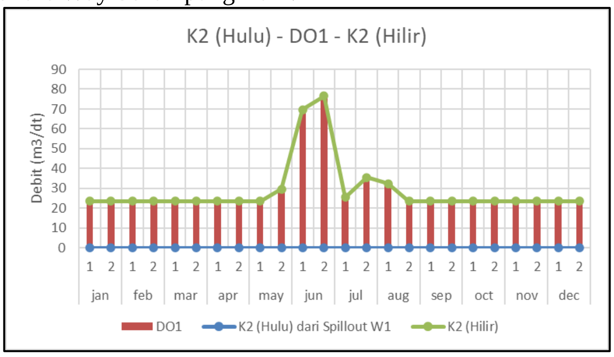
Graph of *inflow* – *outflow* at Batutegi Dam



The condition of the water level of the Batutegi Reservoir in a period of 1 year

C. Water release from Batutegi Dam. Reservoir release

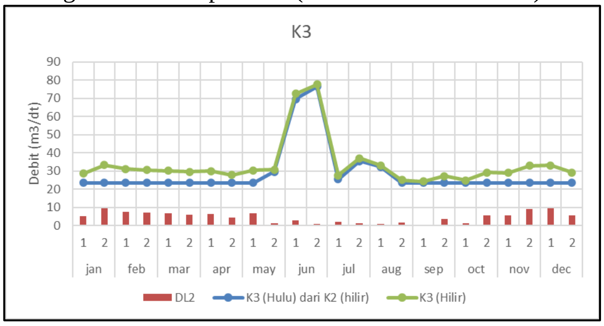
Batutegi from the use of water for hydropower (DO1) returns to the Way Sekampung river flow (k2), plus the supply discharge for the Way Sekampung Dam.



Graph of discharge discharge from Batutegi Dam.

D. The debit enters the Way Sekampung dam.

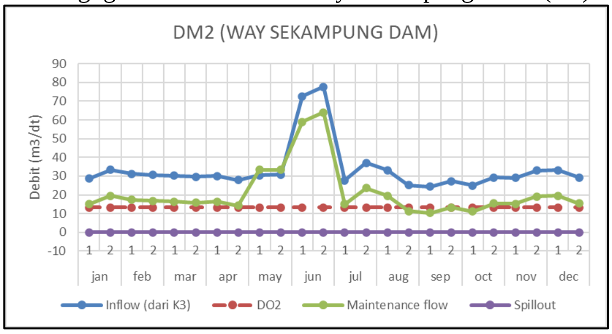
The discharge that enters the Way Sekampung Dam reservoir is the incoming discharge from the discharge of the Batutegi Dam via the Way Sekampung River (K2) and the discharge from the Way Sekampung Dam catchment itself (DL 2 = lateral discharge 2) through the rivers upstream (K3 = flow connector 3)



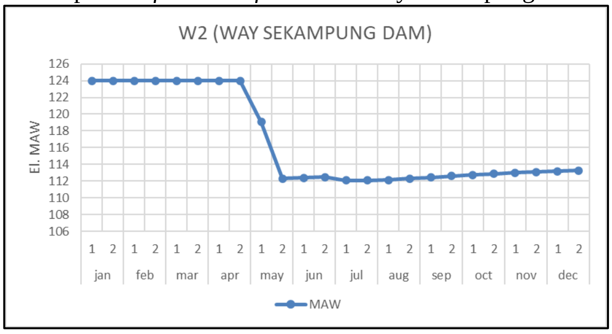
The graph of the discharge into the Way Sekampung Reservoir.

E. *Outflow* Arrangement at Way Sekampung Dam.

The incoming discharge from the discharge of the Batutegi Dam (K2) and the Way Sekampung Dam DTA (DL 2 = Lateral discharge 2) through the rivers upstream (K3 = flow connector 3) is accommodated in the Way Sekampung dam reservoir (W2) and the outflow arrangement is carried out according to the need for hydropower (DO2) and supply for the Argoguruh Weir via the Way Sekampung River (K4).



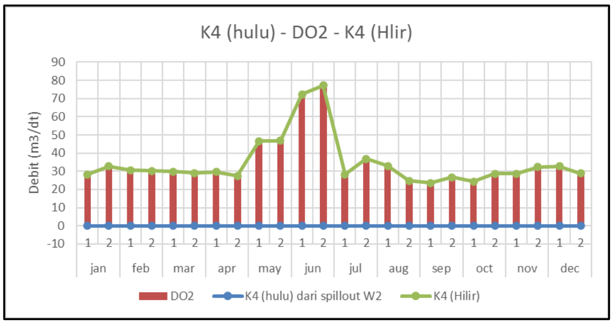
Graph of *inflow* – *outflow* w on Way Sekampung Dam



