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Handtekening ....

Anton de Kom University of Suriname
Faculty of Technology

Academic year: 2020-2021

Modeling the impact of climate change on the hydrological regime of the Kabalebo River Basin in Suriname using the SWAT hydrological model

by

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A thesis submitted to the Anton de Kom University of Suriname, Faculty of Technology, Suriname, in fulfillment of the requirements for the degree of
Master of Science (MSc) in Sustainable Management of Natural Resources

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Date: November 04, 2020
Paramaribo, Suriname

Preface

Doing a research related to ArcGIS, was one of my goals. Finally, I found this topic about predicting the impact of climate change on the Kabalebo River Basin with SWAT that works in the ArcGIS interface. Firstly, I thought that it will be an easy journey, but learning about how the software works and all the trial and error, made it a difficult one. However, I learned a lot from this research and hope that I can contribute where necessary.

My gratitude goes to the Belgian Directorate-General for Development Cooperation (DGDC), the Flemish Interuniversity Council (VLIR-UOS) and Suriname Conservation Foundation (SCF) who made this Master of Science Programme in Sustainable Management of Natural Resources (MSc in SMNR) possible at the Anton de Kom University of Suriname. But also, to all the sponsors who made it possible to continue with this study, after the funding was ended by the DGDC and VLIR-UOS.

I would like to thank Dr. R. Nurmohamed and Ms. K. Fung-Loy MSc. for their patience, constant support and guidance during the progress of this thesis.

I also would like to thank my previous employer, the director of ILACO Suriname NV (ILACO) Mr. R. Patandin, who gave me the opportunity to do this MSc in SMNR during office working hours.

I especially want to thank my parents, siblings and husband. Without their support I would not be able to reach the finish line.

Shastria Wanisha Narain

Paramaribo, November 04, 2020

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List of abbreviations

95PPU:	95% prediction uncertainty
DEM:	Digital Elevation Model
HRU:	Hydrologic Response Units
LULC:	Land use/Land cover
NS:	Nash-Sutcliffe
PT:	Priestley–Taylor
SUFI-2:	Sequential Uncertainty Fitting version-2
SWAT:	Soil Water Assessment Tool (SWAT)

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Executive summary

To predict the impact that climate change can have on the Kabalebo River Basin, the Soil Water Assessment Tool (SWAT) hydrological model is used. The main objectives of this study were (1) creating and calibrating a SWAT model of the Kabalebo River Basin, (2) predict the outcomes of climate change for the years 2030, 2050 and 2100 on the outflow of the Kabalebo River Basin using SWAT, (3) determine the impact of climate change on water resources and environment in the Kabalebo River Basin. The SWAT model presented an adequate performance in the calibration stage and in the validation stage it was better. The R^2 and NS values for calibration were 0.52 and 0.48, respectively, whereas these values were 0.62 and 0.61 for the validation period. When looking at the simulated values per month for 2030, 2050, 2100, we see an increase in the monthly max flow in the big rainy season. One of the expected impacts of climate change on the Kabalebo River Basin will be a decrease in precipitation in the dry season and an increase in precipitation intensity in the wet season , which will cause a higher discharge. An increase in precipitation and outflow can cause floods and may cause damage to areas in the Kabalebo River Basin that are near the river. In the dryer season, some branches of the river may completely dry off. This may cause an issue for people who are dependent of these branches for transport, household chores, drinking water etc. Also, wildlife may be affected by this. The dryer season may also impact the functioning of hydroelectric powerplant in a negative way and thus the supply of hydropower. People who are dependent of rainwater for their daily work, may experience some issues. Extreme and frequent floods because of the change in pattern can erode the riverbank and damage the riparian zone. A limitation in this study was that the data used for this research was outdated (almost 40 years) and contained a lot of missing values for precipitation. Also climate change was in its initial phase for this data period. It is better to do the simulation with more recent data, because the recent data will include climatic change all over the years till now. Also the possibility to have another measuring station for precipitation and temperature in the Kabalebo River Basin should be considered. This will prevent that data is measured wrong. Simulations done with more recent data can be used to validate the output from this research.

Keywords: *ArcSWAT, SWAT-CUP, climate, Suriname, Kabalebo*

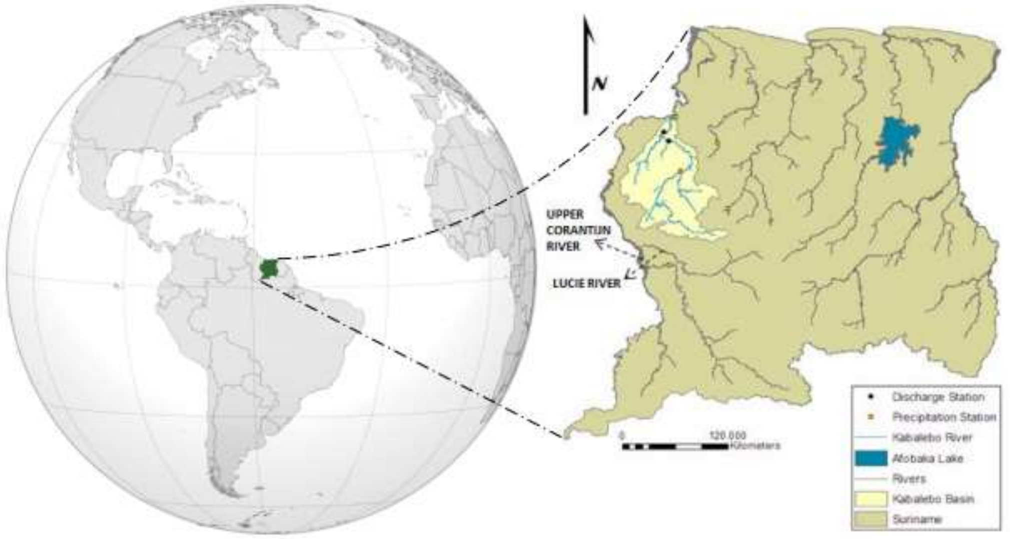
1 Introduction

The Kabalebo River Basin is situated in the western part of the district Sipaliwini (West Suriname), in the area between 3.60° and 5.04° N and 56.66° and 57.80°W (Donk, Nurmohamed, & Willems, 2013). The Kabalebo River Basin is near the borderline between Suriname and Guyana. Sipaliwini has an area of 130,567 km², of which 9,450 km² is covered by the Kabalebo River Basin. The people living in the vicinity of the Kabalebo are mainly indigenous Indians. These people are dependent on the water from the river to do their household chores, such as washing their clothes, bathing etc. (Kambel, 2006). An overview of the Kabalebo River Basin, together with the map of Suriname can be seen in Figure 1.

The Kabalebo River Basin was selected for a hydropower project that was submitted to the World Bank Group in 1979 (The World Bank, 1979). The aim of that project was to develop hydropower potential in Suriname, in order to meet the energy demand in Suriname, which increases 6-10% annually (Donk, Nurmohamed, & Willems, 2013). The surrounding of the Kabalebo River Basin is covered by dense tropical rainforest and is the territory of ingenuous people on which they depend their livelihood (Van Pagee, Groot, Klomp, & Verhagen, 1982) (Goodland, 2006).

Figure 1

Overview of the Kabalebo River Basin in Suriname (Donk, Nurmohamed, & Willems, 2013).



1.1 Problem description

In the last decades the global climate has changed due to the increased greenhouse gases and emissions. The global climate change is noticeable by the change in the hydrologic cycle such as the quantity of precipitation, evaporation, evapotranspiration and the temperature (Kundzewicz, 2008). These changes in the hydrologic cycle may have an impact on watersheds and its surrounding area. Therefore it's important to take measures. With this study it's attempted to predict the effect of climate change on the outflow of the Kabalebo River Basin, which is chosen as a basin to create hydropower. It's also important to know what the impact of climate change will be on the rich biodiversity and the people living of and in the surrounding area of the Kabalebo River Basin.

With the help of the Soil Water Assessment Tool (SWAT) hydrological model, the impact of climate change on the outflow of the basin is predicted.

1.2 Research objectives

The main objectives of this study are (1) creating and calibrating a SWAT model for the Kabalebo River Basin, (2) predict the outcomes of climate change for the years 2030, 2050 and 2100 on the outflow of the Kabalebo River Basin using SWAT, (3) determine the impact of climate change on water resources and environment in the Kabalebo River Basin.

1.3 Outline thesis

This thesis starts with chapter 1, where a general overview of the problem and an introduction is given. Further the problem description and research objectives can be found in this chapter. In chapter 2 the literature review regarding the topic and the model that is used for this study can be found. In chapter 3 the methodology and data used to meet the objective is described. The results are presented in chapter 4 and are also discussed in the same chapter. Finally, the conclusions are presented in chapter 5 with limitations in chapter 6.

2 Literature Review

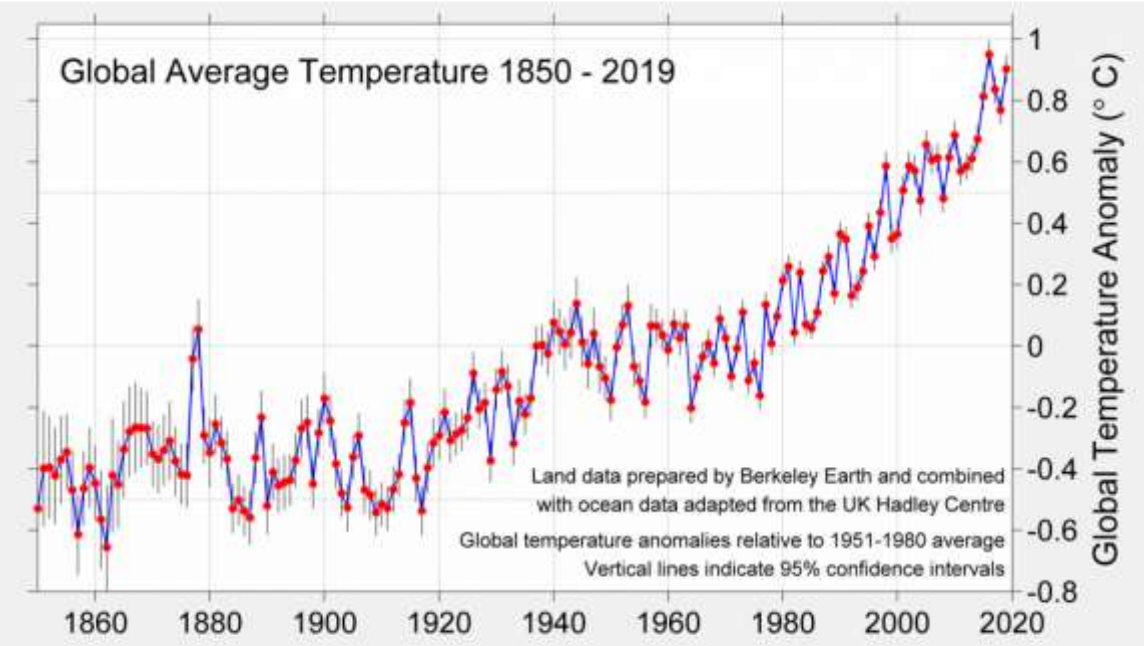
2.1 Climate Change

Climate change refers to changes in temperature, humidity, wind, rainfall and so on. Worldwide some clearly noticeable examples of climate change include shrinking of glaciers, breaking up of ice on rivers and lakes, shifting of animals, accelerated sea level rise, more intense heat waves etc. A contributing factor to climate change is global warming. Global Warming is the increase of Earth's average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning fossil fuels or from deforestation. Global warming is observed since the pre-industrial period between 1850 and 1900. The global warming is due to human activities and burning of fossil fuel, which causes an increase in the greenhouse gas levels that are trapped in the Earth’s atmosphere (Shahzad, 2015). In

Figure 2 below can be seen how the temperature on the earth has been increasing over the years.

Figure 2

Annual Temperature Anomaly (Department of Commerce USA, 2020)



Climate change can have an impact on watershed ecosystems and hydrologic processes. The hydrologic processes are affected by the meteorological parameters, temperature and rainfall, which in the end contributes to the global warming issues (Rahama, 2018). Global warming is impacting the climate negatively by changing the rainfall patterns resulting in drought, famine or severe storms. There are still people believing that the trapped greenhouse gas will cause a change in the global climate over centuries (Union of Concerned Scientists, 2011). In 2019, the global mean temperature was estimated to be 1.28 °C above the average temperature that was measured in the 19th century, from 1850-1900. This period is considered the pre-industrial baseline for global temperature (Hegerl, et al., 1996).

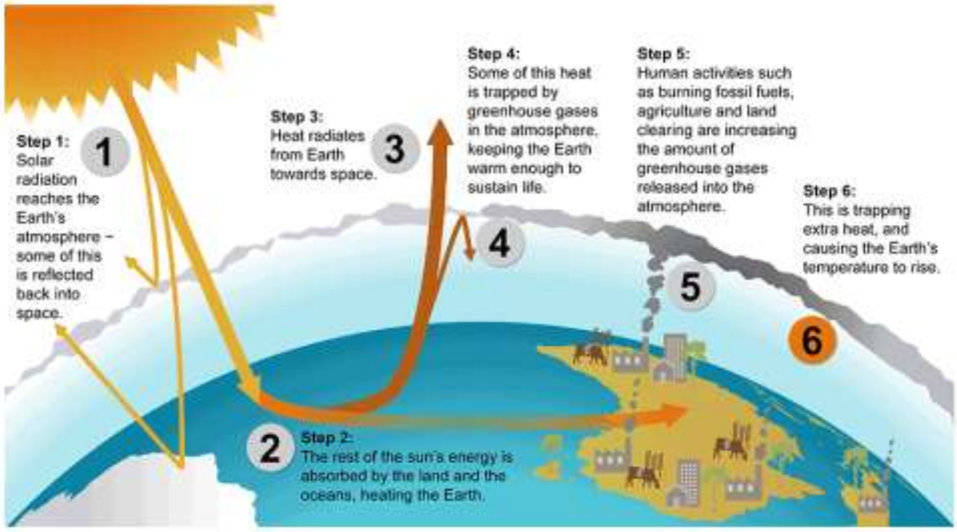
The years 2015 to 2019 are years where the significant warmth was well above all the years since 1850. Also, El Niño and La Niña influence the yearly temperatures. Compared to the average earth surface temperature in 1951-1980, in 2019 it was warmer (Hegerl, et al., 1996).

Greenhouse Effect

Greenhouse effect is a natural process that causes the earth's surface to become warmer. The Sun's energy that is received by the earth, is partly absorbed and re-radiated by greenhouse gases and partly reflected. The greenhouse gases consist of water vapor, carbon dioxide, methane, nitrous oxide, ozone and some artificial chemicals such as chlorofluorocarbons (CFCs). The energy that is absorbed by the greenhouse gases warms the atmosphere and Earth's surface. This temperature makes it possible for living creatures to stay on the earth. However, human activities are causing an increase in greenhouse gases, which is contributing to warming of the Earth (Stephens, Kahn, & Richardson, 2016). In Figure 3 can be seen how the greenhouse effect is caused.

Figure 3

The process of the greenhouse effect (Australian Goverment, 2020)



Also, in Suriname the effects of climate change and global warming are noticeable. These effects are mainly linked to the expected (and observed) rise of the level of the Atlantic Ocean (UNDP, 2016). Some specific effects of climate change in Suriname are saltwater intrusion, increased temperature and drought, high intensity rains, causing floods etc. People living in the coastal zone along the rivers, including the Indigenous and forest-dependent people, are amongst the most vulnerable and stand to be significantly impacted (World Bank Group, 2020).

Figure 4

Flooding caused in the interior of Suriname by intense rainfall (PAHO, 2006)

2.2 Impact of Climate Change on River Basins

Climate change is expected to transform regional hydrologic conditions among others (Ozdemir & Leloglu, 2014). Some potential impacts on the hydrological processes may include evaporation, soil moisture, water temperature, stream flow volume, timing and magnitude of runoff, and frequency. The change in hydrology may impact agricultural productivity, land use, water demand, population in the watershed (Palmer, et al., 2008).

In several studies it’s concluded that however the total annual precipitation isn’t expected to change much, the change in pattern is significant. This may cause more floods and may cause damage to areas in the basin near the river. Another risk is that some branches of the river may completely dry off in the dry season (Poff, Brinson, & Day, 2002). These expected changes in global climate and water needs may lead to flows outside the natural range and cause several issues including loss of biodiversity, risks to ecosystems and water availability for people who depend on them (Lettenmaier, Wood, Palmer, Wood, & Stakhiv, 1999). Some of these issues include that native riverine biodiversity and productivity may decline, water quality for human consumption may be compromised, risk of flooding, with concomitant damage to property and people, may increase (Bunn & Arthington, 2002).

2.3 Soil Water Assessment Tool (SWAT)

SWAT (Soil Water Assessment Tool), which was developed by the United States Department of Agriculture (USDA) is used to model the hydrology of a watershed. SWAT is a conceptual and semi-distribution model, that takes several parameters into consideration, such as soil types, land use, topography etc. The goal of the SWAT model is to predict the impact of land management activities with regard to water, sedimentation, and chemical–agricultural agents in the presence of a variety of soil, land cover, and management conditions during a long period (Ha, Bastiaanssen, van Griensven, van Dijk, & Senay, 2017) (Arnold & Fohrer, 2005). The SWAT model is free and was developed to assist with assessment of watersheds ranging in sizes from small (a few hundred square kilometers) to large watersheds (several thousand square kilometers). One advantage of SWAT is the integration with GIS which provides an improved modelling linkage within a management basin (Srinivasan & Arnold, 2007). SWAT has several components including hydrology features, land use, soil and slope attributes, and weather generator. The documentation for the model is complete and contains equations and algorithms, a user manual describing model inputs and outputs, and an ArcGIS interface manual (Arnold & Fohrer, 2005). Beside the advantages, the model also contains limitations. The spatial representation of the hydrological response units within sub-basins is one of them, which is not possible in SWAT. Infiltration into aquifers in hard rock areas is not modeled correctly by SWAT, because it assumes unlimited capacity for water infiltration (Garg, Karlberg, Barron, Wani, & Rockstrom, 2011).

However, even though several limitations exist, the SWAT model was used in several studies and the application met with acceptable performance (Grey, Webber, Setegn, & Melesse, 2014). These included the modelling of the effects of hypothetical land use change scenarios (primarily deforestation and reforestation of croplands) on flow, sediment, and nutrient yields. Several watershed modelling software have been developed and are universally accepted such as the Better Assessment Science Integrated Point and Nonpoint Sources (BASINS), Modelo Hidrodinâmico (MOHID), SWAT, Water Quality Analysis Simulation Program (WASP), and Watershed Modelling Systems (WMS) among others. Despite the vast wealth of models, the diversity and cost-effective approach, as well as the significantly large and growing model extensions has increased SWAT's application worldwide in developed and developing countries in a wide range of watershed sizes and conditions (Grey, Webber, Setegn, & Melesse, 2014).

3 Methodology

In the following paragraphs the study area, materials and tool used are described.

3.1 Study area

To assess the impact of Climate Change on the discharge rates, levels and volumes of rivers, a study area and a model is chosen. As a study area, the Kabalebo River Basin in Suriname is selected. To model the impact of climate change on the hydrology of the Kabalebo River Basin, the Soil Water Assessment Tool (SWAT) hydrological model is used.

In the Kabalebo area there are several meteorological stations, of which one (1) is used, because it was the only one that was inside the watershed and was representative according to the requirements of the SWAT model, where the station should be located inside the River basin.

3.2 Materials

As indicated earlier, the SWAT hydrological model will be used to model the impact of climate change. In order to use this model, it is required to have ArcGIS installed. ArcGIS version 10.2.2 was used.

For the simulation of precipitation and temperature the datasets used as input in ArcSWAT are indicated in Table 1.

Table 1

Model Input data sources for the Kabalebo River Basin

Name	Resolution, Number of Stations	Year/ Period	Source
Digital elevation model	30 m	2014	SRTM
Land use	1:100.000	2015	Foundation for Forest Management and Production Control
Soil	1: 100.000		Geological Mining Service (GMD)
Precipitation	1 station	1972-1982	Meteorological Service of Suriname
Temperature	1 station	1972-1982	Meteorological Service of Suriname
Discharge	1 station	1972-1982	Waterloopkundige Dienst

The Digital Elevation Model (DEM) from the Shuttle Radar Topography Mission (SRTM) of National Aeronautics and Space Administration (NASA) with 30 m spatial resolution for Suriname was downloaded from "USGS science for a changing world". The land use Land Cover (LULC) data was received from the Foundation for Forest Management and Production Control (Stichting Bosbeheer en Bostoezicht, 2015). The resolution of the data was 1:100.000 and was last updated in 2015.

The soil data was received from Geological Mining Service (Geologisch Mijnbouwkundige Dienst, n.d.) and had a resolution of 1:100.000.

The weather data, consisting of temperature and precipitation, was requested from the Meteorological Institute in Suriname. As no recent data was available, historical data from 1972 to 1982 was used. The temperature and precipitation data were complete for only one (1) station; Kabalebo station. The coordinates of this station are 4.24^{o} N and -57.13^{o} W (Meteorological Institute in Suriname, 1972-1982).

From the Waterloopkundige Dienst (Ministry of Public Works, Transport and Communications) hydrology flow data of the Kabalebo River Basin was obtained for the Avanavero station (4.25^{o} N, -57.43^{o} W). No recent data was available, therefore historical data from 1972 to 1982 was used for this study (Ministry of Public Works, 1972-1982).

3.3 Soil Water Assessment Tool

In the SWAT model each sub watershed is divided into several HRU (Hydrologic Response Units). The HRU is the smallest spatial unit of the model, and the standard HRU definition approach lumps all similar land uses, soils, and slopes within a sub-basin based upon user-defined thresholds. The sub-basin contains several components, which are: hydrology, weather, erosion, sedimentation, soil temperature, plant growth, nutrients, pesticides and land management (Rahama, 2018).

Useful model outputs are evapotranspiration, surface runoff, peak flow, sediment loading, nutrient loading, ground water movement (infiltrated water going to aquifer), soil water content, lateral (subsurface) flow, infiltration, minimum temperature, maximum temperature, precipitation etc. (Priyadarshini, Rahaman, NitheshNirmal, Jegankumar, & Masilamani, 2018). For the SWAT model various input data is used for simulation of the watershed. The input data are Digital Elevation Model (DEM), Land use/Land cover (LULC), soil cover, precipitation and temperature

The various steps that need to be performed in the software are watershed delineation, HRU (Hydrological response Unit) analysis, write input tables, edit input data and SWAT simulation. The output file is used to plot the graphs and maps (Epelde, et al., 2015).

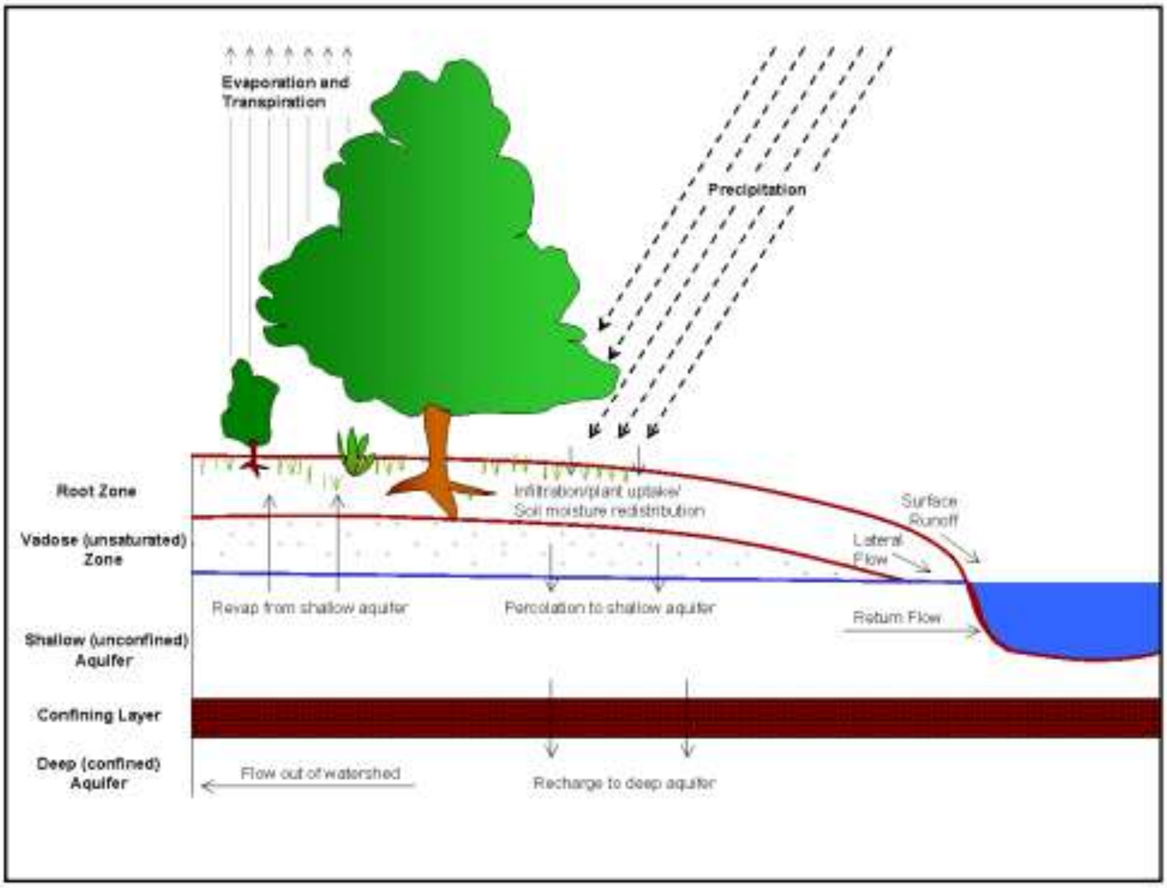
In SWAT, the hydrological cycle is climate driven. Daily precipitation and maximum/minimum air temperature that control the water balance are used as data input. Hydrologic processes simulated by SWAT include canopy storage, surface runoff, and infiltration (Abbaspour, et al., 2015).

Processes in the soil include lateral flow from the soil, return flow from shallow aquifers, and tile drainage, which transfer water to the river; shallow aquifer recharge, and capillary rise from shallow aquifer into the root zone, and finally deep aquifer recharge, which removes water from the system. Other processes include moisture redistribution in the soil profile, and evapotranspiration. Also, vegetation growth is essential in a hydrological model as it contributes to the evapotranspiration. SWAT uses a single plant growth model to simulate growth and yield of all types of land covers and differentiates between annual and perennial plants (Abbaspour, et al., 2015).

In Figure 5 a schematic illustration of the conceptual water balance model in SWAT can be seen.

Figure 5

Schematic illustration of the conceptual water balance model in SWAT (Abbaspour, et al., 2015)



3.4 Model Calibration and Validation

The ArcSWAT model is calibrated with the most suitable parameters that are selected for running a model to a given set of local conditions. This is done to reduce prediction uncertainty. After calibration, the model needs to be validated. In the validation process, it becomes clear if the model can make sufficiently accurate predictions based on the input data (Abbaspour, et al., 2015).

3.4.1 Calibration and Validation.

Calibration is the procedure of adjusting parameter value to optimize model performance according to a set of predefined criteria. Each model uses a set of one or more parameters to determine the basic behavior of a modeled system.

