

CTAHR RESEARCH NEWS

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Protecting Hawaii's watersheds and riparian environment with the latest science and a dedicated team

By Ali Fares

Associate Professor, Natural Resources and Environmental Management (NREM)

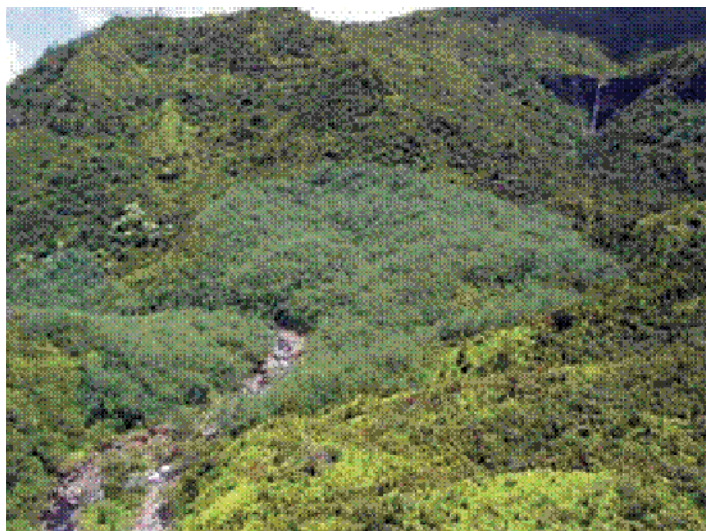
It goes without saying that we must protect our fresh water systems in Hawaii, but few really understand the mechanics of how our water systems get recharged. Looking into the watershed of Manoa, or those surrounding Hilo or in the highlands of Kauai, one might think that the abundance of greenery means the ground over our water channels to streams or into aquifers is protected – but, that might be a faulty assumption! I would like to share some basics of watershed hydrology and introduce you to our projects and our project team.

Upon taking a closer look at the ground cover in our watersheds and next to rivers, we discovered that trees alone are not enough to protect the soil from the high velocity impact of water droplets. And, if those trees or other ground cover are not native, they may not protect the soil like endemic species often do.

When it rains, water percolates into the soil, through volcanic rock, and into a groundwater aquifer but in this case it takes about 20 years for a surface drop of water to reach the underground aquifer. (I suspect you would not wait that long for a cup of coffee!) On the way down, water is “scrubbed” of pollutants and impurities

through their adsorption to vadose zone soil minerals and/or bio-degradation. As you might imagine, each time it rains it is important to slow the speed at which rain water travels along the ground to: 1) allow time for it to infiltrate into the soil if the ground is not already saturated, and 2) reduce soil erosion so that soil is not carried into streams, and eventually the ocean. Natural processes take more than 100 years to create just one inch of soil, and having one inch of soil ending up on a reef can extinguish reef life, like coral, for a long time, if not forever. Because it is critical to keep soil covered and our water systems as nutrient-free as possible, we are investigating watershed character and behavior so that we might formulate some options for better management.

One of our Kauai projects is focused on comparing the performance of native and invasive species in the watersheds surrounding Hanalei Bay as riparian buffer vegetation for adjacent streams and consequently on their impact on erosion and surface and groundwater quality. The two photos (below) illustrate this point. In the left bird's-eye image, the trees give the impression that the ground might be covered, so rain falling through



From the air it looks like the ground is covered, but . . .



. . . not necessarily.

the trees would not lead to soil erosion. However, the right image, which is a ground view of the same plot, shows only a canopy and exposed soil that is susceptible to erosion. In this case, when it rains the soil is eroded and transported by the surface runoff into the adjacent stream. This is the type of situation we are trying to understand and demonstrate sustainable ways on how to remediate.

In Makaha Valley on O'ahu, CTAHR is working in partnership with *Mohala I ka Wai*, a community group, and the Honolulu Board of Water Supply. CTAHR is represented by a multi-disciplinary team that includes Dr. Jonathan Deenik, Dr. Tomoaki Miura and myself. The main emphasis here is on the effects of water pumping and invasive species on the stream flow and groundwater resources of a leeward watershed in the island of Oahu. Our upcoming T-STAR video (right) gives you a more comprehensive look at this exciting project. Check here in a few weeks <http://www2.ctahr.hawaii.edu/t-star/TSTARHilitePage.htm>.

In another effort, we are conducting a long-term water management project. Data from this project will allow us to first develop irrigation water management programs for different vegetable and fruit crops to optimize their yield, and then to help minimize excess water, nutrients and pesticide losses below the rootzone.

The last project our team is working on is a state-wide agricultural water use study. It is another multi-disciplinary effort that involves six NREM faculty and is led by Dr. Carol Ferguson, Dr. Tomoaki Miura and myself. Federal and State funds support this project and the results will help the Hawaii Department of Agriculture and Hawaii Commission on Water Resource Management develop current and future agricultural irrigation water demands for ten major irrigation systems across the state of Hawaii.

These field research activities are complemented with a strong numerical modeling component across a wide range of temporal and spatial scales. This modeling effort is supported by different projects, among them a project funded by National Oceanic Atmospheric Administration (NOAA) that aims to evaluate the performance of N-SPECT. N-SPECT is a watershed model developed by NOAA as a management tool. Using field measured data, it evaluates the effect of land use changes on pollutant movement through coastal watersheds. This project builds and expands on the watershed modeling work that I am conducting



Our watershed video will be available soon!

in Hanalei. This project is USDA-NRCS funded, and complements a multi-disciplinary effort of many federal, state, and Kauai County Agencies including USGS, NOAA, USDA-NRCS, and community groups. The main goal of this work is to evaluate the performance of a decision management tool – AnnAGNPS – a watershed model that will be used to establish best management practices for different Hawaiian watersheds.

