

LETTER OF INTENT

Proposed Center of Expertise within
the UC School of Global Health on

ONE HEALTH: WATER, ANIMALS, FOOD, AND SOCIETY

April 9, 2009

Submitted by UC DAVIS & UC RIVERSIDE

With participating faculty from:

UC Berkeley, UC San Francisco, UC Santa Cruz,
UC Santa Barbara, UC Irvine, UC Los Angeles, UC San Diego



COVER PAGE AND SUMMARY

A.	Name of Proposed Center of Expertise	One Health: Water, Animals, Food, and Society
B.	Names of Proposed COE Directors	Jonna Mazet (UC Davis) and Anil Deolalikar (UC Riverside)
C.	Names of Lead Campuses	UC Davis and UC Riverside
D.	Names of Collaborating Campuses	UC Berkeley; UC San Francisco; UC Santa Cruz; UC Santa Barbara; UC Irvine; UC Los Angeles; UC San Diego

SUMMARY

Every day thousands of people worldwide die from diseases that are not attributable to a single cause but are instead the result of a confluence of factors related to water, animals and plants that work concurrently and synergistically to adversely affect human health. Although the public health burden arising from the interactive effects of poor nutrition, zoonoses, and unsafe food and water is enormous, little policy and research attention has been devoted to this topic. To develop integrated policy interventions that holistically address the different causes of poor human health, we propose the One Health Center (OHC), based on the ‘One Health’ approach, to assess and respond to global health problems arising from the human-water-animal-food interface and to design, implement, and evaluate practical, cost-effective, and sustainable solutions that focus on the foundations of health in collaboration with local partners. OHC will engage in action-based research on reducing morbidity and mortality arising from malnutrition, unsafe water, and animal- and vector-borne diseases. OHC, which already has expertise in most of the required disciplines, will utilize the transformational OH approach to design, implement and evaluate health interventions at the national, regional, community and household levels. The OHC approach to research and education will be transdisciplinary, bringing researchers from the health sciences, social sciences, agricultural and environmental sciences, and engineering to work together to understand the social-biological-cultural determinants of health. The goal will be not to simply juxtapose different perspectives, but instead to bring them into rapprochement through a process of creative, cross-disciplinary engagement focused on a shared object of scrutiny. This will be achieved by intentionally designing courses, research workshops, and projects in ways that promote cross-divisional dialogue and ‘creative tension’ among the different disciplines. To produce a cadre of global leaders in health, the OHC will develop a one-year Masters of Global Health (MGH), and provide curricular requirements for a two-year MGH with a research option and areas of special emphasis, joint degree programs (e.g., MGH with MPVM, MPH, and MPP), and a PhD. OHC faculty at UCR, UCD and our partner institutions will provide the required 3-6 month hands-on field experiences for MGH students to apply and further develop their Core and OHC-prescribed competencies. UCD and UCR are uniquely qualified to lead this effort, as they house UC’s only School of Veterinary Medicine, and their Agricultural Experiment Stations and Cooperative Extension faculty have long-established mechanisms for education and outreach program delivery.

A. Background and Vision

Every day, around the world, thousands of children and adults die from diseases that are not attributable to a single cause but are instead the result of a confluence of factors related to water, animals and plants that work concurrently and synergistically to adversely affect human health. For instance, water scarcity in arid parts of the world, particularly in Sub-Saharan Africa and South Asia, results in people and animals (both domesticated and wild) sharing watering holes, which in turn instigates the transmission of infectious agents from animals to humans, thereby increasing the prevalence of zoonotic diseases in human populations. Water scarcity also means that people use the same water sources for drinking, bathing and washing, which results in serious contamination of drinking water and increased risk of gastrointestinal diseases, including diarrhea. Water scarcity also means less water being available for irrigation, which leads to lower agricultural productivity and greater food insecurity – important (although, by no means, the only) causes of undernutrition. Malnutrition among children, especially in conjunction with diarrhea, makes them more vulnerable to diseases such as malaria and dengue (in large part caused by poor water management), upper respiratory infections (often a result of zoonosis) and measles, and also significantly increases the risk of mortality from these usually non-fatal diseases. Thus, water, animals and plants interact in complex ways to create, and reinforce, a nexus of adverse health effects on humans. The story in Box 1 – unfortunately all too real for millions of children around the world – is a powerful illustration of this nexus.

