*****ENVIRONMENTAL IMPACT ASSESSMENT MODEL FOR THE SIERRA LEONE*****
*****MINING SYSTEM BY JONATHAN BONOPHA TENGBE*****
*****VERSION 1.0 – APRIL 1993*****

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*       SUB-SYSTEM 1 – SIERRA RUTILE MINING SYSTEM
NOTE
NOTE    ECONOMIC MODEL
NOTE
NOTE    PRODUCTION
NOTE
L       PRO.K=PRO.J+DT*RPRO.JK
N       PRO=0
NOTE    PRODUCED RUTILE (tons)
R       RPRO.KL=(DVEG.K*ARCON)/PAT
NOTE    RATE OF RUTILE PRODUCTION (tons/yr)
C       PAT=5
NOTE    PRODUCTION ADJUSTMENT TIME
A       DVEGM.K=VRTL.K+DMINE.K
NOTE    AREAS WHERE MINERAL WAS EXTRACTED (ha)
C       ARCON=400
NOTE    AVERAGE RUTILE CONTENT OF LAND (tons/ha)
NOTE
NOTE    OVERHEADS AND PROFITS
NOTE
L       RECOV.K=RECOV.J+DT*RCOV.JK
N       RECOV=0
NOTE    OVERHEADS AND PROFITS OF THE COMPANY (US$)
R       AMOUNT.KL=RPRO.KL*PRICE
NOTE    AMOUNT FROM THE SALE OF RUTILE (US$/yr)
C       PRICE=400
NOTE    WORLD MARKET PRICE FOR RUTILE (US$/ton)
R       RCOV.KL=AMOUNT.KL-RGOVT.KL-RCOST.KL
NOTE    RECOVERY RATE FROM SALES (US$/yr)
NOTE
NOTE    TAXES AND ROYALTIES
NOTE
L       GOVT.K=GOVT.J+DT*RGOVT.JK
N       GOVT=0
NOTE    GOVERNMENT PROCEEDS FROM MINING (US$)
R       RGOVT.KL=TAX*AMOUNT.KL
NOTE    TAXES AND ROYALTIES TO GOVERNMENT (US$/yr)
C       TAX=0.07
NOTE    PERCENTAGE TAX (dimensionless)
NOTE
NOTE    LOCAL GROSS DOMESTIC PRODUCT
NOTE
L       LGDP.K=LGDP.J+DT*RLGDP.JK
N       LGDP=0
NOTE    LOCAL GROSS DOMESTIC PRODUCT (US$)
R       RLGDP.KL=RGOVT.KL+RAGRPO.KL-ERCOST.KL
NOTE    RATE OF CHANGE OF GROSS DOMESTIC PRODUCT (US$/yr)
A       ELGDP.K=1-MULT1.K
NOTE    EFFECT OF LOCAL GROSS DOMESTIC PRODUCT ON MINING
A       MULT1.K=0
NOTE    MULTIPLIER THAT DETERMINES GOVERNMENT CONTROL OVER MINING
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NOTE
NOTE   REHABILITATION COSTS
NOTE
L      RECOST.K=RECOST.J+DT*RCOST.JK
N      RECOST=0
NOTE   REHABILITATION COST (US$/yr)
R      RCOST.KL=TREHAB.KL*COST
NOTE   RATE OF REHABILITATION COSTS (US$/yr)
C      COST=1000
NOTE   UNIT COST OF REHABILITATION (US$/ha)
R      ERCOST.KL=CLIP(RCOST.KL,0,TIME.K,2020)
NOTE   COST UNDERTAKEN BY GOVERNMENT (US$/yr)
NOTE
NOTE   AGRICULTURAL PRODUCTION
NOTE
L      AGPRO.K=AGPRO.J+DT*RAGPRO.JK
N      AGPRO=0
NOTE   INCOME OBTAINED FROM AGRICULTURAL PRODUCTION (US$)
R      RAGPRO.KL=AGRU.KL*AGCOST
NOTE   RATE OF AGRICULTURAL PRODUCTION (US$/yr)
C      AGCOST=300
NOTE   INCOME FROM AGRICULTURAL PRODUCTION PER HECTARE (US$/ha)
NOTE
NOTE   EFFECTS OF OVERHEADS AND PROFITS ON MINING ACTIVITIES
NOTE
A      EREAT.K=1
NOTE   EFFECTS OF OVERHEADS AND PROFITS
NOTE
NOTE   ECOLOGICAL MODEL
NOTE
NOTE   REHABILITATION MEASURES
NOTE
L      RELAND.K=RELAND.J+DT*TREHAB.JK
NOTE   NEWLY REHABILITATED LAND
N      RELAND=0
NOTE   INITIAL REHABILITATED LAND (ha)
A      REHAB.K=NREHAB*EHAB.K*MNOUT.K
NOTE   RATE OF REHABILITATION (ha/yr)
R      TREHAB.KL=CLIP(REHAB.K,0,TIME.K,1986)
NOTE   START OF REHABILITATION
L      VEGET.K=VEGET.J+DT*REMAT.JK
NOTE   REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
N      VEGET=0
NOTE   INITIAL REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
R      REMAT.KL=RSUCC*ERO.K*DELAY1(TREHAB.KL,5)
NOTE   MATURITY RATE OF THE NEWLY REHABILITATED AREA (ha/yr)
C      NREHAB=0.032
NOTE   NORMAL REHABILITATED RATE PRACTICED BY SRL (frac./yr)
C      RSUCC=0.65
NOTE   SUCCESS RATE OF THE TREES (fraction)
A      EHAB.K=TABHL(TEHAB,FNHAB.K,0,1,0,1)
NOTE   EFFECT OF MINOUT AREA ON THE RATE OF REHABILITATION (dimensionless)
T      TEHAB=3.83/2.22/2.1/1.8/1.67/1.53/1.25/1.8/2.5/1.67/0
NOTE   TABLE VARIABLE NAME FOR EHAB
A      FMHAB.K=RELAND.K/MAX(MNOUT.K,0.01)
NOTE   FRACTION OF MINED OUT AREA REHABILITATED (dimensionless)
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A       MNOUT.K=DMINE.K+EBORL.K+SAND.K
NOTE    MINED OUT AREAS CAPABLE OF BEING REHABILITATED
NOTE
NOTE    ARTIFICIAL LAKES
NOTE
L       VRTL.K=VRTL.J+TARTLA.JK
NOTE    AVAILABLE ARTIFICIAL LAKES (ha)
N       VRTL=0
NOTE    INITIAL ARTIFICIAL LAKES (ha)
A       ARTLA.K=NARTLF*AVEG.K*EPVAR.K*EREAT.K*ELGDP.K
R       TARTLA.KL=CLIP(ARTLA.K,0,TIME.K,1978)
NOTE    ARTIFICIAL LAKE FORMATION (ha)
C       NARTLF=0.002
NOTE    NORMAL ARTIFICIAL LAKE FORMATION (fraction/yr)
A       EPVAR.K=TABHL(TEPVAR,FRTLA.K,0,0.3,0.03)
NOTE    EFFECT OF POTENTIAL VEGETATED LAND ON ARTIFICIAL LAKES
T       TEPVAR=.6/1.2/3.6/4.8/6/7.2/6/7.2/7.2/7.2/0
NOTE    TABLE FOR THE EFFECT OF VEGETATED LAND ON ART. LAKES
A       FRTLA.K=VRTL.K/PVEG.K
NOTE    FRACTION OF POTENTIAL VEGETATED LAND OCCUPIED BY ART. LAKES
A       SAND.K=SF*VRTL.K
NOTE    AREA OF SAND TAILINGS (ha)
C       SF=.05
NOTE    FRACTION OF ARTIFICIAL LAKES THAT IS SAND TAILINGS
NOTE
NOTE    EXCAVATION
NOTE
L       EXCVL.K=EXCVL.J+DT*(ROADC.JK+EBOR.JK+AMINE.JK)
NOTE    TOTAL EXCAVATED AREA
N       EXCVL=47
NOTE    INITIAL EACAVATED AREA (ha)
NOTE
NOTE    ROAD AND CANAL CONSTRUCTION
NOTE
L       ROADL.K=ROADL.J+DT*ROADC.JK
NOTE    SURFACE AREA OF ROADS CONSTRUCTED (ha)
N       ROADL=47
NOTE    SURFACE AREA OF ROADS INITIALLY IN THE REGION
R       ROADC.KL=NROADF*AVEG.K*ERVEG.K*EREAT.K*ELGDP.K
C       NROADF=0.00019
NOTE    NORMAL FRACTION OF ROAD CONSTRUCTED PER YEAR (frac./yr)
A       ERVEG.K=TABHL(TERVEG,FROVEG.K,0,0.1,0.01)
NOTE    EFFECT OF ROAD CONSTRUCTION ON VEGETATION
T       TERVEG=1,1,1,1,1,1,1,1,1,0
A       FROVEG.K=ROADL.K/PVEG.K
NOTE    FRACTION  OF VEGETATED AREAS THAT ARE USED FOR ROADS
NOTE
NOTE    EARTH BORROWING
NOTE
L       EBORL.K=EBORL.J+DT*EBOR.JK
NOTE    BORROWED AREAS (ha)
N       EBORL=0
NOTE    INITIAL BORROWED AREAS (ha)
R       EBOR.KL=NEBORF*AVEG.K*EBVEG.K*ELGDP.K*EREAT.K
NOTE    EFECT OF EARTH BORROWING ON VEGETATION
C       NEBORF=0.00017
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NOTE  NORMAL EARTH BORROWING RATE (fraction/yr)
A     EBVEG.K=TABHL(TEBVEG,FBOVEG.K,0,0.1,0.01)
NOTE  EFFECT OF EARTH BORROWING ON VEGETATION
T     TEBVEG=1,1,1,1,1,1,1,1,1,0
NOTE  TABLE VARIABLE NAME FOR EBVEG
A     FBOVEG.K=EBORL.K/PVEG.K
NOTE  FRACTION OF VEGETATED LAND USED FOR EARTH BORROWING
A     VEARTH.K=EBORL.K*10000.DP
NOTE  VOLUME OF EARTH BORROWED (cubic meter)
C     DP=2
NOTE  AVERAGE DEPTH OF BORROWED PITS
