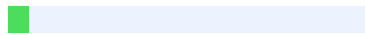




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International Research Journal of Engineering, IT & Scientific Research Available online at <https://sloap.org/journals/index.php/irjeis/> Vol. 9 No. 4, July 2023, pages: 193-210 ISSN: 2454-2261 <https://doi.org/10.21744/irjeis.v9n4.2355> 193 Integrated Water Resources Management in the Bukian Irrigation Area at Badung Regency Ketut Wiwin Andayani a I G N K Mahesa Adi Wardana b I Nyoman Sedana Triadi c I Nyoman Anom Purwa Winaya d I Ketut Sutapa e Article history: Abstract Submitted: 27 May 2023 Revised: 18 June 2023 Accepted: 09 July 2023 Management of Water Resources to meet the needs of living things is very important. Management of Water Resources that are not integrated will cause various problems, including drought, conflicts of interest between water users. The Bukian Irrigation Area is an irrigation area that utilizes surface water for its agricultural activities. Currently, the Bukian Irrigation Area obtains irrigation water from the Bukian I weir and Bukian II weir as a supply weir to increase the need for water discharge required in the irrigation area. In the utilization of surface water that is used to meet irrigation needs at this time, less attention is paid to a good water management system, such as a lack of control over water use. Water management can be carried out properly if the condition of the water balance in the system is known. Related to this, additional discharge and integrated water management are needed to avoid conflicts of interest between water users. The method in this study is a quantitative analysis with the mainstay discharge variable in the Bukian I and II weirs and irrigation water demand based on the existing cropping pattern. This research gives the result that the potential availability of water in the Bukian I and Bukian II weirs has a fluctuating magnitude in each semimonthly period, where the maximum discharge is 0.458 m³/second and 0.130 m³/second which occurs in the February I period, the minimum discharge respectively each of 0.051 m³/second occurred in November I and 0.050 m³/second in September II and October II. The potential of each average discharge is 0.197 m³/second and 0.079 m³/second where all of them are analyzed with a reliability level of 80%. The need for irrigation water is following the existing cropping pattern in D.I. Bukian is 1.57 liters / second / hectare. The condition of the water balance in the Bukian II Dam without any supplementation indicates a water deficit

condition and after adding the discharge through the supplementation from the Bukian I Dam, the result is that the available discharge increases significantly and the water balance indicates a water surplus condition. To obtain a good water resources management system in the Bukian Irrigation Area, arrangements must be made regarding the time and amount of water to be supplied to the Bukian II

Keywords: integrated; irrigation area; management; water balance; water

resources;

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□ ISSN: 2454-2261 IRJEIS Vol. 9 No. 4, July 2023, pages: 193-210 194 Dam following the conditions of the water balance. Excess water in the Bukian I Dam can be channelled directly downstream to meet the water needs of other users to maintain the sustainability and balance of an integrated water utilization system. International research journal of engineering, IT & scientific research © 2023. This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by-nc-nd/4.0/>). Corresponding author: Ketut Wiwin Andayani, Civil Engineering Department, Politeknik Negeri Bali, Badung, Indonesia. Email address:

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1 Introduction Water is one of the resources needed to support the life of living things and is an important element in a sustainable life. Based on the place where it is contained, water is divided into two, namely surface water and groundwater or water that is in the layers of soil or rock ²⁴ below the surface of the soil (Undang-Undang (UU) Nomor 17 Tahun 2019). Excessive use of water to support all human life will cause damage to water resources if it is not accompanied by policies in integrated management (Zulyanti et al., 2022). The use of surface water in the Bukian Irrigation Area currently pays little attention to a good water management system, such as

a lack of control over water use which can be seen from the lack of operation of the weir according to needs (Sutikno, 2014). Following Law No. 17 of 2017 concerning Water Resources, it is explained that the main priority is to fulfil water for the basic needs of clean water and the second priority is to fulfil water for agricultural irrigation (Suni & Legono, 2021). The **2 imbalance between water supply and demand** must be known in advance, as is especially the case for farmers who often experience excess water in the rainy season, but experience water shortages during the dry season (Kustana & Setiawan, 2020). **The most important factor** in the continuity and sustainability of the agricultural system is the availability of water, where agriculture is an important sector in improving the local economy, which requires the participation of the community and government as managers of agricultural production businesses (Dwiwana, 2019). Based on data from the Bali-Penida River Basin Office (2015), the utilization of surface water in the Tukad Ayung Watershed is very complex. There are 33 intake buildings in the form of irrigation weirs to meet agricultural needs and 2 collection buildings in the form of weirs to fulfil the supply of clean water in Badung Regency and Denpasar City. To avoid various problems regarding water resources related to quantity and quality, all parties must be aware that water management needs to be carried out with the right actions to produce an optimal solution because **2 of the existing water** balance conditions (Sun et al., 2006; Bouman et al., 2007). From the explanation above, it can be seen that Integrated Water Resources Management is required. Therefore it is very important to carry out scientific research by considering the necessary analyzes that aim to analyze and evaluate the water balance that occurs in the Bukian Irrigation Area (Wang et al., 2012; Chen et al., 2014). Knowing the water balance that occurs will make it easier to manage water fairly and make efficient use of water. Through this research, it is hoped that findings/innovations will be obtained that a good water management system can improve regional irrigation services (Prajogo & Olhager, 2012; Pahl-Wostl, 2007). Problem **18 formulation Based on the background** described **above, the formulation of the problem** in this study is: 1) What is the potential availability of water in the Bukian I and II Dams for the current conditions? 2) What is the

need for irrigation water in the Bukian Irrigation Area using the Net Field Requirement (NFR) method based on the application of the existing cropping pattern? 3) What is the balance or water balance that occurs in the Bukian II Dam for conditions without any suppletion and after there is suppletion from the Bukian I Dam? 4) How is the integrated water resources management system in the Bukian Irrigation Area seen from the water balance obtained?

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<https://doi.org/10.21744/irjeis.v9n4.2355> 195 Research Purposes: 1) Analyze and determine the potential availability **2 of water in the** Bukian I and II weirs. 2) Analyze **1 the amount of irrigation water needed** in the Bukian Irrigation Area using the Net Field Requirement (NFR) method based on the application of the existing Cultivation Pattern. 3) Analyze and evaluate the water balance that occurs in the Bukian II Dam for conditions without any supply and after there is a supply from the Bukian I Dam. 4) Determining **26 an integrated water resources management** system in the Bukian Irrigation Area is seen from the water balance obtained. Literature review Irrigation Irrigation is an activity of providing water to agricultural land by taking water from surface water and groundwater (Akmal & Mellianda, 2014). One of the main factors in the agricultural production process is water. Therefore, in the context of providing agricultural water for irrigation, investment is very important and strategic. Arrangements of water (irrigation) must be given in the right amount, time and quality, to **2 meet the needs of** water for various farming purposes. If this is not done properly, plant growth will be disrupted which will ultimately affect agricultural production (Assagaf et al., 2018). Cropping pattern Islami et al. (2011), explain that cropping patterns or what is known as cropping systems are attempts to regulate cropping patterns on a plot of land that interacts with land resources and plant

cultivation technology applied within a certain period (Huda et al., 2012). Effective rainfall Effective rainfall is rainfall **2 that can be used** directly for plant growth. Effective rainfall is determined by the amount of R80, which means that the amount of rainfall can be exceeded by as much as 80%. Calculation of effective rainfall for rice plants refers to the USDA (SCS) (1696), which is taken 70% of the minimum rainfall of 15 days (midmonth) with a probability of 80% of the period (Arridha, 2017), which is **expressed by the following formula:** $Re\ Paddy = R80 \times 0,7\ observation\ period$ with description: $Re\ Paddy =$ effective rainfall for paddy (mm/day) $R80 =$ precipitation with 80% probability (mm) The amount of effective rain for crops can also be formulated by the following equation: $Re\ crops = R50 \times 0,7\ observation\ period$ with description: $Re\ Paddy =$ effective rainfall for crops (mm/day) $R50 =$ precipitation with 50% probability (mm) Irrigation water needs The need for irrigation water is the volume of water needed to meet evaporation needs, water loss, and water needs for plants by taking into account **1 the amount of water** provided by nature through rain and the contribution of groundwater (Sosrodarsono & Takeda, 2003).

