

Trip Report  
SUMAWA GL-CRSP project  
Date: 07/23/2004 to 08/08/2004  
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### Objectives

1. Complete the development of preliminary WEAP (Water Evaluation And Planning system) model runs for the Njoro River watershed, including characterization of water supplies, demands and infrastructure, and testing and calibration of the WEAP rainfall/runoff module for the upper portion of the Njoro watershed. (MJ & GM)
2. Demonstrate capabilities of the WEAP model to the SUMAWA research team and evaluate potential applicability and feasibility as a decision support tool in the stakeholder involvement process to be used by watershed stakeholders, water resources decision-makers and other potential audiences to support water resources planning and management decisions within the watershed. (MJ & GM)
3. Run an introductory training for SUMAWA researchers and students on the WEAP system model using the preliminary Njoro application as the basis for hands-on software manipulation and further modeling work. (MJ & GM)
4. Hold meetings with applied economics and stakeholder involvement groups to evaluate 2003-04 accomplishments to date, status of work plan, and formulation of RAPs (research activity proposals) for the 2004-05 work plan. (MJ)
5. Evaluate existing water and environmental engineering capacity and seek out potential new researchers with qualifications for conducting critical path activities on the 3 year proposal related to WEAP (water resources planning and management research) and to in-home drinking water quality and sanitation improvements. (MJ)
6. Work with students on their proposals and on their research: Kiragu on further data collection and revised data analysis; Ndonye and Ngungu on the development of their proposals and refining their research questions (MJ).

### Objectives 1, 2 and 3 Activities:

For objective 1, activities included study of available reference material at Egerton University, three field trips to the Njoro watershed, Lake Nakuru and Egerton University commercial farms, and informal interviews with Egerton University staff responsible for water and wastewater facilities operating and planning. Information collected was used to characterize main watershed water users, surface and groundwater extraction infrastructure and water supplies within WEAP model for demonstration and training purposes. Two model versions were prepared. Version one uses monthly historical stream flow data at Treetops to characterize water availability into the managed river-groundwater system using a sequence of historical wet, average and dry year types. Version two uses WEAP's new rainfall/runoff simulation module to estimate stream flow and groundwater recharge into the system based on observed land cover, soil, crops, and climate data. Model versions development was conducted jointly by MJ and GM, with MJ taking the

lead on version one (water demands-supply planning scenarios) and GM on version two (rainfall/runoff version).

For objective 2, activities included preparation of an 18 hour (3 day) orientation and training workshop for presentation of water resources planning concepts, demonstration of WEAP model capabilities and application in the Njoro River watershed and hands-on training in the design and manipulation of the WEAP software. The training workshop was divided into 6 sessions, prepared and presented jointly by Marion Jenkins and Guilherme Marques.

- Sessions 1: Workshop overview and objectives, (day 1)
- Session 2: Basic concepts of mathematical modeling for non-modelers, three types of models used in water resources and their domains/purposes. (day 1)
- Session 3: Concepts in water resources planning and management – the class of models into which WEAP falls. (day 1)
- Session 4A: WEAP model capabilities, purposes, target users; demonstration of capabilities and purposes using the prototype Njoro watershed application model (version one); exploration of base case situation compared with one scenario (day 1 provided an overview and demonstration of these topics for lay people; they were addresses in much more technical depth and detail in day 2)
- Session 5: Open assessment and discussion of if and how to proceed with WEAP modeling in the SUMAWA project. (day 1)
- Session 4B: WEAP model capabilities in greater depth and scope; Demonstration of capabilities using the prototype Njoro watershed application model with technical details and mechanics (version one); exploration of base case situation compared with two scenarios (day 2)
- Session 6: Hands-on training with a small scale, Njoro River watershed example. (day 3).

Sessions 1 to 4A, and 5 (day 1) were attended by all five SUMAWA PIs, selected project researchers invited from each of the four components (watershed hydrology, stakeholders, applied economics, and ecology) and the agency partners (KWS and Fisheries), and by selected students invited from the watershed hydrology, applied economics, ecology, and engineering school. Egerton University's water facilities manager also attended. A list of participants will be included in the annual report. Sessions 2, 4A and 5 included substantial audience participation and engagement in group and full discussions about the watershed's main problems and proposed solutions, feedback on how these can be quantitatively evaluated using WEAP, the way forward for using WEAP as a decision-support tool with watershed stakeholders, and the critical need for a systematic project-wide data and information management effort to support the integrative aspects of WEAP. The fundamental importance of stakeholder buy-in and support for the WEAP modeling effort was acknowledged and a joint PI-wide unanimous decision made to develop a technical advisory committee of key water management decision-makers and actors in the watershed who would need to be part of any negotiation process over water development, operation and management in the watershed based on the Njoro application. This TAC would then oversee the development of the Njoro WEAP application in order to support medium and long-term planning of water resources in the watershed.

Day 2 and 3 focused on technical hands-on training and were attended by a smaller group of participants composed mostly of members of watershed hydrology components along with invited engineering researchers and selected students. Presentations included participation of the

audience in discussions about data availability, model data use and requirements and preliminary results. Participants were organized in groups of 2 users with access to a laptop loaded with WEAP and a model of the Njoro River watershed. In session 6, participants worked in twos to start development of a small-scale training model by inserting model elements, input data and analyzing results for different scenarios.

### Evaluation of accomplishment of Objectives 1, 2 and 3

The prototype demonstration application of WEAP to the Njoro River system provides a solid start for a more sophisticated parameterization of the model. While the parameters are sometimes based on rough estimates and approximate information, the application provides very useful information and an initial quantification of the current water scarcity situation in time and space for different water uses and users across the system, and the underlying causes of scarcity under the current population and infrastructure situation. A key outcome from this work is the critical importance of groundwater resources for water supply and the need to focus research, modeling and field work to better characterize this resource and its interactions with surface water in the Njoro watershed.