ArcSWAT has an embedded tool to reduce uncertainty through analyzing sensitivity of the parameters. In this method a combination of Latin hypercube and one factor-at-a time sampling is used that allows global sensitivity analysis for various parameters with only limited number of model runs. Therefore, it is required to run the model multiple times for better accuracy of the model simulation outputs (Mehan, Neupane, & Kumar, 2017).

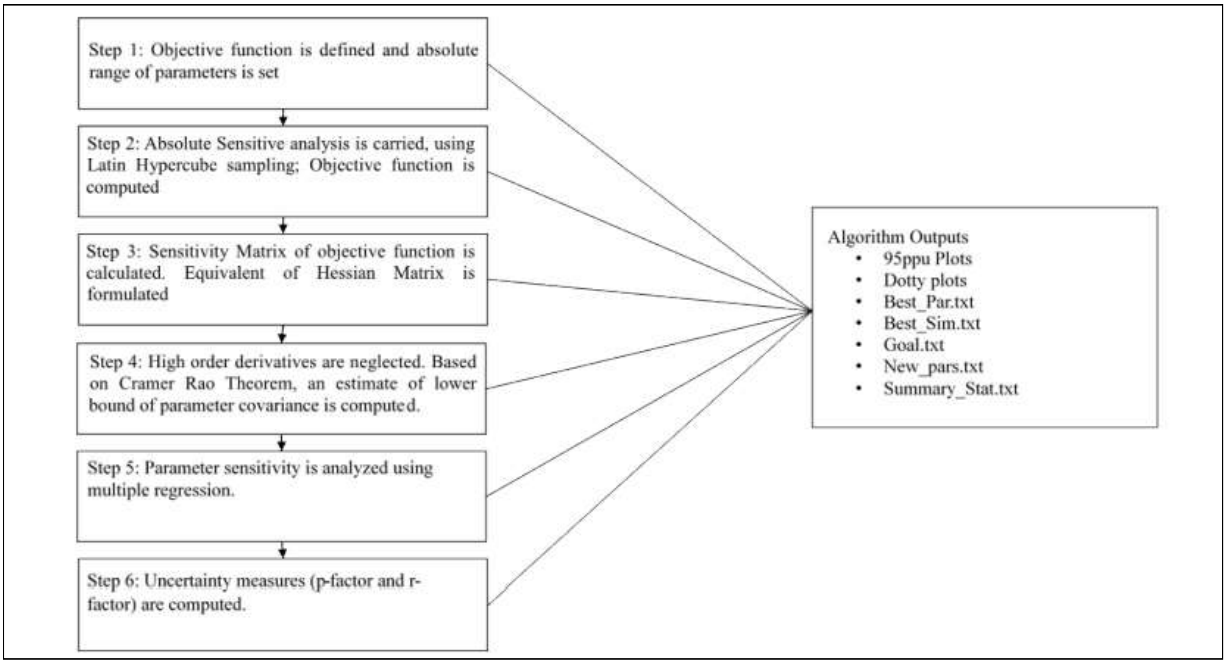
SUFI-2

The SWAT-CUP program links SUFI2, GLUE, ParaSol, MCMC, and PSO to ArcSWAT. Any of the procedures could be used to perform calibration and uncertainty analysis of a SWAT model (Ha, Bastiaanssen, van Griensven, van Dijk, & Senay, 2017).

In this study the Sequential Uncertainty Fitting version-2 (SUFI-2) algorithm in SWAT-CUP was used. With Sequential Uncertainty Fitting-2 is attempted to bracket most of the measured data with the smallest possible uncertainty band. In SUFI-2 the parameter uncertainty is calculated for the attributed sources of uncertainties in a semi distributed hydrological model such as the uncertainties in driving variables. In Figure 6 a schematic representation can be seen of the different work steps in SUFI-2.

Figure 6

Schematic representation of the different work steps in SUFI-2 (Mehan, Neupane, & Kumar, 2017)



95PPU

In SUFI-2, uncertainty in parameters, expressed as ranges (uniform distributions), accounts for all sources of uncertainties such as uncertainty in driving variables (e.g. rainfall), conceptual model, parameters and measured data. Propagation of the uncertainties in the parameters leads to uncertainties in the model output variables, which are expressed as the 95% probability distributions. These are calculated at the 2.5% and 97.5% degree of the cumulative distribution of an output variable obtained through Latin hypercube sampling, by forbidding 5% of the very bad simulations (Abbaspour, et al., 2015). The 95PPUs are the model outputs in a stochastic calibration approach.

P-factor is the percentage of measured data bracketed by the 95% prediction uncertainty (95PPU). The r-factor, however, is related to the strength of the calibration and uncertainty analysis. It is the average thickness of the 95PPU band divided by the standard deviation of the measured data. These 2 important factors (p-factor and r-factor) in this calculation are used for the evaluation of the results. In SUFI2 with the model result (95PPU) is tried to envelop most of the observations. Observation is important because it is the culmination of all the process taking place in the region of study (Arnold, Moriasi, Gassman, Abbaspour, & White, 2012).

R^2 and NS

Goodness of fit can be quantified by the R^2 and/or Nash-Sutcliffe (NS) coefficient between the observations and the final "best" simulation. Nash-Sutcliffe efficiency values can range between $-\infty$ and 1 and provide a measure how well the simulated output matches the observed data along a 1:1 line. A perfect fit between the simulated and observed data is indicated by an NS value of 1. Nash- Sutcliffe efficiency values ≤ 0 indicate that the observed data mean is a more accurate predictor than the simulated output (Jajarmizadeh, Sidek, Harun, & Salarpour, 2020). The R^2 statistic can range from 0 to 1, where 0 indicates no correlation and 1 represents perfect correlation, and it provides an estimate of how well the variance of observed values are replicated by the model predictions (Gassman, Sadeghi, & Srinivasan, 2014).

Global Sensitivity

A t-stat is the coefficient of a parameter divided by its standard error and is a measure of the precision with which the regression coefficient is measured. A lower p-value suggests higher sensitivity of the parameter, and vice-versa. The overall uncertainty in the output is computed by 95 Percent Prediction Uncertainty (95 PPU) and dotty plots for each parameter. This method makes it easier to determine the new ranges and best fitted values. This helps in determining the new ranges and best fitted values that were applied for further iterations to maximize the objective function.

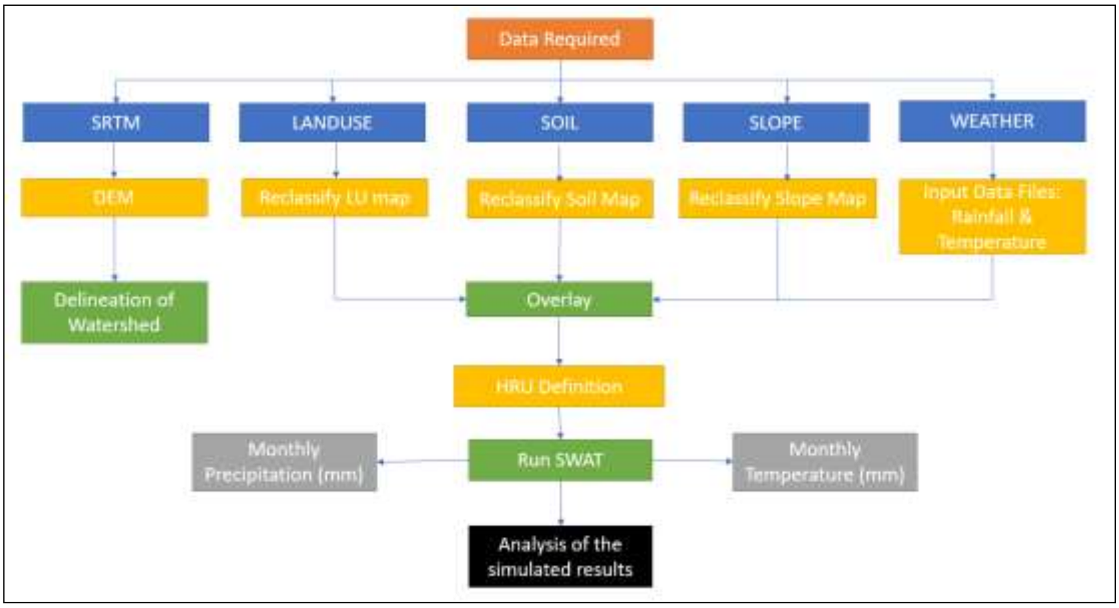
For validation the same calibrated parameter ranges "without any further changes" are used and an iteration is run with the same number of simulations as was run for the calibration (Arnold, Moriasi, Gassman, Abbaspour, & White, 2012).

The validation is based on the use of the model with calibrated parameters in an independent data mass so that the applicability of the model to the event can be evaluated through several tests. After the validation phases, if the model achieves a satisfactory performance, it becomes possible to perform model simulations according to different scenarios.

The workflow that was followed when using the SWAT can be seen in Figure 7.

Figure 7

Workflow for the processes carried out in SWAT



After setting up the model within ArcSWAT 2012, the model was calibrated and validated using SWAT-CUP. SWAT-CUP is used to perform calibration, validation, sensitivity analysis (one-at-a-time and global) and uncertainty analysis. To ensure that the parameters used in the ArcSWAT model represent the study area, model calibration is an essential process.

Using the observed data from 1972-1982 for temperature, precipitation and discharge, the model was calibrated and validated in order to obtain successful hydrological simulation results. Calibration was done for the period January 1974 to December 1979, while validation was done for the period January 1980 to December 1982.

A warm-up period of two years was used for calibration (1972–1973) and validation (1978-1979) to estimate initial conditions for soil water and groundwater storage. The warmup period is mandatory for the SWAT model and is the time that the simulation will run before starting to collect results.

First, a preliminary calibration with a dummy parameter was done, to see the results of the actual model from ArcSWAT. Finally, several parameters were selected in SWAT-CUP to get a good fit of the observed and simulated data.

For statistical measurements of the outcome of the calibration the used results were; R^2, NS, p-factor, r-factor, t-stat, p-value.

Finally, the simulated results were compared with the observed flow to see if there was a good fit between most of the observed data and the results. If this was not the case, the parameters were updated in SWAT-CUP to have a better fit.

For validation the same calibrated parameter ranges obtained from the calibration were used.

3.4.2 Watershed Delineation. For watershed delineation, analysis of topographical features and exploring drainage patterns of the topography is very important. It influences the movement rate and flow direction over the land surface.

The major steps that were included in the watershed delineation process are:

- Set-up of the digital elevation map
- stream burning
- Localization of outlet and inlet
- Selection of basin outlets
- definition and calculation of subbasin parameters

The projected source DEM was clipped to the study area and used as input to delineate the sub-basin automatically in ArcSWAT (SWAT interface in ArcGIS software). The stream definition parameters flow direction and accumulation were calculated for the DEM. After the stream definition comes the projected source DEM, which was used as input to delineate the sub-basin automatically in ArcSWAT. Finally, by selecting the watershed outlets, the sub-basin was delineated. Each sub- basin's respective area covered, length, reach, width, depth etc. were estimated by calculating the sub basin parameters.

3.4.3 HRU Analysis. After carrying out the watershed delineation, the HRU analysis needed to be done. For the HRU analysis the following steps were carried out:

- Land use Definition
- Soil Definition
- Slope Definition

Land use Definition

For the land use definition, the physical land type of the study area was defined by importing the LULC data. The required study area was extracted by using the “Clip” Tool in ArcGIS, where the LULC raster and the boundary of the Kabalebo River Basin were used. The LULC raster was reclassified according to the LULC classes:

- Undistributed Forest (UF)
- Infrastructure (I)
- River/ Creek (RC)
- Rock (R)

Soil Definition

For the soil definition, the shapefile containing the soil data was converted to a raster dataset using the ArcGIS Tool “Polygon to Raster”. The Raster file was used as input for the model. The soil data was reclassified according to the soil types that are identified in the Kabalebo River Basin and can be seen in Table 2.

Table 2

Overview of the soil types in the Kabalebo River Basin

ID	ArcSWAT ID	Description
1.4	a	River clay bank soils
2.1	b	Bleached coarse sand terrace soils
2.2	c	Brown coarse sand terrace soils
3.1	d	Sandy (sillitic) weathering hill soils
3.2	e	Kaolinite (Sialitic) loam weathering hill soils
3.3	f	Lateritic (fersiallite) loam weathering hill soils
3.4	g	Lateritic (fersiallite) clay plateau, hill and mountainside soils
3.5	h	Ferritic clay plateau hill and mountain slope soils
4.2	i	Kaolinite (Sialitic) loam mountainside soils
5	j	Sandy river terrace grounds

Slope Definition

The slope defines how the movement of water takes place in the watershed. Therefore, 4 slope classifications have been defined for the Kabalebo River Basin from 0-5%, 5-10%, 10-20%

and 20- 100%. After importing the land use data, soil data, and slope classifications, the distribution of HRUs within the watershed was determined by overlaying the land use, soil and slope definition results. The Kabalebo River Basin was divided into 23 HRUs for whole catchment and 23 subbasins.

3.4.4 Potential evapotranspiration Method. Potential evapotranspiration can be indicated as the rate at which evapotranspiration would occur from a large area covered with growing vegetation, which has access to supply of water. The Priestley–Taylor (PT) method has been chosen in the model to calculate potential evapotranspiration. According to PT the equation is defined as (Akumaga & Alderman, 2019):

$$ETpt = \frac{\propto \Delta(Rn - G)}{\lambda(\Delta + \gamma)} \quad (1)$$

Where:

ET_{pt} = evapotranspiration (mm d–1)
α = constant equal to 1.26
λ = vaporization latent heat (MJ kg–1)
Δ = slope of the vapor pressure-temperature curve (kPa °C–1)
Rn = net solar radiation (MJ/ m^2 d^1)
G = daily soil heat flux (MJ/ m^2 d^1)
γ = psychrometric constant (kPa/ °C).

4 Results & Discussion

In this chapter the results of all the analysis done in ArcSWAT and SWAT-CUP are listed and discussed.

4.1 Watershed Delineation

After carrying out the process in ArcSWAT as described in the methodology, the results that were obtained are described in this chapter.
The DEM for the study area was clipped (see Figure 8) and was used as input for the watershed delineation. After following the process for stream definition, an area of 18167.04 Ha was defined as the watershed. The number of cells in this watershed were 191187. The outlets and inlets were localized, after which 11 linking stream added outlets were identified and one (1) basin outlet was added. Finally, subbasin parameters were defined and calculated, where 23 subbasins were identified.

Figure 9 gives an overview of the subbasins, reaches and outlets in Kabalebo River Basin.

Figure 8

Overview of the DEM of Suriname and the DEM for the Study Area

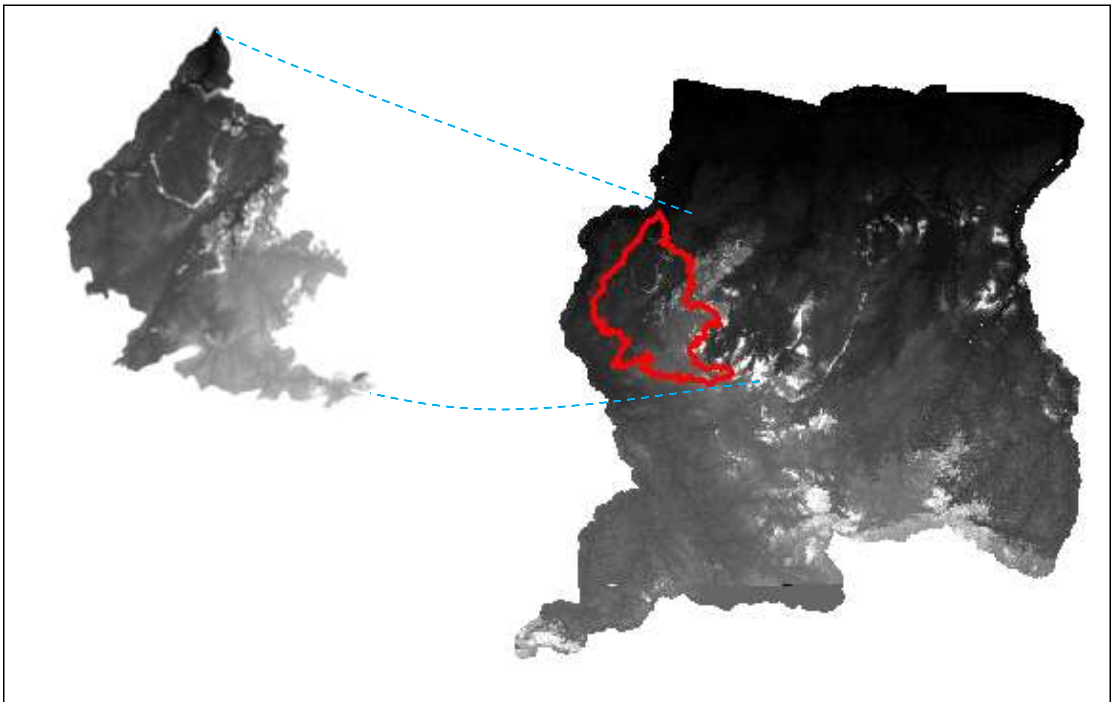
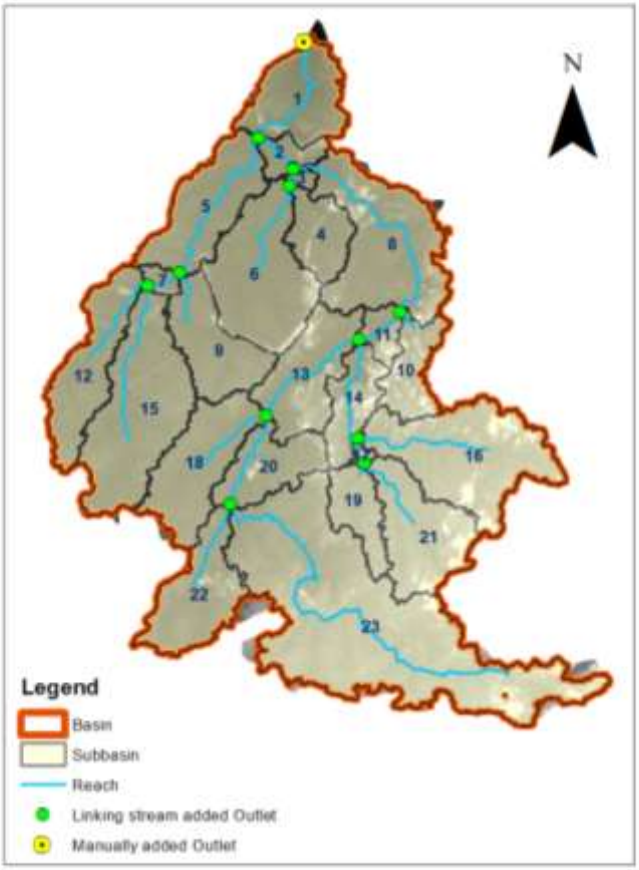


Figure 9

Overview of the subbasins and outlets after the watershed delineation process



4.2 HRU Analysis

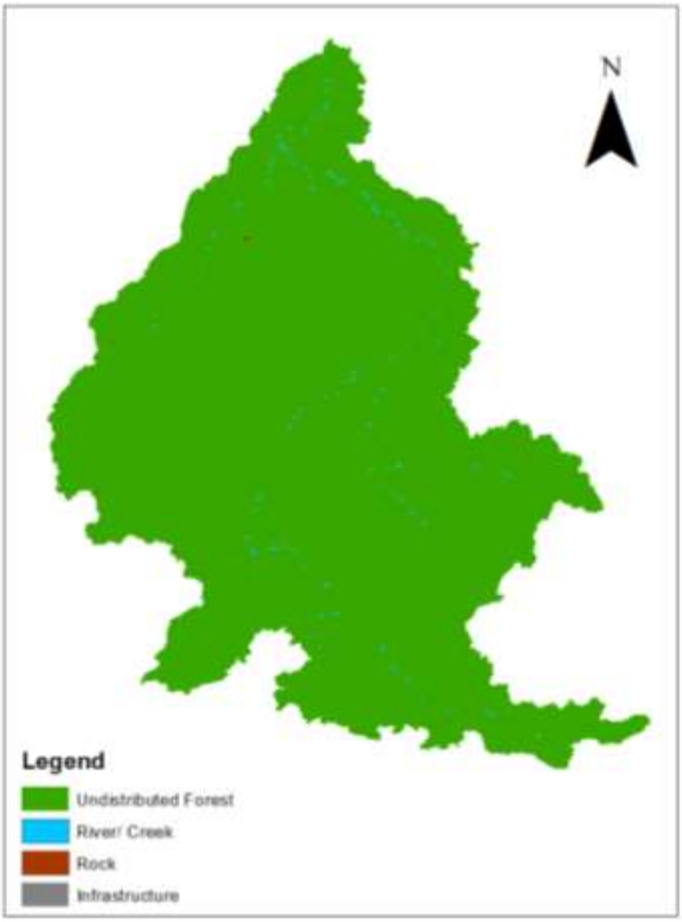
To do the HRU analysis the LULC, soil and slope data were used as input.

LULC

For the study area the LULC (Land Use Land Cover) types were identified in the following percentages; Undistributed Forest (99.535%), River/Creek (0.401%), Rock (0.033%) and Infrastructure (0.031%). See Figure 11 for a distribution of LULC over the Kabalebo River Basin.

Figure 10

Overview of the LULC types in the Kabalebo River Basin



Soil

For the study area, 10 soil types were identified in the following percentages;

a. River clay bank soils (0.18%),

b. Bleached coarse sand terrace soils (5.105%),

c. Brown coarse sand terrace soils (15.914%),

d. Sandy (sillitic) weathering hill soils (1.523%),

e. Kaolinite (Sialitic) loam weathering hill soils (9.934%),

f. Lateritic (fersiallite) loam weathering hill soils (0.038%),

g. Lateritic (fersiallite) clay plateau, hill and mountainside soils (10.231%)

h. Ferritic clay plateau hill and mountain slope soils (51.044%),

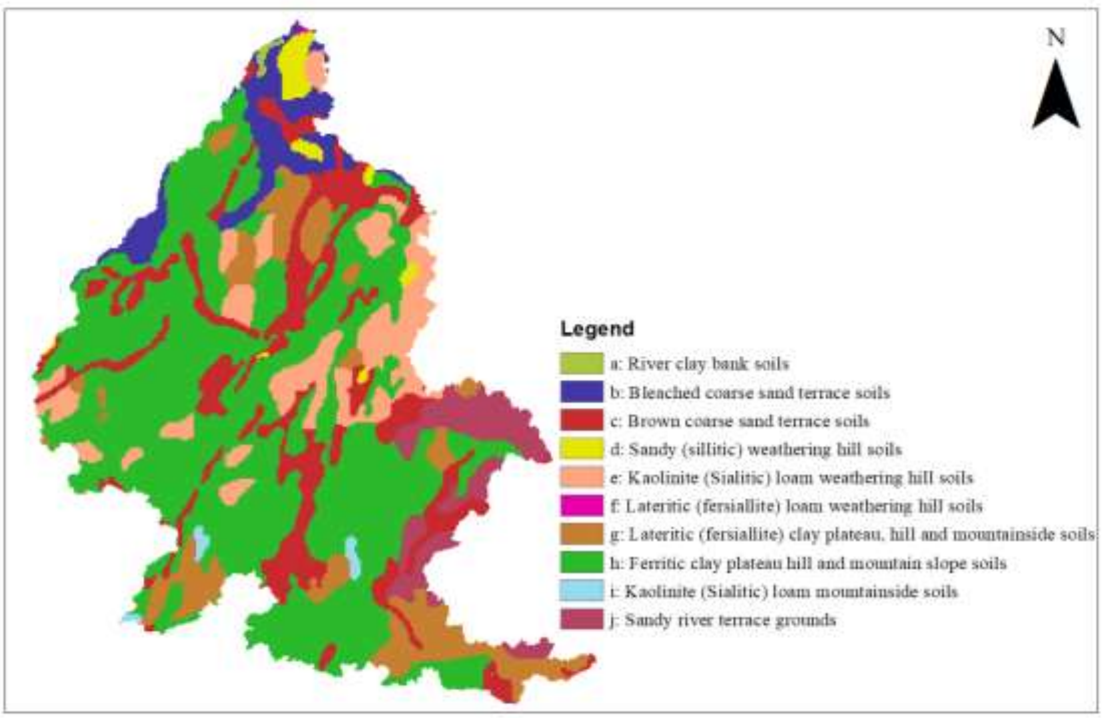
i. Kaolinite (Sialitic) loam mountainside soils (0.517%),

j. Sandy river terrace grounds (5.514 %).

From the obtained results can be seen that the dominating soil type is Ferritic clay plateau hill and mountain slope soils, which covers 51.044% of the basin. Other soil types that also have a big contribution are Brown coarse sand terrace soils (15.914%), Lateritic (fersiallite) clay plateau, hill and mountainside soils (10.231%) and Kaolinite (Sialitic) loam weathering hill soils (9.934%). An overview of the soil types in the Kabalebo River Basin can be found in Figure 11.

Figure 11

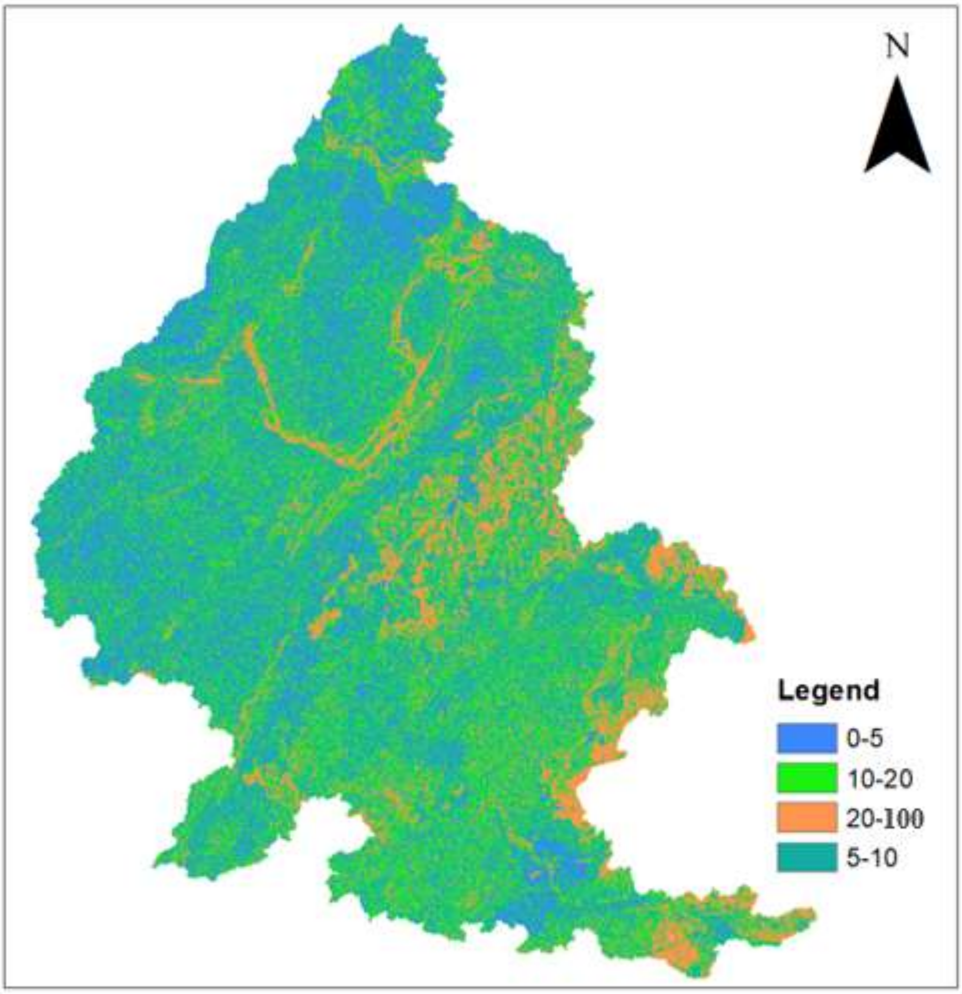
Overview of the soil types in the Kabalebo River Basin



As part of the HRU analysis, 4 slope levels were defined; 0-5%, 5-10%, 10-20% and 20-100%. An overview of the distribution of the different slope levels can be seen in Figure 12.