Water level condition of Way Sekampung Reservoir in a period of 1 year

F. Water release from Way Sekampung Dam.

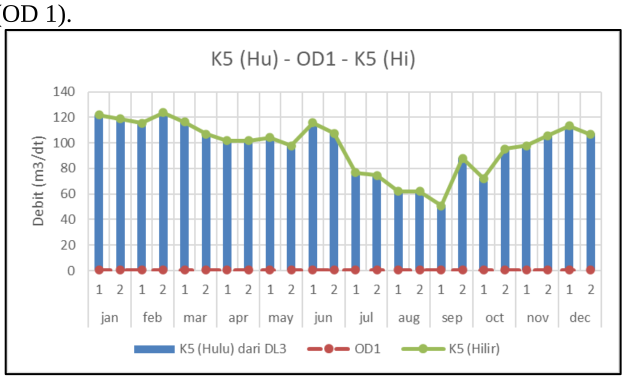
The release of Way Sekampung reservoir water originating from the use of water for the DO2 Hydroelectric Power Plant (PLTA) returns to the Way Sekampung (K4) river flow, plus the discharge to supply the Argoguruh Weir.



The discharge graph of the Way Sekampung Dam.

G. The debit enters the Argoguruh Weir.

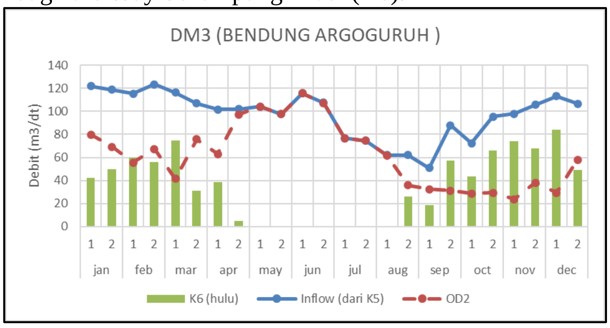
The discharge entering the Argoguruh Weir is the incoming discharge from the release of the Way Sekampung Dam through the Way Sekampung River (K4) and the discharge from the Argoguruh Dam's Water Catchment Area (DL 3 = lateral discharge 3) through the rivers upstream (K5 = flow connector 5). In this segment there is also water extraction for PDAM Pringsewu raw water and Industrial Raw Water for PT. Gramer (OD 1).



Graph of the discharge into the Argoguruh Weir

H. *Outflow* Setting on Argoguruh Weir.

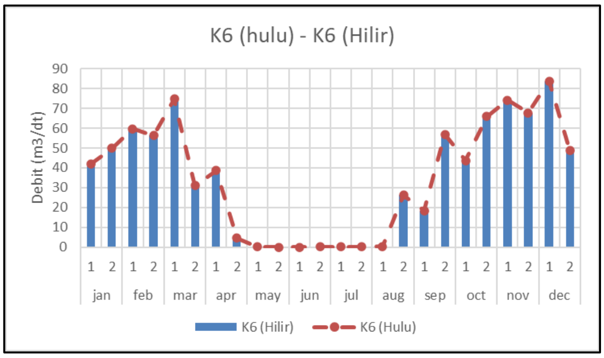
Incoming discharge from the release of the Way Sekampung Dam (K4) and the Argoguruh Dam DTA (DL 3 = lateral discharge 3) through the rivers upstream (K5 = flow connector 5), outflow arrangements are made including the need for Irrigation Water for the Sekampung System Irrigation Area, Irrigation Area Rumbia Extension, Existing and potential Raw Water Needs for Metro, South Lampung, Bandar Lampung, and Branti (OD 2) and discharge for the supply of Margatiga Dam through the Way Sekampung River (K6).



Graph of *inflow – outflow* on Argoguruh Weir

I. Water release from Argoguruh Weir.

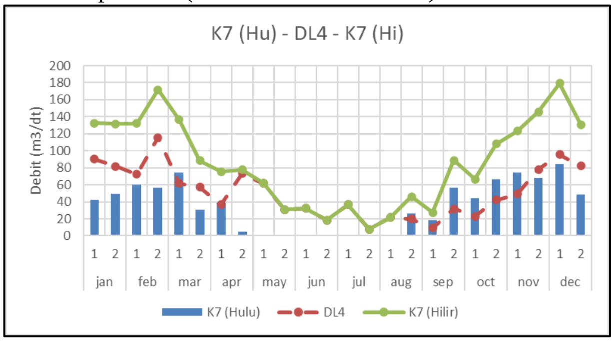
The release of the Argoguruh Weir is runoff that will re-enter the Way Sekampung (K6) river flow for the supply needs of the Margatiga Dam.



