

**Texas A & M University and U.S. Bureau of Reclamation**  
**Hydrologic Modeling Inventory**  
**Model Description Form**  
May 25, 2007

*[updated: October 06, 2008]*

**Name of Model:** Parched-Thirst –Version 3.0 (2007)

**Model Type:** Process-based and semi-distributed by sub-catchments lumped into hydrological response units

**Model Objective(s):**

1. Evaluation and promotion of rainwater harvesting in semi-arid areas
2. Suitable for operation in poor-resource environments
3. Design instrument for rainwater harvesting

**Agency and Office:**

Soil-Water Management Research Group (SWMRG)  
Sokoine University of Agriculture  
P.O.Box 3003, Morogoro, Tanzania  
Email: [swmrg@suanet.ac.tz](mailto:swmrg@suanet.ac.tz); [sdt116@suanet.ac.tz](mailto:sdt116@suanet.ac.tz)

**Technical Contact and Address:**

Soil-Water Management Research Group (SWMRG)  
Sokoine University of Agriculture  
P.O.Box 3003, Morogoro, Tanzania  
Email: [swmrg@suanet.ac.tz](mailto:swmrg@suanet.ac.tz); [sdt116@suanet.ac.tz](mailto:sdt116@suanet.ac.tz)

**Model Structure or Mathematical Basis:**

Hydrological response units with submodels for stochastic climate generation, soil water, crop growth, runoff/routing simulation

**Model Parameters:**

Soil physical parameters, topography, crop parameters, climate parameters. Layout of the rainwater harvesting system. Two levels of parameters: level to be easily changed by the (novice) user and the advanced level, normally default and only to be changed by experts

**Spatial scale employed in the model:**

Hydrological response units can be from few M<sup>2</sup> to several ha.

**Temporal scale employed in the model:**

Daily timestep for most processes. The infiltration/runoff submodel uses disaggregation of rainfall in smaller timesteps; either generated or observed.

**Input data requirements:**

- Daily meteorological data insofar available. Missing values and variables can be generated.
- Scenarios for Rainwater harvesting.
- Physical characterization (see model parameters).

**Computer requirements:**

Programmed in compiled Visual Basic version requires windows 95/98 or later. Interaction with Excel requires Excel 95/97 or later. Recommended Pentium with min. 32 Mbytes RAM

**Model Output:**

Graphs, Excel spreadsheet interaction ( in- and output), text files

**Parameter estimation/model calibration:**

Physical parameters require field measurements and estimation by pedotransfer functions. In principle no calibration required.

### **Model testing and verification:**

Testing and verification of the climate generator (historic data versus stochastic), runoff model (event by event), soil water model (soil water content at regular intervals) and crop model (final yield and leaf area index during growing season).

### **Model sensitivity:**

Very high sensitivity to the soil water retention parameters

### **Model Reliability:**

Reliability dependent on the quality of the physical parameters and meteorological variables

### **Model Application/Case studies:**

- Designed experimental fields and farmers field in Kisangara ( Kilimanjaro region; Tanzania).
- Designed experimental fields at Morogoro (Tanzania). Farmers fields at Mwanza (Tanzania). Validation of pedotransfer functions for the model in Tanzania and Uganda.
- PT Model as a Tool for Studying Farming and Conservation Measures in High Slope Areas: Case-Study of Vidunda Village in Kilosa District.
- The Use of PT Model in Determining Appropriate Management Practices for Maize production in Fulwe Village in Morogoro District.
- Using PT Model to Understand the Importance of Rainwater Harvesting in Semi-Arid/Arid Areas: The Case Study of a Field in Makanya Village, Same District.
- Using PARCHED-THIRST model and seasonal rainfall forecast to forecast maize yield.
- Use of PT model to study drought recurrence in Tanzania.

### **Documentation:**

[http://www.agr.kuleuven.ac.be/vakken/IC03\\_IC04/runoffirri/PTModel\\_download.aspx](http://www.agr.kuleuven.ac.be/vakken/IC03_IC04/runoffirri/PTModel_download.aspx)

### **References to the model:**

- M.D.B. Young,, J.W. Gowing, G.C.L. Wyseure, N. Hatibu. 2002 .Parched–Thirst: development and validation of a process-based model of rainwater harvesting. *Agricultural Water management* 55: 121-140.
- Wyseure G.C.L, J.W. Gowing and M.D.B. Young. 2002. PARCHED-THIRST: an agrohydrological model for planning rainwater harvesting systems in semi-arid areas. Invited chapter in VP.Singh and D Fervert. *Mathematical Models of Small Watershed Hydrology and Applications*. Water Resources Publications. (ISBN 1-887201-35-1 with CD-ROM).
- N. Hatibu, M. D. B. Young, J. W. Gowing H. F. Mahoo and O. B. Mzirai. 2003. Developing Improved Dryland Cropping Systems For Maize In Semi-Arid Tanzania. Part 1: Experimental Evidence For The Benefits Of Rainwater Harvesting. *Experimental Agriculture*, 39:279-292
- J. W. Gowing, M. D. B. Young, N. Hatibu, H. F. Mahoo, F. Rwehumbiza and O. B. Mzirai. 2003. Developing Improved Dryland Cropping Systems For Maize In Semi-Arid Tanzania. Part 2:. Use of a Model to extrapolate and add value to experimental results. *Experimental Agriculture*, 39: 293-306
- Tumbo S.D., T. Mpulila, O.B. Mzirai, H.F. Mahoo, F.B. Rwehumbiza, J.M.R. Semoka and N. Hatibu. 2005. Maize Yield Simulation under Rain-fed and Rainwater Harvesting Systems using Parched-Thirst Model, in Bruce A.L. and H.F. Mahoo (Eds), *Proceedings of the East Africa Integrated River Basin Management Conference* , 7-9th March 2005, Morogoro, Tanzania.
- Mzirai, O. B., Tumbo, S. D., Bwana, T., Hatibu, N., Rwehumbiza, F. B. and J. W. Gowing. Evaluation of Simulators of Synthetic Missing Climate Data Required for Agro-hydrological Modelling and Water Management Planning: The Case of the PARCHED-THIRST and MarkSim Models. *Proceedings of the East Africa Integrated River Basin Management Conference*. 7th – 9th March, 2005. Sokoine University of Agriculture, Morogoro, Tanzania. Edited by B. A. Lankford and H.F. Mahoo. ISBN 9987-681-13-1, pp 338 – 347.

#### Handbook with tutorials

- Omari B. Mzirai, Thomas Bwana, Siza D. Tumbo, Filbert B. Rwehumbiza and Henry Mahoo. PT handbook No 1; Soil Water Management Research Group (SWMRG), SUA, Morogoro, Tanzania
- Tumbo, S. D., Mahoo, H. F., and N. I. Kihupi (Editors). 2006. PARCHED-THIRST case studies: The use of agro-hydrological simulation models in agriculture. SWMRG.
- Tumbo, S. D., Mahoo, H. F., and N. I. Kihupi (Editors). 2006. A Manual for Virtual Laboratory Experiments in Agriculture. The Use of PARCHED-THIRST software in Agricultural Systems Simulations. SWMRG, ISBN 9987-681-15-8.

#### **Other Comments:**

Model suitable for applications in developing countries. Special modules try to cope with limited and lower quality data. Pedotransfer functions to relate simple soil characteristics to soil physical parameters and stochastic climate generator.