NOTE
NOTE  DRY MINING OPERATION
NOTE
L     DMINE.K=DMINE.J+AMINE.JK
NOTE  EXCAVATED AREAS THROUGH DRY MINING (ha)
N     DMINE=0
NOTE  INITIAL DRY MINED AREAS (ha)
A     MINE.K=NMINEF*AVEG.K*EMVEG.K*EREAT.K*ELGDP.K
NOTE  RATE OF DRY MINING (ha/yr)
C     NMINEF=0.00014
NOTE  NORMAL DRY MINING FRACTION (fraction/yr)
R     AMINE.KL=CLIP(MINE.K,0,TIME.K,1989)
NOTE  ACTUAL STARTING DATE OF THE DRY MINING OPERATION
A     EMVEG.K=TABHL(TEMVEG,FMINV.K,0,0.1,0.01)
NOTE  EFFECT OF DRY MINING ON VEGETATION
T     TEMVEG=1,1,1,1,1,1,1,1,1,0
NOTE  TABLE VARIABLE NAME FOR EMVEG
A     FMINV.K=DMINE.K/PVEG.K
NOTE  FRACTION OF VEGETATED AREAS THAT ARE MINED OUT
NOTE
NOTE  SOIL EROSION
NOTE
L     SLOSS.K=SLOSS.J*RLOSS.JK
NOTE  TOTAL SOIL LOSS (tons)
N     SLOSS=0
NOTE  INITIAL SOIL LOSS (tons)
R     RLOSS.KL=R*K*C*SL.K*EROBLE.k*10
NOTE  TOTAL SOIL LOSS RATE (tons/yr)
A     LOSSR.K=R*K*C*P*SL.K
NOTE  SOIL LOSS RATE
C     R=1400
NOTE  RAINFALL EROSION INDEX
C     K=0.0251
NOTE  SOIL ERODIBILITY
C     P=1
NOTE  EROSION CONTROL PRACTICE
A     SL.K=TABHL(TSL,L.K,0,50000,5000)
NOTE  SLOPE LENGTH FACTOR
T     TSL=0/42.5/60.1/73.6/85/95/104.1/112.5/120.3/127.5/134.5
NOTE  TABLE VARIABLE FOR SLOPE LENGTH FACTOR
A     L.K=EROBLE.K*10000/BR
A     EROBLE.K=EXCVL.K+SAND.K
NOTE  AREAS IN THE MINED OUT AREAS THAT ARE SUBJECT TO EROSION
C     BR=22.13
C     C=1
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NOTE   COVER FACTOR
A      ERO.K=TABHL(TERO,LOSSR.K,20,1520,300)
NOTE   EFFECT OF SOIL EROSION ON REHABILITATION
T      TERO=1.0/.95/.92/.9/.85/.8
NOTE   TABLE VARIABLE FOR  ERO
C      TLOSSR=20
NOTE   TOLERABLE SOIL LOSS RATE (kg/m2/yr)
NOTE
NOTE   VEGETATION AND AGRICULTURAL LAND-USE SYSTEMS
NOTE
NOTE   VEGETATION
NOTE
L      AVEG.K=AVEG.J+DT*(REMAT.JK+TARTLA.JK+ROADC..JK-DSTORE.JK^
       -EBOR.JK-AMINE.JK-RSETTL.JK)
NOTE   AVAILABLE VEGETATION (ha)
N      AVEG=PVEG
NOTE   INITIAL VEGETATED AREA (ha)
A      DVEG.K=PVEG.K-AVEG
NOTE   DESTROYED VEGETATION (ha)
C      LEASE=134700
NOTE   TOTAL LEASE AREA (ha)
C      HOUSE=539
NOTE   TOTAL SETTLEMENT AREAS (ha)
NOTE
NOTE   UPLAND CULTIVATION
NOTE
L      AVGR.K=AVGR.J+DT*(0.7*AGRU.JK-0.3*ROADC.JK-0.3*EBOR.JK^
       -AMINE.JK-FALLOW.JK)
NOTE   AVAILABLE CULTIVATED AREAS (ha)
N      AVGR=13227.5
NOTE   INITIAL CULTIVATED AREA (ha)
R      AGRU.KL=AGRU1.K-AGRU2.K
NOTE   EFFECTIVE AGRICULTURAL LAND USE RATE (ha/yr)
A      AGRU1.K=NAGRF*POAGR.K*EAGRV.K
NOTE   AGRICULTURAL LAND USE RATE (ha/yr)
C      NAGRF=0.02
NOTE   NORMAL AGRICULTURAL LAND USE FRACTION (fraction/yr)
A      EAGRV.K=TABHL(TEAGRV,FAGRV,0,1,0.1)
T      TEAGRV=1/1/.95/.9/.85/.8/.75/.7/.5/.3/0
NOTE   TABLE FOR EAGRV
A      FAGRV.K=AVGR.K/POAGR.K
NOTE   FRACTION OF POTENTIAL AGRICULTURAL LAND THAT IS CULTIVATED
A      AGRU2.K=MGRATE.K*ALUP
NOTE   AGRICULTURAL LAND USE DUE TO DISPLACED POPULATION (ha/yr)
C      ALUP=0.13
NOTE   AVERAGE AGRICULTURAL LAND USE PER PERSON PER YEAR (ha/person/yr)
NOTE
NOTE   SWAMP CULTIVATION
NOTE
L      SCULT.K=SCULT.J+DT*(0.3*AGRU.JK-0.3*TARTLA.JK)
NOTE   CULTIVATED VALLEY SWAMPS (ha)
N      SCULT=135
NOTE   INITIAL CULTIVATED SWAMPS (ha)
NOTE
NOTE   VALLEY SWAMPS
NOTE
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L       SWAMPS.K=SWAMPS.J+DT*(-0.6*TARTLA.JK-DSTORE.JK-0.3*AGRU.JK^
    -0.1*ROADC.JK)
NOTE    VALLEY SWAMPS INCLUDING MANGROVE
N       SWAMPS=43346
NOTE    EXISTING SWAMPS (ha)
R       RSWAMPS.KL=0
A       USWAMP.K=SWAMPS.K-SCULT.K
NOTE    UNCULTIVATED SWAMPS (ha)
A       TCULT.K=SCULT.K+AVGR.K
NOTE    TOTAL CULTIVATED AREAS  (ha)
NOTE
NOTE    FARM BUSH
NOTE
L       FLAND.K=FLAND.J+DT*(FALLOW.JK-FAMAT.JK-RSETTLE.JK-0.2*TARTLA.JK-
        0.5*ROADC.JK-0.6*EBOR)
NOTE    FARM BUSH
N       FLAND=58594.5
NOTE    INITIAL FARM BUSH (ha)
R       FALLOW.KL=(0.65*AVGR.K)/CP2
NOTE    RATE AT WHICH THE CULTIVATED LAND IS PUT UNDER FALLOW(ha/yr)
C       CP2=2
NOTE    AVERAGE CULTIVATION PERIOD (yrs)
NOTE
NOTE    SECONDARY FOREST (MATURED FALLOW LAND)
NOTE
L       MATUR.K=MATUR.J+DT*(FAMAT.JK-0.7*AGRU.JK-0.2*TARTLA.JK^
    -0.1*ROADC.JK-0.5*RSETTL.JK)
NOTE    SECONDARY FOREST
N       MATUR=18993
NOTE    SECONDARY FOREST (ha)
R       FAMAT.KL=FLAND.K/FP
NOTE    RATE AT WHICH THE FALLOW LAND MATURES (ha/yr)
C       FP=10
NOTE    THE FALLOW PERIOD (yrs)
A       POAGR.K=MATUR.K+USWAMP.K
NOTE    POTENTIAL AGRICULTURAL LAND (ha)
N       TIME=1978
NOTE    BEGINNING OF SIMULATION
NOTE    WATER MANAGEMENT IMPACT MODEL
NOTE
NOTE    WATER STORAGE IN DAMS
NOTE
L       STORE.K=STORE.J+DT*RSTORE.JK
N       STORE=0
NOTE    STORAGE VOLUME (cubic meter)
R       RSTORE.KL=(VOLS.K-STORE.K)/ST
NOTE    RATE OF STORAGE (cubic meter/yr)
A       VOLS.K=VRTL.K*DEPTH
NOTE    VOLUME TO BE STORED (cubic meter)
C       DEPTH=6
NOTE    AVERAGE DEPTH OF DAMS (m)
C       ST=3
NOTE    STORAGE ADJUSTMENT TIME (yrs)
NOTE
NOTE    PRECIPITATION
NOTE
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C       TOVOL=3.4E9
NOTE    TOTAL VOLUME OF WATER IN THE MINING AREA (cubic meter/yr)
 NOTE
NOTE     WATER STORAGE EFFECT ON VEGETATION
NOTE
L       LSTORE.K=LSTORE.J+DT*DSTORE.JK
N       LSTORE=0
NOTE    LAND DESTROYED DUE TO WATER STORAGE IN DAMS (ha)
R       DSTORE.KL=NSTORF*ESTOV.K*AVEG.K
NOTE    RATE OF DESTRUCTION OF LAND THROUGH STORAGE (ha/yr)
C       NSTORF=0.00001
NOTE    NORMAL FRACTION OF LAND DESTROYED THROUGH STORAGE OF WATER
(fraction/yr)
A       ESTOV.K=TABHL(TESTOV,FSTOVO.K,0.003,0.027,0.002)
NOTE    EFFECT OF WATER STORAGE ON VEGETATION
A       FSTOVO.K=STORE.K/TOVOL
NOTE    FRACTION OF THE TOTAL PRECIPITATION THAT IS STORED
T       TESTOV=.15/.06/.2/.23/1.0/.05/.18/.2/.03/.04/.13/.33/.4
NOTE    TABLE VARIABLE NAME FOR ESTOV
NOTE
NOTE    SOCIAL MODEL
NOTE
NOTE    POPULATION DISPLACEMENT
NOTE
L       DPOP.K=DPOP.J+DT*RPOP.JK
N       DPOP=0
NOTE    DISPLACED POPULATION (persons)
R       RPOP.KL=(DVEG.K*POPD)/DAT
NOTE    RATE OF POPULATION DISPLACEMENT
C       POPD=0.3
NOTE    POPULATION DENSITY (persons/ha)
C       DAT=1
NOTE    POPULATION ADJUSTMENT TIME (yrs)
NOTE
NOTE    EMPLOYMENT AND UNEMPLOYMENT SITUATION
NOTE
A       EPRU.K=FRRU*DPOP.K
NOTE    NUMDER OF DISPLACED PEOPLE EMPLOYED BY SIERRA RUTILE