Graph of discharge of the Argoguruh Weir

J. The debit enters the Margatiga Dam.

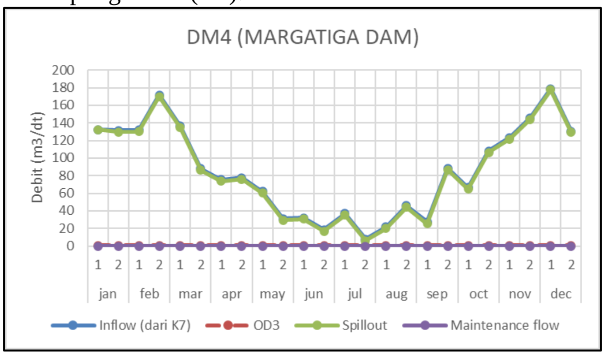
The debits entering the Margatiga Dam are the incoming discharge from the discharge of the Argoguruh Weir via the Way Sekampung River (K6) and the discharge from the Margatiga Dam catchment area itself (DL 4 = Lateral discharge 4) through the rivers upstream (K7 = flow connector 7).



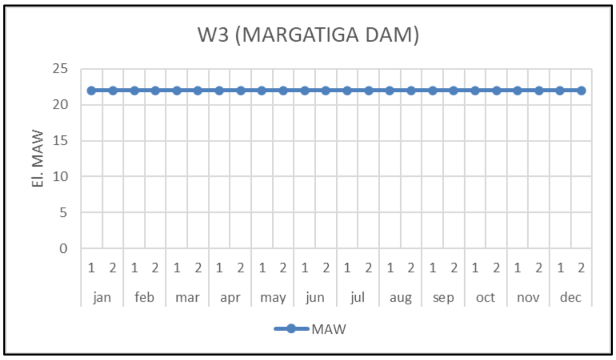
Graph of discharge into the Margatiga Dam

K. *Outflow* settings on the Margatiga Dam.

Incoming discharge from the release of the Argoguruh Weir (K6) and the Water Catchment Area (DTA) of the Margatiga Dam (DL 4 = Lateral discharge 4) through the rivers upstream (K7 = flow connector 7) outflow arrangements are made including the supply of margatiga raw water (OD) 3) and the discharge for the supply of the Jabung Weir via the Way Sekampung River (K8).



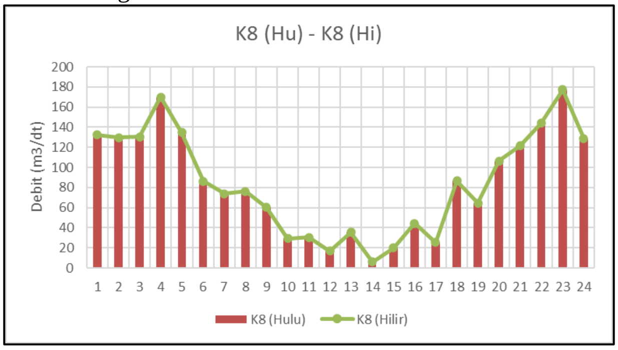
Graph of *inflow – outflow* at Margatiga Dam



The condition of the water level of the Margatiga Reservoir in a period of 1 year

L. Release of water from the Margatiga Dam.

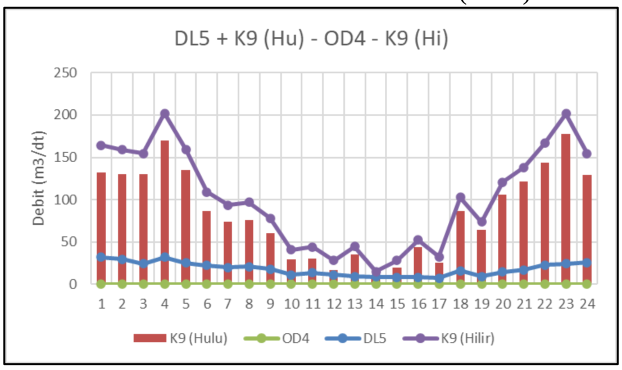
The release of the Margatiga Dam is a runoff that will re-enter the Way Sekampung (K8) river flow for the supply needs of the Gerak Jabung Weir.



Graph of the release of the Margatiga Dam discharge

M. The debit enters the Jabung Motion Weir.

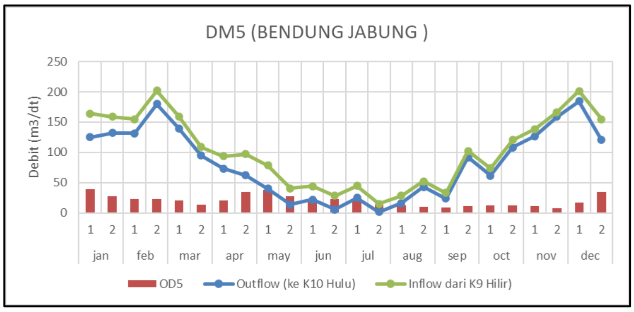
The discharge entering the Jabung Weir is the incoming discharge from the release of the Margatiga Dam through the Way Sekampung River (K8) and the discharge from the Jabung Dam catchment area itself (DL 5 = Lateral discharge 5) through the rivers upstream (K9 = flow connector 9). In this segment there is also water extraction for industrial raw water of PT. Tirta Kreasi Amrita and PT. Fermentech Nusantara (OD 4).