The rainfall/runoff WEAP module was tested with available land cover and climate data, but calibration to observed river flow was not accomplished. The module was found to behave coherently in modeling most physical processes, but a small inconsistency was found regarding soil water holding capacity and soil moisture for different land cover (failure to display a change in moisture response as a function of parameter changes to soil characteristics). This was not totally unexpected given that WEAP's rainfall/runoff module is still in beta version and has only been tested in a very limited number of settings. This problem and the unavailability of temporarily matching stream discharge and rainfall data prevented a successful calibration. WEAP technical support at Tellus Institute, the authors and owners of the software, is being contacted for a solution.

The demonstration of WEAP's purpose and capabilities in the workshop was successful, based on the audience participation and feedback. The integrated structure and visualization capability of the model allowed the audience to debate and question their perceptions of the main underlying water problems in the watershed, the subsequent range of proposed solutions and data availability with a better understanding of the water supply and demand situation in the watershed, and its interconnections. This included:

- Impacts and effects of individual actions on other users and in the watershed
- Feasibility of proposed solutions to develop more water or change allocations
- Importance of the participation of other important water using and wastewater generating stakeholders in the process of problem analysis and solution development.
- Importance of data access and organization of watershed data in a single database.
- Importance of providing stakeholders with clear and objective answers and solutions to local water resources problems.

The hands-on training was successful in giving the audience closer contact with WEAP user's interface, database organization and results visualization. Although the objective was not to train the users on WEAP, the audience demonstrated strong interest in further exploring other features of the WEAP model that were not included in this workshop (environmental and hydropower

operations; demand management options; pollution loading and tracking; costs analysis; rainfall-runoff module).

### Conclusions on WEAP

The Njoro WEAP model and the 3 day training proved to be a useful platform for understanding water resources planning and management concepts, and development of water planning models.

The workshop presented the audience basic concepts for water resources planning and management, and an analytic tool (WEAP model) where these concepts were applied in a systematic and organized way. The audience demonstrated understanding of the main water planning concepts and how WEAP could be applied to investigate local water management solutions. However, successful future use of the model will require dedicated individuals with good knowledge about water planning, and willingness to collaborate with other research groups and stakeholders for model development.

A CD-ROM of the training sessions, preliminary WEAP applications, and background literature on WEAP were produced and copies provided to Dr. Scott Miller, Dr. Shivoga, and Drs. Gichaba and Onyando.

### Objectives 4, 5, and 6 Activities:

Meetings were held with Dr. Ouma (sr.) and Njeri to discuss details of progress and pace of work on the household survey data coding, entry, cleaning, quality control and analysis. Based on a review of progress, difficulties encountered using students to do the coding and data entry, and lack of skills and experience; it was decided to seek professional services to perform the data cleaning, quality control and finalization of the database. A need to return to 25% of the sample households to correct or fill in missing, incomplete or incorrect responses was identified, and planning initiated to carry out this activity once the professional data cleaning had been accomplished. Follow-up discussions with Akula, Dr. Ouma, and Dr. Shivoga were held to discuss budgeting for this, and develop and TOR for the professional services to acquire 2-3 bids before selecting a contractor. Candidate professional dataset cleaning services included Tegemeo Institute and KWS. Others would be identified.

Meetings with Drs. Lelo and Chiuri where held to review progress. The set of critical path tasks for the remaining 2 months of the year were drawn up:

- Finalize the draft PRA reports for the 4 communities whose PRAs are completed (Mwigto, Rumwe, Nessuit, Barut)
- Complete the PRA in Ngata and produce a final report
- Synthesize the PRAs results from all 5 communities into key output documents (chapters) that address specific issues that need to feed back into upcoming work plan and research activities.
- Produce a first draft of the WPRA manual

The key work plan activities for 2004-05 were identified and discussed in some detail, assuming these items are completed this year. Drs. Lelo and Chiuri were charged with writing up drafts of the RAPS for these activities:

- Policy-makers and regulatory implementers meetings to discuss conflicting land, water and forest laws and policies on the ground, using Njoro as example.
- Longitudinal visits between riparian communities
- Tiered 1 – Locational workshops to harmonize and discuss local community CAPS and pick representatives to go to Tiered 2 workshop; specific focus on a development of rules and enforcement for local riparian buffer zoning and management
- Tiered 2 – Divisional workshop to harmonize location CAPS and develop a set of rules and agreements for enforcement for a riparian buffer zoning and management plan across the whole watershed.

Additional meetings were held with:

1. Dr. Saenyi, heading up the new Water and Environmental Engineering Department in the Faculty of Engineering and Technology, to learn more about his research interests, skills and training, and about other researchers in the department. Currently he is the only PhD, and many technical upper-division classes are contracted out to lecturers from other Universities until the department builds up its own faculty. There are 3 PhD students on leave from the department studying abroad who should be returning next year. One of these is studying catchment management, another wastewater treatment, and the other

2. MSc Students Kiragu, Ndongye, and Ngungu.

3. Dr. Shivoga, to discuss future planning to move WEAP forward and water supply and sanitation-related public health intervention RAPS.

4. Three RAPS to break down WEAP model developing into separate research tasks and a sanitation technology development RAP were drafted by MJ and discussed with Dr. Shivoga, Dr. Gichaba, Dr. Onyando and others. A key issue was lack of technical capacity within the current team to handle this research and a need for recruiting new researchers with the necessary qualifications and interest in these areas of research.