

Supplementary materials for:

Sustainability of the Community-based Rural Drinking Water Supply Program (PAMSIMAS) in Indonesia: an Application of the System Dynamics Model

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Equations, constants, and units in the PAMSIMAS model

"% of budget for cost of depreciation" = 0.4
Units: 1/Month

Actual water being supplied = IF THEN ELSE(Availability of water in reservoir>0, Water demand, Water in from source - Water loss due to damage)
Units: m3/Month

Availability of water in reservoir = IF THEN ELSE (Water in from source < (Water loss due to damage + Water demand) , 0 , MIN (Water in from source - Water demand - Water loss due to damage, Max water volume in reservoir))

Units: m3/Month

Big damage = PULSE TRAIN(Starting damage Month + 12,TIME STEP,Big water supply incident interval, FINAL TIME)*Big damage factor

Units: Dmnl

Big damage factor = 0.75

Units: Dmnl

Big water supply incident interval = 24

Units: Month

Budget to environmental degradation conversion = IF THEN ELSE (Environmental conservation budget > 0, 1, 0)

Units: Dmnl

Community characteristics = 3

Units: Dmnl

Community development = Community characteristics*Water board performance

Units: Dmnl

Cost of depreciation = IF THEN ELSE(Water board finance > 0 :AND: Actual water being supplied > 0, "% of budget for cost of depreciation" * Water board finance , 0)

Units: Rupiah/Month

Damage duration = 1

Units: Month

Drought in dry season = WITH LOOKUP (MODULO(Time,12), ([(0,0) - (12,0.7)],(0,0),(2,0),(3,0),(4,0),(5,0.4),(6,0.4),(7,0.6),(8,0.6),(9,0.6),(10,0.4),(12,0)))

Units: Dmnl

Environmental degradation = WITH LOOKUP (Budget to environmental degradation conversion*Community characteristics*Water board performance, ([(0,0)-(25,1)],(0,1),(1,1),(3,0.85),(25,0.5)))

Units: Dmnl

Environmental conservation budget = IF THEN ELSE(Water board finance<0,0,Percent budget for environmental conservation * Water board finance)

Units: Rupiah/Month

External contribution = 5e+06

Units: Rupiah

External investment = 1e+06

Units: Rupiah

Extra use of water factor = 1.2

Units: Dmnl

FINAL TIME = 120

Units: Month

Growth period = 1

Units: Month

incentive water board per person = 100000

Units: Rupiah/(Person*Month)

INITIAL TIME = 0

Units: Month

The initial time for the simulation.

Max water volume in reservoir = Projected Population 5th year*Reservoir volume allowance per person*0.2

Units: m3/Month

Number of people in a household = 5

Units: Person

number of water board = 5

Units: Person

"O&M cost" = IF THEN ELSE(Water board finance>0 :AND: Actual water being supplied > 0, "Portion O&M" * Retribution , 0)

Units: Rupiah/Month

Initial population = 1250

Units: Person

Pamsimas beneficiaries= INTEG (Pamsimas beneficiaries growth, 0)

Units: Person

Pamsimas beneficiaries growth = Pipe network growth/Year to month conversion * Population without access to Pamsimas

Units: Person/Month

Percent budget for environmental conservation = 0.08

Units: 1/Month

Percentage beneficiaries to total population = Pamsimas beneficiaries/Village population

Units: Dmnl

Percentage of beneficiaris who pay water fee = WITH LOOKUP (Community development, [(1,0)-(25,1)],(1,0),(12,0.7),(25,0.95)))

Units: Dmnl

Pipe network growth = WITH LOOKUP (Water board performance, ((1,0)-(5,0.9)],(1,0),(5,0.85)))

Units: Dmnl

Population growth = Village population*Population growth rate/Growth period

Units: Person/Month

Population growth rate = 0.00075

Units: Dmnl

Population without access to Pamsimas = Village population-Pamsimas beneficiaries

Units: Person

"Portion O&M" = 0.2

Units: Dmnl

Projected Population 5th year = Initial population*(1+Population growth rate)^(Time Period/Growth period)

Units: Person

Repair ability = DELAY FIXED (IF THEN ELSE(Theoretical water loss percentage>0,IF THEN ELSE(Water board finance >0,1,0),0),Damage duration,0)

Units: Dmnl

Repair cost = IF THEN ELSE(Water board finance>0,Water loss due to damage*Repair costs per cubic,0)

Units: Rupiah/Month

Repair costs per cubic = 100

Units: Rupiah/m3

Reservoir volume allowance per person = 90/1000

Units: m3/Person/Month

Retribution = Percentage of beneficiaris who pay water fee * (Actual water being supplied * Water price per cubic + (Pamsimas beneficiaries * Subscription fee / Number of people in a household))

Units: Rupiah/Month

Small damage = PULSE TRAIN(Starting damage Month,TIME STEP,Small water supply incident interval, FINAL TIME)*Small damage factor

Units: Dmnl

Small damage factor = 0.15

Units: Dmnl

Small water supply incident interval = 6

Units: Month

Starting damage Month = 12

Units: Month

Subscription fee = 2000

Units: Rupiah/Month

Supply declined from source = Drought in dry season*Environmental degradation

Units: Dmnl

Theoretical water loss percentage = DELAY FIXED (Water loss percentage,TIME STEP,0)

Units: Dmnl

Time Period = 60

Units: Month

TIME STEP = 0.03125

Units: Month [0,?]

Village population = INTEG (Population growth, Initial population)

Units: Person

Water board finance = INTEG (Retribution-Environmental conservation budget-Cost of depreciation-"O&M cost" - Repair cost - Water board incentive, External contribution)

Units: Rupiah

Water board incentive = IF THEN ELSE(Water board finance > 0, incentive water board per person*number of water board , 0)

Units: Rupiah/Month

Water board performance = 4

Units: Dmnl

Water consumption per person per month = 2.1

Units: m3/Month/Person

Water demand = Pamsimas beneficiaries * Water consumption per person per month

Units: m3/Month

Water in from source = Water supplied by source - (Water supplied by source*Supply declined from source)

Units: m3/Month

Water loss due to damage = Water loss percentage*Water in from source

Units: m3/Month

Water loss percentage = MIN(MAX(0,Small damage+Big damage+Theoretical water loss percentage-Repair ability),1)

Units: Dmnl

Water price per cubic = 1000

Units: Rupiah/m³

Water supplied by source = Extra use of water factor*Projected Population 5th year*Water consumption per person per month

Units: m³/Month

Year to month conversion = 12

Units: Month