C       FRRU=.05
NOTE    NORMAL PERCENTAGE EMPLOYED
A       UEMP.K=DPOP.K-EPRU.K
NOTE    UNEMPLOYED POPULATION
NOTE
NOTE    MIGRATION INTO OTHER AREAS
NOTE
A       MGRATE.K=FRMG*DPOP.K
NOTE    OUT-MIGRATION INTO OTHER AREAS (persons)
C       FRMG=0.001
NOTE    FRACTION OF DISPLACED PEOPLE NOT RESETTLED IN MINING ZONE
NOTE
NOTE    RESETTLEMENT AND ITS EFFECTS
NOTE
L       SETTL.K=SETTL.J+DT*RSETTL.JK
NOTE    LAND NEED FOR RESETTLEMENT (ha)
N       SETTL=0
NOTE    INITIAL LAND NEED FOR RESETTLEMENT (ha)
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R       RSETTL.KL=DPOP.K*LAND/DAT
NOTE    RATE OF LAND NEED FOR RESETTLEMENT (ha/yr)
C       LAND=0.002
NOTE    LAND NEEDED PER PERSON FOR RESETTLEMENT (ha/person)
NOTE
NOTE    CONTROL STATEMENTS
NOTE
SAVE    AVEG,DVEG,VRTL,ARTLA,EXCVL,LSTORE,AVGR,^
        LGDP,DSTORE,RELAND,REHAB,SLOSS,RLOSS,LOSSR,AGRU,FLAND,^
        AGPRO,MATUR,POAGR,PRO,RPRO,AMOUNT,GOVT,RECOV,RECOST,DPOP,^
        SAND,RPOP,UEMP,LSTORE,ROADL,EBORL,DMINE,SCULT,SAND,VEARTH,SWAMPS,^
        TCULT,SAND,VEARTH,SWAMPS,SCULT,FLAND,MATUR,MGRATE,SETTL,MNOUT,^
        DVEGM,USWAMP,STORE,VEGET,REMAT,RGOVT,RCOST,RAGPRO,RLGDP,RCOV,^
        TREHAB
SPEC    DT=0.25/LENGTH=2040/SAVPER=1/PRTPER=1/PLOTPER=1
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*       SUB-SYSTEM 2– SIER0MCO MINING SYSTEM
NOTE
NOTE    ECONOMIC MODEL
NOTE
NOTE    PRODUCTION
NOTE
L       PRO.K=PRO.J+DT*RPRO.JK
N       PRO=0
NOTE    PRODUCED BAUXITE (tons)
R       RPRO.KL=(DVEG.K*ARCON)/PAT
NOTE    RATE OF BAUXITE PRODUCTION (tons/yr)
C       PAT=4
NOTE    PRODUCTION ADJUSTMENT TIME
A       DVEGM.K=VRTL.K+DMINE.K
NOTE    AREAS WHERE MINERAL WAS EXTRACTED (ha)
C       ARCON=3950
NOTE    AVERAGE BAUXITE CONTENT OF LAND (tons/ha)
NOTE
NOTE    OVERHEADS AND PROFITS
NOTE
L       RECOV.K=RECOV.J+DT*RCOV.JK
N       RECOV=0
NOTE    OVERHEADS AND PROFITS OF THE COMPANY (US$)
R       AMOUNT.KL=RPRO.KL*PRICE
NOTE    AMOUNT FROM THE SALE OF BAUXITE (US$/yr)
C       PRICE=23
NOTE    WORLD MARKET PRICE FOR BAUXITE (US$/ton)
R       RCOV.KL=AMOUNT.KL-RGOVT.KL-RCOST.KL
NOTE    RECOVERY RATE FROM SALES (US$/yr)
NOTE
NOTE    TAXES AND ROYALTIES
NOTE
L       GOVT.K=GOVT.J+DT*RGOVT.JK
N       GOVT=0
NOTE    GOVERNMENT PROCEEDS FROM MINING (US$)
R       RGOVT.KL=TAX*AMOUNT.KL
NOTE    TAXES AND ROYALTIES TO GOVERNMENT (US$/yr)
C       TAX=.0.375
NOTE    PERCENTAGE TAX (dimensionless)
NOTE
NOTE    LOCAL GROSS DOMESTIC PRODUCT
NOTE
L       LGDP.K=LGDP.J+DT*RLGDP.JK
N       LGDP=0
NOTE    LOCAL GROSS DOMESTIC PRODUCT (US$)
R       RLGDP.KL=RGOVT.KL+RAGRPO.KL-ERCOST.KL
NOTE    RATE OF CHANGE OF GROSS DOMESTIC PRODUCT (US$/yr)
A       ELGDP.K=1-MULT1.K
NOTE    EFFECT OF LOCAL GROSS DOMESTIC PRODUCT ON MINING
A       MULT1.K=0
NOTE    MULTIPLIER THAT DETERMINES GOVERNMENT CONTROL OVER MINING
NOTE
NOTE    REHABILITATION COSTS
NOTE
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L       RECOST.K=RECOST.J+DT*RCOST.JK
N       RECOST=0
NOTE    REHABILITATION COST (US$/yr)
R       RCOST.KL=TREHAB.KL*COST
NOTE    RATE OF REHABILITATION COSTS (US$/yr)
C       COST=2469
NOTE    UNIT COST OF REHABILITATION (US$/ha)
R       ERCOST.KL=CLIP(RCOST.KL,0,TIME.K,2020)
NOTE    COST UNDERTAKEN BY GOVERNMENT (US$/yr)
NOTE
NOTE    AGRICULTURAL PRODUCTION
NOTE
L       AGPRO.K=AGPRO.J+DT*RAGPRO.JK
N       AGPRO=0
NOTE    INCOME OBTAINED FROM AGRICULTURAL PRODUCTION (US$)
R       RAGPRO.KL=AGRU.KL*AGCOST
NOTE    RATE OF AGRICULTURAL PRODUCTION (US$/yr)
C       AGCOST=300
NOTE    INCOME FROM AGRICULTURAL PRODUCTION PER HECTARE (US$/ha)
NOTE
NOTE    EFFECTS OF OVERHEADS AND PROFITS ON MINING ACTIVITIES
NOTE
A       EREAT.K=1
NOTE    EFFECTS OF OVERHEADS AND PROFITS
NOTE
NOTE    ECOLOGICAL MODEL
NOTE
NOTE    REHABILITATION MEASURES
NOTE
L       RELAND.K=RELAND.J+DT*TREHAB.JK
NOTE    NEWLY REHABILITATED LAND
N       RELAND=0
NOTE    INITIAL REHABILITATED LAND (ha)
A       REHAB.K=NREHAB*EHAB.K*MNOUT.K
NOTE    RATE OF REHABILITATION (ha/yr)
R       TREHAB.KL=CLIP(REHAB.K,0,TIME.K,1986)
L       VEGET.K=VEGET.J+DT*REMAT.JK
NOTE    REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
N       VEGET=0
NOTE    INITIAL REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
R       REMAT.KL=RSUCC*ERO.K*DELAY1(TREHAB.KL,5)
NOTE    MATURITY RATE OF THE NEWLY REHABILITATED AREA (ha/yr)
C       NREHAB=0.032
NOTE    NORMAL REHABILITATED RATE PRACTICED BY SRL (frac./yr)
C       RSUCC=0.75
NOTE    SUCCESS RATE OF THE TREES (fraction)
A       EHAB.K=TABHL(TEHAB,FNHAB.K,0,1,0,1)
NOTE    EFFECT OF MINOUT AREA ON THE RATE OF REHABILITATION (dimensionless)
T       TEHAB=3.83/2.22/2.1/1.8/1.67/1.53/1.25/1.8/2.5/1.67/0
NOTE    TABLE VARIABLE NAME FOR EHAB
A       FMHAB.K=RELAND.K/MAX(MNOUT.K,0.01)
NOTE    FRACTION OF MINED OUT AREA REHABILITATED (dimensionless)
A       MNOUT.K=EXCVL.K
NOTE    MINED OUT AREAS CAPABLE OF BEING REHABILITATED
NOTE
NOTE    EXCAVATION
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NOTE
L       EXCVL.K=EXCVL.J+DT*AMINE.JK)
NOTE    TOTAL EXCAVATED AREA
N       EXCVL=0
NOTE    INITIAL EACAVATED AREA (ha)
R       AMINE.K=NMINEF*AVEG.K*EMVEG.K*EREAT.K*ELGDP.K
NOTE    RATE OF EXCAVATION (ha/yr)
C       NMINEF=0.0017
NOTE    NORMAL EXCAVATION FRACTION (fraction/yr)
A       EMVEG.K=TABHL(TEMVEG,FMINV.K,0,0.5,0.05)
NOTE    EFFECT OF DRY MINING ON VEGETATION
T       TEMVEG=1,1,1,1,1,1,1,1,1,0
NOTE    TABLE VARIABLE NAME FOR EMVEG
A       FMINV.K=EXCVL.K/PVEG.K
NOTE    FRACTION OF VEGETATED AREAS THAT ARE MINED OUT
NOTE
NOTE    SOIL EROSION
NOTE
L       SLOSS.K=SLOSS.J*RLOSS.JK
NOTE    TOTAL SOIL LOSS (tons)
N       SLOSS=0
NOTE    INITIAL SOIL LOSS (tons)
R       RLOSS.KL=R*K*C*SL.K*EROBLE.k*10
NOTE    TOTAL SOIL LOSS RATE (tons/yr)
A       LOSSR.K=R*K*C*P*SL.K
NOTE    SOIL LOSS RATE
C       R=1400
NOTE    RAINFALL EROSION INDEX
C       K=0.0251
NOTE    SOIL ERODIBILITY
C       P=1
NOTE    EROSION CONTROL PRACTICE
A       SL.K=TABHL(TSL,L.K,0,50000,5000)
NOTE    SLOPE LENGTH FACTOR
T       TSL=0/42.5/60.1/73.6/85/95/104.1/112.5/120.3/127.5/134.5
NOTE    TABLE VARIABLE FOR SLOPE LENGTH FACTOR
A       L.K=EROBLE.K*10000/BR
A       EROBLE.K=EXCVL.K+SAND.K