Box 1: The Story of Aailyah in eastern Kenya

Aailyah, a two-year-old girl living in the village of Isiolo in eastern Kenya, sits in the dirt, listlessly scratching at her numerous mosquito bites. Aailyah is severely malnourished and emaciated from her frequent bouts of malaria and diarrhea. She watches, eyes red with fever, as her friends chase chickens around the water pump, which is idle because it no longer delivers water. Hafidha, the child’s mother, returns from the local watering hole, where villagers and their animals congregate to bathe and collect their day’s supply of drinking water. She hugs her daughter, feels her feverish forehead, and wearily prepares for the three-hour walk to the nearest health center, wondering if the doctor will even be there when she arrives.

The magnitude of the human health problems that arise from poor environmental health, malnutrition and zoonoses is enormous. Nearly a billion people worldwide, mostly children in the developing world, suffer from diseases, such as cholera, hepatitis, and gastroenteritis, caused by pathogenic microorganisms in water. Even in developed countries, water and food safety have become high priorities, as contamination of water reserves by chemical agents and infectious pathogens is becoming increasingly common. For instance, the CDC estimates there are 2.1 million cases annually in the U.S. of rotavirus gastroenteritis in children under five. Likewise, millions of people get sick because of foodborne zoonoses caused by micro-

organisms such as *Salmonella*, *E. coli*, *Campylobacter* and *Cryptosporidium*, and nearly 55,000 persons die each year worldwide from rabies. Zoonoses represent a significant emerging threat to public health, but many of these diseases are neglected. Water management in rural and urban areas of developing countries is key to reducing the abundance of insects that vector pathogens that cause deadly and debilitating diseases such as malaria, dengue and filariasis. Finally, the global burden of disease from poor nutrition is immense, with roughly a billion people being undernourished and poor nutrition playing a role in at least half of the 10.9 million child deaths that occur each year. Malnutrition magnifies the effect of almost every disease, including diarrhea, malaria, pneumonia, and measles. Unfortunately, because of the manner in which cause-of-death statistics are collected, it is