Figure 12

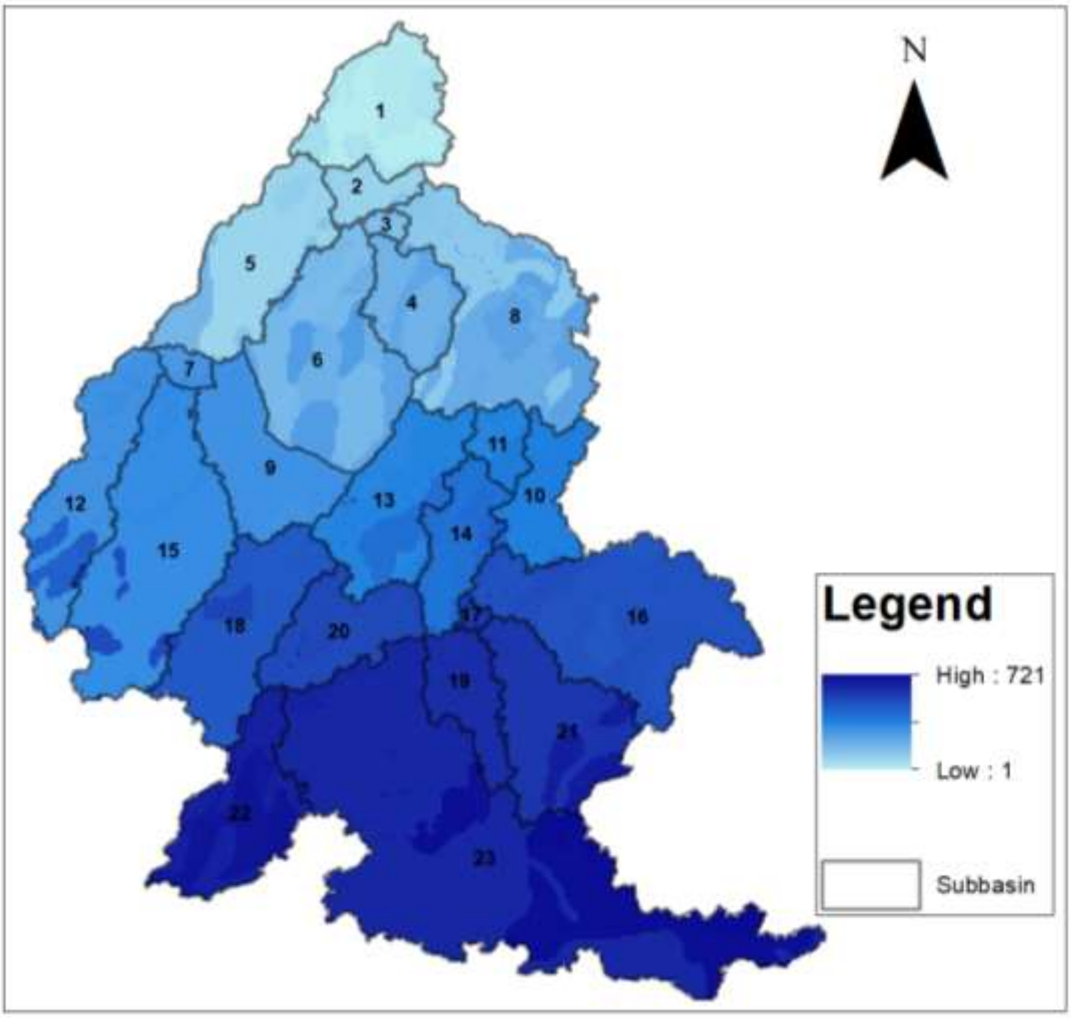
Overview of the slopes defined in the Kabalebo River Basin



The three input parameters (LULC, soil and slope) were overlaid to create the HRU feature classes. Figure 13 is showing the elevation of the basin, which is between 1 and 721m). The outcome of overlaying also provides a report in which each of the 23 HRUs contains the LULC pattern and soil type (see Appendix A). The impact of climate change in one way is dependent on the LULC, soil and slope since measurement is done for each watershed in the sub-basin. Amount of precipitation and temperature are direct sources from observed data that are influencing the HRU.

Figure 13

Overview of the HRUs

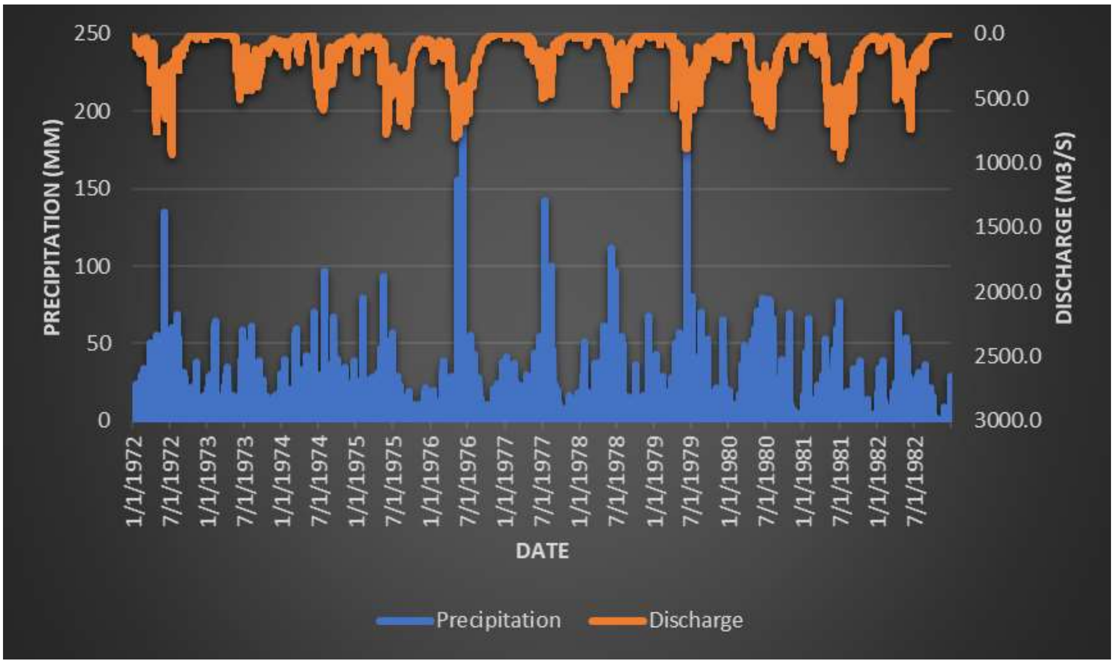


4.3 Simulation in SWAT

For the simulation in SWAT, daily measured weather data (precipitation and temperature data) from the Kabalebo River Basin were used as input. An overview of the weather data can be seen in Appendix B. In below graph (Figure 14) the daily measured precipitation and temperature data that are used as input, are displayed.

Figure 14

Precipitation and Temperature (daily) data that are used for the SWAT model



For the precipitation and temperature data, there were a lot of missing values. To fill in the missing values for the temperature data, the interpolation method was used. The equation for the interpolation method is:

$$
\begin{aligned}
p_1(x) &= y_1 + \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) \\
&= y_1 \frac{x - x_2}{x_1 - x_2} + y_2 \frac{x - x_1}{x_2 - x_1} \\
&= y_1 \ell_1(x) + y_2 \ell_2(x),
\end{aligned}
\tag{2}
$$

For the precipitation data, the missing data was indicated as -99 in the file, as is accepted by the SWAT. Firstly, the interpolation method was also used for the precipitation data. However, after comparing the simulated values with the observed values, it was seen that too high flows were simulated for periods where there are a lot of missing values in a row and which were calculated using the interpolation method. So, it was decided to leave the missing values and work with them.

The precipitation data shows that higher precipitation was received from May to August, which is the big rainy season. Also, in the period from December to January high precipitation values were measured, which is because of the small rainy season.

The maximum value of precipitation received in the big rainy season for all the years was 214 mm in June and 67.70 mm in December.

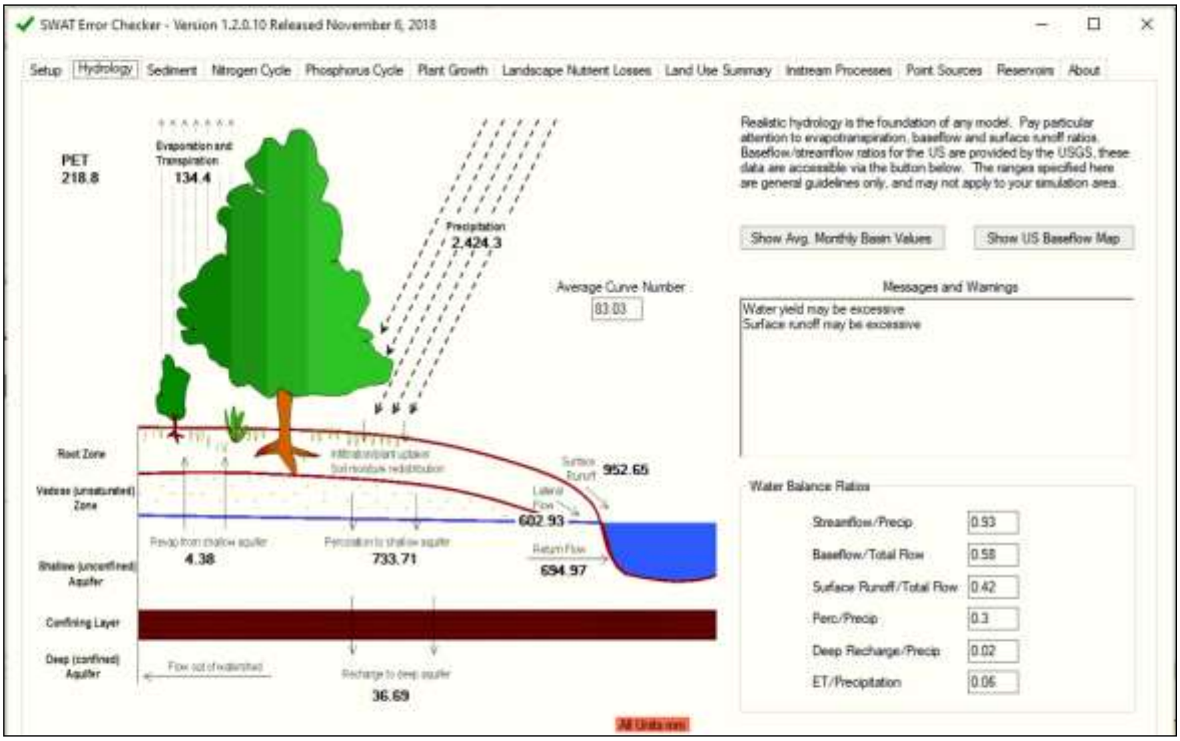
The finalized SWAT input layers and databases were setup and SWAT model was run with observed data from the Kabalebo station for the period 1972-1982. For the calibration, data from 1972-1979 was used, including 2 years of warmup period (1972-1974). For the validation, data from 1978-1982 was used, including 2 years of warmup period (1978-1979). Figure 15 shows the hydrological warnings/ messages that were received in the SWAT error Checker. The warnings that were obtained are:

- Water yield may be excessive
- Surface runoff may be excessive

These 2 warnings indicate that the surface runoff is too high. These warnings help in recognizing what parameters may impact the model output and can be used for the calibration phase.

Figure 15

Hydrological warnings/ messages received in the SWAT error Checker



4.4 Calibration and validation in SWAT-CUP

The Sequential Uncertainty Fitting-2 from SWAT-CUP was used for calibration and validation of the output from ArcSWAT. For calibration and uncertainty evaluation, 500 simulations were performed in each iteration.

For the initial model output (Figure 16), the dummy parameter GWHT.gw was used with a minimum and maximum value of 0. This was done to view the simulation output, before defining any calibration parameters in SWAT-CUP. From the graph, it can be seen that the estimated values were higher compared to the observed values. Therefore, several parameters were used to have a beter simulation. These parameters were selected after a literature review. Also, based on the output in ArcSWAT, where it was indicated that the water yield and the surface runoff were excessive, the parameters were chosen.

In Table 3 a description for each of the selected parameter can be found. See Table 4 for the selected parameters and the fitted value for each of them.

Figure 16

Overview of the initial model output

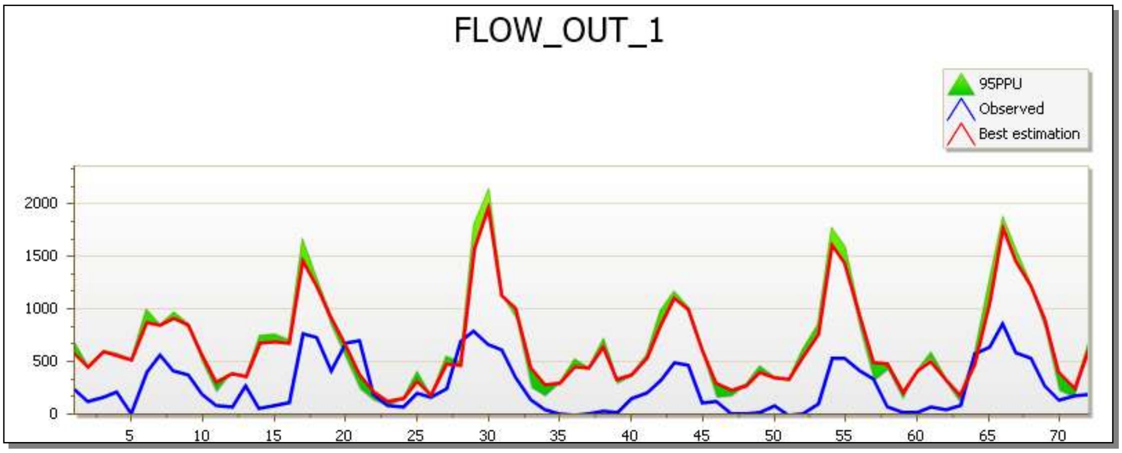


Table 3

Definition of parameters used from the SWAT model

Parameter	Meaning
CN2	Number of the initial curve for the moisture condition AMCII (dimensionless)
ALPHA_BF	Baseline flow recession constant (days)

Parameter	Meaning
GW_DELAY	Time interval for recharge of the aquifer (days)
GWQMN	Water limit level in the shallow aquifer for the occurrence of base flow (mm)
EPCO	Factor of compensation of water consumption by plants (dimensionless)
ESCO	Soil water evaporation compensation factor (dimensionless)
SURLAG	Delay time of direct surface runoff (days)
CANMX	Maximum amount of water intercepted by vegetation (mm)
LAT_TTIME	Lateral flow travel time (days)
CH_K2	Effective hydraulic conductivity of the channel (mm h^{-1})
SLSUBBN	Average Slope Length (m)

Table 4

Range of initial values selected for the calibration of SWAT model using SUFI-2

		Validation			Calibration		
#	Parameter Name	Fitted Value	Min value	Max value	Fitted Value	Min value	Max value
1	R__CN2.mgt	180.54	180.22	188.46	181.12	180.22	188.46
2	V__CN2.mgt	-45.82	-48.86	8.57	-47.08	-48.86	8.57
3	V__ALPHA_BF.gw	0.00	-0.02	0.04	0.04	-0.02	0.04
4	V__GW_DELAY.gw	53.25	52.08	53.26	52.96	52.08	53.26
5	V__GWQMN.gw	2.21	2.01	2.28	2.09	2.01	2.28
6	R__EPCO.bsn	-0.73	-0.74	-0.73	-0.73	-0.74	-0.73
7	R__ESCO.bsn	-0.19	-0.27	0.05	-0.02	-0.27	0.05
8	R__GWQMN.gw	-0.90	-0.92	-0.44	-0.59	-0.92	-0.44
9	R__SURLAG.bsn	0.18	0.15	0.20	0.19	0.15	0.20
10	V__CANMX.hru	121.25	111.83	125.66	121.91	111.83	125.66
11	V__LAT_TTIME.hru	10.15	8.45	10.84	10.48	8.45	10.84
12	V__CH_K2.rte	-10.71	-11.79	71.79	13.70	-11.79	71.79
13	V__SLSUBBSN.hru	14.81	1.51	15.82	9.14	1.51	15.82

**"V_" means the existing parameter value is to be replaced by a given value*

"R_" means an existing parameter value is multiplied by (1+ a given value)

The model evaluation coefficients that were obtained for the pre-calibration, calibration and validation phase are presented in Table 5. For this study, the Nash-Sutcliffe coefficient (NS) was used as a major objective function in the calibration and validation process. The coefficient of determination (R^2) was also an additional criteria used for the evaluation.

The R^2 and NS values for calibration (period from January 1974 to December 1979) were 0.52 and 0.48, respectively, whereas these values were 0.62 and 0.61 for the validation period (period from January 1980 to December 1982). The R^2 indicates that there is 52% correlation between the observed and simulated data for the calibration phase. This means that 52% of the observed values are replicated by the model predictions in tha calibration phase. For the validation phase can be said that 62% of the observed values are replicated by the model.

Nash-Sutcliffe efficiency indicates that 48% of the simulated output matches the observed data along a 1:1 line in the calibration phase. In the validation phase 61% of the simulated output matches the observed data along a 1:1 line.

In this case, based on the values obtained from NS and R^2 can be said that the fit was satisfactory to good. The R^2 and NS value were improved in the calibration phase, indicating a better fit for the simulated and observed values, compared to the pre-calibration phase.

Table 5

Calibration and validation of streamflow simulated for the Kabalebo River Basin

Statistics	Pre-Calibration	Calibration (Jan 1974-Dec 1979)	Validation (Jan 1980 – Dec 1982)
NS	-2.94	0.48	0.61
R^2	0.58	0.52	0.62
p-factor	0.10	0.90	0.72
r-factor	0.29	1.56	1.18

95PPU

In SUFI-2 we want that the 95PPU envelops most of our observed data and therefore the p-factor and r-factor are important. In the calibration phase, a value of 0.90 was obtained for the p-factor, which indicates that 90% of the measured data was bracketed by the 95% PPU. For the r-factor a value of 1.56 was obtained and is related to the strenght of the calibration and uncertainty analysis. It is better to have a r-factor value around 1.

In the validation phase 72% of the measured data was bracketed by the 95% PPU, while a value of 1.18 was obtained for the r-factor. The p-factor was found to achieve desirable values. The large r-factor values may be attributed to a lot of missing and insufficient data in the calibration phase. However, a reexamination of the conceptual model would be needed if the p-factor value did not lie within the proposed acceptable range between 0 and 1. In this case we do not need a reexamination. Generally, a larger p-factor and a smaller r-factor are desired. The p and r-factor were improved in the calibration phase, indicating a better fit for the simulated and observed values, compared to the pre-calibration phase.

The hydrographs of 95 PPU plots are presented in Figure 17 and Figure 18. Also in the figures, it can be seen that most of the data was bracketed. In the case of very high observed discharge, compared to other months, lower values were simulated in the validation phase.

Figure 17

95PPU plot obtained from running SUFI-2 within SWAT-CUP for the Calibration period

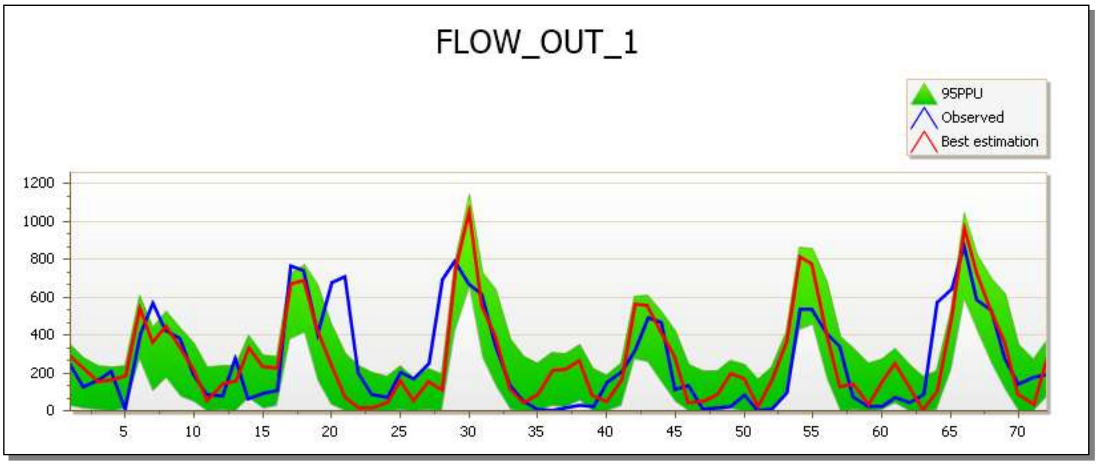
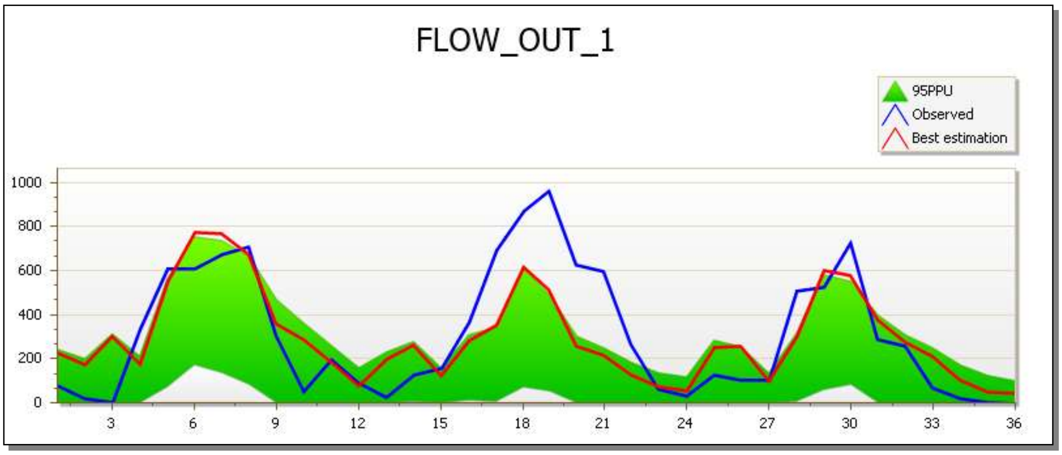


Figure 18

95PPU plot obtained from running SUFI-2 within SWAT-CUP for the Validation period



Parameter sensitivity

The most sensitive input hydrologic parameters identified on the basis of global sensitivity analysis and used for stream discharge simulations are presented in Table 6.

In the global analysis, the larger, in absolute value, the value of the t-stat and the smaller the p-value, the more sensitive the parameter. The t-stat index represents the ratio of the parameter coefficient by the standard error. The p-value is related to the rejection of the hypothesis (Arnold, Moriasi, Gassman, Abbaspour, & White, 2012).

From Table 6 can be seen that EPCO, SLSUBBN, CN2, GWQMN and LAT_TIME have high t-stat values and low p-values, thus were the most sensitive parameters for the calibration. These parameters are related to vegetation water consumption factor (EPCO), length of the slope related to the runoff flow (SLSUBBN), direct surface flow (CN2), groundwater flow (GWQMN) and travel time based on soil hydraulic properties (LAT_TIME).

These sensitive parameters were expected, because in the initial model output, the surface flow was higher than the observed flow. Therefore, can be said; defining meaningful physical range of hydrologic parameters is crucial while working with semi-automated stochastic calibration tool like SWAT-CUP to monitor water balance components of a watershed system.

Also, we see that the ranking for the parameters in the calibration differs from the ranking for the validation. This means that for the calibration period, different sensitive parameters are influencing the stream discharge of the basin, when compared to the validation period.

Table 6

Parameter sensitivity values for calibration and validation

		Calibration			Validation		
#	**Parameter Name**	**t-stat**	**p-value**	**rank**	**t-stat**	**p-value**	**rank**
1	V_CH_K2.rte	-0.72	0.6	6	-13.28	0	2
2	V_ALPHA_BF.gw	0.63	0.64	8	20.66	0	1
3	R_EPCO.bsn	-1.83	0.32	1	-0.26	0.79	10
4	V_GWQMN.gw	-0.83	0.56	4	-0.12	0.91	11
5	V_CN2.mgt	-0.84	0.55	3	-0.38	0.7	9
6	V_LAT_TIME.hru	-0.78	0.58	5	0.66	0.51	7
7	R_GWQMN.gw	-0.2	0.88	12	0.09	0.93	13
8	V_CANMIX.hru	-0.13	0.92	13	0.11	0.91	12
9	R_CN2.mgt	-0.34	0.79	10	-0.86	0.39	6
10	R_SURLAG.bsn	-0.59	0.66	9	0.55	0.58	8
11	R_ESCO.bsn	0.66	0.63	7	-1.29	0.2	3
12	V_GW_DELAY.gw	-0.31	0.56	11	0.94	0.35	5
13	V_SLSUBBN.hru	-1.23	0.22	2	-1.24	0.21	4

Dotty plots

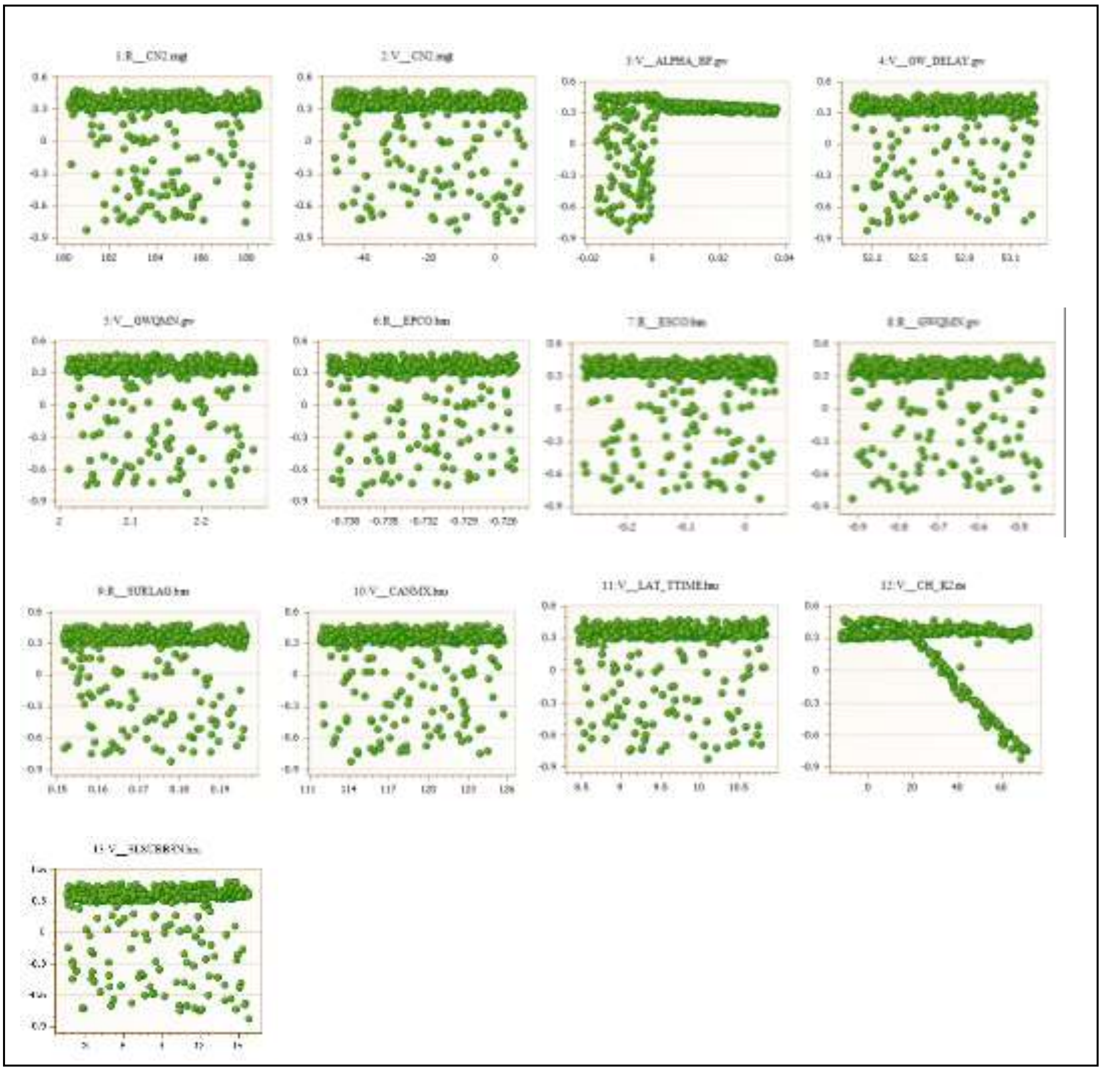
The dotty plots show the distribution of the number of simulations in parameter sensitivity analysis after comparing the parameter values with the objective function (NS) for the monthly calibrations, respectively, via SUFI-2. The dotty plots can be used in identifying the relative sensitivity for each parameter that influences the objective function. From the dotty plots of the calibration can be seen that ALPHA_BF and CH_K2 is showing a trend, which means that it is the most sensitive. However, this was not the case for the global sensitivity. Therefore, when defining the most sensitive parameters, the output from the global sensitivity and the dotty plots are important.