NOTE    AREAS IN THE MINED OUT AREAS THAT ARE SUBJECT TO EROSION
C       BR=22.13
C       C=1
NOTE    COVER FACTOR
A       ERO.K=TABHL(TERO,LOSSR.K,20,1520,300)
NOTE    EFFECT OF SOIL EROSION ON REHABILITATION
T       TERO=1.0/.95/.92/.9/.85/.8
NOTE    TABLE VARIABLE FOR  ERO
C       TLOSSR=20
NOTE    TOLERABLE SOIL LOSS RATE (kg/m2/yr)
NOTE
NOTE    VEGETATION AND AGRICULTURAL LAND-USE SYSTEMS
NOTE
NOTE    VEGETATION
NOTE
L       AVEG.K=AVEG.J+DT*(REMAT.JK-AMINE.JK)
NOTE    AVAILABLE VEGETATION (ha)
N       AVEG=PVEG
```

```
NOTE  INITIAL VEGETATED AREA (ha)
A     DVEG.K=PVEG.K-AVEG
NOTE  DESTROYED VEGETATION (ha)
C     LEASE=32370
NOTE  TOTAL LEASE AREA (ha)
C     HOUSE=126
NOTE  TOTAL SETTLEMENT AREAS (ha)
A     PVEG.K=LEASE-HOUSE
NOTE
NOTE  UPLAND CULTIVATION
NOTE
L     AVGR.K=AVGR.J+DT*(0.7*AGRU.JK-0.2*AMINE.JK-FALLOW.JK)
NOTE  AVAILABLE CULTIVATED AREAS (ha)
N     AVGR=3179
NOTE  INITIAL CULTIVATED AREA (ha)
R     AGRU.KL=AGRU1.K-AGRU2.K
NOTE  EFFECTIVE AGRICULTURAL LAND USE RATE (ha/yr)
A     AGRU1.K=NAGRF*POAGR.K*EAGRV.K
NOTE  AGRICULTURAL LAND USE RATE (ha/yr)
C     NAGRF=0.02
NOTE  NORMAL AGRICULTURAL LAND USE FRACTION (fraction/yr)
A     EAGRV.K=TABHL(TEAGRV,FAGRV,0,1,0.1)
T     TEAGRV=1/1/.95/.9/.85/.8/.75/.7/.5/.3/0
NOTE  TABLE FOR EAGRV
A     FAGRV.K=AVGR.K/POAGR.K
NOTE  FRACTION OF POTENTIAL AGRICULTURAL LAND THAT IS CULTIVATED
A     AGRU2.K=MGRATE.K*ALUP
NOTE  AGRICULTURAL LAND USE DUE TO DISPLACED POPULATION (ha/yr)
C     ALUP=0.13
NOTE  AVERAGE AGRICULTURAL LAND USE PER PERSON PER YEAR (ha/person/yr)
NOTE
NOTE  SWAMP CULTIVATION
NOTE
L     SCULT.K=SCULT.J+DT*0.3*AGRU.JK
NOTE  CULTIVATED VALLEY SWAMPS (ha)
N     SCULT=135
NOTE  INITIAL CULTIVATED SWAMPS (ha)
NOTE
NOTE  VALLEY SWAMPS
NOTE
L     SWAMPS.K=SWAMPS.J+DT*(-0.3*AGRU.JK)
NOTE  VALLEY SWAMPS INCLUDING MANGROVE
N     SWAMPS=291
NOTE  EXISTING SWAMPS (ha)
R     RSWAMPS.KL=0
A     USWAMP.K=SWAMPS.K-SCULT.K
NOTE  UNCULTIVATED SWAMPS (ha)
A     TCULT.K=SCULT.K+AVGR.K
NOTE  TOTAL CULTIVATED AREAS  (ha)
NOTE
NOTE  FARM BUSH
NOTE
L     FLAND.K=FLAND.J+DT*(FALLOW.JK-FAMAT.JK-0.3*AMINE.JK)
NOTE  FARM BUSH
N     FLAND=19122
NOTE  INITIAL FARM BUSH (ha)
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R       FALLOW.KL=(0.65*AVGR.K)/CP2
NOTE    RATE AT WHICH THE CULTIVATED LAND IS PUT UNDER FALLOW(ha/yr)
C       CP2=2
NOTE    AVERAGE CULTIVATION PERIOD (yrs)
NOTE
NOTE    SECONDARY FOREST (MATURED FALLOW LAND)
NOTE
L       MATUR.K=MATUR.J+DT*(FAMAT.JK-0.7*AGRU.JK-0.3*AMINE.JK)
NOTE    SECONDARY FOREST
N       MATUR=9518
NOTE    SECONDARY FOREST (ha)
R       FAMAT.KL=FLAND.K/FP
NOTE    RATE AT WHICH THE FALLOW LAND MATURES (ha/yr)
C       FP=10
NOTE    THE FALLOW PERIOD (yrs)
A       POAGR.K=MATUR.K+USWAMP.K
NOTE    POTENTIAL AGRICULTURAL LAND (ha)
N       TIME=1962
NOTE    BEGINNING OF SIMULATION
NOTE
NOTE    SOCIAL MODEL
NOTE
NOTE    POPULATION DISPLACEMENT
NOTE
L       DPOP.K=DPOP.J+DT*RPOP.JK
N       DPOP=0
NOTE    DISPLACED POPULATION (persons)
R       RPOP.KL=(DVEG.K*POPD)/DAT
NOTE    RATE OF POPULATION DISPLACEMENT
C       POPD=0
NOTE    POPULATION DENSITY (persons/ha)
C       DAT=1
NOTE    POPULATION ADJUSTMENT TIME (yrs)
NOTE
NOTE    EMPLOYMENT AND UNEMPLOYMENT SITUATION
NOTE
A       EPRU.K=FRRU*DPOP.K
NOTE    NUMDER OF DISPLACED PEOPLE EMPLOYED BY SIERRA RUTILE
C       FRRU=0.05
NOTE    NORMAL PERCENTAGE EMPLOYED
A       UEMP.K=DPOP.K-EPRU.K
NOTE    UNEMPLOYED POPULATION
NOTE
NOTE    MIGRATION INTO OTHER AREAS
NOTE
A       MGRATE.K=FRMG*DPOP.K
NOTE    OUT-MIGRATION INTO OTHER AREAS (persons)
C       FRMG=0.001
NOTE    FRACTION OF DISPLACED PEOPLE NOT RESETTLED IN MINING ZONE
NOTE
NOTE    RESETTLEMENT AND ITS EFFECTS
NOTE
L       SETTL.K=SETTL.J+DT*RSETTL.JK
NOTE    LAND NEED FOR RESETTLEMENT (ha)
N       SETTL=0
NOTE    INITIAL LAND NEED FOR RESETTLEMENT (ha)
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R       RSETTL.KL=DPOP.K*LAND/DAT
NOTE    RATE OF LAND NEED FOR RESETTLEMENT (ha/yr)
C       LAND=0.002
NOTE    LAND NEEDED PER PERSON FOR RESETTLEMENT (ha/person)
NOTE
NOTE    CONTROL STATEMENTS
NOTE
SAVE    AVEG,DVEG,VRTL,EXCVL,,AVGR,LGDP,RELAND,REHAB,SLOSS,^
        RLOSS,LOSSR,AGRU,FLAND,AGPRO,MATUR,POAGR,PRO,RPRO,^
        AMOUNT,GOVT,RECOV,RECOST,DPOP,RPOP,UEMP,SCULT,SWAMPS,^
        TCULT,FLAND,MATUR,MGRATE,SETTL,MNOUT,DVEGM,SCULT,^
        USWAMP,VEGET,REMAT,RGOVT,RCOST,RAGPRO,RLGDP,RCOV,TREHAB
SPEC    DT=0.25/LENGTH=2040/SAVPER=1/PRTPER=1/PLOTPER=1
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*       SUB-SYSTEM 3 – NATIVE MINING SYSTEM
NOTE
NOTE    ECONOMIC MODEL
NOTE
NOTE    PRODUCTION
NOTE
L       PRO.K=PRO.J+DT*RPRO.JK
N       PRO=0
NOTE    PRODUCED DAIMONDS (carats)
R       RPRO.KL=(DVEG.K*ARCON)/PAT
NOTE    RATE OF DIAMOND PRODUCTION (carats/yr)
C       PAT=5
NOTE    PRODUCTION ADJUSTMENT TIME
A       DVEGM.K=VRTL.K+DMINE.K
NOTE    AREAS WHERE MINERAL WAS EXTRACTED (ha)
C       ARCON=279
NOTE    AVERAGE DAIMOND CONTENT OF LAND (carats/ha)
NOTE
NOTE    OVERHEADS AND PROFITS
NOTE
L       RECOV.K=RECOV.J+DT*RCOV.JK
N       RECOV=0
NOTE    OVERHEADS AND PROFITS OF THE COMPANY (US$)
R       AMOUNT.KL=RPRO.KL*PRICE
NOTE    AMOUNT FROM THE SALE OF DIAMONDS (US$/yr)
C       PRICE=52
NOTE    WORLD MARKET PRICE FOR DAIMONDS (US$/carat)
R       RCOV.KL=AMOUNT.KL-RGOVT.KL-RCOST.KL
NOTE    RECOVERY RATE FROM SALES (US$/yr)
NOTE
NOTE    TAXES AND ROYALTIES
NOTE
L       GOVT.K=GOVT.J+DT*RGOVT.JK
N       GOVT=0
NOTE    GOVERNMENT PROCEEDS FROM MINING (US$)
R       RGOVT.KL=TAX*AMOUNT.KL
NOTE    TAXES AND ROYALTIES TO GOVERNMENT (US$/yr)
C       TAX=.0
NOTE    PERCENTAGE TAX (dimensionless)
NOTE
NOTE    LOCAL GROSS DOMESTIC PRODUCT
NOTE
L       LGDP.K=LGDP.J+DT*RLGDP.JK
N       LGDP=0
NOTE    LOCAL GROSS DOMESTIC PRODUCT (US$)
R       RLGDP.KL=RGOVT.KL+RAGRPO.KL-ERCOST.KL
NOTE    RATE OF CHANGE OF GROSS DOMESTIC PRODUCT (US$/yr)
A       ELGDP.K=1-MULT1.K
NOTE    EFFECT OF LOCAL GROSS DOMESTIC PRODUCT ON MINING
A       MULT1.K=0
NOTE    MULTIPLIER THAT DETERMINES GOVERNMENT CONTROL OVER MINING
NOTE
NOTE    REHABILITATION COSTS
NOTE
L       RECOST.K=RECOST.J+DT*ERCOST.JK
N       RECOST=0
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NOTE  REHABILITATION COST (US$/yr)