Graph of discharge into the Jabung Motion Weir

N. *Outflow* Setting on Jabung Motion Weir.

Incoming discharge from the release of the Margatiga Dam (K8) and Jabung Dam DTA (DL 5 = Lateral discharge 5) through the rivers upstream (K9 = flow connector 9) the outflow arrangement is carried out including the supply of irrigation water for the Jabung Kiri and Jabung Irrigation Areas Right (OD 4).



Graph of *inflow* – *outflow* on the jabung dam

5 . Conclusion

The principle of the reservoir operating pattern is to balance water availability and water demand, or what is known as the water balance. The derivative of the water balance is water allocation, where the *variable* amount and time of available water availability is not the same as water demand, so it is necessary to allocate between *demand* and *supply* of water using reservoirs. If the water allocation goes well, it is hoped that the water needs in terms of a certain amount and time can be met adequately.

Acknowledgement _ _ _

Thank you to the Mesuji River Basin Sekampung Center, the Directorate General of Water Resources - Ministry of Public Works and Public Housing, as well as the supervising lecturers who have taken the time to assist and provide direction in the preparation of this paper/journal.

Bibliography _ _

Despa, Dikpride And Widyawati, Ratna And Purba, Aleksander And Septiana, Trisya (2020) Edukasi Implementasi Undang – Undang Keinsinyuran Pada Aparatur Sipil Negara (Asn) Pemerintahan Kabupaten Di Lampung. Prosiding Senapati Seminar Nasional Pengabdian Kepada Masyarakat Teknologi Dan Inovasi Pengabdian Masyarakat Di Era Revolusi Industri 4.0 Dan Society 5.0. Pp. 47-50. Issn 2685-0427

Garg, 1982, *Water Resources and Hydrology*, Fourth edition, Khanna Publishers, New Delhi.

Rachmad Jayadi, 2000, *Optimasi dan Simulasi Pengembangan Sumberdaya Air*, Modul Kuliah Magister Pengelolaan Sumberdaya Air, Jurusan Teknik Sipil dan Lingkungan, Fakultas Teknik UGM, Yogyakarta.

Rahmadana, A. (2013). *Studi Pengaturan Air Untuk Meningkatkan Kinerja Waduk Batutegi* (Doctoral dissertation, Universitas Gadjah Mada).

Rencana Alokasi Air Tahunan (RAAT) Wilayah Sungai (WS) Seputih Sekampung (2020-2021).

Sri Harto BR, 2009, *Hidrologi: Teori, Masalah, Penyelesaian*, Nafiri Offset, Yogyakarta.

Sudjarwadi, 1989, *Pola Pengoperasian Waduk*, PAU IT-UGM, Yogyakarta.

Peraturan Pemerintah Nomor 37 Tahun 2010 tentang Bendungan.

Peraturan Menteri Pekerjaan Umum dan Perumahan Rakyat Nomor 27/PRT/2015 tentang Bendungan.

Martinus, Suudi, A., Putra, R.D., and Muhammad, M.A. (2020) Pengembangan Wahana Ukur Kecepatan Arus Aliran Sungai. Barometer, 5 (1). Pp. 220-223. Issn 1979-889x

Martinus and Suudi, Ahmad and Putra, Rahmat Dendi and Muhammad, Meizano Ardhi (2020) Pengembangan

Wahana Ukur Kecepatan Arus Aliran Sungai. Barometer, 5 (1). Pp. 220-223. Issn 1979-889x

Modul Operasi Waduk Tahun 2017, oleh Pusat Pendidikan dan Pelatihan SDA dan Konstruksi - Ditjen SDA - Kementerian PUPR.

Nama, Gigih Forda and Ulvan, Melvi and Ulvan, Ardian and Hanafi, Abdul Munif (2015) Design and implementation web based geographic information system for public services in Bandar Lampung City — Indonesia. In: 2015 International Conference on Science in Information Technology (ICSITech),, 27 - 28 October 2014, Yogyakarta.

Zulmiftahul, Huda and Khairudin, Khairudin and Lukmanul, Hakim and Zebua, Osea (2020) Pelatihan Instalasi Sistem Plts Bagi Siswa-Siswi Di Smk 2 Mei Bandar Lampung. Prosiding Senapati Seminar Nasional Pengabdian Kepada Masyarakat Teknologi Dan Inovasi, 2. Pp. 285-288. Issn Issn: 2685-0427