The process of identifying the most sensitive parameters also helped in defining the values of the parameters for the next iteration. The number of simulations and iterations also impacted the range and best fitted values of the parameters.

The relative sensitivity of each parameter was estimated by observing the impact on an objective function using the dotty plots. It was concluded that if the points on dotty plots are scattered or haphazard; the sensitivity is low for the parameter and if the points do follow a trend, the sensitivity is higher.

Figure 19

The dotty plots derived from SUFI-2 are shown for all the parameters in the calibration phase. In the dotty plots ALPHA_BF and CH_K2 are showing a trend, which means that they are the most sensitive parameters.

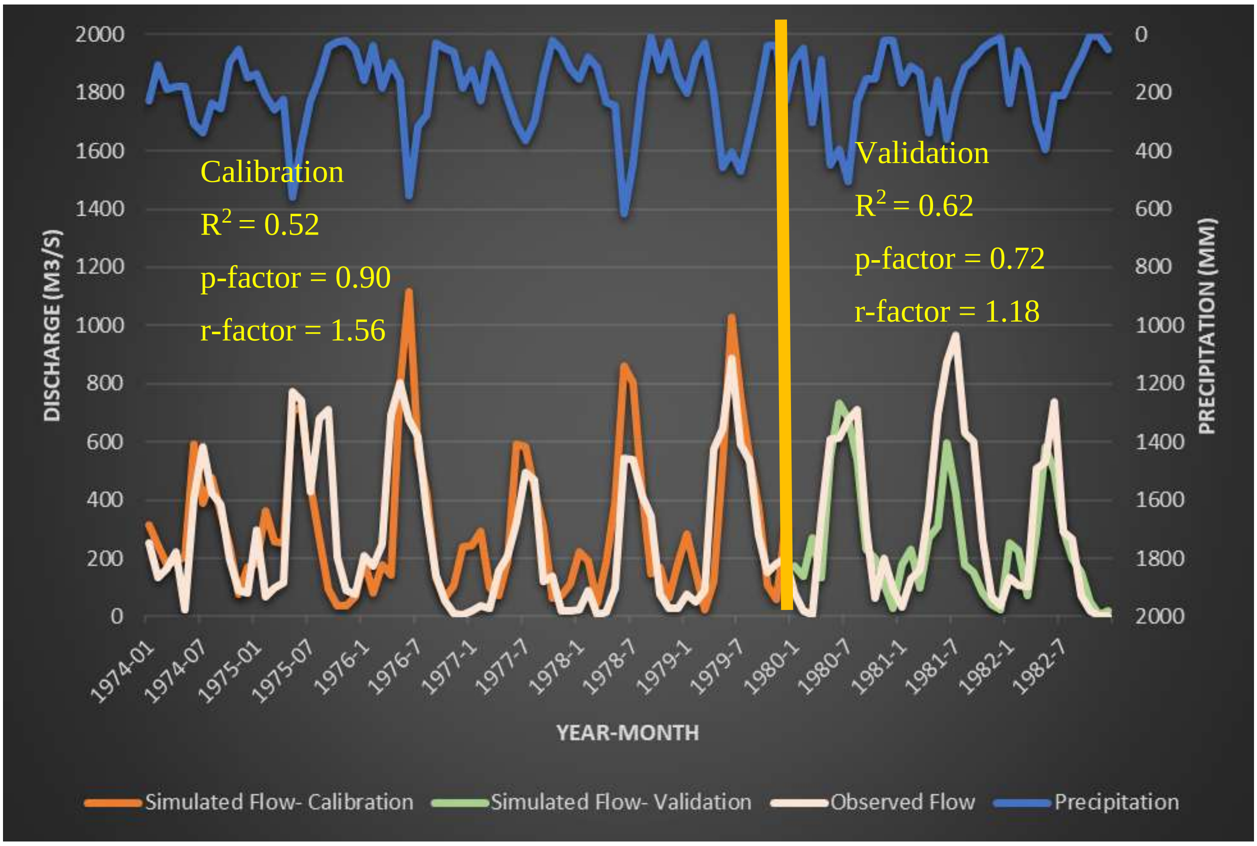


After each simulation SUFI-2 suggested new values for intervals, which were used for a new iteration. After doing several iterations, the iterations with good values for R^2, p-factor and r-factor were finalized and used as default parameters for the ArcSWAT model.

In Figure 20, it can be seen that the observed and simulated values were close, with discrepancies in the regions of observed peak flow. There is still a possibility that the model simulates values that are higher than the observed values in the dry season. The simulated values almost follow the pattern for the wet months.

Figure 20

Overview of simulated and observed values



4.5 Simulation for 2030, 2050 and 2100

The simulation for the years 2030, 2050 and 2100 were done in ArcSWAT, after updating the parameter values in ArcSWAT, that were obtained from the calibration. In Table 7 an overview can be seen of the simulated values. When compared to 1974 and 1982, especially for the wet months an increase in maximum flow can be expected, which means an increase in maximum precipitation. For the dry months a decrease in maximum flow can be expected. Table 7 and Figure 21 show an overview of the simulated values after calibration of the SWAT model. For the big rainy season an increase in flow can be expected, which means also an increase in precipitation intensity. Also the frequency of precipitation may change. When looking at the Caribbean region (particularly Guyana), peaks in precipitation are expected from May to July (Jones, et al., 2015). After comparing the discharge values of 2030, 2050 and 2100 with the journal *"Modelling the impact of climate change on the hydropower potential of the Kabalebo river basin in Suriname"*, it can be seen that the mean annual discharge forecasted by SWAT lays in the same range as predicted in the journal (Donk, Nurmohamed, & Willems, 2013).

Table 7

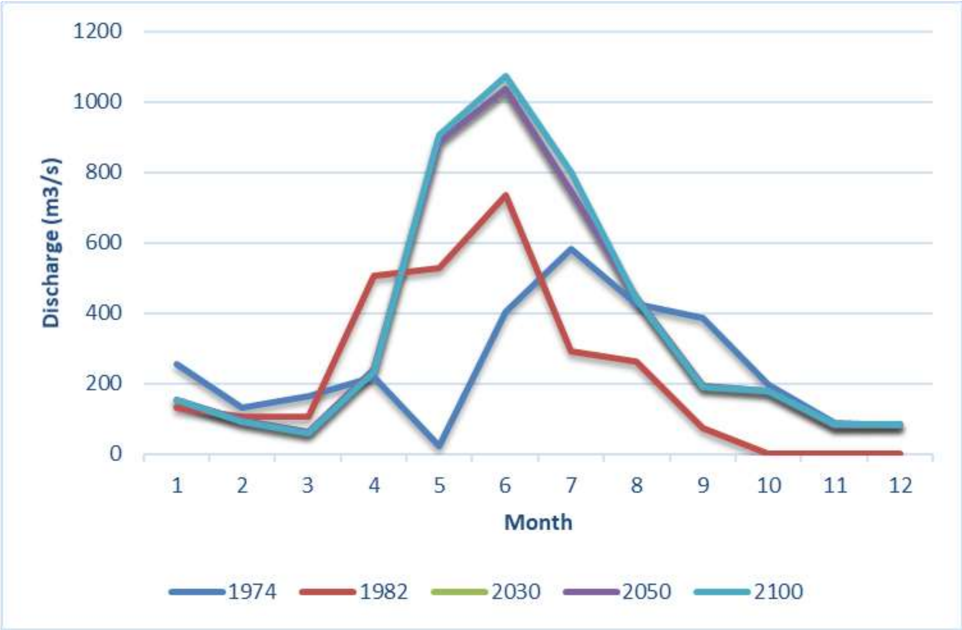
Simulated values for the years 2030, 2050 and 2100 by using the ArcSWAT model

Month	1974	1982	2030	2050	2100
1	254.00	133.00	155.63	155.63	155.63
2	132.00	108.36	95.18	95.18	92.11
3	165.00	105.00	61.97	61.97	60.96
4	220.00	508.00	240.96	240.96	234.43
5	24.60	529.00	888.63	888.63	905.80
6	405.00	737.00	1036.61	1036.61	1073.22
7	583.00	292.00	746.00	746.00	800.00
8	425.00	264.00	444.58	444.58	441.03
9	386.00	73.10	193.22	193.22	190.26
10	197.00	*	180.42	180.42	179.63
11	87.80	*	82.98	82.98	83.73
12	81.70	*	85.58	85.58	85.37

**Missing Data*

Figure 21

Overview of the simulated discharge for the Kabalebo River Basin in 5 different years



5 Conclusions

Several things need to be considered, when using the SWAT in order to conclude if the model works well and if a statement can be made based on the values.

From the watershed delineation and HRU analysis can be concluded that the Kabalebo River Basin contains 23 subbasins and 23 HRUs. Further, the Kabalebo River Basin is covered for 99.535% with Undistributed Forest. The main soil types identified in the Kabalebo River Basin are ferritic clay plateau hill and mountain slope soils (51.044%) brown coarse sand terrace soils (15.914%), Lateritic (fersiallite) clay plateau, hill and mountainside soils (10.231%) and Kaolinite (Sialitic) loam weathering hill soils (9.934%). All soil types that are present in the basin, have a low infiltration capacity, thus impacting the overland flow. Because of the low infiltration capacity, there is higher overland flow causing that a higher discharge will be measured.

From the results it is evident that rainfall is seen mostly decreasing during the months of September to November and February to April/May. The maximum decrease in the amount of the rainfall is seen in the months of October, November and February while increasing trend of rainfall is seen in all the other months. From the results, it is evident that during the dry months, there will be an increase in the temperature and decrease in the amount of rainfall. During the wet months there will be a decrease in the temperature and increase in the rainfall amount.

When looking at the parameters that were adjusted in SWAT-CUP and finally had an impact on the simulated values, it can be said that these are related to direct surface runoff components. In other words, the model was simulating too high values in default mode and needed to be calibrated.

The SWAT model presented an adequate performance in the calibration stage and in the validation stage it was better. The SWAT-CUP module was an important tool for sensitivity analysis, calibration and validation of the model. SWAT, based on its performance, demonstrates the ability to use alternative scenarios simulations and their impacts on the hydrological cycle in future investigations.

The R^2 and NS values for calibration were 0.52 and 0.48, respectively, whereas these values were 0.62 and 0.61 for the validation period. In the calibration phase, the p-factor was 0.90 and the r-factor was 1.56. In the validation phase the p-factor was 0.72 and the r-factor was 1.18. These values indicate that the simulated values for calibration and validation can be considered satisfactory to good. When looking at the simulated values per month for 2030, 2050, 2100, we see an increase in the monthly max flow in the big rainy season. One of the expected impacts of climate change on the Kabalebo River Basin will be a decrease in precipitation in the dry season and an increase in precipitation intensity in the wet season, which will cause a higher discharge.

An increase in precipitation and outflow can cause floods and may cause damage to areas in the Kabalebo River Basin that are near the river. In the dryer season, some branches of the river may completely dry off. This may cause an issue for people who are dependent of these branches for transport, household chores, drinking water etc. Also, wildlife may be affected by this. The dryer season may also impact the functioning of hydroelectric powerplant in a negative way and thus the supply of hydropower. People who are dependent of rainwater for their daily work, may experience some issues. Extreme and frequent floods because of the change in pattern can erode the riverbank and damage the riparian zone

Looking at all the impacts climate change may have on the Kabalebo River Basin and its surrounding community, it can be said that it is very important to model the impacts of climate change in the coming years, so that measures can be taken on time. To model the impact of climate change on the Kabalebo River Basin, the Soil Water Assessment Tool (SWAT) is recommended.

6 Limitations

The data used for this research was outdated (almost 40 years) and contained a lot of missing values for precipitation. Also climate change was in its initial phase for this data period. It is better to do the simulation with more recent data, because the recent data will include climatic change all over the years till now. Also the possibility to have another measuring station for precipitation and temperature in the Kabalebo River Basin should be considered. This will prevent that data is measured wrong. Simulations done with more recent data can be used to validate the output from this research.

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Appendices

Appendix A Reports Generated by SWAT

HRU Distribution Report

Land use, Soil and Slope Distribution Report

Appendix B Weather Data

Temperature

Daily Temperatures in °C — Suriname Meteorological Service
Station : 110 KKABA — River : Kabalebo — Year : 1972

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	26.7	-	27.5	-	27.9	30.1	26.4	28	26.6	-	25.5	28.1	1
2	27.1	-	-	-	26	30.1	28.6	27.7	26.7	-	28.2	28.4	2
3	25.5	-	27.7	28.2	28.7	-	26.8	28.3	27.4	-	28.3	28.3	3
4	25.1	-	27.2	26.2	29.2	27.1	29	-	26.8	-	27.9	28.3	4
5	24.7	-	25	27.5	29.2	29.4	28	28.5	27.5	-	28.3	27.3	5
6	24.3	-	27.5	28.5	29.4	29.7	26.3	28.1	28.1	27.1	25.3	-	6
7	23.5	-	25	28.9	29	29.4	27.8	27.7	25.3	28	24.8	27.4	7
8	26.5	-	27.1	27.1	28.9	30	28.9	27.7	26.1	27	27.3	27.3	8
9	24.4	-	28.1	25.6	28.3	29.9	28.2	27.5	26.9	25.5	27.7	27.3	9
10	25.8	-	26.3	25.8	28.8	30	27.9	28.4	27.5	27.2	27.4	26.8	10
11	24.9	-	26.1	28	28.4	28.7	27.8	25	27.3	26.3	27.3	26.1	11
12	26.1	-	28.7	26.5	29.5	28.2	28.3	27.3	27.7	27.4	27.5	27.5	12
13	27.1	-	28.1	26.4	28	30.1	26.8	26.1	27.2	28.1	27.8	27.2	13
14	27.1	-	27.3	28.8	28.1	29.1	26.6	25.6	27.2	27.1	27.8	27.2	14
15	25.1	27.8	26.9	29.2	29.5	30	27.1	27.1	26.3	26.2	-	27.5	15
16	25.9	-	28.6	28.7	29	30.1	27.7	27.5	26.7	27.9	27.1	27.4	16
17	25.5	28.3	28.5	28.1	28.4	311	27.5	25.5	26.9	26.8	27.1	24.7	17
18	25.9	27.9	27.9	27.6	27.2	29.4	28.9	25.4	26.6	27.8	27.5	26.1	18
19	27.3	26.8	27.1	29.2	29.6	29.7	28.3	25.9	26.5	28.5	27.1	25.7	19
20	26.7	26.9	27.9	27	29.1	29	28.2	26.2	27	25.1	26.7	27.4	20
21	26.4	27.2	26.8	27.4	29	24.7	27.8	27.5	26.1	26.5	25.7	25.4	21
22	27.6	27.2	26.8	28.9	29	28.1	27.6	25.9	25.5	28.4	25.4	26.3	22
23	25.9	27.3	28.4	28.6	28.6	29.9	25.5	25.4	26.9	26.9	28.2	26.6	23
24	26.5	25.6	26.7	28	29.7	29.4	26.6	26.3	26.7	27.1	27.7	26.8	24
25	25.5	26.1	28.1	26.2	30	29.9	27.9	26.2	27.2	26.5	26.4	26.4	25
26	24.9	28.1	26.5	27.2	29.2	29.4	27.1	27.1	-	27.4	27	25.5	26
27	24.5	27.5	26.3	28.5	29.1	29.7	28.5	26.9	26.8	25.9	27.1	24.1	27
28	26.1	27.7	27.3	26.9	27.3	27.6	27.7	26.6	27.8	28.1	-	24.4	28
29	25.2	25.4	27.5	27.3	28.9	29.1	28.2	27.3	-	27.7	-	27.2	29
30	26.3		-	26.3	29.6	30	27.9	29	-	26.7	-	25.7	30
31	25.1		-		29.9		26.9	26.7		28.5		24.7	31

Mmax	28	28	29	29	30	31	29	29	28	29	28	28
Mmean	26	27	27	28	29	29	28	27	27	27	27	27
Mmin	23.5	25.4	25.0	25.6	26	25	26	25	25	25	25	24

Year Maximum 31 — Year Mean 27 — Year Minimum 23.5

Daily Temperatures in °C — Suriname Meteorological Service
Station : 110 KKABA — River : Kabalebo — Year : 1973

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27	-	26.5	27.5	28.1	28.1	27.9	26.5	25.3	27	26.9	27.1	1
2	27.5	-	26.3	29.1	28.7	28.1	27.9	25.9	26.1	25.3	27.5	26.1	2
3	27.5	-	27.1	28.3	28.7	28.2	28.7	26.9	25.8	25.1	27.7	27.7	3
4	25.4	-	27.9	28.7	28.9	28.7	28.4	25.9	24.4	26.5	26.5	24.9	4
5	25	-	27.9	24.9	28.6	26.5	28.5	25.7	26.1	24.5	24.2	26.7	5
6	25.7	-	27.6	26.1	28.7	26.9	27.7	25.5	24.5	25.5	25.4	26.6	6
7	23.9	25	26.6	28.5	27.3	27.1	26.2	24.6	22.4	25.9	24.7	26.6	7
8	25.9	27.3	25.3	26.7	25.3	27.7	25.9	26.1	25.9	26.5	25.2	27	8
9	26.2	26.9	24.1	27.1	28.1	28	24.7	27	25.9	27.2	24.3	26.6	9
10	25.7	26.9	27	25	-	-	25.3	26.7	27.1	25.9	25.3	28.2	10
11	25.9	26.2	28.1	25	28.8	28	-	26.1	25.9	27.1	-	28.5	11
12	25.4	28.1	27	25.3	29	27.6	23.9	25.9	26.5	25.9	27.7	28	12
13	28.5	27.1	27.1	26.1	26.1	28.2	25.8	23.4	26.5	27.9	26.7	27.7	13
14	25.1	27.9	25.9	27.1	28.5	27.9	25.8	24.7	27.1	27.2	27.9	28.8	14
15	26.2	-	25.5	27.3	26.9	27.5	27.1	25.3	27.2	26.9	27.2	28.7	15
16	26.1	-	27.1	28.2	27.3	29.5	26.4	26	25.6	26.1	26.7	28.4	16
17	27.5	-	27.2	26.4	28.2	28.7	26.5	25.8	25.3	26.9	24	28.7	17
18	24.7	-	27.8	26.2	25	27.5	27.1	25.7	26.3	27.5	27.3	29.4	18
19	26.7	-	27.7	27.9	27	27.3	28.1	26	25.8	26.8	26.9	28	19
20	27.5	-	27.6	27.1	27.9	28.3	27.6	25.5	25.1	26.1	27.1	28.8	20
21	26.9	-	27.5	25.1	27.4	28.1	28.5	24.5	25.4	26.5	27.5	29	21
22	27.7	-	28.2	27	29	28.4	24.7	24.5	25.4	25.4	27.9	29.1	22
23	28.3	-	28.5	27	27.5	28.8	25.1	24.5	25.2	25.7	27.4	28.3	23
24	26.1	-	29.3	26.2	28.1	29.1	25.9	25.5	25.6	27.3	28.1	24.5	24
25	27.5	26.8	27.9	28.1	25.2	27.7	26.7	-	26.9	27.9	27.6	26.2	25
26	26.5	27.4	24.9	29.4	26.7	28.5	28.6	24.9	26.5	26.4	26.9	-	26
27	26.3	26.9	26.5	29.1	27.5	28.3	25.5	24.1	26.5	27.4	26.3	27.7	27
28	26.2	27.5	28.6	27.7	27.8	28.8	26	26.4	25.4	26.7	26.1	28.3	28
29	28		28.2	25.1	28.5	26.3	27.2	25.9	26.8	26	26.1	27.4	29
30	27.5		28.9	28.5	27	27	27.1	27	26	26.5	26.5	28.1	30
31	27.7		27.5		27.5		26.9	26.6		27.3		27.9	31

Mmax	29	28	29	29	29	30	29	27	27	28	28	29
Mmean	27	27	27	27	28	28	27	26	26	26	27	28
Mmin	23.9	25.0	24.1	24.9	25	26	24	23	22	25	24	25

Year Maximum 30 — Year Mean 27 — Year Minimum 22.4

Daily Temperatures in °C *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1974*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27.6	27.1	25.2	29.3	27.8	27	27.1	26.5	25.9	25.1	25.8	27.4	1
2	26.4	27.7	26	29.1	26	28.4	27.1	27.7	24.4	-	25.7	26.7	2
3	27.4	28.3	26.6	29.7	26	27.3	27.4	26.1	26.1	26.5	25.7	-	3
4	27.7	26.3	27.6	29.2	27.1	27.9	26.1	24.9	24.6	25.5	25.3	28	4
5	28.3	28.2	25.5	29.2	27.9	28.5	28.1	24.8	24.9	24.2	24.9	27.9	5
6	27.7	23.8	24.5	27.6	25.5	27.4	28.1	25	24.4	25.8	26.9	28.5	6
7	27.3	25.2	24.9	28.1	28.8	27.4	27.1	-	26.3	25.5	26.5	25	7
8	25.3	27.3	25.5	28.3	27.4	25.8	27.6	-	25.8	27.1	25.8	25.2	8
9	27.8	26.1	26.6	28.7	28.3	24.7	27.5	-	25.1	25.1	25.1	26.2	9
10	27.9	24.7	26.5	28.3	27.7	27.2	27.1	-	25.2	25.1	27.1	27.1	10
11	26.7	28.7	26.6	28.9	28.2	29	26.3	-	25.9	24.9	26.7	27.9	11
12	25.1	28.1	27.3	28.8	28.7	27	27.5	-	27.3	26.9	26.6	26.7	12
13	28.1	28.1	26.1	26.7	28.4	28.5	28.1	-	25.6	25.5	27.1	26.6	13
14	26.9	25.7	27.1	27	28.5	-	28.3	-	26.3	25.3	27	27.7	14
15	27.1	28	28.2	26.6	26.9	-	28.1	25.9	26.9	24.9	27.1	26.4	15
16	27.9	25.1	25.5	27.1	26.9	-	26.6	26.2	25.1	23.5	26.2	27	16
17	-	25	25.5	24.5	27.1	-	26.8	25.5	24.5	25.1	25.7	27.3	17
18	24.2	27.1	26.7	27.8	28.2	-	-	24.7	25.1	24.5	26.7	27.7	18
19	27.5	24.6	27.7	27.4	28.4	27.7	25.6	24.1	24.5	25.1	27.3	28	19
20	27.2	25.3	26.6	24.7	28	28.1	27.8	25.4	25.6	25.4	25.3	27.3	20
21	26.5	25.3	26.9	25.5	27.9	26	28	25.3	24.5	27.1	25.6	26.2	21
22	27	25.3	27.1	26.5	28.2	28.5	27.9	26	27.1	27.5	25.5	24.9	22
23	27.7	27.2	26.1	27.8	27	27.5	27.8	26.9	24.7	27.5	-	26.5	23
24	26.3	26.2	27.6	26.7	28.5	29.1	27	24.8	25.3	26.7	28.2	27.3	24
25	23.9	26.3	25.8	25.7	27.7	28.1	27.5	26	25.4	27.5	26.3	26.9	25
26	29.1	27	27.7	26.7	28.1	28.5	28	25.5	26.4	27.1	-	27.7	26
27	25.9	27.1	27.3	27	27.1	27.3	27.5	24.6	26.3	27.3	-	27.7	27
28	27.4	25.7	28	25.9	25.4	27.7	27.7	26.6	-	27	26.7	27.7	28
29	26.7		29.1	27.8	27.2	28.1	28.6	26.1	26.4	24.6	27.1	27.6	29
30	26.9		27.3	28.8	26	26.9	26.7	25.9	-	26.1	25.8	27.8	30
31	27.4		28.2		26.5		27.5	27.1		26.4		26.1	31
Mmax	29	29	29	30	29	29	29	28	27	28	28	29	
Mmean	27	26	27	28	27	28	27	26	26	26	26	27	
Mmin	23.9	23.8	24.5	24.5	25	25	26	24	24	24	25	25	