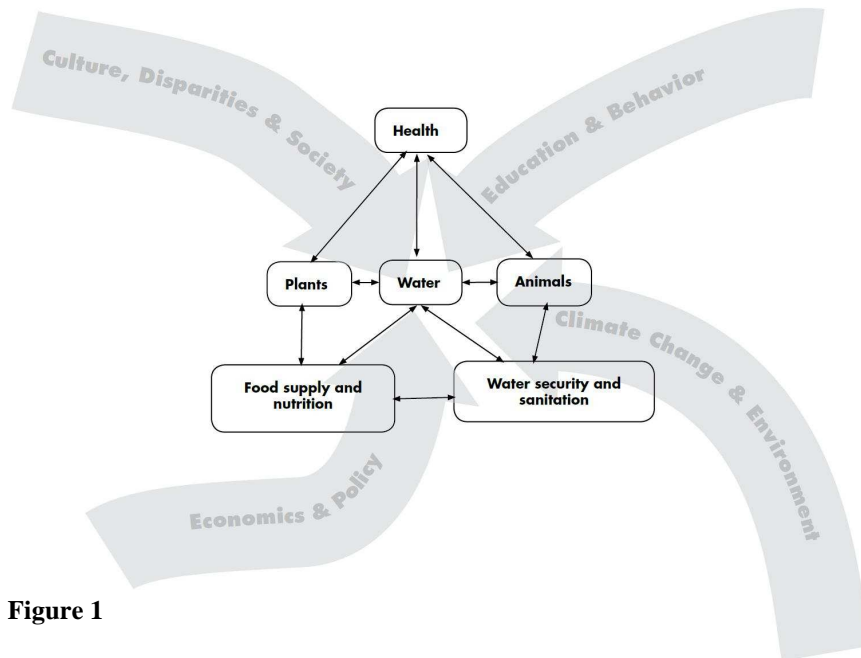


Figure 1

not possible to accurately identify the extent of morbidity and mortality arising from the interactive effects of poor nutrition, zoonoses, and unsafe food and water, but casual empiricism suggests that this is a large public health burden.

The interconnectedness of human, animal, and environmental health (including water and nutrition security and sanitation) is at the heart of the ‘One Health’ approach, which is an increasingly popular prism through which governments, NGOs and health practitioners view human health and design health interventions. An important implication of the One Health approach

is that integrated policy interventions that simultaneously and holistically address the different causes of poor human health – unsafe and scarce water, lack of sanitation, food insecurity, and close proximity between animals and humans – will yield significantly larger health benefits than policies that target each of these factors individually and in isolation from other factors. By its very nature, the One Health approach is trans-disciplinary, since it is predicated on agricultural scientists, anthropologists, economists, educators, engineers, entomologists, hydrologists, microbiologists, nutritionists, physicians, sociologists and veterinarians working collaboratively to improve and promote human health. Figure 1 depicts schematically the various ways in which plants, water, and animals interact to influence human health and the manner in which different disciplines can contribute to an understanding of these interactions and to the design of effective interventions.

We propose a Center of Expertise headquartered on the Davis and Riverside campuses whose mission will be to assess and to respond to global health problems arising from the human-water-animal-food interface and to design, implement, and evaluate practical, cost-effective, and sustainable solutions that focus on the foundations of health in collaboration with local partners. This mission will be realized by (i) integrating expertise drawn from a variety of disciplines, including the health sciences, agricultural and environmental sciences, social sciences and engineering; (ii) engaging collaboratively with partners in California and around the world in action-based research aimed at improving and promoting health using the One Health approach; and (iii) training a cadre of global leaders, health workers, scientists and engineers in the One Health approach.

B. Specific Activities

I. Action-based Research and Training

The One Health Center (OHC) will engage in action-based research on reducing morbidity and mortality arising from malnutrition, unsafe water, and animal- and vector-borne diseases. The Center, which already has expertise in most of the required disciplines, **will utilize the transformational One Health approach to design, implement and evaluate practical, cost-effective health interventions at the national, regional, community and household levels**. As examples, we discuss below seven types of interventions in which the OHC will engage.

(i) Improved water management in underserved areas of the world to conserve water, increase its quantity and quality, and utilize it more effectively to specifically improve health outcomes: By some estimates, nearly two-thirds of the rural population in sub-Saharan Africa lacks access to adequate water supply. This water scarcity increases work stress, especially in women and children, and brings animals and people together more frequently, increasing the likelihood of water contamination and transmission of infectious diseases. Likewise, the manner in which water is used for agricultural and animal production affects worker health, food safety, and the health of those who drink or bathe in water. Better water management encompasses more rational water pricing as well as improved irrigation techniques that result in more efficient use of water in agriculture, which is inextricably linked to agricultural production and better nutrition. The OHC will engage in research on superior water distribution and irrigation systems and more rational water-pricing mechanisms to increase the availability and quality of water. The advantage of the One Health approach is that these model systems will consider multiple facets of water distribution and utilization, including sanitation and pathogen surveillance, proper drainage to control insect vector populations and prevent downstream contamination, and irrigation to improve agricultural productivity and food availability.

