

Promoting farm-level use of a crop-soil simulation model

Supporting farmers using rainwater harvesting



Researchers have developed crop-soil simulation models that are relevant to improving agriculture in developing countries. However, in most cases, these models have not been developed in response to well-articulated demand from potential end-users such as planners, local service providers and farmers. Indeed most potential users are not experienced in the use of models nor do they appreciate the relevance of models to their work. In spite of this, simulation models do have potential for supporting development planning and farm management decisions. In Tanzania a model that started life as a research tool is now being used to help farmers who produce maize and rice using rainwater harvesting systems.

Rainwater harvesting

Since 1992 the Soil and Water Management Research Group (SWMRG) at Sokoine University of Agriculture has been working to promote rainwater harvesting to improve maize and rice production in the semi-arid regions of Tanzania. It is a method of farming that is highly relevant to sub-Saharan Africa as it occupies the middle ground between arable farming that solely depends on rainfall and irrigated agriculture that requires relatively large investment in structures and equipment for water management. Rainwater harvesting is about collecting rainwater runoff from a catchment area and channelling it to increase the water available in smaller cropped areas. Some farmers practice this technique on individual farms but Tanzanian farmers generally prefer macro-catchment

systems that collect runoff from large, distant catchments and serve many farms.

SWMRG has pursued a programme of technical research on rainwater harvesting alongside a sustained effort over many years to change the perceptions of both government and the farming community. This comprehensive strategy has proved successful and rainwater harvesting is now fully recognised in the country's Agricultural Sector Development Strategy and is a common feature in district council development plans.

PARCHED-THIRST

A computer-based simulation model – known as PARCHED-THIRST (PT) – supports Sokoine's strategy for promoting the use of rainwater harvesting. The PT model is agro-hydrologically based and is capable of simulating maize and rice production under both rainfed conditions and rainwater harvesting systems. It was jointly developed by the University of Newcastle in the UK and Sokoine University of Agriculture.

Field trials conducted over several seasons indicated higher maize yields were obtained through rainwater harvesting. But these findings were inevitably restricted to the specific trial sites for a limited number of seasons. Given the extreme variability of rainfall patterns and its dominant influence on crop performance, extrapolation and transfer of experimental results was recognised from the outset as a difficult problem. Researchers turned to simulation modelling as a solution because it enabled them to simulate reliability and risk for crop performance at various sites over 20 to 30 years providing good historical rainfall data were available.



District planners are now using PT to develop plans as well as provide advice to farmers on rainwater harvesting

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Researchers recognised the potential of PT as a tool that could help farmers and those working for farming communities to make good decisions about investment in rainwater harvesting, scheme design, and crop management. However, in order for PT to benefit farmers, a more 'user-friendly' version was needed that could be easily used by agricultural planners and local professionals who provide advice directly to farmers who practise rainwater harvesting. To achieve this SWMRG researchers enlisted the support of computer systems specialists from the University's Computer Centre to develop a robust yet user-friendly model. The consequences of this collaboration were significant. The Computer Centre became the institutional home for the model which confirmed its ownership and stimulated further development and support for PT.

Promotion and uptake of PT

One of the main targets for promoting the use of PT was district agricultural planners who are responsible for formulating District Agricultural Development Plans. Local agricultural extension staff were also targeted and this was supported by farmers who, on seeing demonstrations of PT, encouraged researchers to train their district and ward extension workers to use it so that they could offer better advice to them.

SWMRG initially provided PT to a large number of potential users by distributing it to each of them on compact disk. At the same time, a Help Desk was established in the University's Computer Centre to promote the use of PT and to provide support for users with specialist advice and training. This is staffed by computer specialists and professionals from the university's departments of Agricultural Engineering and Land Planning, and Soil Science. Help Desk staff also continue to upgrade PT and they maintain a promotional website from which the current version of PT can be downloaded (see box at end of article).

Under the current project various demonstration and training initiatives were undertaken in two districts in Tanzania; Same and Mwanga. With the added support

of geographic information systems (GIS), District Agricultural planners are now using PT to develop plans and undertake yield gap analysis as well as provide advice to farmers on rainwater harvesting techniques and appropriate field sizes.

In Same District local professionals used PT to analyse the local effects of planting dates, maize varieties and plant populations on crop yields on farms. The results were used in farmers' seminars to increase awareness of these issues and advise farmers on appropriate agronomic practices. The model was also used to assess runoff from adjacent catchments for the design of the Vumari dam.

PT has also found practical application in the villages of Mwembe, Bangalala and Makanya. Structures are planned for construction to control harvested water for local farms. Linked with this, PT was used to help to decide their location and determine their size by simulating the expected runoff from given catchment areas and anticipated rainfall patterns.

In Mwanga District a local NGO is cooperating with SWMRG to use PT to improve soil and water conservation and crop yields on small farms. One interesting outcome of this has been an increased awareness among NGO staff of the need for good, reliable rainfall measurements and hence the need for more rain gauges in the area to improve model predictions. As a result the NGO has fabricated and distributed rain gauges to villagers to improve rainfall data collection.

PT has potentially wider application than Tanzania and is now being promoted internationally to participants attending courses in Tanzania and elsewhere. These have included participants on the annual course of the World Meteorological Organisation (WMO) for Statistics and Agricultural Climatology (SIAC) from 2001 to 2004; those attending an irrigation and water management course of the African Institute for Capacity Development in February 2004; and a group of visiting Rwandan scientists. It was also promoted at an exhibition for Sub-Saharan Africa Water Week held in Dar-es-Salaam, a workshop organised by the Kenya Rainwater Association in Nairobi, and a seminar on Smallholder Land and Water Management Systems in Bangkok.



Meteorologists as well

Agricultural planners and local professionals are not the only potential users of the PT model. Meteorologists were also targeted not just because the model relies heavily on climate data to produce results. It is envisaged that the Tanzania Meteorological Agency, with support from the Ministry of Agriculture and Food Security, could add value to their weather forecasts by providing information on crop performance and likely yields. A team comprising people from these two organisations is now working with researchers from SWMRG to integrate PT into the process of yield prediction and forecasting and food security analysis.

Future expectations are that PT will be used for agricultural planning and food security purposes especially in yield forecasting by the Department of Early Warning and Food Security within the Ministry of Agriculture and Food Security. It is also expected that in the near future more districts in Tanzania will be using PT to advise farmers on appropriate water harvesting techniques, yield forecasting, yield gap analysis and food security planning. The model will also be used as a virtual laboratory to help students studying agriculture to better understand the interactions between soil, water, nutrients and plants in rainwater harvesting production systems.

R8088A Promotion of and support to the use of the PARCHED-THIRST model v2.1 in eastern Africa, and the development of version 2.2

R7949 PARCHED-THIRST model: Development of a client-friendly version 2.1

This project builds on:

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