R     RCOST.KL=TREHAB.KL*COST
NOTE  RATE OF REHABILITATION COSTS (US$/yr)
C     COST=1000
NOTE  UNIT COST OF REHABILITATION (US$/ha)
R     ERCOST.KL=CLIP(RCOST.KL,0,TIME.K,2020)
NOTE  COST UNDERTAKEN BY GOVERNMENT (US$/yr)
NOTE
NOTE  AGRICULTURAL PRODUCTION
NOTE
L     AGPRO.K=AGPRO.J+DT*RAGPRO.JK
N     AGPRO=0
NOTE  INCOME OBTAINED FROM AGRICULTURAL PRODUCTION (US$)
R     RAGPRO.KL=AGRU.KL*AGCOST
NOTE  RATE OF AGRICULTURAL PRODUCTION (US$/yr)
C     AGCOST=300
NOTE  INCOME FROM AGRICULTURAL PRODUCTION PER HECTARE (US$/ha)
NOTE
NOTE  EFFECTS OF OVERHEADS AND PROFITS ON MINING ACTIVITIES
NOTE
A     EREAT.K=1
NOTE  EFFECTS OF OVERHEADS AND PROFITS
NOTE
NOTE  ECOLOGICAL MODEL
NOTE
NOTE  REHABILITATION MEASURES
NOTE
L     RELAND.K=RELAND.J+DT*TREHAB.JK
NOTE  NEWLY REHABILITATED LAND
N     RELAND=0
NOTE  INITIAL REHABILITATED LAND (ha)
A     REHAB.K=NREHAB*EHAB.K*MNOUT.K
NOTE  RATE OF REHABILITATION (ha/yr)
R     TREHAB.KL=CLIP(REHAB.K,0,TIME.K,1986)
L     VEGET.K=VEGET.J+DT*REMAT.JK
NOTE  REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
N     VEGET=0
NOTE  INITIAL REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
R     REMAT.KL=RSUCC*ERO.K*DELAY1(TREHAB.KL,5)
NOTE  MATURITY RATE OF THE NEWLY REHABILITATED AREA (ha/yr)
C     NREHAB=0
NOTE  NORMAL REHABILITATED RATE PRACTICED BY SRL (frac./yr)
C     RSUCC=0.65
NOTE  SUCCESS RATE OF THE TREES (fraction)
A     EHAB.K=TABHL(TEHAB,FNHAB.K,0,1,0,1)
NOTE  EFFECT OF MINOUT AREA ON THE RATE OF REHABILITATION (dimensionless)
T     TEHAB=3.83/2.22/2.1/1.8/1.67/1.53/1.25/1.8/2.5/1.67/0
NOTE  TABLE VARIABLE NAME FOR EHAB
A     FMHAB.K=RELAND.K/MAX(MNOUT.K,0.01)
NOTE  FRACTION OF MINED OUT AREA REHABILITATED (dimensionless)
A     MNOUT.K=DMINE.K+EBORL.K+SAND.K
NOTE  MINED OUT AREAS CAPABLE OF BEING REHABILITATED
NOTE
NOTE  ARTIFICIAL LAKES
NOTE
L     VRTL.K=VRTL.J+TARTLA.JK
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NOTE  AVAILABLE ARTIFICIAL LAKES (ha)
N     VRTL=0
NOTE  INITIAL ARTIFICIAL LAKES (ha)
A     ARTLA.K=NARTLF*AVEG.K*EPVAR.K*EREAT.K*ELGDP.K
R     TARTLA.KL=CLIP(ARTLA.K,0,TIME.K,1978)
NOTE  ARTIFICIAL LAKE FORMATION (ha)
C     NARTLF=0.000322
NOTE  NORMAL ARTIFICIAL LAKE FORMATION (fraction/yr)
A     EPVAR.K=TABHL(TEPVAR,FRTLA.K,0,0.3,0.03)
NOTE  EFFECT OF POTENTIAL VEGETATED LAND ON ARTIFICIAL LAKES
T     TEPVAR=.6/1.2/3.6/4.8/6/7.2/6/7.2/7.2/7.2/0
NOTE  TABLE FOR THE EFFECT OF VEGETATED LAND ON ART. LAKES
A     FRTLA.K=VRTL.K/PVEG.K
NOTE  FRACTION OF POTENTIAL VEGETATED LAND OCCUPIED BY ART. LAKES
A     SAND.K=SF*VRTL.K
NOTE  AREA OF SAND TAILINGS (ha)
C     SF=.05
NOTE  FRACTION OF ARTIFICIAL LAKES THAT IS SAND TAILINGS
NOTE
NOTE  EXCAVATION
NOTE
L     EXCVL.K=EXCVL.J+DT*AMINE.JK
NOTE  TOTAL EXCAVATED AREA
N     EXCVL=0
NOTE  INITIAL EACAVATED AREA (ha)
R     AMINE.KL=NMINEF*AVEG.K*EMVEG.K*EREAT.K*ELGDP.K
NOTE  RATE OF EXCAVATION (ha/yr)
C     NMINEF=0.000322
NOTE  NORMAL EXCAVATION FRACTION (fraction/yr)
A     EMVEG.K=TABHL(TEMVEG,FMINV.K,0,0.1,0.01)
NOTE  EFFECT OF EXCAVATION ON VEGETATION
T     TEMVEG=1,1,1,1,1,1,1,1,1,0
NOTE  TABLE VARIABLE NAME FOR EMVEG
A     FMINV.K=DMINE.K/PVEG.K
NOTE  FRACTION OF VEGETATED AREAS THAT ARE MINED OUT
NOTE
NOTE  SOIL EROSION
NOTE
L     SLOSS.K=SLOSS.J*RLOSS.JK
NOTE  TOTAL SOIL LOSS (tons)
N     SLOSS=0
NOTE  INITIAL SOIL LOSS (tons)
R     RLOSS.KL=R*K*C*SL.K*EROBLE.k*10
NOTE  TOTAL SOIL LOSS RATE (tons/yr)
A     LOSSR.K=R*K*C*P*SL.K
NOTE  SOIL LOSS RATE
C     R=1400
NOTE  RAINFALL EROSION INDEX
C     K=0.0251
NOTE  SOIL ERODIBILITY
C     P=1
NOTE  EROSION CONTROL PRACTICE
A     SL.K=TABHL(TSL,L.K,0,50000,5000)
NOTE  SLOPE LENGTH FACTOR
T     TSL=0/42.5/60.1/73.6/85/95/104.1/112.5/120.3/127.5/134.5
NOTE  TABLE VARIABLE FOR SLOPE LENGTH FACTOR
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A       L.K=EROBLE.K*10000/BR
NOTE    LENGTH OF ERODABLE AREAS (m)
A       EROBLE.K=EXCVL.K+SAND.K
NOTE    AREAS IN THE MINED OUT AREAS THAT ARE SUBJECT TO EROSION
C       BR=22.13
C       C=1
NOTE    COVER FACTOR
A       ERO.K=TABHL(TERO,LOSSR.K,20,1520,300)
NOTE    EFFECT OF SOIL EROSION ON REHABILITATION
T       TERO=1.0/.95/.92/.9/.85/.8
NOTE    TABLE VARIABLE FOR  ERO
C       TLOSSR=20
NOTE    TOLERABLE SOIL LOSS RATE (kg/m2/yr)
NOTE
NOTE    VEGETATION AND AGRICULTURAL LAND-USE SYSTEMS
NOTE
NOTE    VEGETATION
NOTE
L       AVEG.K=AVEG.J+DT*(REMAT.JK-ARTLA.JK-AMINE.JK)
NOTE    AVAILABLE VEGETATION (ha)
N       AVEG=PVEG
NOTE    INITIAL VEGETATED AREA (ha)
A       DVEG.K=PVEG.K-AVEG
NOTE    DESTROYED VEGETATION (ha)
C       LEASE=3221504
NOTE    TOTAL LEASE AREA (ha)
C       HOUSE=12652
NOTE    TOTAL SETTLEMENT AREAS (ha)
NOTE
NOTE    UPLAND CULTIVATION
NOTE
L       AVGR.K=AVGR.J+DT*(0.7*AGRU.JK-0.3*AMINE.JK-FALLOW.JK)
NOTE    AVAILABLE CULTIVATED AREAS (ha)
N       AVGR=74095
NOTE    INITIAL CULTIVATED AREA (ha)
R       AGRU.KL=AGRU1.K-AGRU2.K
NOTE    EFFECTIVE AGRICULTURAL LAND USE RATE (ha/yr)
A       AGRU1.K=NAGRF*POAGR.K*EAGRV.K
NOTE    AGRICULTURAL LAND USE RATE (ha/yr)
C       NAGRF=0.02
NOTE    NORMAL AGRICULTURAL LAND USE FRACTION (fraction/yr)
A       EAGRV.K=TABHL(TEAGRV,FAGRV,0,1,0.1)
T       TEAGRV=1/1/.95/.9/.85/.8/.75/.7/.5/.3/0
NOTE    TABLE FOR EAGRV
A       FAGRV.K=AVGR.K/POAGR.K
NOTE    FRACTION OF POTENTIAL AGRICULTURAL LAND THAT IS CULTIVATED
A       AGRU2.K=MGRATE.K*ALUP
NOTE    AGRICULTURAL LAND USE DUE TO DISPLACED POPULATION (ha/yr)
C       ALUP=0.13
NOTE    AVERAGE AGRICULTURAL LAND USE PER PERSON PER YEAR (ha/person/yr)
NOTE
NOTE    SWAMP CULTIVATION
NOTE
L       SCULT.K=SCULT.J+DT*(0.3*AGRU.JK-0.3*ARTLA.JK)
NOTE    CULTIVATED VALLEY SWAMPS (ha)
N       SCULT=90202
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```
NOTE   INITIAL CULTIVATED SWAMPS (ha)
NOTE
NOTE   VALLEY SWAMPS
NOTE
L      SWAMPS.K=SWAMPS.J+DT*(0.3*AGRU.JK-ARTLA..JK)
NOTE   VALLEY SWAMPS INCLUDING MANGROVE
N      SWAMPS=90202
NOTE   EXISTING SWAMPS (ha)
A      USWAMP.K=SWAMPS.K-SCULT.K
NOTE   UNCULTIVATED SWAMPS (ha)
A      TCULT.K=SCULT.K+AVGR.K
NOTE   TOTAL CULTIVATED AREAS  (ha)
NOTE
NOTE   FARM BUSH
NOTE
L      FLAND.K=FLAND.J+DT*(FALLOW.JK-FAMAT.JK-0.5*AMINE..JK)