(ii) Enhanced vector-control and disease-surveillance strategies: In addition to water management, reduction of morbidity and mortality from infectious diseases requires improved surveillance and management of pathogens and their vectors. Interventions designed by the OHC will include: development of effective low-cost methods for field-based detection of pathogens in water, food, vectors and hosts; measurement of dispersal and gene flow among pathogen, host, and vector populations through the application of massive genome sequencing; improved strategies for disruption of transmission of disease agents by arthropod vectors; collection of remotely-sensed environmental data that influence population dynamics and pathogen transmission to inform evidence-based policy making; and development of more effective and ecologically-sustainable bio-pesticidal larvicides and adulticides for vector control. Escalating rates of pesticide resistance to pyrethroids and other chemical insecticides worldwide makes it necessary to explore other non-chemical control tactics for the future.

(iii) Superior food safety through water and ecosystem management: Recently, more than 200 people in 26 states in the U.S. became ill after eating spinach contaminated by *E.coli* O157:H7; over 50% needed hospitalization and a significant number developed hemolytic uremic syndrome (three of whom died), resulting in a collapse of public trust in food safety and loss of income to California farmers. The same bacteria were found in cattle grazing near the contaminated spinach fields in the Salinas Valley in California and in wild hogs running through them. Working together, hydrologists, microbiologists, epidemiologists, and ecologists traced the problem to pathogen pollution resulting from drought followed by heavy rains. The OHC will bring together physicians, public health and food safety experts, veterinarians, molecular biologists, ecologists, economists, agricultural scientists, nutritionists, environmental engineers, and hydrologists to work with each other and with resource managers, food producers and local communities to address pathogen and contaminant pollution problems in water and food supplies. We will provide rapid screening tests for enteric pathogens that can be used at the local level, as well as improved water engineering plans to reduce transmission of pathogens both in drainage and through vectors. These complex

issues involve land use, water rights, regulatory responsibilities, and constituent needs, and are best addressed at the community level where local stakeholder priorities and possible solutions can be evaluated for shared resource problems.

(iv) Promotion of low-cost and sustainable approaches to combat malnutrition: The OHC will evaluate the cumulative effects of nutritional interventions, including improved local foods, in the context of high prevalence of infectious disease and unsafe and scarce water and food. The use of fortified lipid-based nutrient supplements (such as “plumpy nut”) has proven very effective in treating severe malnutrition. Our faculty and international partners are currently assessing the impact of adding much smaller amounts of more concentrated lipid-based nutrient supplements to local foods to prevent chronic infant and child under-nutrition in Sub-Saharan Africa and elsewhere. Likewise, improving poultry and egg production at the village level has great potential to provide a critical source of food and income for extremely poor households. However, this production has been severely limited by Newcastle and other poultry diseases. In test villages in Tanzania, our collaborative team is training the primary keepers of village chickens to vaccinate using cheap, simple technology, resulting in an increase in nutrient-rich foods available for consumption and sale. The ripple effects may include increased income for other high-quality foods, education, and health care, as well as reduced risk of bush meat consumption – a high-risk food for zoonotic disease transmission and a problem for wildlife conservation.

(v) Use of agricultural biotechnology for improved nutrition and food security: There are many situations in which nutrition can be improved through the introduction of new varieties of crops that are richer in certain nutrients and that produce higher and more stable yields than currently-produced crops. Researchers at UC Davis have produced new wheat varieties that contain markedly higher protein, iron and zinc content. Genetic improvement of cowpea varieties with significantly enhanced resistance to drought and disease by UCR researchers has been implemented in West Africa to enhance agricultural productivity under conditions of climate change and improve protein content of local diets. UCR and UCD plant geneticists have developed a flood-tolerant rice variety that can provide increased food security in flood-prone areas worldwide. The OHC will bring together nutritionists, plant scientists, water experts, and economists to develop, test and disseminate crop varieties that will improve food security and nutrition around the world.