Year Maximum 30 *Year Mean* 27 *Year Minimum* 23.5

Daily Temperatures in °C *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1975*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27.2	26.8	26.1	27.5	28.1	28.3	27.8	26.9	26.5	27.7	26.7	-	1
2	26.5	26.3	25.7	24.3	27.5	29.1	29.3	25.9	25.7	26.8	26.5	-	2
3	26.9	26.6	25.9	26.2	-	24.9	29.1	26.9	22.5	26.1	25.4	-	3
4	26.7	26.3	23.3	27.2	-	29.5	28.9	27	26.3	26.6	27	-	4
5	27.3	27.8	26.3	28.7	-	28.7	29.1	26	26.2	27	26.7	-	5
6	24.9	25.2	26.5	29.2	-	28.7	29	26.5	24.9	26.3	25.6	-	6
7	25.7	26.3	23.8	27.5	-	29.7	29.1	27.6	26.6	26.1	24.9	-	7
8	26.5	25.6	27.3	26.7	-	28.5	28.2	28	25.3	25.7	26.1	-	8
9	27.3	25.5	25.4	26.3	-	-	27.7	27.7	26.4	25.5	27.4	-	9
10	26.5	26.3	24.1	25.7	-	29.5	27.7	27.6	27.4	25.5	27.5	-	10
11	26.3	27.3	24.5	25.7	-	28.5	28.5	26.8	27.5	24.8	26.1	-	11
12	26.3	26.7	20	26.7	28.3	29.5	29.3	27.8	27.5	25.3	26	-	12
13	27.6	25.8	23	24.8	27.1	27.9	29.1	29	27.4	25.1	26.7	-	13
14	27.1	25.7	25.6	27.5	26.9	26.7	28.4	27.9	27.7	25.9	25.9	-	14
15	25.1	25.9	24.8	28.2	26.5	25.7	26.1	27.7	26.3	27.1	27.1	-	15
16	26.5	26.9	27	27	26.8	28.5	26.2	26	25.6	25.7	24.5	25	16
17	27.1	27	26.7	27.2	25.9	29	26.9	26.8	26.8	26.5	26.1	27.1	17
18	28.1	26.9	25.7	28.5	28.2	27.9	27.9	26.9	25.3	26.6	26.9	26.2	18
19	25.9	25.6	24	28.1	28.2	28.4	27.7	23.1	27.5	26.5	25.3	27.7	19
20	27.1	27.1	25.2	28.1	28.4	27.8	27.2	25.3	27.8	24.8	24.1	26.4	20
21	25	27.3	24.8	24.8	27.9	28.2	26.4	24.6	26.9	25.6	24.7	27.1	21
22	25.4	26.6	26.3	27.1	28.1	28.1	26.1	24.4	24.5	24.5	27.1	24.8	22
23	25.7	26.7	26.4	27.9	26.2	28.3	26.6	24.7	27.3	24.5	26.2	26.6	23
24	26.4	26.6	24.4	27.6	27.9	28.4	27.7	24.6	26.5	-	26.7	26.7	24
25	25.7	26.3	24	24.6	28.1	28.8	28.4	24.5	27.3	-	25.6	26.9	25
26	26.4	25.7	27.1	26.3	28.3	28.5	27.3	26.5	27.5	-	27.3	26.8	26
27	25.1	26.2	27.4	24.4	28.4	28.9	26.9	26.1	26.6	25.3	-	24.5	27
28	26.2	25.7	26.2	25.1	28.4	29.1	25.3	26.7	24.5	24.4	-	26.4	28
29	27		25.9	27.2	28.7	28.5	27	26.4	26.4	23.8	-	26.3	29
30	26.3		24.9	27.9	28.2	28.3	25.8	27.1	26.3	26.2	-	26.6	30
31	26.5		27.7		27.6		27	26.3		27.4		25.8	31
Mmax	28	28	28	29	29	30	29	29	28	28	28	28	
Mmean	26	26	25	27	28	28	28	26	26	26	26	26	
Mmin	24.9	25.2	20.0	24.3	26	25	25	23	23	24	24	25	

Year Maximum 30 *Year Mean* 27 *Year Minimum* 20.0

Daily Temperatures in °C — *Suriname Meteorological Service*

Station : 110 KKABA — *River : Kabalebo* — *Year : 1976*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	25.5	26.6	27.9	26.7	26.4	-	26	27.3	26.4	-	27.3	27.5	1
2	28.3	26.1	27.3	28.8	-	-	26	27.1	26.9	27.3	28.1	-	2
3	24.5	25.7	27.4	28.8	29.1	-	26.7	27.1	25.7	27.5	27.2	28.7	3
4	25.8	26.9	28.2	26.9	27.5	-	27.3	25.1	25.4	24.7	27.1	27.8	4
5	25.5	26.2	27.7	28.3	29.1	-	24.7	25.7	25.4	24.8	27.9	26.1	5
6	25.5	28.5	25.8	28.1	29.3	-	26.4	26.1	25.4	26.2	26.8	27.4	6
7	25.5	27.9	25.1	28.3	27.4	-	25	26.7	26.9	26.5	27.4	27.5	7
8	25.7	28	25.3	28.9	29.1	-	26	25.8	26.1	26.5	28.9	24.9	8
9	28.1	27.7	26.3	28.8	28.7	-	26.7	25.5	26.7	26.3	27.7	26.6	9
10	27.2	26.8	25.2	29.9	28.9	28.5	25.3	27.1	27	26.8	28.9	24.9	10
11	27.2	26.7	27.5	28.7	28.2	29.2	25.1	27.1	27.4	26.9	28.1	25	11
12	26.7	25.9	27.3	28.1	27.6	29.1	26.7	26.7	27.6	-	27.5	26.2	12
13	27.3	26.4	27.8	28.3	27.7	29	27.2	26.9	26.7	27.2	26.5	26.5	13
14	27.2	25.8	26	28.9	28.5	29	26.1	26.3	26.7	27.1	27.1	27.9	14
15	26.5	27.3	26.5	27.3	29	27.1	26.7	24.8	26.5	27	28.1	27.7	15
16	27.1	26.7	26.7	25.2	30	28.4	27	25.7	27.5	26.3	27.2	25.1	16
17	24.7	26.1	26.9	27.9	29.3	27.6	27.8	24	27.2	25.7	27.2	26.9	17
18	27.4	27.6	28.4	28.9	28	29.6	26.2	25.4	27.6	27.7	26.7	26.4	18
19	27.9	26.3	28	28.5	28	29.1	28.4	26.1	27.6	28.2	27.9	27.3	19
20	27.8	25.5	26.4	29.3	29	28.8	25.9	26.1	26.4	25.6	28	27.9	20
21	28.9	26.1	28.4	29.6	28.9	28.4	26.1	27.5	26.9	26.4	28.7	26.4	21
22	26.8	28.3	29	27.8	29.7	28.2	25.5	25.3	27.5	26.9	29	26.7	22
23	26.9	28.4	28.8	26.8	28.8	28.7	24.7	24.1	27.2	26.7	27.8	26.5	23
24	27.3	29	28.1	28.2	28.8	27.2	25.3	25.6	25.5	26.1	28.9	28.2	24
25	27.4	27.7	27.9	26.8	-	28.6	26.1	25.7	25.8	27.8	28.6	27.6	25
26	26.5	26.7	29	25.3	-	27.2	25.9	25.5	26.9	25.8	27.9	26.4	26
27	-	27.4	28.9	27.1	-	26.2	26.8	25.1	25.7	26.6	25.9	26.9	27
28	25.5	27	29	27.6	-	25.7	26.6	27.8	25.7	26.1	26.7	26.9	28
29	25.5	25.9	28.4	-	-	25.9	26.6	27.5	27.5	26.9	27.8	26.6	29
30	25.1		28.2	26.8	-	-	25.9	27.6	-	25	26.1	27.1	30
31	25.8		27.6		-		25.8	25.9		26.5		28.1	31
Mmax	29	29	29	30	30	30	28	28	28	28	29	29	
Mmean	27	27	27	28	29	28	26	26	27	27	28	27	
Mmin	24.5	25.5	25.1	25.2	26	26	25	24	25	25	26	25	

Year Maximum 30 *Year Mean* 27 *Year Minimum* 24.0

Daily Temperatures in °C — *Suriname Meteorological Service*

Station : 110 KKABA — *River : Kabalebo* — *Year : 1977*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	28.3	25.4	26.7	24.1	29.2	28.5	28.1	26.3	24.8	27	27.6	25.1	1
2	28.3	-	26.7	26.3	29.7	27.7	28.7	24.8	25.5	27.3	28.5	25.4	2
3	25.6	27.5	25.7	28	29.2	27.7	28.8	24.3	-	27.2	28.2	27.6	3
4	25.5	26.9	27.7	28.9	29.1	28.7	28.8	25.3	-	27.4	27.5	27.5	4
5	27.7	26.3	26.7	29.4	26.9	28.3	26.3	24.9	-	24.9	27.7	26.5	5
6	26.9	25.1	28.5	29.1	-	-	27.5	25.1	-	-	28	28.7	6
7	24.7	26.3	25.7	28.9	28.9	-	-	24.7	-	-	27.2	27.3	7
8	26.7	24.9	28.2	28.1	28.7	-	27.3	26.1	-	-	24.9	24.2	8
9	26.7	27.2	28.3	26.3	29.1	-	27.5	27.2	-	25.4	26.2	-	9
10	26.8	28.1	27.6	27.2	28.8	28.5	27.1	25.8	26.6	25	27.4	26.7	10
11	24.9	25.4	25.7	27.1	28.5	29.2	27.4	25.6	27	27.3	26.5	26.8	11
12	26.9	26.7	24.9	27.5	29.3	29.1	26.3	23.5	26.3	27.1	27.5	27.5	12
13	25.9	26.3	25.1	27.5	29.2	28.5	25.7	25.9	26.3	27.9	26.3	28	13
14	26.3	27.9	24.9	27.4	29.5	29.2	25.9	26.1	26.6	25.3	25.8	28.1	14
15	26.8	27.8	27.6	28.6	28.1	29.1	25.3	26.1	25.3	25.7	27.6	27.9	15
16	25.8	27.3	28.2	28.1	28.1	26.4	26.5	27.6	25.3	23.7	25.3	27.9	16
17	26	28.1	26.9	27.9	-	27.1	27.5	27.7	27.4	27	26.4	28.9	17
18	25.1	29.3	27.6	28.5	-	27.7	25.9	27.1	25.5	27.3	25.9	27.7	18
19	27.1	28.4	28.5	28	-	27	26.6	25.6	25.3	26.5	26.5	28.7	19
20	27.6	28.3	27.2	27.8	-	28.1	27.1	25.3	26.9	25.6	26.5	28.2	20
21	26.7	25.6	23.7	27.7	-	28.2	26.9	26	26.1	26.7	28.2	27.7	21
22	28.2	27.6	23.7	28.7	-	29.5	27	27.3	26.6	27.8	26.5	24.9	22
23	27.9	26.1	25.1	28.7	-	29.4	26.3	26.7	26	27.7	27.6	26.7	23
24	26.4	28.2	25.3	27.9	27.3	25.1	26.6	25.7	27.8	28.1	27.4	27.9	24
25	25.6	27.8	24.2	29.1	27.3	27.5	25.5	24.1	27.4	25.3	25.4	26.7	25
26	26.6	28.5	26	29.2	26.6	28.1	25.9	25.2	24.9	26.8	25.6	25.3	26
27	25.9	27.8	27.2	29.3	27.6	28.9	25.5	26.1	25.6	27.9	26.1	27	27
28	25.1	27.7	24.7	27.9	28	29.2	26.5	25	25.7	28.5	28	26.4	28
29	25.1		26.5	28.1	26.5	29.3	26	24.9	25.4	27	26.8	25.2	29
30	25.1		23.9	28.7	27	28.7	27.1	25.5	25.9	26.5	27.3	26.1	30
31	25.9		25.6		27.8		26.9	25.8		27.2		27.4	31
Mmax	28	29	29	29	30	30	29	28	28	29	29	29	
Mmean	26	27	26	28	28	28	27	26	26	27	27	27	
Mmin	24.7	24.9	23.7	24.1	27	25	25	24	25	24	25	24	

Year Maximum 30 *Year Mean* 27 *Year Minimum* 23.5

Daily Temperatures in ℃ — Suriname Meteorological Service

Station : 110 KKABA — River : Kabalebo — Year : 1978

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	25.1	25.2	27.5	28.7	29.2	28.1	24.9	27.8	25.1	28.4	25.6	27.0	1
2	25.0	26.7	27.3	28.9	26.7	27.6	26.7	27.9	25.8	28.7	25.6	25.5	2
3	28.3	26.0	28.0	26.8	27.0	27.4	26.4	27.5	26.6	25.5	25.7	25.9	3
4	26.4	26.0	28.7	27.5	27.9	25.9	26.3	25.3	27.3	27.9	25.7	25.8	4
5	27.8	26.1	28.8	27.9	28.8	28.0	25.1	25.7	28.0	24.7	25.7	24.6	5
6	27.1	26.1	28.1	28.3	29.2	28.0	25.7	26.3	26.2	26.9	25.7	25.9	6
7	27.7	26.2	27.6	29.7	28.7	27.4	25.2	27.1	26.1	26.2	25.8	24.9	7
8	27.3	26.2	28.8	27.9	28.7	27.8	23.3	24.9	26.4	27.2	25.8	26.3	8
9	27.4	26.3	27.5	27.2	28.8	28.4	25.8	26.5	28.0	26.8	27.6	28.1	9
10	25.9	26.3	25.7	27.7	28.8	28.3	27.5	26.2	25.0	25.9	28.2	28.8	10
11	28.3	26.4	27.9	27.7	28.9	27.9	26.9	26.9	27.1	25.9	29.1	27.5	11
12	26.2	26.4	26.9	28.3	28.9	28.5	25.0	25.7	27.4	25.7	26.8	27.3	12
13	24.3	26.5	27.4	28.8	29.0	28.5	25.8	25.8	25.9	26.7	27.0	27.0	13
14	25.8	26.5	27.9	28.5	29.0	28.4	27.5	25.6	25.3	26.5	27.7	28.0	14
15	25.1	27.4	28.9	27.5	29.1	27.8	27.2	25.7	27.4	26.4	26.3	29.1	15
16	24.9	24.5	27.8	28.0	29.1	28.3	26.1	28.3	27.9	26.3	26.5	28.8	16
17	26.6	25.3	29.4	28.7	29.3	26.7	26.4	28.3	27.1	26.0	26.3	28.4	17
18	25.2	23.1	29.1	28.9	28.7	27.1	26.7	28.3	26.1	24.9	24.9	27.1	18
19	26.1	25.0	28.5	28.8	29.1	28.1	26.6	27.9	24.5	26.7	26.8	27.7	19
20	28.4	25.7	28.5	27.4	29.1	26.7	26.6	26.9	27.2	26.4	26.7	27.4	20
21	27.0	26.0	29.3	26.7	29.3	27.1	27.0	27.2	27.6	27.9	27.7	27.4	21
22	25.0	25.7	29.4	28.5	29.0	25.9	25.7	24.7	27.2	26.6	28.2	27.5	22
23	23.9	25.6	29.4	29.1	28.5	26.1	25.5	24.0	27.5	25.0	25.5	28.1	23
24	26.0	27.3	27.4	28.5	28.3	27.6	26.0	24.3	27.8	27.2	26.5	27.7	24
25	26.4	26.6	28.4	27.9	28.0	28.7	26.8	24.7	26.3	27.1	26.9	25.2	25
26	25.2	27.4	28.1	29.6	29.7	27.9	26.3	25.0	25.7	26.9	26.9	26.7	26
27	25.4	27.5	27.8	29.1	28.7	27.8	27.1	25.3	24.7	26.0	27.9	27.8	27
28	25.7	28.7	28.9	28.7	29.7	27.0	27.1	25.7	24.8	25.5	26.0	27.0	28
29	25.5		27.2	28.7	26.5	25.9	27.3	26.0	27.4	25.5	27.8	25.5	29
30	26.3		28.5	28.4	26.4	25.5	27.4	25.1	28.2	25.6	28.0	26.7	30
31	24.3		28.3		27.3		27.7	24.4		25.6		26.8	31
Mmax	28	29	29	30	30	29	28	28	28	29	29	29	
Mmean	26	26	28	28	29	27	26	26	27	26	27	27	
Mmin	23.9	23.1	25.7	26.7	26	26	23	24	25	25	25	25	

Year Maximum 30 — Year Mean 27 — Year Minimum 23.1

Daily Temperatures in ℃ — Suriname Meteorological Service

Station : 110 KKABA — River : Kabalebo — Year : 1979

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27.7	26.5	25.6	28.8	28.1	27.5	26.7	25.9	26.6	28.5	26.5	28.1	1
2	25.7	27.1	28.5	26.7	27.3	28.0	26.5	24.2	28.0	27.1	25.8	27.7	2
3	25.5	27.6	28.7	26.7	28.2	26.9	27.4	26.6	25.9	27.6	26.3	27.3	3
4	29.9	26.7	29.7	27.5	25.7	27.5	27.1	25.3	27.3	27.7	27.1	26.2	4
5	28.2	27.4	29.5	28.3	24.5	27.2	27.1	25.8	26.9	25.7	26.8	25.1	5
6	25.3	28.1	29.1	29.1	23.5	26.3	27.3	26.2	27.1	26.9	26.9	26.1	6
7	26.3	27.9	28.3	29.1	26.1	25.8	27.6	25.9	27.3	26.3	27.5	26.3	7
8	26.8	27.3	28.5	27.4	26.1	27.9	26.7	26.5	28.6	27.8	25.9	27.8	8
9	27.2	28.0	28.9	28.2	26.7	28.3	24.7	26.7	28.2	25.9	26.0	28.0	9
10	30.0	29.0	29.2	28.6	28.0	27.7	26.5	27.3	28.1	26.5	27.6	24.3	10
11	27.9	28.7	29.4	28.8	27.2	27.3	27.1	26.6	28.1	25.9	27.2	26.5	11
12	27.9	28.1	29.5	28.7	26.1	27.2	27.0	27.1	27.2	27.2	26.3	25.7	12
13	28.5	28.7	27.8	29.3	27.3	27.6	26.8	27.5	28.2	27.9	27.5	26.1	13
14	30.2	28.7	29.4	29.3	26.7	26.9	26.7	28.2	28.1	27.5	26.7	25.8	14
15	26.2	25.2	28.5	28.3	26.7	27.6	26.5	27.5	27.7	26.1	28.0	24.9	15
16	28.9	26.1	28.1	29.1	26.6	26.9	26.4	26.3	28.6	27.9	27.9	27.0	16
17	29.7	26.9	28.7	29.5	26.7	26.9	26.2	26.7	28.3	27.8	26.4	26.3	17
18	24.4	25.1	29.2	29.6	26.9	26.2	26.1	26.5	26.6	26.7	25.6	27.1	18
19	26.5	26.4	29.5	29.4	27.0	26.3	25.9	26.6	26.2	25.4	26.9	26.0	19
20	26.3	28.5	29.8	29.2	27.1	26.5	25.8	26.6	28.4	24.7	26.7	26.8	20
21	26.5	29.5	29.0	29.7	27.2	26.6	25.6	26.7	27.9	25.8	25.9	26.0	21
22	26.4	27.9	26.0	29.5	27.4	26.7	25.5	26.7	27.1	26.4	26.5	25.3	22
23	28.9	29.2	28.8	28.9	27.5	26.8	25.3	27.9	28.2	27.0	25.9	24.9	23
24	26.6	28.1	29.2	28.3	27.6	27.0	25.2	28.3	27.2	25.9	26.1	24.5	24
25	28.3	28.9	29.1	29.3	27.4	27.1	25.0	27.5	27.1	26.6	27.3	26.0	25
26	27.9	28.6	28.2	29.3	27.6	27.2	24.9	27.1	28.1	26.9	27.4	26.6	26
27	27.7	27.7	29.1	29.3	27.9	27.3	25.6	25.3	26.6	28.4	27.6	27.1	27
28	24.7	25.0	28.0	28.8	27.7	27.5	26.7	26.9	28.3	26.1	27.7	27.7	28
29	25.3		28.9	29.1	26.7	27.6	24.9	27.3	26.3	25.2	27.8	27.6	29
30	24.5		28.6	29.9	25.9	27.7	25.8	26.9	27.9	26.0	28.0	26.7	30
31	25.9		29.5		27.4		23.9	26.9		25.6		25.9	31
Mmax	30	30	30	30	28	28	28	28	29	29	28	28	
Mmean	27	28	29	29	27	27	26	27	28	27	27	26	
Mmin	24.4	25.0	25.6	26.7	24	26	24	24	26	25	26	24	

Year Maximum 30 — Year Mean 27 — Year Minimum 23.5

Daily Temperatures in ℃ — Suriname Meteorological Service

Station : 110 KKABA — River : Kabalebo — Year : 1980

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27.6	27.0	28.1	28.5	28.6	28.3	27.4	27.0	26.2	25.8	616	27.1	1
2	27.1	27.6	28.1	28.1	29.1	27.6	27.3	26.3	25.1	26.3	26.7	27.5	2
3	27.3	27.6	27.5	28.7	29.3	27.5	27.2	26.7	26.3	26.3	27.2	25.4	3
4	24.5	27.0	28.0	28.7	28.5	27.4	27.1	25.2	26.9	23.5	27.8	27.1	4
5	27.3	27.1	28.1	28.2	28.1	28.4	27.0	26.0	26.2	25.1	29.1	26.7	5
6	27.0	28.9	28.3	27.5	26.2	28.4	26.9	26.1	26.9	27.3	26.7	27.0	6
7	25.9	27.1	28.1	25.4	29.0	28.3	26.8	26.4	26.8	25.8	24.3	27.6	7
8	26.9	27.5	29.1	26.8	29.5	27.0	26.6	26.6	24.8	25.7	25.3	27.4	8
9	27.5	26.3	28.3	27.9	27.4	26.3	26.5	26.7	24.4	26.7	27.0	27.2	9
10	24.4	27.4	27.0	27.9	28.5	28.4	26.4	26.7	25.7	28.0	26.5	28.2	10
11	25.3	28.5	28.8	27.7	28.5	27.7	26.3	26.8	25.7	27.3	25.9	27.7	11
12	26.2	27.8	28.3	28.1	26.7	25.9	26.2	26.9	26.0	27.1	26.3	26.0	12
13	24.1	26.3	28.5	27.5	26.0	25.5	26.1	27.0	26.0	26.8	26.0	27.3	13
14	24.1	26.8	28.3	29.1	28.5	27.1	26.9	27.0	26.0	26.7	25.1	27.5	14
15	24.1	27.6	27.1	28.2	27.4	26.4	25.9	27.1	26.0	24.4	26.8	27.5	15
16	24.1	27.5	28.7	28.8	28.2	25.7	25.6	27.2	26.0	26.9	28.0	27.5	16
17	25.0	26.7	28.6	28.4	27.9	27.2	25.6	27.2	25.9	28.2	26.7	27.5	17
18	25.5	28.3	28.7	28.4	27.7	26.7	26.5	27.3	25.9	28.2	26.7	27.5	18
19	25.9	26.9	28.1	27.1	28.0	25.7	26.9	27.4	25.9	27.1	24.2	27.5	19
20	25.3	26.8	28.0	27.3	27.5	25.9	26.5	27.4	25.9	26.7	26.0	27.6	20
21	25.3	28.1	28.9	28.4	28.5	27.1	24.6	27.5	25.9	27.2	42.5	27.6	21
22	26.1	24.5	29.1	28.6	28.1	27.5	26.8	27.6	25.9	24.4	28.7	27.6	22
23	28.0	27.9	28.3	28.1	28.3	26.7	27.8	27.7	25.9	27.1	26.1	27.6	23
24	27.0	26.5	27.0	28.6	28.6	28.0	26.8	27.7	25.9	27.1	26.8	27.6	24
25	26.3	26.6	27.1	28.7	27.5	27.1	25.7	27.8	25.9	27.1	25.7	27.6	25
26	27.9	26.3	27.2	28.5	27.2	26.9	28.1	27.6	25.9	26.2	26.1	27.6	26
27	27.8	27.8	27.6	29.1	26.9	27.1	27.9	27.4	25.8	25.1	26.7	27.6	27
28	27.8	27.6	28.6	28.7	27.4	25.7	26.8	27.2	25.8	26.0	26.9	27.6	28
29	27.7	27.3	26.5	28.4	28.0	26.8	25.9	26.9	25.8	26.9	26.5	27.6	29
30	29.0		26.2	28.3	28.7	26.0	25.0	26.7	25.8	28.3	28.7	27.6	30
31	28.0		27.5		28.0		25.1	26.5		27.3		27.7	31
Mmax	29	29	29	29	30	28	28	28	27	28	62	28	
Mmean	26	27	28	28	28	27	27	27	26	27	28	27	
Mmin	24.1	24.5	26.2	25.4	26	26	25	25	24	24	24	25	

Year Maximum 62 — Year Mean 27 — Year Minimum 23.5

Daily Temperatures in ℃ — Suriname Meteorological Service

Station : 110 KKABA — River : Kabalebo — Year : 1981

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27.7	28.3	28.4	28.8	27.5	28.4	24.4	26.5	28.5	26.9	25.5	28.6	1
2	27.7	27.2	27.0	28.5	29.3	28.6	27.6	26.5	28.5	26.5	27.6	27.4	2
3	27.7	25.3	28.1	28.5	28.9	28.8	26.9	26.5	28.4	27.0	28.0	27.4	3
4	27.7	27.7	28.8	28.3	28.3	28.9	26.9	26.4	28.3	26.8	27.7	26.2	4
5	27.7	28.2	29.2	28.6	28.0	28.2	26.9	26.4	27.5	25.2	27.4	26.8	5
6	26.7	28.6	29.5	28.9	27.8	29.4	26.9	26.4	27.6	26.5	26.9	28.1	6
7	26.6	28.1	28.5	28.5	27.5	29.0	26.8	26.4	27.4	25.9	28.5	25.8	7
8	26.6	26.2	28.6	29.0	28.2	29.7	26.8	26.1	28.7	28.0	26.5	28.2	8
9	26.9	24.1	28.9	29.5	28.7	28.5	26.8	26.6	27.9	28.2	28.5	28.8	9
10	26.5	27.0	29.1	28.8	29.1	28.8	26.8	24.6	26.7	27.0	28.9	28.2	10
11	27.6	28.1	29.7	28.6	29.4	30.2	26.8	27.2	26.0	26.5	27.7	27.8	11
12	27.1	27.7	29.0	28.5	29.4	29.4	26.8	27.2	27.4	25.7	27.7	26.2	12
13	27.7	27.7	28.6	29.2	29.3	29.2	26.8	27.1	27.1	24.3	25.6	25.7	13
14	27.2	28.4	28.9	28.3	29.7	28.6	26.7	27.4	28.5	24.8	28.0	26.6	14
15	27.5	28.1	28.9	29.0	29.7	28.3	26.7	26.0	28.7	25.8	27.6	28.0	15
16	26.8	26.9	29.6	28.3	29.9	25.4	26.7	26.5	27.9	26.5	27.5	27.8	16
17	27.0	27.6	29.7	28.7	29.4	27.5	26.7	26.2	28.5	26.7	27.7	27.0	17
18	27.5	27.5	29.8	28.3	30.0	26.9	26.7	27.1	26.3	28.2	28.6	28.3	18
19	26.8	28.7	27.0	28.9	29.4	27.3	26.7	28.1	27.0	27.0	28.1	27.9	19
20	28.0	28.3	28.3	29.9	29.6	28.1	26.7	26.7	28.0	26.8	28.9	28.3	20
21	27.9	28.3	28.0	29.6	28.5	28.2	26.6	26.6	28.4	28.3	28.6	28.3	21
22	26.2	26.4	28.9	29.1	29.1	27.5	26.6	25.8	27.0	25.7	29.2	23.9	22
23	27.6	26.1	27.7	30.0	29.1	25.7	26.6	27.7	26.5	27.7	28.5	27.3	23
24	27.3	28.5	28.1	29.3	29.2	26.3	26.6	28.0	25.9	26.7	28.3	27.7	24
25	27.0	28.3	28.2	29.2	29.3	27.0	26.6	28.5	25.5	27.9	28.1	27.5	25
26	27.1	28.4	28.7	28.6	29.8	25.9	26.6	27.8	27.7	28.3	26.5	27.7	26
27	25.8	27.6	28.9	28.7	28.4	26.9	26.6	28.1	26.5	26.8	26.7	28.8	27
28	24.0	27.3	28.8	27.4	28.3	26.3	26.5	27.7	27.1	28.0	26.3	28.5	28
29	26.7		28.7	28.2	27.4	26.7	26.5	27.0	28.8	27.1	28.2	27.6	29
30	27.8		29.7	26.7	27.8	26.3	26.5	27.1	28.1	27.4	28.7	26.3	30
31	27.9		29.0		27.7		26.5	28.6		27.6		27.5	31
Mmax	28	29	30	30	30	30	28	29	29	28	29	29	
Mmean	27	28	29	29	29	28	27	27	28	27	28	27	
Mmin	24.0	24.1	27.0	26.7	27	25	24	25	26	24	26	24	