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Evapotranspiration To calculate the amount of evapotranspiration of a particular plant, a crop coefficient is needed which is highly dependent on the type and period of plant growth (Doorenbos & Pruitt, 1981). Calculation of the amount of plant evapotranspiration can be calculated as follows: $Etc = Kc \times Eto$ with description: $Etc =$ plant-specific evapotranspiration (mm/day), $Kc =$ crop coefficient which depends on the type and period of plant growth, $Eto =$ potential evapotranspiration or reference plant (mm/day). The **15**

Net Field Water Requirement (NFR) The **Net Field Water Requirement (NFR)** is an estimate of the amount of water for irrigation based on factors such as plant type, soil type, method of water supply, soil processing method, amount of rainfall, time of planting, climate, canal maintenance and dam buildings and so on. According to the Irrigation Planning Criteria (KP-01) (K. Dirjen Sumber Daya Air, 2013), **1 the amount of water** for irrigation in paddy fields can be formulated as follows: $NFR = ETc + P + WLR - Re$ with

description: $NFR = \text{Net Field Water Requirement (mm/day)}$ $ET_c = \text{Plant evaporation (mm/day)}$ $P = \text{Percolation (mm/day)}$ $WLR = \text{Replacement of water layer (mm/day)}$ $Re = \text{Effective rainfall (mm/day)}$ Irrigation efficiency

Quantitatively, the irrigation efficiency of an irrigation network is very little known and is a parameter that is difficult to measure. Loss of irrigation water in rice plants is related to: (a) loss of water in primary, secondary and tertiary canals through seepage, evaporation, and water withdrawal without permits, (b) losses due to operations including excessive water supply (Kalsim, 2002).

Analysis of water availability In analyzing the available water discharge in a catchment area, it is determined by the presence of low flow rates. In this study, the mainstay discharge analysis is carried out using the FJ method. Mock. The Mock Method was developed by Dr F.J. Mock. The Mock method for estimating the amount of discharge of a watershed is based on **2 the concept of water** balance. Evapotranspiration in the Mock Method is evapotranspiration which is influenced by the type of vegetation, soil surface and number of rainy days (Suhartanto et al., 2012).

Regional rainfall Rainfall data used is semi-monthly rainfall data. The rainfall station used is a station that is considered to represent the rain conditions in the area which have previously gone through regional rain analysis. Analysis of the transformation of rain data into discharge data using the F.J. Mock Dr. F.J. Mock in 1973 introduced a simple model to simulate monthly water balances for flows from rainfall data. In this case, there must be a balance between falling rain and evapotranspiration, surface runoff and infiltration as soil moisture and groundwater recharge. Flow in a river is the amount of flow that is directly on the ground surface and baseflow [16]. Mock describes a method for estimating river flow discharge with the following stages:

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<https://doi.org/10.21744/irjeis.v9n4.2355> 1) Limited evapotranspiration (Et) 2) Area of Watershed 3) Soil Moisture Capacity 4) Water balance on the ground surface 5) Ground Water Content 6) Groundwater Flow and Storage 7) Percolation and Infiltration 8) River Flow The water flowing in the river is the sum of direct runoff, interflow and base flow.

Interflow = Infiltration - Groundwater volume (mm), Direct Run Off = Water Surplus - Infiltration (mm), Base Flow = River flow that is always there throughout the year (m³/s), Run Off = Interflow + Direct Run Off + Base Flow (m³/s). Mainstay

discharge = (River Flow x Watershed Area) / 15 days (in seconds). The Mock method of rain-discharge simulation analysis was carried out based on FAO, 1973. 13 Water

Balance The water balance illustrates that the total water input is equal to the total water output plus the change in reserve water over a certain period. The reserve water change value can be positive or negative (Suhartanto et al., 2012). In general, the water balance equation is formulated as follows (Harto, 1993): $I = O \pm \Delta S$ with information: I = input

O = output ΔS = change in water reserves 7 The concept of integrated water resources

management Integrated water resources management is a process aimed at improving and developing the management of water resources, 25 land and related resources in a

coordinated manner by looking at the characteristics of the region to achieve community welfare (Minghua et al., 2009; Collings & Mellahi, 2009). Integration that is carried out

takes into account various interests coupled with the ability and carrying capacity of the environment wisely which in the end can improve people's welfare (Jaya, 2004). The

management approach is mostly sectoral, each sector (household utilization, agriculture, industry, environmental protection, and others) is managed separately with limited

coordination between sectors. This approach causes fragmented and uncoordinated 2

development of water resources (Qadir et al., 2007; Davies & Simonovic, 2011). Many

uses of water have spillover effects on other uses and sometimes have unintended social and environmental consequences (Sudana, 2016). In research conducted by Yekti (2017),

a study was carried out on the pattern of dam operation in fulfilling sustainable water for the Subak irrigation network in the Tukad Yeh Hoo Watershed in Tabanan Regency. The

results of this study show that the system of providing irrigation water in the area is a natak-tiyis system where the wastewater (drain) from rice fields is reused to irrigate the fields downstream. Excess irrigation water that occurs will be reused for activities downstream so that there will be a pattern of water use repeatedly (reuse). Such a pattern is a return flow in a river system or watershed (Triadi et al., 2023).