(vi) Better household practices to prevent the spread of water-related diseases: In regions where water is scarce, the same water body that is used for bathing, watering animals, and disposal of human waste is also used as a source of drinking and irrigation water and may provide habitat for insect vectors that spread disease. In just the human waste, there are numerous types of enteric pathogens including *Vibrio cholerae*, *Shigella*, *Giardia*, rotavirus, and hepatitis A virus, which can contaminate the environment and foods, causing diarrheal diseases. In animal waste, these and zoonotic pathogens such as *Cryptosporidium*, *Brucella*, and *Mycobacterium bovis/tuberculosis* may be present and contribute to the disease burden among human and animal populations. The OHC will develop and promote point-of-use water purification technologies ranging from low-tech solar water treatment to high-tech processes, depending on household needs and resources. Toward this end, active research programs at UCR and UCD will join forces to further develop and promote novel technologies such as thin film nano-composite reverse osmosis and biosand filters that can produce water free of pathogen and chemical contaminants and be used to generate income through microfinance programs. In addition, hydrologists, engineers, and sociologists will work to develop scalable and sustainable best management practices for disposal of household wastes, irrigation, and vector control.

(vii) Research and education to promote health, nutrition and hygiene: The OHC will partner with international and local institutions to evaluate household behaviors that should be targeted for health education interventions. These interventions will focus on nutrition and transmission of disease from un- and under-recognized sources, such as animals in and around the home and municipally-supplied water, and will include information on personal hygiene, food and water safety, nutritional value of locally available foods, and the special nutritional needs of pregnant and lactating women and children under two. While such messages are typically delivered through information, education, and communication (IEC) campaigns for adults, the OHC will partner with the core and other centers of expertise in the SGH to explore novel methods to deliver health information, such as electronic media and mobile phone technology. The OHC will also develop public health messages to deliver to children via school-based curricula to facilitate long-term behavioral changes.

Juxtaposed across these interventions are five cross-cutting themes, to which the OHC research agenda will be particularly sensitive. First, individuals and households – not governments or NGOs – **are the ultimate agents of change in society.** For instance, removal of standing water in and around dwellings can reduce considerably the incidence of vector-borne diseases, but only if households actually adopt this practice. Thus, behavioral change and public acceptance are necessary conditions for any new scientific method or technology to succeed and should be considered in the design of interventions. Likewise, regardless of their efficacy, new techniques and methods that are not sensitive to local cultural and social practices are unlikely to be adopted. **Second**, since public budgets are necessarily limited, it is important to prioritize different health interventions. In the past, scientists have tended to ignore the use of cost-benefit and cost-effectiveness criteria to rank alternative interventions, but this will be necessary if societies wish to obtain the maximum health impact out of their limited health budgets. **Third**, an essential component of cost-benefit analysis is the assessment of benefits of different interventions. In turn, this requires that impact evaluation be an integral part of any project intervention. Monitoring and evaluation are also

critical for recognizing the weaknesses of an intervention approach and allowing for adaptive management. Fourth, for bringing about lasting health improvements, interventions need to be sustainable in the long term and not dependent on the whims, largesse, and technical expertise of external actors. This means that the communities that are served by OHC projects should be true stakeholders in, and take full ownership of, the interventions at every stage of the process – design, implementation, and evaluation. Fifth and finally, understanding who is likely to benefit from an intervention is critical in designing and implementing interventions. For example, since girls and women are largely responsible for water collection among rural households in developing countries, enhanced water systems that bring clean water to rural areas are especially likely to improve female health and well-being. On the other hand, new point-of-use water filtration methods that require large upfront investments are less likely to be adopted by poor households. Thus, some interventions are likely to exacerbate existing disparities in health outcomes while others are likely to narrow them.