Year Maximum 30 — Year Mean 28 — Year Minimum 23.9

Daily Temperatures in °C *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1982*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	26.6	27.5	28.3	28.7	30.6	29.9	27.5	25.1	26.8	27.8	26.5	24.8	*1*
2	26.3	27.1	27.6	28.8	30.1	30.2	27.1	26.2	26.1	27.5	26.2	25.5	*2*
3	28.2	27.1	28.7	29.3	28.9	29.5	28.1	23.8	26.6	28.3	27.6	26.1	*3*
4	26.5	27.6	27.5	29.4	29.2	29.5	27.0	25.5	25.9	27.5	26.2	24.5	*4*
5	27.2	28.0	27.6	29.1	29.2	28.1	25.8	26.5	25.7	26.2	26.4	25.4	*5*
6	27.9	28.2	28.3	29.8	29.7	29.8	25.9	25.7	24.5	26.6	27.3	26.6	*6*
7	26.1	27.4	27.0	27.6	29.5	28.2	25.3	25.2	26.1	28.1	27.3	26.5	*7*
8	27.7	26.4	27.9	28.0	28.0	29.1	25.3	25.9	26.1	29.8	27.4	26.2	*8*
9	28.1	26.3	28.6	28.4	29.4	29.0	25.1	27.2	26.0	27.9	26.6	27.4	*9*
10	27.1	28.0	29.2	29.3	29.0	29.0	26.2	25.3	26.0	28.0	26.5	25.1	*10*
11	25.5	28.9	28.5	28.8	30.5	28.9	25.7	26.7	25.9	26.4	27.4	26.3	*11*
12	27.7	27.7	28.8	28.6	27.1	27.8	25.3	27.3	25.4	25.7	28.3	27.9	*12*
13	28.3	27.9	28.7	28.6	27.2	28.3	25.2	25.7	27.0	26.5	27.1	27.0	*13*
14	27.9	28.8	27.5	29.4	29.3	27.4	26.1	25.3	25.6	27.3	27.8	25.7	*14*
15	26.7	27.8	26.2	29.5	29.1	26.4	26.8	25.4	27.7	27.1	27.8	25.9	*15*
16	27.0	29.1	27.7	30.1	29.8	25.4	26.4	25.6	27.3	27.8	28.1	25.7	*16*
17	27.7	28.4	28.5	29.6	28.9	26.6	27.2	26.1	27.0	28.1	26.8	26.5	*17*
18	28.4	28.3	28.8	28.4	29.1	27.0	26.2	26.2	27.3	27.8	26.6	25.8	*18*
19	27.1	26.6	28.4	29.7	28.7	27.0	26.1	24.8	27.3	28.2	25.8	26.8	*19*
20	27.3	28.3	28.1	28.4	29.7	28.1	26.0	24.6	27.4	28.3	25.9	27.7	*20*
21	26.7	28.3	28.2	30.0	29.6	26.6	27.1	23.6	28.1	27.6	25.3	26.0	*21*
22	27.0	28.5	28.4	30.1	28.6	28.3	27.4	25.0	26.3	28.1	24.2	26.1	*22*
23	27.1	27.4	29.4	30.8	29.4	26.7	25.2	26.3	27.5	29.5	25.9	27.0	*23*
24	28.0	27.5	29.1	30.0	30.2	25.9	26.7	26.8	28.0	26.5	25.2	28.0	*24*
25	28.0	28.5	29.3	30.1	29.8	25.6	25.8	26.5	27.9	26.9	25.3	26.7	*25*
26	27.4	24.9	29.2	29.7	29.3	27.3	26.4	25.9	28.1	25.8	25.7	26.2	*26*
27	28.3	28.5	29.5	29.9	29.1	28.1	26.1	25.5	27.5	27.7	25.1	27.7	*27*
28	28.5	27.5	27.8	30.2	29.4	27.3	24.8	24.3	27.5	26.4	26.1	26.8	*28*
29	27.5		29.9	29.7	29.7	25.8	25.5	27.1	27.7	25.1	26.1	26.7	*29*
30	26.7		28.3	29.3	29.4	25.3	24.9	26.8	27.1	26.2	26.2	26.4	*30*
31	26.8		28.4		30.1		26.5	25.1		27.3		25.2	*31*
Mmax	29	29	30	31	31	30	28	27	28	30	28	28	
Mmean	27	28	28	29	29	28	26	26	27	27	26	26	
Mmin	25.5	24.9	26.2	27.6	27	25	25	24	25	25	24	25	

Year Maximum 31 *Year Mean* 27 *Year Minimum* 23.6

Precipitation

Daily Precipitation in mm							Suriname Meteorological Service						
Station : 110 KKABA					River : Kabalebo					Year : 1972			
	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	2.2	0	0	7.2	0.4	2.2	1.4	2.6	0	0.5	0	9.7	1
2	0.4	0	0	19.8	24.6	23.7	1.3	0.2	0	6	1.5	3.7	2
3	1.1	4.2	6	1.6	11.8	10.2	1.6	18.5	20.7	3.5	0	0	3
4	0	0	0	12.4	0.2	14.1	2.8	68.5	25.1	0	0	0	4
5	0	0	2.6	1.4	7.9	-	6.7	0.9	0	0.3	0	0	5
6	0	0	3.4	2.4	2.4	-	3.3	7.7	0.1	0.9	0	0	6
7	0	0	0	3.4	20.6	134.6	0	0.4	0.3	0.2	1.5	0	7
8	0	4.5	0	2.1	2.1	2.5	0	0	2.6	0	38	0	8
9	2.5	12.9	0	19.2	0	4.1	0	0	31.2	0	0	5.4	9
10	2.7	29.2	3.4	0.1	0	1.1	0	1.3	11.2	0	0.8	13.4	10
11	0.6	6.1	4.3	0.1	1.3	15.7	0	0.9	0.7	1.3	8.5	5.6	11
12	0	1.5	0	0.1	0.2	41.5	0	53.3	4.1	13.3	3.9	0.4	12
13	0.4	0.3	6.7	0	0.2	45.4	0.6	3.8	28.3	0	0	0.9	13
14	0.3	0	4	18.3	19.7	2.2	60.5	0	0.5	0	0	16.4	14
15	0.2	0.5	5.9	30.2	10.7	1.4	19.5	2.8	0.5	0	1.7	0	15
16	23.6	0.3	0.9	0	21.9	6.8	22.5	2.2	19.9	0.4	0.7	4.5	16
17	2	0	0.2	0	10.5	21.8	0	2.3	7.7	6.1	5.5	1.4	17
18	1.6	1.8	0	0	15.2	8.2	1.5	23.1	3.2	10.2	0	0.4	18
19	2.8	2.2	0	0.4	0.2	3.7	0	11.3	9.2	11.6	1.9	0	19
20	9.1	2.7	0	5	0	14.6	0	1	0	3.6	0	0.8	20
21	2	16.4	0	0.2	0	53	0	1.3	4.1	22.3	4.7	0	21
22	0	4	25	0.2	0	1.4	0	3.1	0.6	2.5	0	0	22
23	0	4	3.8	0	0.2	5.5	0	0	4.4	0.8	0	2.5	23
24	2.6	0.3	0.1	0	12.6	5.5	41.2	0	5	0	0	5.8	24
25	0	33.7	0	0	10.2	26.5	30	0.3	7.2	0	0	0.5	25
26	0	1.6	0	0	3.9	0	0	0	0.4	6.5	0	0.3	26
27	0.5	0	3.7	0	4.8	1.9	0	0	0.8	0	0	0.2	27
28	2.3	1	50	0	4.3	10.1	8	16.5	5.7	0.2	0	0	28
29	0	0	11.3	55	5.9	1.9	3.5	5.6	0	8.6	0	5.7	29
30	0		1.4	0.1	2.6	0	0	3.3	3.8	0.4	0.6	5.4	30
31	0		10.5		17.5		1.5	0.2		0		0	31
Mmax	24	34	50	55	25	135	61	69	31	22	38	16	
Mmean	2	4	5	6	7	16	7	7	7	3	3	3	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	
	Year Maximum			135	Year Mean		6		Year Minimum			0.0	

Daily Precipitation in mm							Suriname Meteorological Service						
Station : 110 KKABA					River : Kabalebo					Year : 1973			
	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0	0	0	0	15.4	0	5.9	0	0	9.2	0	7.5	1
2	0	0	4.9	0	2.6	0	41.3	26.8	0	0.8	0	0	2
3	2.2	12.2	1.3	0.3	0	0.5	49.6	9.6	16.6	6.3	0.2	1	3
4	21.7	0	0.9	0	0	0	5.1	11.4	8	13.3	0	1.3	4
5	0	11	0	2.6	0	0	10.8	13.3	0.2	0	5.8	1.9	5
6	4.5	14.8	6	29.3	16.6	1.4	2.6	22.5	0.3	0	3.1	12.8	6
7	14.2	14.7	0	0.3	1.9	0	13.6	2.7	0	0	0.3	1.2	7
8	4.2	60.7	2.2	2.9	0.7	2.6	9	60.9	7.2	0.4	0.3	1.5	8
9	8.7	64.5	14.9	7.1	0	9.4	11.3	14.7	0	0	2.9	0	9
10	2	0.2	13	2.8	0	0.6	0	1.2	11.6	0	3.1	0.3	10
11	0	1.2	4.4	5.5	6.9	17.2	50.3	19.5	0	0	1	0	11
12	0	17.7	0	34.4	0	8	31	0	0	0	0	0	12
13	15.9	0.9	0	7.4	0	17.5	0	0	38.9	16.2	0	17	13
14	28.9	0	0	7.7	0	0	4.1	7.9	0.4	1.4	0	0	14
15	4.3	0.1	0	0.2	0	1.5	27.6	3.5	11.6	0	0.4	2.5	15
16	25.3	0	0	0	0	19.2	16.5	5.5	0	0	0	0	16
17	9.3	2.1	0.5	0	0	1.5	14.1	0	0	0	0	0.4	17
18	29.4	16.9	1.9	1.8	0	6.3	22.3	9.5	7	0	12.5	0	18
19	0.1	1.9	0	14.6	0	39.6	13.3	11.1	24.9	0.6	0	0	19
20	17.2	0.8	0	0	2	2.2	12.6	4.6	27.5	3.4	3	0	20
21	2.3	0	0	0.4	0	14.5	20.5	3.7	0	0	0	0	21
22	4.8	0.5	0	1.5	0	4.9	30.2	0	20.2	0	0	0	22
23	16.1	0.1	0	11	0	58.9	3.9	6.2	3.7	0	15.2	0	23
24	0.4	2.3	0.2	0	6.6	0	0.3	0	3.1	0	0	0.1	24
25	0.6	6.9	2.3	0	6.5	17.8	5.8	0	2.1	13.4	0	0	25
26	3.1	5.3	0	0	0	4.9	2.9	0	2.1	0	1.9	3.9	26
27	13	3.2	0	0.2	0	22	0	0	0	8.3	11.3	0	27
28	3.4	0	22.6	0	0	1.2	2.1	0.8	0	12.8	0.7	0.3	28
29	1.5		1.1	2.5	8.4	0.8	16	0.3	0.6	0	0	6.2	29
30	1		0	1.4	0.6	5.1	32	0	26.2	0	0	10.6	30
31	0		0		0		2.3	0		0		30.3	31
Mmax	29	65	23	34	17	59	50	61	39	16	15	30	
Mmean	7	9	2	4	2	9	14	8	7	3	2	3	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	
	Year Maximum			65	Year Mean		6		Year Minimum			0.0	

Daily Precipitation in mm *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1974*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	25.6	3.2	0.9	12.3	0	37.9	2.3	0	11.4	21.5	0	0.1	1
2	11.3	20.4	2.5	1.5	6.2	10.2	29.6	14.1	2.5	34.6	0.6	0	2
3	2.3	0	1.3	29.3	42.1	0.7	26.1	8.2	13.9	18	0.2	0	3
4	1.2	1.2	0	32.8	9.1	0	1	4.6	5	0.1	0	0	4
5	8.8	9.2	0.1	6.1	4.3	5.2	8.5	4.6	6.9	1.8	0	6	5
6	8.2	0.2	11.6	2.3	0	10.3	10.6	5.4	3.9	0	34.7	12.3	6
7	11.1	0	3.6	5.9	0	7.5	4	5.1	0	0.1	0	9.7	7
8	0.8	20.7	17.7	0.6	1	9.2	3.9	0	21.1	0	0	0	8
9	0.8	7.1	5.5	2.8	2	69.8	22.3	6	0.4	7.9	0	0	9
10	7.2	0.4	56.4	3	0.3	31.9	8.6	9.7	0	0.1	0	0	10
11	0	9.2	0	0.5	1.3	5.1	18.1	3.6	0	0	0	2	11
12	4	1.7	1	7.7	0.5	0	4	10.6	0.2	0	0	0	12
13	11.3	0.3	4.4	3.5	0	7	0	10	8.6	0	9.4	2.4	13
14	15.3	6	0	5.1	5	16.2	2.5	8.9	0	0	0	25.6	14
15	39.2	4.1	59.1	3.4	0	0.1	15.3	0.7	0.2	8.6	0	0	15
16	0.1	4.1	3.4	0.6	13.6	15.6	0	12.8	67	0	0	0.3	16
17	0.7	8.1	0	0	23.1	4.3	1	14.5	7.9	0	0	0	17
18	0.9	0	0	0	8	9.8	0.2	36.1	41	0	0	10	18
19	0	2.4	0	0	0	23.5	5.9	21.3	19.1	0	0	6.4	19
20	2.9	0	0	29.1	6.2	17.6	1.2	0.1	4	1.2	0	0	20
21	2.8	0.1	0.6	0.8	0	10	10.4	30.2	2.6	0.3	0	7.5	21
22	14.9	0.9	0.4	1.9	0	4.5	1.9	17.2	0.2	0.5	0	38.6	22
23	6.2	0.6	0	1.4	0	4.2	2.5	0	0	0	0	0	23
24	3.5	1.5	0	4.7	0	2.8	0.1	0	0	0	0	5	24
25	0.8	0	3.4	4.2	0	0	14.3	2	0	2.5	0.2	3	25
26	4.2	1.1	2	19	2.4	1.6	30.7	0.6	0.1	0	0	7.3	26
27	9.5	1.4	0.7	0.3	9	0.2	10.4	4.6	0	0	0	0.9	27
28	10.1	0.4	0.1	0	0	0.3	0	0	0	0	1.1	10.9	28
29	5.1		0	0	39.6	1.6	2.1	3.9	0	0	3.4	0	29
30	16.7		0.3	0	6.4	0.8	4.9	0.2	39.5	0	0.2	0.2	30
31	3.5		13.8		1		96.9	1.5		0		0.9	31
Mmax	39	21	59	33	42	70	97	36	67	35	35	39	
Mmean	7	4	6	6	6	10	11	8	9	3	2	5	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 97 *Year Mean* 6 *Year Minimum* 0.0

Daily Precipitation in mm *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1975*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	6.5	14.9	0.4	11.5	21.6	27.7	9.3	20.8	0.1	0	0	0	1
2	0.7	14	0.4	3.7	47	29.7	13.1	17.8	0	0	0	18.6	2
3	0	-	5.9	0.7	19.2	17	2	23.1	3	0	4.5	0	3
4	0	79.6	26.2	1.7	45.7	0.2	9	0	0	0	0	0	4
5	0	4.8	1.1	0	1.2	18.1	0	0	11	0	0	0	5
6	0	4.5	3	0	6.5	3	5.4	1.5	0.1	0	0	0.5	6
7	0.4	14.4	7	1	0.4	16.8	0.5	11.3	0	0	0.1	0	7
8	0	3.9	0.6	0.1	0	27.5	0.5	2.9	3.6	0	10.7	0	8
9	0	9.6	0	0	12.6	26.8	20	6.7	7.6	0	0	0	9
10	25.4	14	13.4	1	4	11.5	6	10.4	0	0	2.1	0	10
11	0.3	0	23.8	0	18.2	13.5	8.7	0.1	0.1	0	0	21.4	11
12	0.4	0	24.7	0.3	7	7	2.9	6.3	0	1.8	0	0.8	12
13	1.8	5.5	15.2	1.8	17.3	22.5	3.6	7.1	0	0	0	0	13
14	9.2	7	9.4	12.5	12	15.7	14.6	7.4	0	0	0	1.2	14
15	0.4	9.8	3.5	29.9	93.1	12.2	20.2	2.4	0	0	0	0	15
16	1.7	7.4	-	12.1	21.4	17	6.2	1.8	18.8	10.8	0	0	16
17	0	4.9	0	18.7	9.6	29.5	0.8	0	0	0.9	2.2	0	17
18	3.1	0	3.1	16.8	35.2	7.4	5.9	0	0	0	0	0	18
19	6.3	0	9.2	0	0.6	14	25.9	0	0.3	0	0	0	19
20	3.3	0	28.1	11.5	22.2	0.8	6.2	0	0	0	0	0	20
21	12.7	0	1.8	31.3	1.9	7.8	18	15.2	0	4.8	0	0	21
22	5.2	4.8	1.6	29.6	3.6	21.7	0	0	0	1.3	0	6.3	22
23	8.8	5.2	19.2	3.4	3.4	0.6	0.1	2.4	0	0	0	0	23
24	13.2	12.1	23.6	0	29.5	6.9	4.9	0	0	0	0	0.2	24
25	4.2	17.6	1.7	14	6.8	1.9	6.4	0.3	0	1.4	0	0.4	25
26	1.7	0	4.1	5.5	51.9	0	8.3	0	0	5.2	0	0	26
27	8.4	0	18.4	0	18	0.4	29.1	0.5	0	0	0	0	27
28	0.9	0	1.4	2.8	11.6	3.6	0.9	0	0	0	0	0	28
29	10.9		2.6	15.6	14.8	56.7	0.9	3.6	0	0	0	0	29
30	11		3.2	11.1	20.5	0	0	0	0	0	0	0	30
31	0		6.7		1.2		0	5.1		0		0.9	31
Mmax	25	80	28	31	93	57	29	23	19	11	11	21	
Mmean	4	8	9	7	18	12	7	5	1	1	1	2	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 93 *Year Mean* 6 *Year Minimum* 0.0

Daily Precipitation in mm — Suriname Meteorological Service

Station : 110 KKABA — River : Kabalebo — Year : 1976

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0	0.4	0	0.1	-	-	16.7	26.9	0	0	0.5	0	1
2	1.4	3.5	0.1	5.8	-	-	20.7	20.5	0	0	0	0	2
3	10.1	0.3	31	4.1	-	-	21.1	43.1	2.5	0	0	0	3
4	2.5	0.1	38.8	11.1	-	-	0.5	39.8	1.2	0	0	0.6	4
5	5.1	1.6	13.3	0.6	-	-	4.9	3.2	15	10.7	20.8	0.1	5
6	0.2	0	10.8	1.9	-	21.4	5.1	0	0.4	8.3	0.1	2.4	6
7	0	0	25.9	0	-	36.1	10.8	0.7	0.1	2.8	3.1	0	7
8	13.4	0	11	4	-	5.6	4.5	0	0	0	0	0	8
9	7.9	0	0.2	2	-	18.2	8.4	0.9	17	0	0.7	9.4	9
10	11	0	9.1	1.5	-	0	0.6	8.2	0.2	0	0	0	10
11	0.1	3.6	0	18	-	4.9	0	4.7	0	0	0	0.1	11
12	2.8	0	0.6	28.9	-	15	0	20.5	0	0.8	0	4	12
13	15.1	0	4.5	12	-	12.2	4	0	0	0.6	-	0	13
14	19.6	14	1.2	0	-	54.1	12.1	0	0	0	-	0	14
15	1.8	2.2	0.2	0.2	-	1	11	19	0	2.9	-	10	15
16	5.5	0	9.9	0.1	-	0.1	14.6	0	0	4.3	-	10.6	16
17	13.3	0	0	4	155.7	12	3.1	2.6	0	0	12.3	10.4	17
18	2.9	0	4.5	-	-	7.9	27.5	0	0	6.8	-	0.4	18
19	11	0	3.7	-	-	29.9	55.2	2.7	0.8	0.7	-	6.4	19
20	10.3	2.7	2.5	-	-	7.1	27.3	3	4.6	1.1	-	38	20
21	11.5	10.9	16.1	-	-	17	20.6	2.2	1.5	0	-	8.4	21
22	0.4	0	0.3	-	-	44.3	20.9	0	0	0	-	13.2	22
23	3.3	8.2	0	-	-	2.8	9	1	0	2.2	-	18.1	23
24	0	1.5	0	-	-	0.2	0.5	0	2.7	3.3	-	16	24
25	0	0	3.4	-	-	29	5.4	0	0	0	-	12	25
26	1.2	0.1	6.5	-	-	2.2	5.5	28	0.3	0	-	0	26
27	2	0.9	0	-	-	2	12	18.9	0	0	-	30.7	27
28	12.9	1.2	0.9	-	-	1.6	1.1	3.2	0	0	23.5	2.6	28
29	0.5	0	1	-	-	43.5	0	11.6	0	2.6	0	2.3	29
30	0.4		0	-	-	8.8	0	11.1	0	0	0	0.3	30
31	0		0		-		3.4	2.5		0.1		0.2	31
Mmax	20	11	39	29	156	214	55	43	15	11	24	38	
Mmean	5	1	6	6	156	22	10	9	1	2	4	6	
Mmin	0.0	0.0	0.0	0.0	156	0	0	0	0	0	0	0	

Year Maximum 214 — Year Mean 19 — Year Minimum 0.0

Daily Precipitation in mm — Suriname Meteorological Service

Station : 110 KKABA — River : Kabalebo — Year : 1977

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0.2	2.9	0	0	4.3	14.8	17	30.8	0	1.3	0	0	1
2	0	1	0	0	16.2	6.6	6.5	10.1	0.1	0.1	0	0	2
3	0	0.5	0	0.4	0.1	0	4.9	0	13.3	0	0	0	3
4	0	1.3	0	6.1	0.9	30.3	12.8	0	2.2	7.7	0	0	4
5	0	0	0	0	0.2	0.9	6.7	0	2.5	0	0	0	5
6	8.6	0	0.8	0	6	9.1	10.6	2.8	23	0	5.5	2.9	6
7	10.7	0.2	0.8	8.7	0	13.7	27.8	14	7.1	0.3	8.7	11.8	7
8	7.3	2.3	5.8	10.4	4.3	2.2	13	0	10.2	0	7.1	0	8
9	41.4	12.8	0	1.2	0	15.1	0.3	4.8	0	0	0	0.1	9
10	20.6	10.5	3.5	14	0	20.3	0	0	9.1	0	0.8	0	10
11	6	27.6	0.4	9	0	2.1	6.3	0	2.8	0	16.1	0	11
12	1.2	4	0	0	0	10.5	19.7	0	3	0	0.1	0	12
13	0	17.4	0.3	6.5	0	0	0.1	0	8.4	0	0.1	0	13
14	1.9	0	0	23.3	4.2	39.5	13	6.3	19.4	0	0	0	14
15	0.6	0	5.9	14	1	8.7	142.4	0.3	15.1	0	5.4	0	15
16	0.1	5.9	0	0.1	17	5.7	11.3	100	0.1	1.7	0.9	0	16
17	0.2	12.5	11.2	29.4	22.5	0.2	19.7	15	0	0	0	1.5	17
18	0	36.8	0	3.2	12.6	2.7	0.1	35.2	0	0.8	0	10	18
19	10.7	11.5	2.2	0.5	3.4	0	2.4	14	0	0	0	0	19
20	0	6.7	23.2	0.4	0	54.7	0.8	12	0	0	0	0	20
21	0	25.2	0	0	0.8	1.9	2.8	0.7	0	0	0	10.3	21
22	6.6	22.2	7.8	0	9.9	0.3	16.3	0	0	0	0	0.4	22
23	1.9	10.4	0	13	0	1.5	2.5	2.7	6.3	0	0	15.6	23
24	0.3	14	3.5	1.6	0	10	0	0	0.4	0	0	11.4	24
25	1.4	2	0.8	0.3	15.6	8.4	8.5	46.1	10.4	4.5	0	11.4	25
26	0	0.3	0	1	43.3	0.4	0.1	9.1	11.6	0	0	16.3	26
27	0	0	0	0.5	33.6	16.6	0	23.1	0.8	5.8	0.6	17.7	27
28	0	0	0	4.5	0.8	8.3	10.9	10.1	0.5	0.7	3.9	0	28
29	0		0	0	3.1	15.2	15.3	0.6	0	0	0.5	3.8	29
30	4.3		0	10.1	31.5	7.4	19.3	9	0	0	0	1.8	30
31	0.1		0		5		0	14		0		1	31
Mmax	41	37	23	29	43	55	142	100	23	8	16	18	
Mmean	4	8	2	4	7	10	12	10	5	1	2	4	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 142 — Year Mean 6 — Year Minimum 0.0

Daily Precipitation in mm — *Suriname Meteorological Service*

Station : 110 KKABA — *River : Kabalebo* — *Year : 1978*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0	5.4	0	32	60.8	6.3	11.2	3.9	4.6	10.8	0	0	1
2	0.4	0	6.6	0.6	14.5	5.2	14.5	38.4	0	5.6	0	1.3	2
3	0.6	0.1	1.6	0.3	0	0.7	35.2	49.2	0	0	0	0.2	3
4	0.9	0	0	0	6.6	0	24.9	5.3	0	34	0	0	4
5	0.1	0	1.9	0	0	1.5	7.5	0.3	0	0	0	12.3	5
6	0.7	4.6	3.2	5.9	3.4	12.6	16	0	0	36.5	0	67.7	6
7	13.6	0	0.6	5.6	7	11.7	7.5	0	0	0	0	6.9	7
8	0.6	0.6	0.6	0.4	6.2	59.7	0.3	0	0.9	0	4.5	0.1	8
9	0.3	8.1	0	13.4	0.9	112	4.1	0	-	0	1.9	2.1	9
10	5.3	5.4	0.6	15.8	0	5.1	9.3	2.8	-	0	16.4	0	10
11	0	18.6	0.6	15.8	0	39	21.9	2.8	-	0	2.8	26.5	11
12	0	9	0.6	0.2	3	16.5	8.4	3.9	-	2.8	0	0.1	12
13	0	1.9	0	0	13.6	1.8	16.6	0	-	0	0	2.9	13
14	5.3	14.7	0	0	15.4	12.6	30.2	0	-	0	0	0.1	14
15	1.8	-	0.5	0	0	4	25.3	1	-	0	0	0	15
16	4.1	-	0	0.7	2	8.4	-	10.1	-	0	0	0	16
17	11.8	-	1.6	0	5.7	1.3	-	0.9	-	0	0	0	17
18	29.3	0	0	0	0.2	11.9	-	0.9	-	7.1	0	0	18
19	7.8	-	0	0	27.2	7.6	35	7.5	0	1	0	0	19
20	2.4	-	1.6	6.8	61.4	2	-	-		0	0	0	20
21	0	3.4	36.9	0.8	0.4	5.6	-	2.8	0.1	0	0	0	21
22	9.4	0	4.9	0.4	0.7	0	-	0	0	1.5	0	0	22
23	-	0	0	15.6	0	71.9	19.3	0	0	12	0	0	23
24	50.8	2.4	0	16.4	0	60	0	0	0.8	0	0	4.8	24
25	2.3	0.4	0	13.9	0	15.8	7.8	1	0.5	2	0	4.1	25
26	0	0.4	2.7	14.6	0	97	12.2	10.5	0	0	0	0	26
27	5.5	11	9	7	12	6.7	39.5	0	0	8.4	0	3.4	27
28	0	0.2	37	39.2	0	4.4	14.2	0.1	0	0	0	6	28
29	0.1		0.6	2.3	4.1	20.3	54.6	14.6	0	0.3	0.2	5.1	29
30	0		0	26.4	0	15.3	24.9	3.5	0	0	0	0.3	30
31	0.2		1.4		0.3		1.4	15.5		0		0	31
M max	51	19	37	39	61	112	55	49	5	37	16	68	
M mean	5	3	4	8	8	21	18	6	0	4	1	5	
M min	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 112 — *Year Mean* 7 — *Year Minimum* 0.0