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Materials and Methods **Research design** This research was designed for 6 months starting with field studies related to the location of the study area and the current conditions. The method in this study is quantitative by using primary data analysis and secondary data to solve problems. To achieve the objectives of this study, it was started by collecting primary data based on field surveys and collecting secondary data obtained from related agencies. Briefly, the stages in carrying out the research to be carried out are as follows: 1) Field survey to determine the existing condition of the object and research location. 2) Measure the instantaneous discharge at the Bukian I and II weirs. 3) Collect secondary data from several related agencies such as rain data, climatological data, cropping patterns and others. 4) Analyse the potential availability **2 of water and the** need for irrigation water. 5) Conduct analysis and evaluation of the water balance that occurs. 6) Determine an integrated water resources management system in the Bukian Irrigation **Area in terms of** the water balance obtained. **Figure 1. Fishbone Research Diagram** **3 Results and Discussions** **3.1 Momentary discharge measurement results** Measurements were taken 6 (six) times for each weir within the period during which the research took place from May to June 2023. Measurements were made using a current meter measuring instrument and using the mean section method. **Secondary Data Collection** Collection of cropping pattern data, rain data and climatological data **Coordination with related agencies** such as: management subak, BWS, Existing Conditions The existing condition of the weir as the main intake building **Inventory and grouping of datampokan data** **Operational pattern of irrigation water use in Bukian I and II Weir** **Water Availability Data Analysis** **Rain Data**

Analysis includes: rain data test, rainfall calculation, rain data transformation into discharge
 Mainstay discharge analysis in the study area Calibration of the results of transforming rain
 data into discharge with data from instantaneous discharge measurements Location of
 study area and research object Primary Data Retrievaler Determination of discharge
 measurement locations Instantaneous discharge measurement using a current meter Field
 survey Water Demand Data Analysis Adjustment of cropping pattern with existing
 conditions Calculation of irrigation water needs with the NFR method **8** The results of the
 analysis of irrigation water needs in DI. Buian Water Balance Analysis Comparison of
 availability debit with demand debit **2** **Analysis of the water resources management**
 system in the Bukian Scenarios of water management based on the existing water balance
 conditions Management of Integrated **7** **Water Resources Management in** the Bukian
 Irrigation Area, Badung Regency

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<https://doi.org/10.21744/irjeis.v9n4.2355> 199 Table 1 Momentary discharge measurement
 results No Measurement Time Discharge at Bukian I weir (m³/second) Discharge at
 Bukian II weir (m³/second) 1 6 Mei 2023 0,185 2 7 Mei 2023 0,078 3 13 Mei 2023
 0,180 4 14 Mei 2023 0,077 5 27 Mei 2023 0,140 6 28 Mei 2023 0,065 7 3 Juni 2023
 0,108 8 4 Juni 2023 0,065 9 10 Juni 2023 0,101 10 11 Juni 2023 0,061 11 17 Juni 2023
 0,091 12 18 Juni 2023 0,059 Average discharge 0,101 From the data obtained, **2** **it can
 be seen** that the discharge generated by the Bukian Weir is relatively constant with a
 discharge range between 0.185 m³/second to 0.059 m³/second. The average discharge
 from the Bukian Weir is 0.101 m³/second. 3.2 Hydrological Analysis Regional rainfall
 analysis Table 2 Probability of half-monthly mainstay rain in the Tukad Ayung watershed
 basic month method 3.3 Analysis of water availability In this study, the mainstay

discharge analysis is carried out using the FJ method. Mock. The Mock Method was developed by Dr FJ. Mock. The Mock method for estimating the amount of discharge in a watershed is based on the concept of water balance. Rainwater that falls (precipitation) will experience evapotranspiration according to the vegetation that covers the catchment area. Evapotranspiration in the Mock Method is evapotranspiration which is influenced by the type of vegetation, soil surface and number of rainy days.

MEI	JUN	DES	Prob. %	PEB	MAR	APR	OKT	NOP	JAN	Total	AGT	SEP		
11,11%	404,9	171,3	238,6	114,8	159,0	191,2	64,5	92,4	48,3	43,7	34,1	43,0	61,4	26,7
14,2	9,1	31,8	53,1	79,4	73,6	104,6	158,8	222,0	202,0	2642,5	22,22%	184,1	160,5	116,6
113,5	127,2	140,4	59,8	80,3	38,9	41,6	22,2	37,0	50,8	25,8	11,4	8,4	19,8	18,2
70,2	116,9	174,1	184,4	1923,0	33,33%	183,7	120,5	102,3	102,2	109,9	113,6	58,0	67,9	38,6
38,6	35,3	20,0	25,2	14,4	16,8	9,0	4,2	19,3	13,1	56,0	46,5	69,9	70,1	163,9
173,8	1634,5	44,44%	151,9	117,6	97,2	100,2	100,4	103,5	46,3	64,5	30,0	30,0	19,2	24,6
13,5	14,9	5,7	2,7	15,0	4,7	52,2	44,0	60,3	65,2	150,5	173,3	1487,4	55,56%	149,9
115,4	93,6	76,5	93,0	98,3	45,6	62,0	28,7	21,7	16,3	20,4	11,2	12,3	5,2	2,4
6,0	4,0	39,7	30,5	52,6	63,6	138,4	145,2	1332,8	66,67%	119,5	113,1	89,7	74,5	92,1
97,6	39,2	50,7	24,2	16,2	12,1	10,8	2,8	10,9	1,9	0,6	2,4	1,4	29,4	27,7
51,5	38,1	136,8	143,3	1186,6	77,78%	117,0	107,3	87,0	73,0	82,7	75,4	28,5	34,7	24,2
15,9	6,8	8,5	2,0	8,3	0,4	0,1	2,1	0,2	4,7	18,9	30,9	37,2	128,9	132,8
1027,2	88,89%	103,1	99,3	76,0	71,8	76,2	74,3	27,8	24,3	17,6	15,3	2,5	2,3	1,7
7,1	0,0	0,0	0,0	0,0	0,0	0,0	0,2	2,1	17,2	12,7	47,0	30,5	599,7	R80
114,2	105,7	84,8	72,8	81,4	75,2	28,4	32,6	22,9	15,8	6,0	7,3	2,0	8,1	0,3
0,1	1,7	0,2	4,5	16,1	29,9	32,7	118,8	125,9	986,7	R50	150,9	116,5	95,4	88,3
96,7	100,9	46,0	63,3	29,4	25,9	17,7	22,5	12,4	13,6	5,5	2,6	10,5	4,4	46,0
37,2	56,4	64,4	144,5	159,2	1410,1	R20	228,3	162,6	141,0	113,8	133,6	150,6	60,8	82,8
40,8	42,0	24,6	38,2	52,9	26,0	12,0	8,5	22,2	25,2	72,4	54,8	77,1	125,3	183,7
187,9	2066,9	Rerata	167,3	121,8	108,2	87,1	101,2	105,5	43,3	53,9	29,7	24,6	15,0	19,1
17,6	14,0	5,3	3,1	10,7	10,5	37,3	33,1	53,7	64,1	137,7	142,6	1406,5	JUL	

Recapitulation of potential semi-monthly mock inflow models in the Cachment Area of the

Bukian I weir (m3/s) Table 4 Inflow potential probability semi-monthly mock model in the

Cachment Area of the Bukian I weir (m3/s) Table 5 Recapitulation of potential semi-

monthly mock inflow models in the Cachment Area of the Bukian II weir (m3/s) I II I II I

II I II I II I II I II I II I II I II 1 2007 0,60 0,47 0,49 0,43 0,40 0,38 0,31 0,27 0,22 0,16

0,13 0,15 0,12 0,09 0,08 0,06 0,06 0,05 0,08 0,10 0,19 0,19 0,41 0,48 2 2008 0,61 0,62

0,62 0,54 0,46 0,44 0,36 0,33 0,27 0,22 0,18 0,16 0,11 0,08 0,07 0,06 0,06 0,05 0,13 0,16

0,23 0,26 0,44 0,58 3 2009 1,06 0,77 0,93 0,75 0,68 0,68 0,48 0,43 0,31 0,20 0,14 0,10

0,08 0,07 0,07 0,06 0,06 0,07 0,10 0,10 0,11 0,09 0,14 0,14 4 2010 0,29 0,33 0,40 0,34