In order for us to handle all these critical water related tasks, a competent team and supportive colleagues are key. The Watershed Hydrology Laboratory benefits from the expertise of many people, including: Dr. Ahmet Dogan, a visiting hydrology professor from the University of Suleyman Demirel University, Turkey; Dr. Akitsu Kimoto, a post-doctoral researcher visiting from Japan; and Dr. Ted Radovich, an assistant researcher from Hawaii. These colleagues have been actively contributing to the different research, teaching and outreach activities of the Hydrology Lab. Mr. Hamdhani, as research associate, has been very instrumental in providing support to most the Hydrology Lab research team. Alan Mair (PhD student) is leading the hydrology component of the Makaha project with the help of NREM's Nghia Tran and Domingos Maria, Research Assistants funded through the McIntire Stennis Project. Mohammad Safeeq and Amjad Ahmed, two PhD students, are working on improving the accuracy of different soil water measuring sensors and water

flow and solute transport in the field, respectively. Ms. Chui Leng, a graduate student, is working on the NOAA project with the help of Gongbu Zhaxi and Greg Grigson, two graduate students at the Watershed Hydrology Laboratory. I am very fortunate to have the people in the picture below, to help with the science and recommendations stemming from our collective work. It is our sincere hope that our work can impact planning decisions for a long time to come.

Ali Fares

Hometown: Manzel BelOuaer, Tunisia

Joined CTAHR: 2002

Educational History: BS Horticultural Engineering, University of Susa, Tunisia, 1984; MS Agronomy and Computer Science, University of Florida 1990; PhD Hydrologic Science, Soil & Water Science Department, University of Florida 1996.

Specialization: Watershed Hydrology

Current Work: Associate Professor of Watershed Hydrology

Languages spoken: Arabic, English and French



Front (L-R): Gongbu Zhaxi (China), Dr. Akitsu Kimoto (Japan), Chui Ling Cheng (USA).
 Middle (L-R): Domingos Maria (East Timor), Hamdhani (Indonesia), Dr. Ahmet Dogan (Turkey), Amjad Ahmad (Iraq), Dr. Ted Radovich (USA), Dr. Ali Fares (Tunisia), Nghia D. Tran (Vietnam), Mohammad Safeeq (India).
 Back (L-R): Alan Mair (USA), Greg Grigson (USA).

<p>Amjad Ahmad Hometown: Mosul, Iraq Joined CTAHR: 2003 Educational history: B.Sc. Crop Science, University of Mosul, Iraq; MSc. Crop Science, University of Mosul, Iraq Specialization: Field crop production and statistics Current work: Research assistant, Natural Resources and Environmental Management Languages spoken: English, Arabic</p>	<p>Chui Ling Cheng Hometown: San Jose, California Joined CTAHR: August 2005 (as a graduate student in NREM) Educational history: BS, Biological Science, UC Davis Specialization: Hydrologic modeling Current work: Evaluating performances of N-SPECT and AnnAGNPS Language spoken: English, Cantonese</p>	<p>Ahmet Dogan Home country: Turkey Joined CTAHR: 2006 (visiting faculty member from Suleyman Demirel University, Isparta, Turkey). Educational history: BS (1991), Civil Engineering, METU, Ankara, Turkey; MS (1993) Civil Engineering (Hydromechanics), METU, Ankara Turkey; PhD (1999) Civil Engineering (Water Resources Research), University of Florida, Gainesville, FL. Specialization: Water Resources Engineering, Surface-Subsurface Hydrology, Groundwater Modeling. Current work: Research Associate Languages spoken: English, Turkish</p>	<p>Hamdhani Hometown: Palangkaraya, Indonesia Joined CTAHR: 2005 (as a research assistant) Educational history: BS, Agricultural Social & Economic, University of Palangkaraya (Indonesia); MS, Natural Resources and Environmental Management (Hydrology), UH Manoa Specialization: Electromagnetic soil water content sensor calibration and installation. Current work: Specialist in hydrological instrumentation in the Watershed Hydrology Laboratory, Dept. of NREM-UH Manoa Languages spoken: Indonesian, English</p>
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<p>Alan Mair Hometown: Kailua, Hawaii Joined CTAHR: 2004 (started PhD program) Educational history: BS Electrical Engineering, University of California, Santa Barbara MEng Environmental Engineering, California Polytechnic State University, San Luis Obispo Specialization: Watershed hydrology Current work: Research assistant, Mākaha valley watershed study Languages spoken: English, Tagalog</p>	<p>Domingos Maria Hometown: Dili, East Timor Joined CTAHR: May 2006 Educational history: BS, NREM, UH Manoa, 2006 Specialization: Hydrology Current work: Field and Laboratory Technician of Upper Makaha Valley Watershed Study Languages spoken: English, Indonesian, Tetum, Kemak and a bit of Portuguese</p>	<p>Theodore (Ted) J.K. Radovich Hometown: Waimanalo, Hawaii Joined CTAHR: 1991 as an undergraduate. Most recently, 2004. Educational history: Ph.D., Horticulture and Crop Science, The Ohio State University; M.Sc. Horticulture, UH Manoa; B.Sc., Horticulture, UH Manoa. Specialization: Ecology, physiology and quality of vegetables and other high value crops. Current work: Assistant Researcher in Hydrology. Languages spoken: English, Gambian Mandinka</p>	<p>Mohammad Safeeq Hometown: Siddharth Nagar Joined CTAHR: 2006 (as a graduate student) Education history: BTech, Agricultural Engineering, CSA University Kanpur (India); MTech, Agricultural Systems and Management, IIT Kharagpur (India). Specialization: Hydrology Current work: Pursuing PhD in the department of NREM Language spoken: English, Hindi, Urdu</p>
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