NOTE   FARM BUSH
N      FLAND=2805930
NOTE   INITIAL FARM BUSH (ha)
R      FALLOW.KL=(0.65*AVGR.K)/CP2
NOTE   RATE AT WHICH THE CULTIVATED LAND IS PUT UNDER FALLOW(ha/yr)
C      CP2=2
NOTE   AVERAGE CULTIVATION PERIOD (yrs)
NOTE
NOTE   SECONDARY FOREST (MATURED FALLOW LAND)
NOTE
L      MATUR.K=MATUR.J+DT*(FAMAT.JK-0.7*AGRU.JK-0.5*AMINE.JK)
NOTE   SECONDARY FOREST

N      MATUR=161075
NOTE   SECONDARY FOREST (ha)
R      FAMAT.KL=FLAND.K/FP
NOTE   RATE AT WHICH THE FALLOW LAND MATURES (ha/yr)
C      FP=10
NOTE   THE FALLOW PERIOD (yrs)
A      POAGR.K=MATUR.K+USWAMP.K
NOTE   POTENTIAL AGRICULTURAL LAND (ha)
N      TIME=1956
NOTE   BEGINNING OF SIMULATION
NOTE
NOTE   SOCIAL MODEL
NOTE
NOTE   IN-MIGRATION
L      MIG.K=MIG.J+DT*RMIG.JK
N      MIG=0
NOTE   MIGRANTS

R      RMIG.KL=FRMG*(DVEG.K*LABN)/DAT
NOTE   RATE OF IN-MIGRATION
C      DAT=1
NOTE   POPULATION ADJUSTMENT TIME
C      FRMG=2
NOTE   FACTOR TO TAKE CARE OF FAMILIES
NOTE   CONTROL STATEMENTS
NOTE
SAVE   AVEG,DVEG,VRTL,ARTLA,EXCVL,AVGR,^
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      LGDP,RELAND,REHAB,SLOSS,RLOSS,LOSSR,AGRU,FLAND,^
      AGPRO,MATUR,POAGR,PRO,RPRO,AMOUNT,GOVT,RECOV,RECOST,DPOP,^
      SAND,DMINE,SWAMPS,TCULT,FLAND,MATUR,DVEGM,^
      USWAMP,VEGET,REMAT,RGOVT,RCOST,RAGPRO,RLGDP,RCOV,TREHAB,MIG,RMIG
SPEC  DT=0.25/LENGTH=2040/SAVPER=1/PRTPER=1/PLOTPER=1
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*       SUB-SYSTEM 4 – NATIONAL DIAMOND MINING COMPANY
NOTE
NOTE    ECONOMIC MODEL
NOTE
NOTE    PRODUCTION
NOTE
L       PRO.K=PRO.J+DT*RPRO.JK
N       PRO=0
NOTE    PRODUCED DAIMONDS (carats)
R       RPRO.KL=(DVEG.K*ARCON)/PAT
NOTE    RATE OF DIAMOND PRODUCTION (carats/yr)
C       PAT=4
NOTE    PRODUCTION ADJUSTMENT TIME
A       DVEGM.K=VRTL.K+DMINE.K
NOTE    AREAS WHERE MINERAL WAS EXTRACTED (ha)
C       ARCON=279
NOTE    AVERAGE DAIMOND CONTENT OF LAND (carats/ha)
NOTE
NOTE    OVERHEADS AND PROFITS
NOTE
L       RECOV.K=RECOV.J+DT*RCOV.JK
N       RECOV=0
NOTE    OVERHEADS AND PROFITS OF THE COMPANY (US$)
R       AMOUNT.KL=RPRO.KL*PRICE
NOTE    AMOUNT FROM THE SALE OF DIAMONDS (US$/yr)
C       PRICE=52
NOTE    WORLD MARKET PRICE FOR DAIMONDS (US$/carat)
R       RCOV.KL=AMOUNT.KL-RGOVT.KL-RCOST.KL
NOTE    RECOVERY RATE FROM SALES (US$/yr)
NOTE
NOTE    TAXES AND ROYALTIES
NOTE
L       GOVT.K=GOVT.J+DT*RGOVT.JK
N       GOVT=0
NOTE    GOVERNMENT PROCEEDS FROM MINING (US$)
R       RGOVT.KL=TAX*AMOUNT.KL
NOTE    TAXES AND ROYALTIES TO GOVERNMENT (US$/yr)
C       TAX=.0.51
NOTE    PERCENTAGE TAX (dimensionless)
NOTE
NOTE    LOCAL GROSS DOMESTIC PRODUCT
NOTE
L       LGDP.K=LGDP.J+DT*RLGDP.JK
N       LGDP=0
NOTE    LOCAL GROSS DOMESTIC PRODUCT (US$)
R       RLGDP.KL=RGOVT.KL+RAGRPO.KL-ERCOST.KL
NOTE    RATE OF CHANGE OF GROSS DOMESTIC PRODUCT (US$/yr)
A       ELGDP.K=1-MULT1.K
NOTE    EFFECT OF LOCAL GROSS DOMESTIC PRODUCT ON MINING
A       MULT1.K=0
NOTE    MULTIPLIER THAT DETERMINES GOVERNMENT CONTROL OVER MINING
NOTE
NOTE    REHABILITATION COSTS
NOTE
L       RECOST.K=RECOST.J+DT*RCOST.JK
N       RECOST=0
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NOTE  REHABILITATION COST (US$/yr)
R     RCOST.KL=TREHAB.KL*COST
NOTE  RATE OF REHABILITATION COSTS (US$/yr)
C     COST=2469
NOTE  UNIT COST OF REHABILITATION (US$/ha)
R     ERCOST.KL=CLIP(RCOST.KL,0,TIME.K,2020)
NOTE  COST UNDERTAKEN BY GOVERNMENT (US$/yr)
NOTE
NOTE  AGRICULTURAL PRODUCTION
NOTE
L     AGPRO.K=AGPRO.J+DT*RAGPRO.JK
N     AGPRO=0
NOTE  INCOME OBTAINED FROM AGRICULTURAL PRODUCTION (US$)
R     RAGPRO.KL=AGRU.KL*AGCOST
NOTE  RATE OF AGRICULTURAL PRODUCTION (US$/yr)
C     AGCOST=300
NOTE  INCOME FROM AGRICULTURAL PRODUCTION PER HECTARE (US$/ha)
NOTE
NOTE  EFFECTS OF OVERHEADS AND PROFITS ON MINING ACTIVITIES
NOTE
A     EREAT.K=1
NOTE  EFFECTS OF OVERHEADS AND PROFITS
NOTE
NOTE  ECOLOGICAL MODEL
NOTE
NOTE  REHABILITATION MEASURES
NOTE
L     RELAND.K=RELAND.J+DT*TREHAB.JK
NOTE  NEWLY REHABILITATED LAND
N     RELAND=0
NOTE  INITIAL REHABILITATED LAND (ha)
A     REHAB.K=NREHAB*EHAB.K*MNOUT.K
NOTE  RATE OF REHABILITATION (ha/yr)
R     TREHAB.KL=CLIP(REHAB.K,0,TIME.K,1986)
L     VEGET.K=VEGET.J+DT*REMAT.JK
NOTE  REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
N     VEGET=0
NOTE  INITIAL REHABILITATED AREAS THAT ACTUALLY MATURES (ha)
R     REMAT.KL=RSUCC*ERO.K*DELAY1(TREHAB.KL,5)
NOTE  MATURITY RATE OF THE NEWLY REHABILITATED AREA (ha/yr)
C     NREHAB=0
NOTE  NORMAL REHABILITATED RATE PRACTICED BY SRL (frac./yr)
C     RSUCC=0.75
NOTE  SUCCESS RATE OF THE TREES (fraction)
A     EHAB.K=TABHL(TEHAB,FNHAB.K,0,1,0,1)
NOTE  EFFECT OF MINOUT AREA ON THE RATE OF REHABILITATION (dimensionless)
T     TEHAB=3.83/2.22/2.1/1.8/1.67/1.53/1.25/1.8/2.5/1.67/0
NOTE  TABLE VARIABLE NAME FOR EHAB
A     FMHAB.K=RELAND.K/MAX(MNOUT.K,0.01)
NOTE  FRACTION OF MINED OUT AREA REHABILITATED (dimensionless)
A     MNOUT.K=EXCVL.K
NOTE  MINED OUT AREAS CAPABLE OF BEING REHABILITATED
NOTE
NOTE  EXCAVATION
NOTE
L     EXCVL.K=EXCVL.J+DT*AMINE.JK
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NOTE  TOTAL EXCAVATED AREA
N     EXCVL=0
NOTE  INITIAL EACAVATED AREA (ha)
A     VEARTH.K=EXCVL.K*10000*DP
NOTE  VOLUME OF EARTH BORROWED (m3)
C     DP=3
NOTE  AVERAGE DEPTH OF MINING (m)
NOTE
NOTE  DRY MINING OPERATION
NOTE
L     DMINE.K=DMINE.J+DT*AMINE.JK
NOTE  EXCAVATED AREAS THROUGH DRY MINING (ha)
N     DMINE=0
NOTE  INITIAL DRY MINED AREAS (ha)
R     MINE.KL=NMINEF*AVEG.K*EMVEG.K*EREAT.K*ELGDP.K
NOTE  RATE OF DRY MINING (ha/yr)
C     NMINEF=0.0014
NOTE  NORMAL DRY MINING FRACTION (fraction/yr)
NOTE  ACTUAL STARTING DATE OF THE DRY MINING OPERATION
A     EMVEG.K=TABHL(TEMVEG,FMINV.K,0,0.1,0.01)
NOTE  EFFECT OF DRY MINING ON VEGETATION
T     TEMVEG=1,1,1,1,1,1,1,1,1,0
NOTE  TABLE VARIABLE NAME FOR EMVEG
A     FMINV.K=DMINE.K/PVEG.K
NOTE  FRACTION OF VEGETATED AREAS THAT ARE MINED OUT
NOTE
NOTE  SOIL EROSION
NOTE
L     SLOSS.K=SLOSS.J*RLOSS.JK
NOTE  TOTAL SOIL LOSS (tons)
N     SLOSS=0
NOTE  INITIAL SOIL LOSS (tons)
R     RLOSS.KL=R*K*C*SL.K*EROBLE.k*10
NOTE  TOTAL SOIL LOSS RATE (tons/yr)
A     LOSSR.K=R*K*C*P*SL.K
NOTE  SOIL LOSS RATE
C     R=1400
NOTE  RAINFALL EROSION INDEX
C     K=0.0251
NOTE  SOIL ERODIBILITY