The OHC approach to research and training will be innovative and transformational in three distinct ways. First, it will be transdisciplinary, bringing researchers from the health sciences, agricultural and environmental sciences, social sciences, and engineering to work together to understand the social-biological-cultural determinants of health. Historians of science have suggested that real breakthroughs occur when scientists representing different disciplines engage deeply enough with each other's work to grasp the presuppositions and logic on which they rest. The goal of the OHC will not be to simply juxtapose different perspectives but instead to bring them into rapprochement through a process of creative, cross-disciplinary engagement focused on a shared object of scrutiny. This will be achieved by intentionally designing research workshops, proposals, and projects in ways that promote cross-divisional dialogue and 'creative tension' among the social and natural science disciplines. Second, the research and training conducted by the OHC will be holistic and systems-oriented. The One Health approach emphasizes the inextricable linkages among food, water, and plants as they affect human health. The OHC will strive to develop and promote interventions that integrate agricultural, water-related and zoonotic solutions to health problems. Third, the work done by the OHC will be transformational in that it will integrate cutting-edge research in ways that increase its applicability and relevance to real-world health issues. The OHC will bring this about by organizing multi-disciplinary teams to work on specific health problems. The teams will consider all aspects of the problem, including technology, cost effectiveness, social and cultural acceptability, and sustainability. Further, the same teams will extend their research projects into the field in ways that integrate communities into the interventions in sustainable ways.

II. Education and Curriculum

The curriculum of the OHC Masters of Global Health program will complement and interdigitate with the core curriculum of the SGH to produce transformational global health leaders who are (a) globally aware of the impact of animal (wildlife, livestock, and companion animals) and ecosystem health on human health in diverse cultural contexts; (b) knowledgeable about the conditions and constraints, including socio-economic and ecological factors, relevant to addressing health and environmental conservation issues in developing countries, as well as California; (c) informed about nutritional, food security and water (quality and availability) factors that affect global health; (d) able to access the knowledge, technology, and expert advice required to become life-time learners and problem solvers; and (e) connected to a broad network of international experts and colleagues with whom to exchange ideas and propose solutions to the health problems they will confront in their studies and 'on the job' as global health professionals.

The OHC curriculum will include classes currently offered in our Masters programs for International Agricultural Development (IAD), Preventive Veterinary Medicine (MPVM), Public Health (MPH), and Public Policy (MPP) (to be offered at UC Riverside from 2011), such as Applied Epidemiologic Problem-Solving, Philosophy and Practice of Agricultural Development, Emerging Issues in Ecosystem Health, 21st Century Issues in Global Health, Agriculture, and Economic Development, as well as new classes, such as Emergence of Zoonotic Diseases at the Human-Animal-Environmental Interface, Transdisciplinary Approaches to Global Health Challenges, and One Health Project Planning and Evaluation. In addition to a one-year Masters of Global Health (MGH), the OHC will provide curricular requirements for a two-year MGH with a research option and areas of special emphasis, joint degree programs (e.g., MGH with MPVM, MPH, and MPP), and a PhD in Global Health. OHC faculty at UCR, UCD and our partner institutions in California and abroad will provide the required 3-6 month hands-on field experiences for MGH students to apply and further develop their Core and OHC-prescribed competencies. Examples of these field experiences include participation in designing surveillance programs for transboundary diseases in North America, water and sanitation management projects in southern Africa or research projects to evaluate the effects of nutritional supplements, emerging zoonotic disease or water scarcity in Latin America or Southeast Asia. In addition, the OHC will utilize our existing UC Cooperative Extension Programs as a model, to provide ongoing training to our students once they have returned to their home communities. This will involve the use of modern communications technology ranging from broadband internet connections to new mobile phone technologies. The executive-education model will provide the SGH with an ever-growing base of well-placed alumni around the world, who could contribute their expertise and generate new field experiences, data, and research opportunities for our students and faculty.