Daily Precipitation in mm — *Suriname Meteorological Service*

Station : 110 KKABA — *River : Kabalebo* — *Year : 1979*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0	0	0	0.7	0	11.1	31.5	2.6	10.5	1.5	1.7	0	1
2	1.8	0	0	28	4.3	1.4	5.4	3.1	0.3	0	0	0	2
3	4.9	0	18.5	0	9.2	5	5.5	6.4	36.7	1.9	0	0	3
4	1.9	0	3.4	0.2	36.4	10.9	9	39.3	0	18.8	0	7.9	4
5	12.6	0	0	0	1.8	-	42.3	0	33.7	2.5	21.7	3.1	5
6	24.3	0	0	0.4	57.2	-	0	20.3	0.1	0	0	2.9	6
7	0.9	17.9	0	5.7	0	-	27.5	15	23	0	0	17.1	7
8	0.4	0	0	7.8	2.5	-	80.2	24	0	0	0	65	8
9	0.3	2.6	0	0	2.3	-	13	2.5	0.1	0	0	53.8	9
10	9.5	1.2	0	0	5	-	4.4	0	33	0	0	0.8	10
11	9.5	8.2	0		6	-	17.6	0.8	0	0	0	18.1	11
12	42.7	0.4	0	0.5	9.6	-	25.4	12.7	0	0	0	1.4	12
13	34	28.8	0	7.6	23.2	-	8.3	0.6	0	0	0	0.8	13
14	22.6	8.4	0	7	25	227.3	26.9	27.5	0.1	0	0	12.2	14
15	7	0.4	0	3.5	1.8	5.7	24.3	0.2	0.6	0	3.2	27.1	15
16	0.5	0.3	0	26.4	31.7	0	0	0.5	0.6	0	0.1	0	16
17	0.1	0.3	0	0.6	6.9	0	4.2	4.8	0	1.4	2.7	0.8	17
18	3.7	0.4	0	19.9	14.4	2	24.2	0	0.5	0	0	6.7	18
19	4.3	0.1	0	17.2	6.9	3.7	1.9	0	0	2	0	0.6	19
20	0	3.9	-	1.3	40.3	10.5	3.9	48.2	0	2.2	0.1	-	20
21	0	2	0	50.3	12	0.3	0.4	70.3	1.7	0	0	-	21
22	11.5	0	0	1.9	3.2	38	0	0	0	0	8.6	-	22
23	0.3	2.5	0	0	6.8	13.4	3	0	0.2	0	0	-	23
24	0	2.3	0	0	53.7	1.8	41.4	26.9	53.1	0	0	-	24
25	1.9	0	0	0	34.7	5.8	16	2.2	7	7.7	0	0.7	25
26	6.1	0	0	11.4	12.9	0.5	3.5	10.9	0	0	0	0	26
27	0	0	0	11.3	1.6	1.6	16.5	0.2	0	0	0	0	27
28	0.5	0.7	0	0	3.4	24.3	1.6	17.6	0.4	0	0	0.1	28
29	0.5		0.7	0	26.7	7.6	0	6.3	0	0	0	0	29
30	0		2.9	0	7.3	31.3	18.5	0.2	0	0	0	0	30
31	0		5.6		10.3		15.1	3.3		0		8.3	31
M max	43	29	19	50	57	227	80	70	53	19	22	65	
M mean	7	3	1	7	15	19	15	11	7	1	1	9	
M min	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 227 — *Year Mean* 8 — *Year Minimum* 0.0

Daily Precipitation in mm *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1980*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	19.3	0.2	7.4	2.5	11	31.1	3.6	0.1	0.1	22	0	0	1
2	0	0.1	5.5	0.7	29.6	8.9	16.5	8.9	10.8	0	0	0	2
3	0	0	15.2	0	15.4	13	3.5	0.9	13	0	0	18	3
4	0	0.3	0.4	0.7	19	0.5	24.5	17.7	0	0	10.8	0	4
5	0.2	0	3.3	0	11.4	2.8	47.8	18	0	0.1	0	0	5
6	0	0	8.4	0	24.5	10.6	4.9	0	7.3	0	0	16	6
7	19.5	0	4.3	0	0.7	5.5	3.9	2.6	16	15.5	0	0	7
8	19	0	29.2	0	2.5	37.1	12	0.5	0.2	1	0	1	8
9	16	0	36.3	0	12	6.6	0.5	66.2	4.8	0	0	5	9
10	4.2	3.6	13.4	0	6.7	26.9	40.2	12.5	0	0	0	0.6	10
11	0.6	4.8	0	0	0.9	4.8	13	65	3.4	0.2	0	0	11
12	0.3	0	14.3	0	59.6	14.1	6.1	0	28.2	0	0	0	12
13	6.4	-	0.2	0	28.5	6.7	3.5	0	0	0	0	0	13
14	4.3	-	17	0	0.1	18.2	28.6	0.4	0.7	0	0	0	14
15	3.7	-	0	0	4.4	3	11.4	0	11	0	7.6	0	15
16	0	-	0	0	11.2	0.2	6.8	4.9	16	0	0.1	0.5	16
17	11.2	-	0	0	0	24.5	4	5.1	0	0	0	0	17
18	8.2	-	5.6	0	0.1	79.2	0.2	24.6	14	0	0	0.7	18
19	8	-	19	0.4	38.6	0.8	11.3	3.8	0	0	0	0	19
20	13	-	48.8	0.1	17.7	7.2	21.8	10.8	39.5	0	0	0	20
21	0	7.2	0	0	21.4	3.1	78.1	0	24	0	0	0	21
22	-	-	18	0	12.6	18.4	7.2	0	0	15.7	0	4	22
23	-	-	5.1	0	27.7	25.2	9.9	3.8	0.7	24.2	0	0.4	23
24	-	-	2.1	17.1	71.1	33.2	22.2	0	12	0	0	0	24
25	-	17	0.2	7.3	4	0.2	0	0	0.3	1	0	0	25
26	-	4	16	0	2.7	15	0	0	0	69.3	4.4	0	26
27	-	4	2.5	0	0	3.8	0.9	11	14	0	0	0	27
28	-	0.5	16.2	7.4	24.6	2.5	77.1	0	13	0.1	0	0.3	28
29	-	3.8	11.5	51.9	11.9	11	8.1	0	0	0	0	0.2	29
30	-		21.5	0.1	2.5	7.4	19.8	0	17	3.2	0	3.3	30
31	-		26.9		2.6		27	11		0		0.1	31
Mmax	20	17	49	52	71	79	78	66	40	69	11	5	
Mmean	4	3	10	3	14	13	16	7	5	5	1	1	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 79 *Year Mean* 7 *Year Minimum* 0.0

Daily Precipitation in mm *Suriname Meteorological Service*

Station : 110 KKABA *River : Kabalebo* *Year : 1981*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	3.4	6.2	13.9	0	5.7	26.5	31	5.7	0	0.4	0	0	1
2	0	66.4	6.2	0	0	32.5	76.6	0.3	18	0.3	0	0	2
3	0	3.8	8.9	0.2	3.9	46.5	17	16.2	15.6	0	0	0	3
4	16.7	0.9	2.8	12.8	0.8	0	14	0.2	0	0	0	0	4
5	3.1	0.2	0	10.2	14	31.2	0	0	0	0	0	0	5
6	2.2	0	0.1	11.4	0.4	11.4	4.9	0	0	0	0.5	0	6
7	10.1	0	0.2	13	0	12.3	8.7	0	0.1	0	0	0	7
8	9.4	3.7	3.5	2.5	0	19	0	6	0	0	0	0	8
9	4.3	0	2.5	0	0.8	12.1	1	18.7	0.9	0	0	0	9
10	0	2.7	15	11.1	2	0.7	8.9	0.1	33.4	0	0	0	10
11	5.5	0	0.1	11.8	24.3	3	15.9	0	0	2.9	0	2.6	11
12	0	13	19	29.8	1	4.1	0.2	0	0	39.1	0	0	12
13	0.4	0	22.8	2.5	14	9.7	9.6	0.3	0	0	0	0	13
14	5.7	0	11.7	0.3	0.7	20.1	5.7	0	0	0	0	0	14
15	0.4	0	11.3	8.4	8.2	9.5	0.9	0	0	14	0	0	15
16	44.4	11	11.1	2.1	0.5	2.7	0	3.5	22.5	0	0	0	16
17	0.6	18	7.3	14.1	0.6	2	0.2	8.3	12.9	0	0	0	17
18	0	0.4	0	5.8	6.6	2.3	0	19	0	0	14.1	0	18
19	19	0	0	14	11		0	6.3	0	0	0	0	19
20	0	11	0.1	0	12.6	59.6	15.6	5.3	0	0.6	4.8	4.1	20
21	0.3	0	0	9.9	3.5	0.8	0.3	5.1	1	0	5.3	4.5	21
22	3.2	0.9	0	21.3	22.2	17.1	0	7.1	0	0	0	0	22
23	0.2	0.2		49.1	17.1	2	7.5	13	0	4.2	0	0	23
24	8.5	3.4	9.6	53.1	3.4	0	0	0	0	0	0	0	24
25	13.5	12.2	15	0	0.5	3.3	1	0	0	0	0	0	25
26	0.1	16	4	20.6	15	2.9	0	0	0	0.5	0	0	26
27	0	0	7.6	3.4	17.6	27.8	0	8.4	0	0	0	0	27
28	2.6	0	0.5	8.8	12.7	16.3	0	18	0	0	0	0	28
29	6.7		0.9	30.5	0	0	1	0	0.1	0	2.5	0	29
30	20		0.3	16.7	0.7	0.5	0.7	0	0	0	0	0	30
31	4.7		0		6.5		7.5	0		0		0	31
Mmax	44	66	23	53	24	60	77	19	33	39	14	5	
Mmean	5	4	4	11	5	12	6	4	3	2	1	0	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	

Year Maximum 77 *Year Mean* 5 *Year Minimum* 0.0

Daily Precipitation in mm						*Suriname Meteorological Service*							
Station : 110 KKABA						*River : Kabalebo*				*Year : 1982*			
	Jan	**Feb**	**Mrt**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
1	0	1.5	1.3	8.7	7.5	47.5	3.5	0	0	0.7	0	0	*1*
2	0	8.5	3.2	25	23.6	24.6	13.6	0.5	0	0.1	0	2.3	*2*
3	0.5	0	0	4.2	23.2	28.5	2.7	11.5	0.8	0	0.1	0	*3*
4	0	10.2	0	0.9	2	16.6	19.1	0.9	0	0	0.3	0	*4*
5	2.2	4.9	0	0	14.3	9	6.2	0	0	0	0	0	*5*
6	8.2	0	0	0.2	7.5	0.3	0.1	0.6	0	0	0	0	*6*
7	0.6	-	0	20.6	4.7	8.2	0	2.7	12.3	0	0	0	*7*
8	18.7	12.7	0	9	23.4	1.4	0	0	0.2	0	0	0	*8*
9	0	2.4	1.3	0.1	12.2	1.6	0	4.9	0.3	0	0	0	*9*
10	1.7	3.3	0	0.3	3.1	0	3.5	3.4	0	0	0	0	*10*
11	1.9	0	2.5	11.6	0.8	1.9	27.5	0	11.1	0	0	0	*11*
12	9.4	6.2	6.9	4.5	28.5	0.8	10.9	0	2.2	0	0	0	*12*
13	33.4	0	5	8.6	38.9	3.3	2.1	2.9	0.8	0	0	0	*13*
14	2.8	0	5.1	16.3	6.6	0	2	0	5.1	0	0	0	*14*
15	1.5	0	4.8	1.8	18.8	1.8	0	0	0	2.5	0	0	*15*
16	34.5	5.1	0	0	11.8	22.1	0	24.5	7	1.2	0	0	*16*
17	0.2	0	3.8	69.3	25.1	0.3	26.3	0	0	0	0	0	*17*
18	15	0	7	1.3	5.2	0	29.1	0	0.2	0	0	0	*18*
19	0.5	0	13.6	0	19.2	4.1	6.3	0	0	0	0	0	*19*
20	15.4	0	4.1	0	12	19	0	4.6	0	0	0	0	*20*
21	26	-	19	0	14.5	2.6	1	9.2	0	0	0	0.1	*21*
22	0	0.1	14	3.6	53.7	1.8	10.3	1.8	0	0	0	0	*22*
23	-	-	0	10.2	0	0.4	0	0.3	21.2	0	0	0	*23*
24	-	-	0	16	1.5	0.1	8.5	1.9	0	0	0	1.1	*24*
25	0	-	3.5	35.8	0.1	0	0.4	0	0	0	0	2.5	*25*
26	8.5	0	5	19.3	25.7	13.5	31.6	30.8	0.2	0	0	0	*26*
27	8.7	0	14.2	11.8	1.2	0	0	36.3	0	0	8.6	0	*27*
28	3.5	0	0	0	7.1	0	0	0.3	2.2	0	0	0	*28*
29	2.8		0	0.6	0.2	0.1	0	0.2	0	0	0.1	4	*29*
30	38.6		2.5	23.6	0	0	7.2	0	15.8	0	0	11.1	*30*
31			0		0.8		0	0		0		28.4	*31*
Mmax	39	13	19	69	54	48	32	36	21	3	9	28	
Mmean	8	2	4	10	13	7	7	4	3	0	0	2	
Mmin	0.0	0.0	0.0	0.0	0	0	0	0	0	0	0	0	
	Year Maximum			69	*Year Mean*		5		*Year Minimum*			0.0	

Appendix C Discharge Data

Daily Mean Discharges in Cumecs — *Hydraulic Research Division / Hydrology BWKW*

Station : 1607 Avanavero Boven — *River : Kabalebo* — *Km 237* — *Year : 1972*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	27.3	99.7	51.9	197	675	386	285	143	156	30.0	10.0	8.6	1
2	26.3	91.1	48.7	159	610	366	318	134	138	27.3	10.9	7.8	2
3	25.0	87.8	45.7	127	504	355	413	127	121	25.9	14.5	7.0	3
4	24.3	94.5	45.7	111	433	336	517	127	105	25.0	23.3	6.4	4
5	24.6	123	43.7	94.5	378	307	574	127	92.8	24.6	23.6	5.7	5
6	34.6	150	41.0	80.2	351	285	637	125	81.7	24.6	21.5	5.4	6
7	41.9	153	37.6	74.5	333	271	713	138	75.9	24.3	25.4	5.2	7
8	45.7	150	35.3	77.3	329	257	812	143	70.5	23.0	30.6	5.2	8
9	71.8	132	36.8	87.8	366	307	895	237	68.0	22.0	30.0	5.6	9
10	94.5	109	57.6	105	405	454	932E	223	70.5	19.6	33.9	6.4	10
11	87.8	91.1	105	99.7	413	587	911E	264	84.7	17.7	41.9	7.8	11
12	84.7	74.5	129	86.3	378	628	858	271	94.5	16.5	32.5	8.0	12
13	74.5	65.6	194	87.8	329	656	757	240	97.9	14.9	28.8	9.3	13
14	66.8	62.2	194	148	303	637	569	204	105	14.1	25.9	12.1	14
15	61.1	64.4	162	204	344	587	382	172	101	14.9	23.6	15.3	15
16	57.6	64.4	136	217	405	565	292	150	81.7	15.7	24.6	17.7	16
17	55.2	61.1	119	250	429	483	257	136	69.3	15.3	28.3	17.7	17
18	69.3	53.0	109	275	433	405	233	129	61.1	13.8	26.3	18.6	18
19	78.7	47.7	94.5	307	429	351	220	127	56.4	12.7	23.3	22.0	19
20	91.1	43.7	87.8	355	405	340	230	127	53.0	12.1	22.0	25.4	20
21	96.2	41.9	83.2	394	351	355	217	121	51.9	11.5	19.6	26.8	21
22	103	40.1	74.5	470	378	409	210	127	50.8	11.5	17.3	24.6	22
23	109	37.6	69.3	578	433	425	207	121	47.7	12.1	16.1	23.9	23
24	111	36.1	65.6	628	466	417	200	107	43.7	13.1	14.5	28.8	24
25	111	39.3	66.8	675	491	390	217	105	39.3	12.7	13.8	28.3	25
26	103	46.6	127	722	504	363	257	109	36.1	12.1	13.4	23.9	26
27	97.9	48.7	303	742	491	318	261	115	35.3	12.1	12.7	21.5	27
28	99.7	46.6	382	737	474	268	240	125	34.6	10.9	11.5	18.6	28
29	121	49.7	348	722	458	237	210	138	33.9	10.0	10.6	16.5	29
30	123		285	698	429	240	181	153	31.8	9.8	9.8	15.3	30
31	107		230		442		159	168		9.8		14.1	31
Mmax	123	153	382	742	675	656	932E	271	156	30.0	41.9	28.8	
Mmean	75.0	76.0	123	317	425	400	425	153	73.0	16.8	21.3	14.8	
Mmin	24.3	36.1	35.3	74.5	303	237	159	105	31.8	9.8	9.8	5.2	

Year Maximum 932E *Year Mean* 177 *Year Minimum* 5.2

Daily Mean Discharges in Cumecs — *Hydraulic Research Division / Hydrology BWKW*

Station : 1607 Avanavero Boven — *River : Kabalebo* — *Km 237* — *Year : 1973*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	12.4	3.6E	3.0	10.6	11.8	254	96.2	268	329	119	117	54.1	1
2	11.2	3.4E	2.9	9.8	13.8	351	109	271	366	117	105	58.8	2
3	10.6	3.4E	2.7	9.1	13.8	409	178	244	351	109	92.8	61.1	3
4	11.2	3.2	2.6	8.6	14.1	413	278	282	382	99.7	83.2	65.6	4
5	11.8	3.0	2.4	8.2	16.1	394	336	348	413	97.9	70.5	74.5	5
6	12.1	2.9	2.4	7.8	16.5	401	310	378	386	99.7	63.3	91.1	6
7	12.1	3.1	2.2	8.8	24.3	421	257	413	355	109	60.0	92.8	7
8	11.2	3.9	2.2	12.4	42.8	454	191	437	314	109	60.0	73.2	8
9	10.3	5.0	2.1	11.5	48.7	504	138	437	278	109	75.9	66.8	9
10	9.8	5.0	2.1	11.2	41.9	512	115	413	296	105	81.7	56.4	10
11	9.1	5.0	2.1	12.7	31.8	500	103	351	336	109	70.5	50.8	11
12	8.6	4.8	2.0	11.8	26.3	479	125	278	321	113	66.8	48.7	12
13	8.8	4.8	2.0E	9.5	23.9	470	285	213	289	103	63.3	75.9	13
14	10.6	4.5	2.0E	8.2	23.3	458	405	178	261	99.7	54.1	109	14
15	11.8	4.3	1.9E	7.0	21.5	446	437	172	244	89.5	48.7	109	15
16	10.9	4.2	2.6	6.0	20.0	409	413	175	261	101	44.7	103	16
17	9.8	4.0	3.6	5.6	19.1	366	366	172	300	119	41.9	84.7	17
18	8.8	3.9	4.3	5.0	20.0	351	307	184	271	134	40.1	70.5	18
19	8.0E	3.7	6.2	4.6	22.4	386	237	261	223	138	36.8	61.1	19
20	7.3E	3.3	6.4	4.5	24.6	378	184	303	197	136	38.5	55.2	20
21	6.6E	3.2	6.2	4.8	27.3	344	191	289	204	129	43.7	51.9	21
22	6.2E	3.1	5.4	5.0	36.1	314	325	244	244	125	43.7	50.8	22
23	5.6E	2.9	5.2	5.0	87.8	275	359	210	250	115	41.0	49.7	23
24	5.2E	2.9	5.2	5.6	138	223	421	184	250	99.7	41.9	48.7	24
25	4.8E	3.0	5.7	6.4	213	178	409	165	197	84.7	43.7	45.7	25
26	4.5E	3.1	7.0	6.4	278	143	359	143	165	80.2	45.7	64.4	26
27	4.3E	3.1	8.2	6.4	292	123	300	125	145	94.5	41.9	80.2	27
28	4.0E	3.1	8.6	7.0	285	123	240	129	129	115	40.1	78.7	28
29	3.9E		11.2	7.0	244	113	197	138	119	148	41.9	73.2	29
30	3.7E		12.4	8.0	191	101	178	143	115	141	45.7	74.5	30
31	3.6E		11.8		187		207	178		125		71.8	31
Mmax	12.4	5.0	12.4	12.7	292	512	437	437	413	148	117	109	
Mmean	8.3E	3.7	4.6	7.8	79.3	343	260	249	266	112	58.1	69.4	
Mmin	3.6E	2.9	1.9E	4.5	11.8	101	96.2	125	115	80.2	36.8	45.7	

Year Maximum 512 *Year Mean* 122 *Year Minimum* 1.9E

Daily Mean Discharges in Cumecs — *Hydraulic Research Division / Hydrology BWKW*

Station : 1607 Avanavero Boven — *River : Kabalebo* — *Km 237* — *Year : 1974*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	65.6	132	38.5	175	19.6	8.8	329	409	271	94.5	71.8	40.1	1
2	61.1	123	36.1	159	17.3	9.3	310	417	300	105	63.3	38.5	2
3	68.0	113	33.2	220	15.7	25.9	303	425	271	121	61.1	36.8	3
4	83.2	94.5	30.0	99.7	14.1	73.2	355	390	240	111	58.8	40.1	4
5	107	81.7	27.8	75.9	12.7	61.1	417	325E	227	94.5	65.6	41.9	5
6	136	73.2	25.9	69.3	11.8	53.0	442	289E	227	83.2	66.8	36.8	6
7	159	73.2	24.3	70.5	10.9	71.8	491	296E	321	75.9	73.2	32.5	7
8	159	71.8	23.0	94.5	9.8	121	495	314E	386	75.9	77.3	28.8	8
9	148	70.5	21.0	96.2	9.1	115	508	344E	370	75.9	87.8	26.3	9
10	132	70.5	19.6	84.7	8.2	81.7	543	340E	321	69.3	87.8	25.0	10
11	129	66.8	18.2	71.8	7.5	78.7	560	398E	296	65.6	80.2	23.6	11
12	119	64.4	17.3	61.1	7.8	105	538	405	271	65.6	70.5	22.7	12
13	107	63.3	16.5	49.7	9.1	138	504	390	230	78.7	63.3	22.0	13
14	96.2	63.3	14.9	45.7	9.3	168	470	359	213	80.2	57.6	22.0	14
15	86.3	61.1	14.5	41.9	11.8	148	413	318	197	181	53.0	21.5	15
16	81.7	65.6	13.4	38.5	22.2	127	348	264	168	197	62.2	22.0	16
17	78.7	75.9	12.7	34.6	23.9	101	340	227	153	159	53.0	23.6	17
18	71.8E	75.9	12.1	29.4	23.0	91.1	351	197	172	129	46.6	27.3	18
19	69.3E	68.0	11.5	26.8	24.6	115	351	172	168	101	44.7	33.9	19
20	64.4E	61.1	10.9	26.8	23.6	261	336	148	172	81.7	42.8	48.7	20
21	60.0E	54.1	10.3	24.3	22.4	390	359	132	165	70.5	40.1	64.4	21
22	58.8E	47.7	9.8	22.4	19.1	405	417	132	168	65.6	36.1	71.8	22
23	63.3E	41.9	24.3	22.2	15.3	374	446	136	181	63.3	34.6	73.2	23
24	63.3E	38.5	165	23.0	12.7	321	450	132	165	65.6	35.3	81.7	24
25	63.3E	38.5	101	23.0	10.9	278	512	121	141	75.9	40.1	78.7	25
26	63.3	39.3	74.5	22.4	9.8	275	583	113	125	91.1	55.2	70.5	26
27	86.3	40.1	68.0	22.4	9.1	296	583	105	109	89.5	50.8	64.4	27
28	230	40.1	74.5	23.0	8.6	325	538	103	94.5	80.2	43.7	62.2	28
29	254		54.1	22.7	8.4	355	508	127	87.8	73.2	38.5	58.8	29
30	172		58.8	22.0	8.2	355	479	213	86.3	75.9	38.5	51.9	30
31	136		111		8.2		500	207		80.2		48.7	31
Mmax	254	132	165	220	24.6	405	583	425	386	197	87.8	81.7	
Mmean	106E	68.2	37.8	60.0	13.7	178	444	256E	210	92.2	56.7	43.2	
Mmin	58.8E	38.5	9.8	22.0	7.5	8.8	303	103	86.3	63.3	34.6	21.5	

Year Maximum 583 — *Year Mean* 131 — *Year Minimum* 7.5

Daily Mean Discharges in Cumecs — *Hydraulic Research Division / Hydrology BWKW*

Station 1607 Avanavero Boven — *River : Kabalebo* — *Km 237* — *Year : 1975*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	77.3	55.2	65.6	33.9	65.6	742	370	442	321	204	89.5	64.4	1
2	150	54.1	83.2	33.2	77.3	698	359	454	344	191	84.7	65.6	2
3	250	55.2	94.5	33.9	156	656	344	512	517	191	83.2	62.2	3
4	296	58.8	97.9	36.8	318	619	321	569	628	178	77.3	55.2	4
5	271	64.4	84.7	37.6	366	614	285	637	675	168	73.2	54.1	5
6	200	68.0	68.0	35.3	344	651	254	670	713	168	68.0	56.4	6
7	143	65.6	57.6	33.2	321	684	261	679	708	165	63.3	60.0	7
8	143	61.1	46.6	45.7	310	698	303	670	684	159	60.0	64.4	8
9	111	54.1	38.5	62.2	261	675	310	623	651	156	58.8	68.0	9
10	105	48.7	32.5	56.4	129	637	314	534	610	148	56.4	68.0	10
11	107	43.7	29.4	47.7	75.9	596	336	442	569	150	55.2	62.2	11
12	97.9	38.5	26.8	42.8	62.2	551	378	401	543	153	51.9	62.2	12
13	91.1	35.3	25.9	42.8	58.8	500	363	394	521	148	49.7	65.6	13
14	91.1	33.9	24.3	41.9	60.0	401	325	370	437	138	46.6	73.2	14
15	89.5	31.8	23.3	36.8	66.8	310	310	355	310	132	44.7	74.5	15
16	113	31.2	23.3	31.8	75.9	271	314	336	351	123	42.8	65.6	16
17	74.5	30.6	23.9	27.8	74.5	268	359	359	462	107	42.8	60.0	17
18	81.7	29.4	25.0	25.0	74.5	292	386	491	454	97.9	45.7	56.4	18
19	87.8	27.8	25.4	23.9	89.5	382	348	462	487	94.5	45.7	57.6	19
20	94.5	26.3	25.9	30.6	107	429	329	437	530	89.5	41.9	60.0	20
21	109	25.0	33.2	87.8	107	466	336	437	547	87.8	37.6	54.1	21
22	117	24.3	57.6	115	96.2	487	351	437	543	94.5	36.8	47.7	22
23	125	25.4	54.1	96.2	84.7	487	370	405	512	105	37.6	43.7	23
24	117	28.3	54.1	69.3	94.5	491	394	386	425	115	40.1	40.1	24
25	97.9	34.6	51.9	55.2	162	483	386	421	340	113	46.6	39.3	25
26	81.7	50.8	48.7	45.7	303	462	344	454	307	105	50.8	48.7	26
27	71.8	66.8	45.7	54.1	587	433	336	425	292	97.9	51.9	56.4	27
28	69.3	65.6	40.1	92.8	679	446	336	398	264	101	57.6	69.3	28
29	68.0		34.6	84.7	727	421	359	366	237	103	56.4	75.9	29
30	65.6		31.2	70.5	772	382	394	351	217	99.7	60.0	68.0	30
31	56.4		31.8		772		429	340		94.5		63.3	31
Mmax	296	68.0	97.9	115	772	742	429	679	713	204	89.5	75.9	
Mmean	118	44.1	45.3	51.0	241	508	342	460	473	132	55.2	60.1	
Mmin	56.4	24.3	23.3	23.9	58.8	268	254	336	217	87.8	36.8	39.3	