C     P=1
NOTE  EROSION CONTROL PRACTICE
A     SL.K=TABHL(TSL,L.K,0,50000,5000)
NOTE  SLOPE LENGTH FACTOR
T     TSL=0/42.5/60.1/73.6/85/95/104.1/112.5/120.3/127.5/134.5
NOTE  TABLE VARIABLE FOR SLOPE LENGTH FACTOR
A     L.K=EROBLE.K*10000/BR
A     EROBLE.K=EXCVL.K+SAND.K
NOTE  AREAS IN THE MINED OUT AREAS THAT ARE SUBJECT TO EROSION
C     BR=22.13
C     C=1
NOTE  COVER FACTOR
A     ERO.K=TABHL(TERO,LOSSR.K,20,1520,300)
NOTE  EFFECT OF SOIL EROSION ON REHABILITATION
T     TERO=1.0/.95/.92/.9/.85/.8
NOTE  TABLE VARIABLE FOR  ERO
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C       TLOSSR=20
NOTE    TOLERABLE SOIL LOSS RATE (kg/m2/yr)
NOTE
NOTE    VEGETATION AND AGRICULTURAL LAND-USE SYSTEMS
NOTE
NOTE    VEGETATION
NOTE
L       AVEG.K=AVEG.J+DT*(REMAT.JK-AMINE.JK)
NOTE    AVAILABLE VEGETATION (ha)
N       AVEG=PVEG
NOTE    INITIAL VEGETATED AREA (ha)
A       DVEG.K=PVEG.K-AVEG
NOTE    DESTROYED VEGETATION (ha)
C       LEASE=77440
NOTE    TOTAL LEASE AREA (ha)
C       HOUSE=252
NOTE    TOTAL SETTLEMENT AREAS (ha)
A       PVEG.K=LEASE-HOUSE
NOTE
NOTE    UPLAND CULTIVATION
NOTE
L       AVGR.K=AVGR.J+DT*(0.7*AGRU.JK-0.2*AMINE.JK-FALLOW.JK)
NOTE    AVAILABLE CULTIVATED AREAS (ha)
N       AVGR=14823
NOTE    INITIAL CULTIVATED AREA (ha)
R       AGRU.KL=AGRU1.K-AGRU2.K
NOTE    EFFECTIVE AGRICULTURAL LAND USE RATE (ha/yr)
A       AGRU1.K=NAGRF*POAGR.K*EAGRV.K
NOTE    AGRICULTURAL LAND USE RATE (ha/yr)
C       NAGRF=0.02
NOTE    NORMAL AGRICULTURAL LAND USE FRACTION (fraction/yr)
A       EAGRV.K=TABHL(TEAGRV,FAGRV,0,1,0.1)
T       TEAGRV=1/1/.95/.9/.85/.8/.75/.7/.5/.3/0
NOTE    TABLE FOR EAGRV
A       FAGRV.K=AVGR.K/POAGR.K
NOTE    FRACTION OF POTENTIAL AGRICULTURAL LAND THAT IS CULTIVATED
A       AGRU2.K=MGRATE.K*ALUP
NOTE    AGRICULTURAL LAND USE DUE TO DISPLACED POPULATION (ha/yr)
C       ALUP=0.13
NOTE    AVERAGE AGRICULTURAL LAND USE PER PERSON PER YEAR (ha/person/yr)
NOTE
NOTE    SWAMP CULTIVATION
NOTE
L       SCULT.K=SCULT.J+DT*0.3*AGRU.JK
NOTE    CULTIVATED VALLEY SWAMPS (ha)
N       SCULT=270
NOTE    INITIAL CULTIVATED SWAMPS (ha)
NOTE
NOTE    VALLEY SWAMPS
NOTE
L       SWAMPS.K=SWAMPS.J+DT*(0.3*AGRU.JK)
NOTE    VALLEY SWAMPS INCLUDING MANGROVE
N       SWAMPS=282
NOTE    EXISTING SWAMPS (ha)
R       RSWAMPS.KL=0
A       USWAMP.K=SWAMPS.K-SCULT.K
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NOTE   UNCULTIVATED SWAMPS (ha)
A      TCULT.K=SCULT.K+AVGR.K
NOTE   TOTAL CULTIVATED AREAS  (ha)
NOTE
NOTE   FARM BUSH
NOTE
L      FLAND.K=FLAND.J+DT*(FALLOW.JK-FAMAT.JK-0.3*AMINE..JK)
NOTE   FARM BUSH
N      FLAND=42476
NOTE   INITIAL FARM BUSH (ha)
R      FALLOW.KL=(0.65*AVGR.K)/CP2
NOTE   RATE AT WHICH THE CULTIVATED LAND IS PUT UNDER FALLOW(ha/yr)
C      CP2=2
NOTE   AVERAGE CULTIVATION PERIOD (yrs)
NOTE
NOTE   SECONDARY FOREST (MATURED FALLOW LAND)
NOTE
L      MATUR.K=MATUR.J+DT*(FAMAT.JK-0.7*AGRU.JK-0.5*AMINE.JK)
NOTE   SECONDARY FOREST
N      MATUR=23268
NOTE   SECONDARY FOREST (ha)
R      FAMAT.KL=FLAND.K/FP
NOTE   RATE AT WHICH THE FALLOW LAND MATURES (ha/yr)
C      FP=10
NOTE   THE FALLOW PERIOD (yrs)
A      POAGR.K=MATUR.K+USWAMP.K
NOTE   POTENTIAL AGRICULTURAL LAND (ha)
N      TIME=1930
NOTE   BEGINNING OF SIMULATION
NOTE
NOTE   SOCIAL MODEL
NOTE
NOTE   POPULATION DISPLACEMENT
NOTE
L      DPOP.K=DPOP.J+DT*RPOP.JK
N      DPOP=0
NOTE   DISPLACED POPULATION (persons)
R      RPOP.KL=(DVEG.K*POPD)/DAT
NOTE   RATE OF POPULATION DISPLACEMENT
C      POPD=0
NOTE   POPULATION DENSITY (persons/ha)
C      DAT=1
NOTE   POPULATION ADJUSTMENT TIME (yrs)
NOTE
NOTE   EMPLOYMENT AND UNEMPLOYMENT SITUATION
NOTE
A      EPRU.K=FRRU*DPOP.K
NOTE   NUMDER OF DISPLACED PEOPLE EMPLOYED BY SIERRA RUTILE
C      FRRU=.05
NOTE   NORMAL PERCENTAGE EMPLOYED
A      UEMP.K=DPOP.K-EPRU.K
NOTE   UNEMPLOYED POPULATION
NOTE
NOTE   MIGRATION INTO OTHER AREAS
NOTE
A      MGRATE.K=FRMG*DPOP.K
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NOTE   OUT-MIGRATION INTO OTHER AREAS (persons)
C      FRMG=0.001
NOTE   FRACTION OF DISPLACED PEOPLE NOT RESETTLED IN MINING ZONE
NOTE
NOTE   RESETTLEMENT AND ITS EFFECTS
NOTE
L      SETTL.K=SETTL.J+DT*RSETTL.JK
NOTE   LAND NEED FOR RESETTLEMENT (ha)
N      SETTL=0
NOTE   INITIAL LAND NEED FOR RESETTLEMENT (ha)
R      RSETTL.KL=DPOP.K*LAND/DAT
NOTE   RATE OF LAND NEED FOR RESETTLEMENT (ha/yr)
C      LAND=0.002
NOTE   LAND NEEDED PER PERSON FOR RESETTLEMENT (ha/person)
NOTE
NOTE   CONTROL STATEMENTS
NOTE
SAVE   AVEG,DVEG,VRTL,ARTLA,EXCVL,AVGR,^
       LGDP,RELAND,REHAB,SLOSS,LOSSR,AGRU,FLAND,^
       AGPRO,MATUR,POAGR,PRO,RPRO,AMOUNT,GOVT,RECOV,RECOST,DPOP,^
       RPOP,UEMP,DMINE,SWAMPS,TCULT,TCULT,FLAND,MATUR,DVEGM,^
       USWAMP,VEGET,REMAT,RGOVT,RCOST,RAGPRO,RLGDP,RCOV,TREHAB,MIG,RMIG
SPEC   DT=0.25/LENGTH=2040/SAVPER=1/PRTPER=1/PLOTPER=1
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LIST OF VARIABLES

SYMBOL	TYPE	DEFINITION
AGPRO	L	INCOME ABTAINED FROM AGRICULTURAL PRODUCTION (US$)
AGCOST	C	UNIT COST OF AGRICULTURAL PRODUCTION (US$/ha)
AGRU	R	EFFECTIVE AGRUCULTURAL LAND USE RATE (US$/yr)
AGRU1	A	NORMAL AGRUCULTURAL LAND USE RATE (US$/yr)
AGRU2	A	AGRUCULTURAL LAND USE DUE TO DISPLACED POPULATION (US$/yr)
AMOUNT	R	AMOUNT OBTAINED FROM THE SALE OF MINERAL (US$/yr)
ALUP	C	AVERAGE AGRICULTURAL LAND USE PER PERSON PER YEAR (ha/person/ yr)
ARCON	C	AVERAGE MINERAL CONTENT OF LAND (tons/yr)
ARTLA	R	ARTIFICIAL LAKE FORMATION (ha/yr)
AVEG	L	AVAILABLE VEGETATION (ha)
AVGR	L	CULTIVATED LAND AREA (ha)
AVGRN	C	INITIAL CULTIVATED LAND (ha)
BR	C	BREATH OF SLOPE (m)
C	C	VEGETATION COVER FACTOR
COST	C	UNIT COST OF REHABILITATION (US$/ha)
CP	C	AVERAGE CULTIVATION PERIOD (yrs)
DAT	C	POPULATION ADJUSTMENT TIME (yrs)
DP	C	AVERAGE DEPTH OF BORROWED PITS (m)
DEPTH	C	AVERAGE DEPTH OF DAM (m)
DPOP	L	DISPLACED POPULATION (persons)
DSTORE	R	RATE OF DESTRUCTION OF LAND THROUGH WATER STORAGE (ha/yr)
DVEG	A	DESTROYED VEGETATION (ha)
DMINE	L	EXCAVATED AREAS THROUGH DRY MINING (ha)
ERCOST	R	RATE OF REHABILITATION COST INCURRED BY GOVERNMENT (US$/yr)
ERVEG	A	EFFECT OF ROAD CONSTRUCTION ON VEGETATION
EHAB	A	EFFECT OF MINED OUT AREAS ON REHABILITATION
EPVAR	A	Effect Of Potential Vegetated Land On Artificial Lakes.