0,32 0,31 0,30 0,29 0,25 0,20 0,17 0,14 0,11 0,10 0,09 0,08 0,09 0,15 0,23 0,26 0,26 0,27

0,40 0,45 5 2011 0,48 0,46 0,46 0,40 0,40 0,38 0,36 0,27 0,21 0,17 0,13 0,13 0,09 0,07

0,06 0,06 0,05 0,05 0,09 0,14 0,18 0,22 0,37 0,50 6 2012 0,63 0,61 0,54 0,52 0,51 0,51

0,38 0,26 0,19 0,14 0,11 0,09 0,09 0,10 0,08 0,07 0,06 0,06 0,13 0,16 0,21 0,19 0,38 0,45

7 2013 0,54 0,50 0,47 0,46 0,40 0,31 0,23 0,16 0,14 0,16 0,14 0,17 0,20 0,15 0,12 0,09

0,12 0,09 0,07 0,08 0,24 0,42 0,64 0,65 8 2014 0,66 0,55 0,52 0,43 0,36 0,32 0,29 0,31

0,23 0,14 0,10 0,08 0,15 0,12 0,09 0,07 0,06 0,06 0,05 0,05 0,05 0,22 0,28 0,46 9 2015

0,45 0,43 0,46 0,40 0,41 0,40 0,36 0,32 0,28 0,20 0,19 0,14 0,10 0,07 0,06 0,06 0,05 0,05

0,05 0,05 0,05 0,05 0,26 0,32 0,593 0,527 0,544 0,477 0,437 0,417 0,341 0,295 0,232

0,177 0,144 0,127 0,116 0,096 0,080 0,067 0,067 0,071 0,105 0,122 0,167 0,212 0,368

0,446 No Tahun Jan 19 Feb Mar Apr Mei Jun Jul Agust Sep Okt Nop Des Reratal II I II I II

I II I II I II I II I II I II I II 1 10% 1,058 0,773 0,931 0,755 0,680 0,684 0,481 0,434

0,313 0,223 0,188 0,167 0,196 0,145 0,120 0,090 0,115 0,149 0,232 0,257 0,256 0,422

0,640 0,646 2 20% 0,661 0,618 0,624 0,544 0,507 0,511 0,375 0,328 0,281 0,204 0,183

0,157 0,146 0,116 0,094 0,076 0,086 0,089 0,132 0,163 0,236 0,265 0,440 0,580 3 30%

0,630 0,610 0,538 0,518 0,458 0,438 0,358 0,325 0,267 0,202 0,166 0,149 0,118 0,104

0,090 0,073 0,063 0,073 0,127 0,156 0,227 0,260 0,412 0,496 4 40% 0,614 0,549 0,524

0,458 0,414 0,404 0,358 0,312 0,246 0,200 0,145 0,140 0,114 0,101 0,084 0,067 0,060

0,057 0,102 0,137 0,206 0,221 0,399 0,477 5 50% 0,600 0,497 0,494 0,435 0,399 0,384
0,356 0,290 0,225 0,172 0,140 0,138 0,110 0,093 0,076 0,063 0,057 0,055 0,094 0,104
0,190 0,218 0,375 0,458 6 60% 0,542 0,471 0,468 0,429 0,398 0,384 0,313 0,274 0,218
0,161 0,131 0,125 0,098 0,080 0,067 0,059 0,057 0,054 0,080 0,098 0,180 0,192 0,372
0,453 7 70% 0,485 0,458 0,463 0,405 0,397 0,325 0,302 0,274 0,208 0,156 0,127 0,099
0,093 0,074 0,065 0,058 0,055 0,053 0,071 0,082 0,110 0,186 0,277 0,446 8 80% 0,453
0,431 0,458 0,403 0,361 0,315 0,288 0,261 0,187 0,140 0,114 0,091 0,088 0,074 0,064
0,057 0,054 0,052 0,054 0,052 0,051 0,094 0,258 0,319 9 90% 0,290 0,331 0,400 0,343
0,324 0,308 0,235 0,157 0,141 0,138 0,102 0,078 0,076 0,072 0,063 0,056 0,054 0,052
0,051 0,051 0,050 0,050 0,144 0,142 0,453 0,431 0,458 0,403 0,361 0,315 0,288 0,261
0,187 0,140 0,114 0,091 0,088 0,074 0,064 0,057 0,054 0,052 0,054 0,052 0,051 0,094
0,258 0,319 0,600 0,497 0,494 0,435 0,399 0,384 0,356 0,290 0,225 0,172 0,140 0,138
0,110 0,093 0,076 0,063 0,057 0,055 0,094 0,104 0,190 0,218 0,375 0,458 0,661 0,618
0,624 0,544 0,507 0,511 0,375 0,328 0,281 0,204 0,183 0,157 0,146 0,116 0,094 0,076
0,086 0,089 0,132 0,163 0,236 0,265 0,440 0,580 Nop Des No Prob. Jan Feb Sep Okt Mei
Jun Q80% Q50% Mar Apr Jul Agust Q20% I II III III III III III III III III III III 1 2007
0,16 0,13 0,14 0,12 0,12 0,12 0,10 0,09 0,08 0,07 0,07 0,07 0,06 0,06 0,06 0,05 0,05 0,05
0,06 0,06 0,08 0,08 0,12 0,13 2 2008 0,16 0,16 0,16 0,15 0,13 0,13 0,11 0,10 0,09 0,08
0,08 0,07 0,06 0,06 0,05 0,05 0,05 0,05 0,07 0,07 0,08 0,09 0,13 0,15 3 2009 0,25 0,19
0,22 0,19 0,17 0,17 0,13 0,12 0,10 0,08 0,07 0,06 0,06 0,05 0,05 0,05 0,05 0,05 0,06 0,06
0,06 0,06 0,07 0,07 4 2010 0,10 0,10 0,12 0,11 0,10 0,10 0,10 0,10 0,10 0,09 0,08 0,07 0,07
0,06 0,06 0,06 0,06 0,06 0,07 0,09 0,09 0,09 0,09 0,12 0,13 5 2011 0,13 0,13 0,13 0,12
0,12 0,12 0,11 0,09 0,08 0,07 0,06 0,06 0,06 0,05 0,05 0,05 0,05 0,05 0,06 0,07 0,08 0,08
0,11 0,14 6 2012 0,16 0,16 0,15 0,14 0,14 0,14 0,11 0,09 0,08 0,07 0,06 0,06 0,06 0,06
0,06 0,05 0,05 0,05 0,07 0,07 0,08 0,08 0,11 0,13 7 2013 0,15 0,14 0,13 0,13 0,12 0,10
0,09 0,07 0,07 0,07 0,07 0,07 0,08 0,07 0,06 0,06 0,06 0,06 0,05 0,06 0,09 0,12 0,17 0,17
8 2014 0,17 0,15 0,14 0,13 0,11 0,10 0,10 0,10 0,08 0,07 0,06 0,06 0,07 0,06 0,06 0,05
0,05 0,05 0,05 0,05 0,05 0,08 0,09 0,13 9 2015 0,13 0,12 0,13 0,12 0,12 0,12 0,11 0,10