Year Maximum 772 — *Year Mean* 212 — *Year Minimum* 23.3

Daily Mean Discharges in Cumecs — Hydraulic Research Division / Hydrology BWKW

Station 1607 Avanavero Boven — River: Kabalebo — Km 237 — Year: 1976

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	63.3	136	136	289	742	574	504	351	141	47.7	11.5	3.0	1
2	62.2	172	119	370	782	565	512	318	141	48.7	10.3	3.6	2
3	61.1	162	123	409	802	547	538	275	129	54.1	9.3	4.8	3
4	56.4	129	136	382	757	525	534	250	117	51.9	8.6	5.6	4
5	45.7	103	134	348	679	512	583	240	105	48.7	8.0	5.7	5
6	56.4	86.3	129	351	587	487	614	220	97.9	44.7	7.5	5.6	6
7	77.3	74.5	172	344	508	462	619	213	92.8	40.1	7.3	5.0	7
8	113	71.8	194	289	454	446	614	213	87.8	36.1	7.0	4.6	8
9	117	75.9	178	204	417	437	543	200	84.7	33.2	6.8	4.3	9
10	109	86.3	150	148	450	429	474	194	80.2	31.2	6.4	4.0	10
11	97.9	96.2	134	119	491	413	458	197	75.9	29.4	5.7	3.7	11
12	97.9	96.2	129	109	458	401	462	197	74.5	27.8	5.6	3.4	12
13	99.7	83.2	117	121	560	417	421	184	74.5	26.3	5.0	3.2	13
14	117	71.8	105	178	605	417	401	175	74.5	24.6	4.8	3.0	14
15	200	63.3	105	271	651	458	382	175	73.2	23.6	4.5	2.9	15
16	210	58.8	113	325	679	565	386	194	70.5	22.4	4.3	2.7	16
17	181	55.2	115	325	718	642	401	217	64.4	21.5	4.2	2.7	17
18	141	58.8	105	409	752	675	398	217	62.2	20.0	4.0	2.7	18
19	121	68.0	101	433	772	675	363	213	58.8	18.2	4.0	2.6	19
20	138	73.2	99.7	382	777	642	333	207	56.4	16.5	3.9	2.5	20
21	162	70.5	97.9	318	762	583	329	200	53.0	14.9	3.7	2.4	21
22	148	66.8	91.1	310	747	504	344	200	49.7	14.5	3.4	2.3	22
23	132	63.3	81.7	325	732	442	366	204	46.6	14.5	3.4	2.2	23
24	123	74.5	74.5	386	713	413	366	210	42.8	14.1	3.4	2.2	24
25	119	111	68.0	450	675	417	344	197	41.0	14.9	3.3	2.2	25
26	121	145	63.3	525	628	421	318	181	40.1	17.7	3.2	2.2	26
27	134	175	60.0	560	614	425	310	162	38.5	19.1	3.2	2.2	27
28	132	165	58.8	583	623	500	374	150	38.5	18.6	3.2	2.3	28
29	123	148	64.4	633	642	530	405	138	49.7	16.9	3.1	2.6	29
30	121		134	694	623	521	390	132	48.7	14.9	3.0	3.4	30
31	111		250		591		366	136		13.1		5.0	31
Mmax	210	175	250	694	802	675	619	351	141	54.1	11.5	5.7	
Mmear	116	98.0	117	353	645	502	434	205	73.7	27.1	5.4	3.4	
Mmin	45.7	55.2	58.8	109	417	401	310	132	38.5	13.1	3.0	2.2	

Year Maximum 802 — Year Mean 215 — Year Minimum 2.2

Daily Mean Discharges in Cumecs — Hydraulic Research Division / Hydrology BWKW

Station : 1607 Avanavero Boven — River : Kabalebo — Km 237 — Year : 1977

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	6.8	3.0	14.9	25.4	109	153	213	-	83.2	138	17.3	8.8	1
2	8.2	2.9	13.8	23.6	73.2	159	244	-	78.7	109	16.9	9.1	2
3	8.6	2.7	13.1	20.5	61.1	138	366	-	78.7	84.7	17.3	9.3	3
4	8.6	2.7	13.4	19.6	56.4	123	421	-	83.2	71.8	17.3	9.3	4
5	8.2	2.7	13.4	19.6	48.7	121	470	-	89.5	65.6	15.3	9.3	5
6	11.8	2.6	15.7	17.7	39.3	141	495	-	89.5	63.3	13.4	9.3	6
7	17.7	2.6	20.0	22.0	33.2	172	487	-	87.8	60.0	12.1	9.5	7
8	16.5	2.5	19.6	38.5	31.2	153	462	-	87.8	56.4	11.2	10.3	8
9	14.1	2.3	17.3	56.4	31.2	134	421	-	89.5	50.8	10.3	11.5	9
10	12.1	2.2	14.5	54.1	29.4	132	378	-	92.8	48.7	9.5	12.4	10
11	10.9	2.2	12.1	47.7	33.9	162	340	-	92.8	46.6	8.8	11.8	11
12	10.3	2.1	10.6	38.5	36.8	172	300	429	86.3	47.7	8.2	10.9	12
13	10.0	2.1	9.3	30.0	40.1	191	254	454	77.3	43.7	7.8	10.6	13
14	9.1	2.0	8.4	25.4	58.8	197	213	458	68.0	41.0	7.3	10.3	14
15	8.2	2.1	8.0	22.7	53.0	187	237	462	63.3	39.3	7.0	-	15
16	7.3	2.2	8.2	19.6	46.6	187	310	470	57.6	36.8	6.8	-	16
17	7.0	2.6	8.6	16.9	48.7	247	382	450	51.9	41.9	6.6	-	17
18	6.6	3.2	8.8	14.5	58.8	307	454	394	49.7	41.9	-	-	18
19	6.2	4.5	8.0	13.1	91.1	325	483	329	50.8	39.3	-	-	19
20	5.6	7.0	7.5	12.1	148	296	462	292	57.6	36.1	-	-	20
21	5.0	11.2	7.0	11.2	200	275	413	271	68.0	34.6	-	-	21
22	4.6	24.6	7.8	10.9	210	250	340	254	68.0	31.2	-	-	22
23	4.3	35.3	9.5	10.9	200	233	271	213	61.1	27.8	-	-	23
24	4.2	31.2	9.8	13.1	178	227	227	168	55.2	25.4	-	-	24
25	4.0	26.3	10.0	16.9	148	210	233	148	50.8	24.3	-	-	25
26	4.0	23.0	11.2	43.7	127	168	244	134	47.7	23.3	-	-	26
27	3.7	19.6	11.8	119	117	143	254	123	42.8	22.7	-	-	27
28	3.7	16.5	13.8	156	111	134	250	113	43.7	22.2	-	-	28
29	3.6		24.6	141	119	168	223	103	71.8	21.5	-	-	29
30	3.3		28.8	129	138	220	200	96.2	119	19.6	9.3	-	30
31	3.2		26.3		148		191	89.5		18.6		-	31
Mmax	17.7	35.3	28.8	156	210	325	495	-	119	138	-	-	
Mmean	7.7	8.7	13.1	39.7	91.1	191	330	-	71.5	46.3	-	-	
Mmin	3.2	2.0	7.0	10.9	29.4	121	191	-	42.8	18.6	-	-	

Year Maximum - — Year Mean 93.0 — Year Minimum -

Daily Mean Discharges in Cumecs — *Hydraulic Research Division / Hydrology BWKW*

Station : 1607 Avanavero Boven — *River : Kabalebo* — *Km 237* — *Year : 1978*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	25.4	3.9	6.0	2.6	8.4	71.8	538	237	344	35.3	30.0	5.6	1
2	22.2	4.6	6.0	2.9	8.0	61.1	479	244	156	31.8	25.4	5.0	2
3	18.2	7.5	6.0	4.2	8.0	75.9	348	217	134	29.4	22.7	4.8	3
4	15.3	12.1	6.0	6.6	6.0	181	264	181	117	28.3	20.5	4.6	4
5	14.1	17.3	5.6	8.6	8.6	227	240	153	105	26.3	18.2	4.5	5
6	12.7	36.1	5.4	9.8	8.8	194	240	143	97.9	24.3	16.1	4.3	6
7	10.9	41.9	5.2	10.0	9.1	143	244	168	103	22.7	13.4	4.5	7
8	10.0	41.9	5.0	9.5	10.3	117	230	244	117	21.5	11.8	6.2	8
9	9.1	58.8	4.8	9.1	13.1	105	213	355	138	22.2	10.6	11.5	9
10	8.2	91.1	4.3	10.9	42.8	109	366	417	143	22.0	9.5	22.7	10
11	7.8	81.7	4.2	13.4	81.7	115	217	398	129	21.5	8.6	26.8	11
12	7.5	65.6	4.2	13.4	61.1	115	237	340	111	21.5	8.4	25.4	12
13	7.5	46.6	4.5	11.5	68.0	113	230	285	96.2	22.2	8.2	22.4	13
14	7.5	33.9	3.6	9.5	60.0	109	220	217	87.8	23.0	8.8	19.6	14
15	7.0	26.3	3.6	8.4	49.7	111	204	153	83.2	22.7	8.8	17.7	15
16	6.6	22.4	3.6	7.8	60.0	121	204	132	75.9	22.2	8.2	15.7	16
17	6.2	19.1	3.4	7.3	60.0	172	181	132	68.0	19.6	7.5	13.8	17
18	6.0	16.1	3.3	7.5	58.8	230	150	129	63.3	16.9	6.6	12.4	18
19	5.4	14.1	3.1	7.8	51.9	275	129	136	63.3	14.9	6.2	10.9	19
20	4.6	11.8	3.0	8.0	49.7	303	111	204	64.4	14.5	6.2	9.8	20
21	4.2	10.6	3.0	8.2	57.6	289	97.9	282	66.8	21.0	6.0	9.1	21
22	3.7	9.5	2.9	8.4	73.2	227	91.1	300	62.2	24.3	5.7	8.4	22
23	3.4	8.8	2.9	9.5	69.3	153	86.3	344	54.1	24.6	5.6	8.0	23
24	3.2	8.0	2.7	10.3	80.2	125	83.2	314	47.7	51.9	5.6	7.5	24
25	2.9	7.3	2.6	10.3	96.2	121	77.3	282	47.7	74.5	5.6	7.0	25
26	3.0	6.6	2.5	10.3	99.7	141	71.8	264	44.7	77.3	6.2	6.6	26
27	3.0	6.2	2.4	9.8	89.5	257	66.8	271	43.7	73.2	7.0	6.4	27
28	2.9	6.2	2.3	8.6	91.1	474	65.6	285	42.8	61.1	7.0	5.7	28
29	3.2		2.2	8.0	30.0	534	70.5	300	41.0	49.7	6.8	5.4	29
30	4.0		2.2	8.4	38.5	543	113	285	38.5	41.9	6.2	5.2	30
31	4.0		2.4		89.5		187	244		35.3		4.8	31
Mmax	25.4	91.1	6.0	13.4	99.7	543	538	417	344	77.3	30.0	26.8	
Mmean	8.1	25.6	3.8	8.7	49.6	194	195	247	92.9	32.2	10.6	10.4	
Mmin	2.9	3.9	2.2	2.6	6.0	61.1	65.6	129	38.5	14.5	5.6	4.3	

Year Maximum 543 — *Year Mean* 73.5 — *Year Minimum* 2.2

Daily Mean Discharges in Cumecs — *Hydraulic Research Division / Hydrology BWKW*

Station : 1607 Avanavero Boven — *River : Kabalebo* — *Km 237* — *Year : 1979*

	Jan	Feb	Mrt	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	-	-	3.9	-	394	296	363	289	194	105	47.7	33.9	1
2	3.7	30.6	4.2	16.1	474	237	351	271	217	99.7	41.9	29.4	2
3	3.9	28.8	5.0	26.3	483	213	351	247	220	87.8	37.6	25.9	3
4	5.2	30.6	7.3	14.9	479	271	336	227	197	83.2	34.6	23.9	4
5	5.0	32.5	8.8	18.2	442	413	314	96.2	156	80.2	32.5	23.0	5
6	5.6	30.0	8.2	23.9	409	605	285	187	134	73.2	30.0	23.0	6
7	6.6	25.0	7.3	27.3	378	812	268	178	125	66.8	28.3	22.2	7
8	8.6	22.0	10.0	81.7	333	848	275	168	121	62.2	26.8	21.5	8
9	4.5	18.6	19.6	181	204	874	340	162	115	61.1	25.4	19.6	9
10	24.3	15.3	22.4	355	119	884	398	178	107	63.3	24.3	21.5	10
11	26.8	13.1	18.6	450	113	889	479	223	97.9	65.6	23.3	30.0	11
12	34.6	11.5	13.4	521	113	858	521	363	96.2	64.4	22.2	41.9	12
13	33.9	10.0	19.6	574	103	822	547	474	111	81.7	21.5	56.4	13
14	26.3	9.1	53.0	547	96.2	812	591	517	153	63.3	20.0	57.6	14
15	22.2	8.4	48.7	458	105	797	574	534	210	58.8	18.6	48.7	15
16	17.3	7.5	41.0	296	111	767	583	530	233	57.6	16.1	44.7	16
17	13.4	7.0	33.9	159	107	727	538	487	247	56.4	15.3	44.7	17
18	11.2	6.6	26.8	117	113	703	474	405	278	53.0	16.5	75.9	18
19	10.0	6.2	23.0	107	148	703	413	289	261	54.1	35.3	103	19
20	8.8	5.6	20.5	97.9	187	684	359	213	233	60.0	45.7	136	20
21	8.2	5.4	19.1	87.8	285	637	310	175	204	68.0	46.6	125	21
22	7.8	5.0	18.6	77.3	454	587	278	184	165	75.9	41.0	103	22
23	7.3	4.8	89.5	71.8	547	538	261	264	143	96.2	40.1	87.8	23
24	6.8	5.0	26.3	69.3	578	479	244	318	125	141	123	89.5	24
25	6.6	4.8	27.3	68.0	596	466	250	351	113	150	184	123	25
26	6.6	4.6	42.8	111	623	578	247	336	101	134	141	148	26
27	6.6	4.3	42.8	153	646	534	227	278	91.1	113	101	194	27
28	6.4	4.0	33.9	145	642	483	223	230	83.2	89.5	73.2	200	28
29	6.6		27.3	123	610	442	261	197	86.3	74.5	54.1	162	29
30	7.5		23.3	109	525	394	289	184	97.9	64.4	42.8	127	30
31	74.5		20.0		348		-	197		55.2		105	31
Mmax	74.5*	32.5*	89.5	574*	646	889	591*	534	278	150	184	200	
Mmean	13.9*	13.2*	24.7	175*	347	612	365*	282	157	79.3	47.0	75.7	
Mmin	3.7*	4.0*	3.9	14.9*	96.2	213	223*	96.2	83.2	53.0	15.3	19.6	

Year Maximum 889* — *Year Mean* 184* — *Year Minimum* 3.7*

Daily Mean Discharges in Cumecs *Hydraulic Research Division/Hydrology BWKW*

Station : 1607 Avanavero Boven *River : Kabalebo* *Km 237* *Year : 1980*

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
1	80.2	-	3.3	18.9	347	317	243	693	151	61.9	21.6	46.7	
2	73.1	-	3.1	57.5	332	306	236	712	162	59.7	21.6	42.8	*2*
3	64.3	-	2.8	92.8	321	321	295	693	233	56.4	20.3	48.8	*3*
4	56.4	-	2.8	84.7	366	351	381	660	299	54.2	18.9	65.5	*4*
5	49.8	-	2.6	58.6	355	381	413	595	310	53.1	16.5	86.3	*5*
6	45.7	-	2.4	41.0	321	401	409	503	271	52.0	15.3	92.8	*6*
7	43.7	20.8	2.2	26.3	281	401	417	421	226	49.8	14.1	83.2	*7*
8	40.1	18.9	2.2	26.3	281	405	409	362	187	46.7	13.4	64.3	*8*
9	36.1	16.9	2.1	22.2	314	421	429	325	156	42.8	12.7	52.0	*9*
10	33.2	15.3	2.0	17.9	385	441	508	299	138	40.1	11.8	41.9	*10*
11	30.6	13.8	2.0	14.9	425	461	569	285	124	38.5	10.6	36.1	*11*
12	27.8	12.4	2.0	12.7	466	441	609	278	120	36.8	9.8	32.5	*12*
13	25.9	11.8	2.1	11.8	503	409	627	306	131	36.1	8.6	30.0	*13*
14	23.9	10.9	2.1	10.6	512	381	651	358	156	36.1	8.2	27.3	*14*
15	22.7	10.0	2.0	11.8	495	358	674	366	162	43.7	7.5	24.6	*15*
16	21.6	9.3	2.0	19.4	470	378	669	370	148	59.7	8.4	23.0	*16*
17	20.3	8.6	2.0	26.3	508	470	641	362	133	59.7	14.5	22.0	*17*
18	18.4	8.0	2.0	31.2	495	569	618	328	116	57.5	40.1	21.6	*18*
19	16.5	7.3	2.0	31.2	486	609	609	281	101	52.0	140	21.2	*19*
20	14.9	6.4	2.0	33.9	491	614	582	250	92.8	45.7	200	22.0	#
21	14.5	5.8	2.0	44.7	482	609	538	243	87.8	39.3	177	23.3	*21*
22	-	5.4	2.0	55.3	474	582	499	233	86.3	33.9	126	25.9	#
23	-	5.0	2.0	77.3	478	542	474	226	83.2	30.0	101	25.4	#
24	-	4.6	2.2	116	551	503	470	210	83.2	26.8	91.1	23.9	#
25	-	4.5	3.1	156	609	466	482	197	77.3	25.0	89.5	22.7	#
26	-	4.1	4.1	219	609	417	474	181	71.8	23.9	91.1	22.2	#
27	-	4.0	4.6	260	573	393	445	171	68.0	23.0	86.3	21.2	#
28	-	3.7	5.5	295	542	351	401	159	63.1	22.4	77.3	20.3	#
29	-	3.4	6.4	314	508	310	366	156	61.9	22.2	65.5	21.6	#
30	-		5.5	339	429	274	381	148	60.8	22.0	55.3	23.6	#
31	-		6.9		355		538	148		21.6		24.6	*31*
Mmax	-	-	6.9	339	609	614	674	712	310	61.9	200	92.8	
Mmean	-	9.2*	2.9	84.2	444	429	486	339	139	41.0	52.5	36.7	
Mmin	-	-	2.0	10.6	281	274	236	148	60.8	21.6	7.5	20.3	

Year Maximum 712* *Year Mean* 183* *Year Minimum* 2.0*

Daily Mean Discharges in Cumecs *Hydraulic Research Division/Hydrology BWKW*

Station : 1607 Avanavero Boven *River : Kabalebo* *Km 237* *Year : 1981*

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
1	28.8	9.5	97.9	8.8	397	618	651	632	573	120	66.8	36.8	*1*
2	25.9	8.2	103	8.2	516	547	746	632	586	138	61.9	34.6	*2*
3	23.6	8.0	105	7.5	516	684	852	595	600	174	64.3	31.2	*3*
4	22.7	8.0	96.2	7.3	679	722	930	542	578	210	61.9	31.2	*4*
5	32.5	9.3	83.2	7.1	693	761	966	503	533	226	61.9	25.4	*5*
6	29.4	9.8	70.5	7.5	632	873	961	457	466	267	60.8	23.9	*6*
7	27.8	13.4	70.5	9.5	508	858	940	425	374	246	58.6	23.0	*7*
8	25.4	16.9	69.3	10.6	437	722	935	397	332	219	57.5	22.2	*8*
9	24.3	18.9	91.1	11.5	457	674	925	381	233	190	57.5	22.0	*9*
10	24.6	22.0	159	25.0	-	614	935	366	229	168	57.5	22.2	*10*
11	25.4	23.0	156	86.3	-	551	914	355	278	145	52.0	23.3	*11*
12	23.3	25.0	135	120	-	482	873	336	281	129	47.7	25.9	*12*
13	22.2	26.3	110	97.9	-	425	811	351	264	124	46.7	25.4	*13*
14	21.2	25.9	107	71.8	-	491	707	366	233	129	46.7	23.9	*14*
15	20.3	26.8	70.5	101	-	586	591	393	203	135	47.7	24.3	*15*
16	18.4	27.8	55.3	140	-	651	533	405	184	140	47.7	25.4	*16*
17	18.4	30.0	45.7	145	-	651	542	385	177	133	44.7	25.4	*17*
18	20.3	42.8	37.6	165	-	609	547	358	177	118	41.9	24.3	*18*
19	19.4	77.3	32.5	203	-	609	533	343	174	103	41.9	23.6	*19*
20	16.5	124	28.3	168	-	618	512	321	223	92.8	41.0	23.6	*20*
21	14.5	131	25.4	187	-	591	582	299	210	87.8	41.9	24.3	*21*
22	12.1	86.3	23.3	274	-	542	811	362	190	83.2	42.8	25.9	*22*
23	10.9	81.6	22.0	351	595	547	863	374	171	83.2	41.0	26.8	*23*
24	9.8	73.1	19.9	370	605	503	852	336	153	80.2	37.6	26.3	*24*
25	9.5	68.0	17.3	326	591	486	837	325	145	75.9	36.1	25.4	*25*
26	8.4	56.4	15.3	264	569	466	806	317	143	77.3	33.9	26.3	*26*
27	9.1	50.9	13.4	219	573	421	781	317	140	77.3	31.8	28.3	*27*
28	9.1	60.8	12.1	190	609	413	722	299	138	80.2	31.2	30.6	*28*
29	9.5		11.2	219	674	503	641	325	126	80.2	35.3	30.0	*29*
30	9.8		10.3	332	-	547	627	417	120	75.9	36.8	27.3	*30*
31	9.8		9.8		-		632	516		70.5		24.6	*31*
Mmax	32.5	131	159	370	-	873	966	632	600	267	66.8	36.8	
Mmea	18.8	41.5	61.4	138	-	592	760	401	274	132	47.8	26.2	
Mmin	8.4	8.0	9.8	7.1	-	413	512	299	120	70.5	31.2	22.0	

Year Maximum 966* *Year Mean* 243* *Year Minimum* 7.1*

Daily Mean Discharges in Cumecs *Hydraulic Research Division/Hydrology BWKW*

Station : 1607 Avanavero Boven *River : Kabalebo* *Km 237* *Year : 1982*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	24.6	-	33.2	281	177	529	236	206	73.1	21.6	3.6	1.8	*1*
2	25.4	-	27.3	433	-	529	219	190	73.1	20.3	3.4	1.8	*2*
3	31.2	-	24.6	495	-	525	210	162	73.1	19.4	3.3	1.8	*3*
4	29.4	-	22.7	508	-	516	190	140	71.8	17.3	3.1	1.8	*4*
5	36.1	-	21.6	503	366	512	174	133	66.8	15.7	3.0	1.8	*5*
6	39.3	-	18.4	482	362	547	171	131	60.8	14.5	2.8	1.8	*6*
7	44.7	-	15.3	466	374	569	165	131	56.4	12.7	2.6	1.8	*7*
8	50.9	52.0	14.5	482	374	591	168	131	53.1	11.8	2.6	1.8	*8*
9	49.8	49.8	13.8	457	374	618	174	124	52.0	11.2	2.4	1.8	*9*
10	46.7	41.0	13.4	393	358	627	274	110	56.4	10.9	2.3	-	*10*
11	45.7	35.3	12.7	292	347	660	292	99.7	60.8	10.6	-	-	*11*
12	52.0	31.8	12.4	197	366	703	264	105	57.5	9.8	-	-	*12*
13	108	41.0	17.3	143	421	722	236	126	52.0	9.1	-	-	*13*
14	133	45.7	19.9	114	445	737	223	151	46.7	8.6	-	-	*14*
15	131	39.3	23.0	97.9	466	732	216	165	41.0	8.2	-	-	*15*
16	99.7	31.8	27.8	87.8	486	688	190	143	36.8	8.0	-	-	*16*
17	70.5	27.3	28.3	77.3	470	627	165	116	33.2	7.8	-	-	*17*
18	54.2	24.6	33.2	69.3	425	503	151	103	30.6	7.1	-	-	*18*
19	43.7	23.0	49.8	64.3	370	433	153	103	27.8	6.6	-	-	*19*
20	-	22.2	73.1	65.5	321	421	153	120	25.9	6.2	-	-	*20*
21	-	21.6	94.5	83.2	295	389	148	200	24.6	6.0	-	-	*21*
22	-	21.6	92.8	89.5	292	362	140	264	23.9	6.0	-	-	*22*
23	-	23.3	87.8	105	306	336	135	236	24.3	5.5	-	-	*23*
24	-	25.4	78.7	97.9	358	303	138	177	24.6	5.4	-	-	*24*
25	-	36.1	71.8	97.9	405	274	135	131	24.3	5.2	-	-	*25*
26	-	43.7	68.0	99.7	417	246	138	112	23.6	5.0	1.8	-	*26*
27	-	44.7	64.3	94.5	393	223	162	108	23.3	4.6	1.8	-	*27*
28	-	40.1	60.8	107	445	210	159	107	23.3	4.5	1.8	-	*28*
29	-		54.2	108	503	223	174	97.9	23.3	4.3	1.8	-	*29*
30	-		56.4	110	521	236	203	87.8	22.7	4.0	1.8	-	*30*
31	-		105		529		210	77.3		3.7		-	*31*
Mmax	-	-	105	508	-	737	292	264	73.1	21.6	-	-	
Mmea	-	-	43.1	223	392*	486	186	138	42.9	9.4	-	-	
Mmin	-	-	12.4	64.3	-	210	135	77.3	22.7	3.7	-	-	

Year Maximum - *Year Mean* - *Year Minimum* -