EREAX	A	EFFECTS OF OVERHEADS AND PROFITS ON MINING
ERAEX	A	EFFECT OF OVERHEADS AND PROFITS ON ROAD CONSTRUCTION RATE
EREAT	A	EFFECT OF OVERHEADS AND PROFITS ON THE ARTIFICIAL LAKE FORMATION.
EBOR	L	BORROWED AREAS (HA)
EAGRV	A	EFFECT OF POTENTIAL VEGETATED AREA ON AGRICULTURE
EHAB	A	EFFECT OF MINED OUT AREAS ON REHABILITATION
EPRU	A	NUMBER OF DISPLACED PEOPLE EMPLOYED IN MINING (persons)
EPVAR	A	EFFECT OF POTENTIAL VEGETATED AREAS ON ARTIFICIAL LAKE FORMATION
EBVEG	A	EFFECT OF EARTH BORROWING ON VEGETATION
ERO	A	EFFECT OF SOIL EROSION ON REHABILITATION
ESTOV	A	EFFECT OF WATER STORAGE ON VEGETATION
ELGDP	A	EFFECT OF LOCAL GDP ON MINING

EXCV	R	EXCAVATION RATE (ha/yr).
EXCVL	L	EXCAVATED LAND (ha)
EXVEG	A	EFFECT OF POTENTIAL VEGETATION ON EXCAVATION
EMVEG	A	EFFECT OF DRY MINING ON VEGETATION
FAGRV	A	FRACTION OF POTENTIAL AGRIC. LAND THAT IS CULTIVATED
FALLOW	R	RATE AT WHICH CULTIVATED LAND IS PLACED UNDER FALLOW (ha/yr)
FAMAT	R	RATE AT WHICH FALLOW LAND MATURES (ha/yr)
FEXCV	A	FRACTION OF POTENTIAL VEGETATED LAND EXCAVATED
FLAND	L	LAND UNDER FALLOW (ha)
FLANDN	C	INITIAL FALLOW LAND (ha)
FROVEG	A	FRACTION OF VEGETATED LAND THAT IS USED FOR ROADS CONSTRUCTION
FARTLA	A	FRACTION OF LAND OCCUPIED BY ARTIFICIAL LAKES
FMHAB	A	FRACTION OF MINED OUT AREA REHABILITATED
FBOVEG	A	FRACTION OF VEGETATED LAND BORROWED
FMINV	A	FRACTION OF VEGETATED AREAS THAT ARE MINED OUT
FP	C	FALLOW PERIOD (yr)
FRRU	C	NORMAL PERCENTAGE OF DISPLACED PEOPLE EMPLOYED IN MINING
FRTLA	A	FRACTION OF POTENTIAL VEGETATED LAND OCCUPIED BY ARTIFICIAL LAKES
FSTOVO	A	FRACTION OF TOTAL PRECIPITATION THAT IS STORED
GOVT	L	TAXES AND ROYALTIES TO GOVERNMENT (US$)
K	C	SOIL ERODIBILITY FACTOR
LOSSR	A	EFFECTIVE SOIL LOSS RATE (tons/ha/yr)
L	C	LENGTH OF THE SLOPE (m)
LSTORE	L	LAND DESTROYED DUE TO WATER STORAGE IN DAMS (ha)
MATUR	L	MATURED FALLOW LAND – SECONDARY FOREST (ha)
MATURN	C	INITIAL MATURED FALLOW LAND (ha)
MNOUT	A	MINED OUT AREA NOT FLOODED (ha)
MINE	R	RATE OF DRY MINING (ha/yr)
NMINEF	C	NORMAL DRY MINING FRACTION (frac./yr)
NAGRF	C	NORMAL AGRIC. LAND USE FRACTION
NREHAB	C	REHABILITATION RATE IMPOSED BY GOVERNMENT (fraction/yr)
NARTLF	C	NORMAL ARTIFICIAL LAKE FORMATION FRACTION. (fraction/yr)
NEXCVF	C	NORMAN EXCAVATION FRACTION (fraction/yr)
NSTORF	C	NORMAL FRACTION OF LAND DESTROYED THROUGH WATER STORAGE (fraction/yr)
NROADF	C	NORMAL FRACTION OF ROADS CONSTRUCTED PER YEAR (fraction/yr)
NBORF	C	NORMAL EARTH BORROWING RATE (frac./yr)
PAT	C	PRODUCTION ADJUSTMENT TIME (hrs)
PVEG	C	POTENTIAL VEGETATED AREA (ha)
PRICE	C	World Market Price For Mineral (US$/unit)
POAGR	A	POTENTIAL AGRIC. LAND (ha)
POPD	C	POPULATION DENSITY (persons/ha)
PRO	L	PRODUCED MINERAL (unit)
RECOV	A	OVERHEADS AND PROFITS (US$)
RECOST	A	REHABILITATION COSTS (US$)
R	C	RAINFALL EROSION INDEX
RCOST	R	RATE OF REHABILITATION COST INCURMENT (US/yr)
REHAB	R	REHABILITATION RATE (ha/yr)
RAGPRO	R	RATE OF AGRICULTURAL PRODUCTION (US$/yr)
RELAND	R	REHABILITATED LAND (ha)
RECOV	A	MINING COMPANY'S OVERHEADS AND PROFITS (US$)

REMAT	R	RATE OF MATURITY OF THE REHABILITATED AREA (ha/yr)
ROADL	L	SURFACE AREA OF ROADS CONSTRUCTED (ha)
RSUCC	C	SUCCESS RATE (FRACTION)
RSLOSS	R	TOTAL RATE OF SOIL LOSS (tons/yr)
RPOP	R	RATE OF POPULATION DISPLACEMENT (persons/yr)
RPRO	R	RATE OF MINERAL PRODUCTION ((tons/yr)
RSTORE	R	RATE OF WATER STORAGE m3/yr)
SL	A	SLOPE-LENGTH FACTOR
SAND	A	AREA OF SAND TAILINGS (ha)
SF	A	FRACTION OF ARTIFICIAL LAKE THAT IS SAND TAILINGS
SLOSS	L	TOTAL SOIL LOSS (TONS)
ST	C	STORAGE ADJUSTMENT TIME (yrs)
STORE	L	STORAGE VOLUME (m3)
TSS	C	TIME TAKEN FOR THE REHABILITATED AREAS TO MATURE TO A FULLY VEGETATED AREA (yrs)
TAX	C	TAX AND ROYALTIES (fraction)
TEAGRV	T	TABLE FOR THE EFFECT OF POTENTIAL VEGETATED AREA ON AGRICULTURE
TEPVAR	T	TABLE FOR THE EFFECT OF VEGETATED LAND ON ARTIFICIAL LAKES
TERVEG	T	TABLE FOR THE EFFECT OF ROAD CONSTRUCTION ON VEGETATION
TEHAB	T	TABLE FOR THE EFFECT OF MINE OUT AREA ON REHABILITATION
TERO	T	TABLE FOR THE EFFECT OF EROSION ON REHABILITATION
TESTOV	T	TABLE FOR THE EFFECT OF WATER STORAGE ON VEGETATION
TEXVEG	T	TABLE FOR THE EFFECT OF POTENTIAL VEGETATION ON EXCAVATION
TLOSSR	R	TOLERABLE SOIL LOSS RATE (tons/yr)
TIME	N	BEGINNING OF SIMULATION
TOVOL	C	TOTAL MAXIMUM VOLUME OF WATER IN THE MINING AREA (m3/yr)
TSL	T	TABLE VARIABLE FOR SLOPE-LENGTH FACTOR
UEMP	A	UNEMPLOYED POPULATION (persons)
VEGET	L	RE-VEGETATED AREAS THAT ACTUALLY MATURES (ha)
VEARTH	A	VOLUME OF EARTH BORROWED (cubic meter)
VOLS	A	VOLUME TO STORED (m3)
VRTL	L	AVAILABLE ARTIFICIAL LAKES (ha)

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