0,10 0,08 0,08 0,07 0,06 0,05 0,05 0,05 0,05 0,05 0,05 0,05 0,05 0,05 0,05 0,09 0,10 0,156
 0,143 0,147 0,133 0,126 0,122 0,107 0,098 0,085 0,075 0,068 0,065 0,063 0,059 0,056
 0,053 0,053 0,054 0,061 0,064 0,073 0,082 0,112 0,127 Agust Sep Okt Nop Des Rerata
 No Tahun 4 Jan Feb Mar Apr Mei Jun Jul

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<https://doi.org/10.21744/irjeis.v9n4.2355> 201 Table 6 Inflow potential probability semi-
 monthly mock model in the Cachment Area of the Bukian II weir (m³/s) Results of rain-
 discharge simulation analysis of the F.J. Mock in Cachment Area Bukian I weir Table 7
 FJ's Mock mainstay rain-debit simulation for the Cachment Area of the Bukian I Weir

Figure 2. FJ Mock rain-discharge simulation graphics for the Cachment Area of the Bukian
 I weir

1	10%	0,247	0,191	0,222	0,188	0,173	0,174
0,134	0,125	0,101	0,084	0,077	0,073	0,079	0,069
0,064	0,058	0,063	0,069	0,086	0,091	0,090	0,123
0,165	0,166	2	20%	0,169	0,161	0,162	0,146
0,139	0,140	0,114	0,104	0,095	0,080	0,076	0,071
0,069	0,063	0,059	0,055	0,057	0,058	0,066	0,072
0,086	0,092	0,126	0,154	3	30%	0,163	0,159
0,145	0,141	0,130	0,126	0,110	0,104	0,092	0,080
0,073	0,069	0,063	0,058	0,053	0,055	0,065	0,071
0,085	0,091	0,121	0,137	4	40%	0,160	0,148
0,142	0,130	0,121	0,119	0,110	0,101	0,088	0,079
0,068	0,068	0,063	0,060	0,057	0,053	0,052	0,051
0,060	0,060	0,060	0,067	0,080	0,083	0,118	0,133
5	50%	0,157	0,137	0,137	0,125	0,118	0,115
0,110	0,097	0,084	0,074	0,068	0,067	0,062	0,058
0,055	0,053	0,051	0,051	0,051	0,051	0,056	0,059
0,075	0,078	0,113	0,129	7	70%	0,135	0,130
0,131	0,119	0,118	0,104	0,099	0,094	0,081	0,071
0,065	0,059	0,058	0,055	0,053	0,051	0,051	0,051
0,051	0,051	0,054	0,056	0,062	0,077	0,094	0,127
8	80%	0,129	0,124	0,130	0,119	0,111	0,102
0,097	0,091	0,077	0,068	0,062	0,058	0,057	

0,055 0,053 0,051 0,051 0,050 0,051 0,050 0,050 0,059 0,091 0,102 9 90% 0,097 0,105
0,118 0,107 0,103 0,100 0,086 0,071 0,068 0,067 0,060 0,055 0,055 0,054 0,052 0,051
0,051 0,050 0,050 0,050 0,050 0,050 0,068 0,068 0,129 0,124 0,130 0,119 0,111 0,102
0,097 0,091 0,077 0,068 0,062 0,058 0,057 0,055 0,053 0,051 0,051 0,050 0,051 0,050
0,050 0,059 0,091 0,102 0,157 0,137 0,137 0,125 0,118 0,115 0,110 0,097 0,084 0,074
0,068 0,067 0,062 0,058 0,055 0,053 0,051 0,051 0,059 0,060 0,077 0,083 0,114 0,130
0,169 0,161 0,162 0,146 0,139 0,140 0,114 0,104 0,095 0,080 0,076 0,071 0,069 0,063
0,059 0,055 0,057 0,058 0,066 0,072 0,086 0,092 0,126 0,154 Q20% Sep Okt Mei Jun
Q80% Q50% Mar Apr Jul Agust Nop Des No Prob. Jan Feb 0,45 0,43 0,46 0,40 0,36 0,31
0,29 0,26 0,19 0,14 0,11 0,09 0,09 0,07 0,06 0,06 0,05 0,05 0,05 0,05 0,05 0,09 0,26 0,32
2,31 1,86 1,75 1,69 1,51 1,34 1,16 0,91 0,58 0,44 0,34 0,29 0,12 0,11 0,04 0,02 0,02 0,01
0,01 0,17 0,30 1,08 1,56 2,17 3,11 2,26 2,83 2,63 2,79 2,29 2,29 1,84 1,39 1,44 1,02 1,00
0,53 0,28 0,15 0,11 0,07 0,04 0,04 0,64 1,76 1,83 2,76 2,40 114,19 105,66 84,77 72,75
81,37 75,16 28,37 32,58 22,87 15,76 5,96 7,28 1,98 8,07 0,33 0,05 1,65 0,15 4,46 16,07
29,93 32,65 118,76 125,87 150,90 116,55 95,36 88,35 96,71 100,90 45,97 63,26 29,36
25,87 17,75 22,50 12,36 13,59 5,45 2,57 10,52 4,39 45,97 37,25 56,43 64,41 144,46
159,21 228,25 162,65 140,98 113,79 133,60 150,55 60,77 82,75 40,81 42,05 24,56 38,18
52,92 25,96 11,97 8,51 22,22 25,20 72,36 54,83 77,10 125,30 183,67 187,94 Q80% Q50%
Q20% R80 R50 R20

□ ISSN: 2454-2261 IRJEIS Vol. 9 No. 4, July 2023, pages: 193-210 202 Results of rain-discharge simulation analysis of the F.J. Mock in Cachment Area Bukian II weir Table 8 FJ's Mock mainstay rain-debit simulation for the Cachment Area of the Bukian II Weir Figure 3. FJ rain-discharge simulation graphics. Mock for the Cachment Area Of the Bukian II weir Comparison of momentary measurement discharge with F.J Mock discharge simulation method To validate **8** the results of the Mock method analysis that has been carried out, it will then be compared with the instantaneous discharge measurement data in the same period, namely May I, May II, June I and June II. This is

done **1** to ensure that the results of the calculation of discharge by the Mock method are following the results of **measurements in the field.**

Figure 4. Comparison of

the Mock Method of Discharge

Figure 5. Comparison of the Mock Method of

Discharge with the Momentary Discharge at the Bukian I weir with the Momentary

Discharge at the Bukian II weir 0,13 0,12 0,13 0,12 0,11 0,10 0,10 0,09 0,08 0,07 0,06

0,06 0,06 0,05 0,05 0,05 0,05 0,05 0,05 0,05 0,05 0,06 0,09 0,10 2,31 1,86 1,75 1,69 1,51

1,34 1,16 0,91 0,58 0,44 0,34 0,29 0,12 0,11 0,04 0,02 0,02 0,01 0,01 0,17 0,30 1,08 1,56

2,17 3,11 2,26 2,83 2,63 2,79 2,29 2,29 1,84 1,39 1,44 1,02 1,00 0,53 0,28 0,15 0,11 0,07

0,04 0,04 0,64 1,76 1,83 2,76 2,40 114,19 105,66 84,77 72,75 81,37 75,16 28,37 32,58

22,87 15,76 5,96 7,28 1,98 8,07 0,33 0,05 1,65 0,15 4,46 16,07 29,93 32,65 118,76 125,87

150,90 116,55 95,36 88,35 96,71 100,90 45,97 63,26 29,36 25,87 17,75 22,50 12,36 13,59

5,45 2,57 10,52 4,39 45,97 37,25 56,43 64,41 144,46 159,21 228,25 162,65 140,98 113,79

133,60 150,55 60,77 82,75 40,81 42,05 24,56 38,18 52,92 25,96 11,97 8,51 22,22 25,20

72,36 54,83 77,10 125,30 183,67 187,94 Q80% Q50% Q20% R80 R50 R20

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<https://doi.org/10.21744/irjeis.v9n4.2355> 203 3.4 Analysis of irrigation water

needs Cropping pattern The cropping pattern that applies in the Bukian Irrigation Area is

Paddy I – Paddy II – Paddy III/Palawija. Based on data obtained from the Public Works

and Spatial Planning Office of Badung Regency, it is known that the Planting Intensity (IP)

for the Bukian Irrigation Area is an average of 280% overall. The following shows a

recapitulation of cropping patterns in the Bukian Irrigation Area: Figure 6. Planting Pattern

of the Bukian Irrigation Area Source: Public Works and Spatial Planning Office of Badung

Regency, 2023 Analysis of effective rainfall Based on the explanation of the calculation of

effective rainfall for rice and secondary crops, **8** the results of the analysis for the effective

rainfall of the two types of plants can be explained. Table 9 Effective rainfall calculation results (Re) for paddy and palawija No. Subak Name Area Wide (m²) One Year of Planting 4 Jan Feb Mar Apr Mei Jun Jul Ags Sep Okt Nov Des 1 Subak Tirta Amerta 55,77 With information : : Paddy I : Paddy II : Paddy III / Crops Jempanang Primary Channel Bukian Primary Channel Jumlah Total 55,77

Month	Paddy I	Paddy II	Paddy III	Crops	Total
January I	114,19	79,93	5,33	150,9	105,63
January II	105,66	73,96	4,62	116,55	81,59
February I	84,77	59,34	4,24	95,36	66,75
February II	72,75	50,93	3,64	88,35	61,85
March I	81,37	56,96	3,8	96,71	67,70
March II	75,16	52,61	3,29	100,9	70,63
April I	28,37	19,86	1,32	45,97	32,18
April II	32,58	22,81	1,52	63,26	44,28
May I	22,87	16,01	1,07	29,36	20,55
May II	15,76	11,03	0,69	25,87	18,11
June I	5,96	4,17	0,28	17,75	12,43
June II	7,28	5,10	0,34	22,5	15,75
July I	1,98	1,39	0,09	12,36	8,65
July II	8,07	5,65	0,35	13,59	9,51
August I	0,33	0,04	0,2	2,57	1,80
August II	0,05	0,11	0,02	5,45	3,82
September I	1,65	1,16	0,08	10,52	7,36
September II	0,15	0,11	0,01	4,39	3,07
October I	4,46	3,12	0,21	45,97	32,18
October II	16,07	11,25	0,7	37,25	26,08
November I	29,93	20,95	1,4	56,43	39,50
November II	32,65	22,86	1,52	64,41	45,09
December I	118,76	83,13	5,54	144,46	101,12
December II	125,87	88,11	5,51	159,21	111,45

December Month R80 Re = 0,7 x R80 Re Paddy R50 28 Re = 0,7 x R50 Re Crops (mm) (mm) (mm/day) (mm) (mm/day) II 125,87 88,11 5,51 159,21 111,45 6,97

□ ISSN: 2454-2261 IRJEIS Vol. 9 No. 4, July 2023, pages: 193-210 204 Net irrigation water requirement (NFR) in the Bukian Irrigation Area Table 10 Calculation of the NFR method of irrigation water needs in Bukian Irrigation Area 3.5 Analysis of water balance (water balance) The calculation of the water balance will 27 be carried out at the

7,93 7,65 0,00 0,00 7,63 7,63 15 Use of Paddy Consumption mm/day 9,86 9,71 8,53 5,59
3,20 0,00 6,03 6,03 5,45 5,36 5,74 3,77 2,82 0,00 0,00 0,00 0,00 0,00 7,63 7,63 16 Use of
Crops Consumption mm/day 2,97 3,24 4,52 5,74 7,67 7,65 7,93 7,65 0,00 0,00 17 Net
Water Requirement NFR 1 mm/day 8,23 8,79 6,89 4,55 0,91 0,00 1,65 4,91 3,06 1,03 18
NFR 2 mm/day 1,22 3,86 4,25 1,39 8,08 8,37 8,07 6,03 4,38 4,39 19 NFR 3 mm/day 2,40
2,65 4,27 5,62 7,18 7,44 5,79 6,02 0,00 0,00 Net Water Requirement NFR 1 Liters/sec/ha
0,95 1,02 0,80 0,53 0,10 0,00 0,19 0,57 0,35 0,12 NFR 2 Liters/sec/ha 0,14 0,45 0,49 0,16
0,94 0,97 0,93 0,70 0,51 0,51 NFR 3 Liters/sec/ha 0,28 0,31 0,49 0,65 0,83 0,86 0,67 0,70
0,00 0,00 Liters/sec/ha Water Requirements in Intake DR1 Liters/sec/ha 1,47 1,57 1,23
0,81 0,16 0,00 0,30 0,88 0,55 0,18 DR2 Liters/sec/ha 0,22 0,69 0,76 0,25 1,44 1,50 1,44
1,08 0,78 0,78 DR3 Liters/sec/ha 0,43 0,47 0,76 1,00 1,28 1,33 1,03 1,08 0,00 0,00
Liters/sec/ha Source : Calculation Results Early Planting: November I No. Description
Measure PADDY I PADDY II 20 Total 15 Net Field water Requirement 0,95 1,02 0,80
0,53 0,25 0,45 0,49 0,16 0,94 0,97 0,93 0,70 0,78 0,81 0,49 0,65 0,83 0,86 0,67 0,70 0,19
0,57 0,35 0,12 21 Total D R 1,47 1,57 1,23 0,81 0,38 0,69 0,76 0,25 1,44 1,50 1,44 1,08
1,21 1,26 0,76 1,00 1,28 1,33 1,03 1,08 0,30 0,88 0,55 0,18 4 Jan Feb Mar Apr Mei Jun
Jul Ags Sep Okt Nov Des Land Preparation Land Preparation

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<https://doi.org/10.21744/irjeis.v9n4.2355> 205 Table 11 Water balance calculation at Bukian
Weir II (Without supplement from Bukian I Weir) Figure 7. Graph of water balance at
Bukian II Weir (Without supplement from Bukian I Weir) Month Qmainstay Q demand DR
Remaining Water Information liter/sec liter/sec Paddy I Paddy II Crops Functional Area
(Ha) 55,77 55,77 55,77 55,77 Liter/sec Jan I 128,66 82,00 1,47 II 124,49 87,53 1,57 Feb I
129,65 68,62 1,23 II 118,95 45,37 0,81 Mar I 110,74 21,20 0,16 0,22 II 101,71 23,05 0,00

0,69 Apr I 96,53 25,40 0,76 II 91,24 8,32 0,25 May I 76,70 48,29 1,44 II 67,61 50,05 1,50
 Jun I 62,44 48,20 1,44 II 58,00 36,02 1,08 Jul I 57,33 45,28 0,78 0,43 II 54,77 47,31 0,78
 0,47 Aug I 52,74 34,02 0,76 II 51,38 44,82 1,00 Sep I 50,79 57,21 1,28 II 50,43 59,30 1,33
 Oct I 50,73 46,12 1,03 II 50,37 47,98 1,08 Nov I 50,21 16,47 0,30 0,00 II 58,67 48,94 0,88
 Dec I 90,55 30,52 0,55 II 102,48 10,22 0,18 Amount 1887,17 1032,24 854,93 Max 1,57
 1,50 1,33 Average 78,63 43,01 46,66 Enough 36,96 Enough 61,03 Enough 73,58 Enough
 89,54 Enough 78,66 Enough 71,13 Enough 82,92 Enough 28,41 Enough 17,56 Enough
 14,24 Enough 21,98 Enough 12,05 Enough 7,46 Enough 18,72 Enough 6,56 Enough -6,42
 Not Enough -8,87 Not Enough 4,61 Enough 2,39 Enough 33,74 Enough 9,73 Enough
 60,03 Enough 92,26 Enough Success Period 92% Source : The Calculation Result

□ ISSN: 2454-2261 IRJEIS Vol. 9 No. 4, July 2023, pages: 193-210 206 Table 12
 Water balance calculation at Bukian Weir II (After receiving supplement from Bukian I
 Weir) Figure 8. Graph of water balance at Bukian II Weir (With supplement from Bukian
 I Weir) Month Q mainstay Q Demand DR Remaining water Information Liter/sec Liter/sec
 Paddy I (100%) Paddy II (100%) Crops (80%) Function Area (Ha) 55,77 55,77 55,77
 44,616 lt/dt Jan I 581,54 82,00 1,47 II 555,97 87,53 1,57 Feb I 587,60 68,62 1,23 II 522,07
 45,37 0,81 Mar I 471,82 21,20 0,16 0,22 II 416,52 23,05 0,00 0,69 Apr I 384,85 25,40 0,76
 II 352,45 8,32 0,25 May I 263,45 48,29 1,44 II 207,77 50,05 1,50 Jun I 176,17 48,20 1,44 II
 148,96 36,02 1,08 Jul I 144,87 45,28 0,78 0,43 II 129,21 47,31 0,78 0,47 Aug I 116,76
 34,02 0,76 II 108,45 44,82 1,00 Sep I 104,85 57,21 1,28 II 102,61 59,30 1,33 Oct I 104,47
 46,12 1,03 II 102,25 47,98 1,08 Nov I 101,29 16,47 0,30 0,00 II 153,07 48,94 0,88 Dec I
 348,24 30,52 0,55 II 421,23 10,22 0,18 Amount 6606,44 1032,25 5574,20 Max 1,57 1,50
 1,33 Average 275,27 43,01 Source : The Calculation Result 499,53 Enough 468,44
 Enough 518,97 Enough 476,70 Enough 450,62 Enough 393,47 Enough 359,45 Enough
 344,13 Enough 215,16 Enough 157,73 Enough 127,96 Enough 112,94 Enough 99,59
 Enough 81,90 Enough 82,74 Enough 63,63 Enough 47,63 Enough 43,31 Enough 58,35
 Enough 54,27 Enough 84,82 Enough 104,13 Enough 317,72 Enough 411,01 Enough

Success Period 100%

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<https://doi.org/10.21744/irjeis.v9n4.2355> 207 3.6 Analysis of water resources management system in the Bukian Irrigation Area **1 By looking at the** water balance that occurs in the Bukian II Weir with no supplementation from the Bukian I Weir, it can be seen the potential for **water shortages in the** Bukian Irrigation Area which has the potential to occur in May to November. Based on **8** the results of the analysis after supplementation from the Bukian I Weir, the water balance that occurred in the Bukian II Weir showed a surplus condition. To anticipate water shortages in the Bukian II Weir, **2 it is necessary to** have additional flow (suppletion) from the Bukian I Weir. To obtain a good water resources management system in the Bukian Irrigation Area, arrangements must be made regarding the time **21 and amount of water** to be supplied to the Bukian I Weir. From May to November by opening the intake of the Bukian I Weir. **1 The amount of water** flowing must be following the needs. When the water balance condition in Bukian II Weir is in a surplus condition, the flow from Bukian I Weir must be stopped, namely from December to April by closing the intake gate of Bukian I Weir. Excess water in Bukian I Weir can be channelled directly downstream to the river to meet **the water needs of** other users. This is done to maintain the sustainability and balance of an integrated water utilization system. 4

Conclusion Based **22 on the results of** the field review and data analysis that was carried out at the 70% progress report stage, the researcher can conclude several things, including: 1) Based **on the results of** discharge analysis using the FJ method. The mock result is that the potential availability **2 of water in the** Bukian I and Bukian II weirs has a fluctuating magnitude in each semi-monthly period. Each maximum discharge of 0.458 m³/second and 0.130 m³/second occurred in the first February period, the minimum

discharge was 0.051 m³/second each in the November I period and 0.050 m³/second in September II and October II. The average discharge potential of each is 0.197 m³/second and 0.079 m³/second which are all analyzed with a reliability level of 80%. 1) 2) Based on the results of the calculation of the net irrigation water requirement (NFR), the amount of irrigation water needed according to the existing cropping pattern is 1.57

liters/second/hectare. 3) The condition of the water balance in the Bukian II Dam without any supply shows the water deficit condition that occurred in September I and II, where the remaining water is shown to be negative, respectively -6.42 liters/second and -8.87 liters/second. The water balance also shows the potential for water shortages that occur in the period from May to November or predominate in the third planting season. After adding the discharge through the supplementation of the Bukian I Dam, the result was that the availability discharge increased significantly and the water balance indicated a surplus of water, which was indicated by the remaining water which was entirely positive. 4) To obtain a good water resources management system in the Bukian Irrigation Area, arrangements must be made regarding the time 21 and amount of water to be supplied to the Bukian II Weir. The supplement can only be done when 13 the water balance is experiencing a deficit or when there is a potential for water shortages, namely from May to November. The amount of water that is channelled must be following the needs, where if the water balance conditions in the Bukian II Dam are in a surplus condition, the flow from the Bukian I Dam must be stopped, namely from December to April. Excess water in the Bukian I Dam can be channelled directly downstream to meet 1 the water needs of other users to maintain the sustainability and balance of an integrated water utilization system. Conflict of interest statement The authors declared 8 that they have no competing interests. Statement of authorship The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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IRJEIS ISSN: 2454-2261 □ Andayani, K. W., Wardana, I. G. N. K. M. A., Triadi, I. N. S., Winaya, I. N. A. P., & Sutapa, I. K. (2023). Integrated water resources management in the Bukian irrigation area at Badung Regency. ⁹ International Research Journal of Engineering, IT & Scientific Research, 9(4), 193–210.

<https://doi.org/10.21744/irjeis.v9n4.2355> 209 References Akmal, M., & Mellianda, E. (2014). ²⁹ Efisiensi irigasi pada petak tersier di daerah irigasi Lawe Bulan Kabupaten Aceh Tenggara. Jurnal Teknik Sipil Pascasarjana Universitas Syiah Kuala, 3(3), 20-37. Arridha, I. H. (2017). Analisis Kebutuhan Air Irigasi (Studi Kasus Pada Daerah Irigasi Cimanuk Hilir Daerah Kabupaten Sumedang, Jawa Barat) (Doctoral dissertation, Sekolah Tinggi Teknik PLN). Assagaf, S. A., Silahooy, C., Kunu, P. J., Talakua, S., & Soplanit, R. (2018). Efisiensi ¹⁶ pemberian air pada jaringan irigasi way bini Kecamatan Waeapo Kabupaten Buru Provinsi Maluku. Agrologia, 5(2), 288766. Bouman, B. A. M., Feng, L., Tuong, T. P., Lu, G., Wang, H., & Feng, Y. (2007). ⁶ Exploring options to grow rice using less water in northern China using a modelling approach: II. Quantifying yield, water balance components, and water productivity. Agricultural Water Management, 88(1-3), 23-33. <https://doi.org/10.1016/j.agwat.2006.10.005> Chen, C., Li, J., Chen, P., Ding, R., Zhang, P., & Li, X. (2014). Occurrence of antibiotics and antibiotic resistances in soils from wastewater irrigation areas in Beijing and Tianjin, China. Environmental Pollution, 193, 94-101. <https://doi.org/10.1016/j.envpol.2014.06.005> Collings, D. G., &

Mellahi, K. (2009). Strategic talent management: A review and research agenda. *Human resource management review*, 19(4), 304-313. <https://doi.org/10.1016/j.hrmr.2009.04.001>

Davies, E. G., & Simonovic, S. P. (2011). Global water resources modeling with an integrated model of the social– economic–environmental system. *Advances in water resources*, 34(6), 684-700. <https://doi.org/10.1016/j.advwatres.2011.02.010>

Doorenbos, J., & Pruitt, W. O. (1981). Guidelines for predicting crop water requirements. Dwiwana, L. (2019). Analisa Ketersediaan Dan Kebutuhan Air Irigasi Di Daerah Irigasi Terdu. *JeLAST: Jurnal PWK, Laut, Sipil, Tambang*, 6(1). Harto, S. (1993). Analisis hidrologi. Jakarta: Gramedia pustaka utama.

Huda, M. N., Harisuseno, D., & Priyantoro, D. (2012). Kajian Sistem Pemberian Air Irigasi sebagai Dasar Penyusunan Jadwal Rotasi pada Daerah Irigasi Tumpang Kabupaten Malang. *Jurnal Teknik Pengairan: Journal of Water Resources Engineering*, 3(2), 221-229.

Islami, T., Guritno, B., & Utomo, W. H. (2011). Performance of cassava (*Manihot esculenta* Crantz) based cropping systems and associated soil quality changes in the degraded tropical uplands of East Java, Indonesia. *Journal of Tropical Agriculture*, 49, 31-39.

Jaya, A. (2004). Konsep pembangunan berkelanjutan (sustainable development). Program Pasca Sarjana IPB, Bogor.

Kalsim, D. K. (2002). Rancangan Irigasi Gravitasi, Drainase Dan Infrastruktur. Kustana, K., & Setiawan, C. (2020). Resolusi konflik sistem pengelolaan irigasi pertanian di pedesaan. *Jurnal Pembangunan Nasional Temali*, 3(1), 149-187.

K. Dirjen Sumber Daya Air. (2013). Standar Perencanaan Irigasi KP-01. Jakarta.

Minghua, Z., Xiumin, F., Rovetta, A., Qichang, H., Vicentini, F., Bingkai, L., ... & Yi, L. (2009). Municipal solid waste management in Pudong new area, China. *Waste management*, 29(3), 1227-1233. <https://doi.org/10.1016/j.wasman.2008.07.016>

Pahl-Wostl, C. (2007). The implications of complexity for integrated resources management. *Environmental modelling & software*, 22(5), 561-569. <https://doi.org/10.1016/j.envsoft.2005.12.024>

Prajogo, D., & Olhager, J. (2012). Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration. *International Journal of Production Economics*, 135(1), 514-522. <https://doi.org/10.1016/j.ijpe.2011.09.001>

Presiden Republik

Indonesia, (2019). Undang-undang (UU) Nomor 17 Tahun 2019 tentang Sumber Daya Air, no. 011594. p. 50. Qadir, M., Sharma, B. R., Bruggeman, A., Choukr-Allah, R., & Karajeh, F. (2007). **12 Non-conventional water resources and opportunities for water augmentation to achieve food security in water scarce countries.** *Agricultural water management*, 87(1), 2-22. <https://doi.org/10.1016/j.agwat.2006.03.018> Sosrodarsono, S., & Takeda, K. (2003). *Hidrologi Untuk Pengairan*, IX. Jakarta: PT. Pradnya Paramita. Sudana, I. N. (2016). *Kendala Dan Strategi* **17 Penerapan Pengelolaan Sumber Daya Air Terpadu Untuk Pencapaian Mdg's Dalam Pengelolaan Sumber Daya Air** Di Indonesia. *Jurnal teknik sipil*, 1(1), 33-42. Suhartanto, E., Limantara, L. M., & Samosir, A. (2012). Analisis Neraca Air Sub DAS Irigasi Wirway Kabupaten Sarmi Provinsi Papua. *Jurnal Irigasi*, 7(2), 74-86.

□ ISSN: 2454-2261 IRJEIS Vol. 9 No. 4, July 2023, pages: 193-210 210 Sun, H. Y., Liu, C. M., Zhang, X. Y., Shen, Y. J., & Zhang, Y. Q. (2006). Effects of irrigation on water balance, yield and WUE of winter wheat in the North China Plain. *Agricultural water management*, 85(1-2), 211-218. <https://doi.org/10.1016/j.agwat.2006.04.008> Suni, Y. P., & Legono, D. (2021). Manajemen Sumber Daya Air Terpadu Dalam Skala Global, Nasional Dan Regional. *Jurnal Teknik Sipil*, 10(1), 77-88. Sutikno, S. (2014). *Pengelolaan Sumberdaya Air Terpadu (Integrated Water Resources Management, IWRM)*. **23 MESA (Teknik Mesin, Teknik Elektro, Teknik Sipil, Arsitektur)**, 1(1), 9-25. Triadi, I. N. S., Yasa, I. M. T., Mudhina, M., Andayani, K. W., & Sutapa, I. K. (2023). Analysis of integrated clean water services for west Bali region. **9 International Research Journal of Engineering, IT & Scientific Research**, 9(2), 57-64. <https://doi.org/10.21744/irjeis.v9n2.2286> Wang, Y., Qiao, M., Liu, Y., & Zhu, Y. (2012). **10 Health risk assessment of heavy metals in soils and vegetables from wastewater irrigated area, Beijing-Tianjin city cluster, China.** *Journal of Environmental Sciences*, 24(4), 690-698. [https://doi.org/10.1016/S1001-0742\(11\)60833-4](https://doi.org/10.1016/S1001-0742(11)60833-4) Yekti, M. I. **11 (2017). Role of reservoir operation in sustainable water supply to Subak irrigation schemes in Yeh Ho River Basin.** Wageningen University and Research. Zulyanti, Z., Angela, R., & Cahyaningrum, W. (2022). Analisis **14 Pemanfaatan Air Sungai Bagi**

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KHATULISTIWA: Jurnal Pendidikan Geografi dan Pariwisata, 2(1), 37-53.

Sources

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