C. Benefit to California

Throughout California's history, water has been a vital and valuable natural resource. With California projected to add 15 million residents by 2040, increased water demand coupled with decreased supply will make these issues even more prominent. Furthermore, California's economy is severely stressed by health-related costs. Expenditures for a single year for West Nile Virus control surpassed \$200 million, and estimates for the financial burden that would result from a highly pathogenic avian influenza pandemic are over \$1 trillion. Agricultural losses due to *Salmonella*, *E. coli*, and other pathogen contamination of agricultural commodities produced in the state are ever-increasing. Rapid and continuing urbanization has generated increased toxicological challenges as industry and agricultural run-off impinges upon aquatic, soil, and atmospheric resources throughout the state. These unprecedented cost predictions drove huge federal and state investment in preparedness and surveillance. The outcome was the broad-based acknowledgment that a new approach is needed to address the growing, emerging disease and environmental-related health problems – a One Health approach. While this approach is being praised and encouraged nationally and internationally by the United Nations, the World Organization for Animal Health (OIE), the World Health Organization (WHO), UNICEF, the American Medical Association, and the American Veterinary Medical Association, there remains more dialogue than action. We propose the first academic-based center to advance One Health research, education, and practice, maintaining California's leadership role in global health. A unified approach that improves health and economic productivity while reducing human suffering will be in the best interest of California as well as the world.

D. A North-South Strategy for the Proposed Center

Rationale: The OHC will be jointly operated across the Davis and Riverside campuses. These campuses bring unique strengths to the pursuit and implementation of the One Health approach. Both campuses have strong agricultural roots, including Cooperative Extension and Agricultural Experiment Station faculty, which will enable the OHC to address the agriculture-health connection in its action research projects in a way that no other global health school in the country can. The land grant mission of both campuses also means that UCD and UCR scientists are adept at, and have a long history of, taking cutting-edge research from the laboratory into the field.

In addition, Davis has strong programs in nutrition (e.g., the Program in International and Community Nutrition which has a 20-year track record of research and outreach in global nutrition issues) and in the plant sciences (including expertise to selectively increase crop production to satisfy local nutritional needs). Davis is also the only UC campus that has a School of Veterinary Medicine, which will play an important role in the OHC regarding animal-human health linkages.

UC Riverside has a long history of expertise in environmental sciences with foci in aquatic and soil contaminants, including microorganisms and chemicals. It also has considerable expertise in environmental engineering, especially in aquatic systems. UCR scientists are engaged in developing catalytic materials for application in water treatment, testing for and remediating the presence of contaminants in the natural environment, and utilizing sunlight to disinfect water supplies compromised by pathogens. The UC-wide Center for Water Resources, which focuses on conservation, development, management, distribution and utilization of water resources in the state, is housed at UCR.

Both campuses have well-established departments of entomology with a strong research and extension presence in biological insect control, integrated pest management, and insecticide resistance. Both campuses have vector-disease centers that conduct interdisciplinary research on the problem of vector-transmitted pathogens. For example, UCR's Center for Disease Vector Research explores the novel interaction of resurgent and new diseases from the Pacific Rim and Latin America with native reservoirs of potential pathogens and vectors in California and the impact of these interactions on human health.

Governance: The OHC will rely on a diverse faculty from disparate fields. New faculty will be recruited for their ability to create teams and facilitate collaborative research, teaching, outreach, and problem-solving. The OHC will practice joint governance split between UC Davis and UC Riverside, with one co-director located on each campus. Each co-director will have signature authority for student and local needs, and will work as a team to lead the overall Center. Decisions on center development and policy, as well as division of resources, will be made by the co-directors and a faculty executive committee (elected according to by-laws) that will meet at least quarterly. In addition, the Center will solicit the advice of an external advisory board and project-specific steering committees comprised of public and private-sector experts and stakeholders.

Evaluation: A system of regular assessments will be built into the organizational structure of the OHC, so as to ensure that the Center continues to serve its research, training, and outreach mission and improves its effectiveness over time. The evaluation and adaptive Center management will be accomplished through three mechanisms. First, the Center will appoint an external advisory board consisting of global health experts and stakeholders, which will meet semi-annually to assess the activities and the impact of the Center. Second, the OHC will solicit an external peer review every three years. The peer review will help indicate the areas of strengths and weaknesses in the Center's program and identify the areas where a change in strategy might be needed to improve its effectiveness. Third, the Center will institute a comprehensive system of evaluation and feedback by students, graduates, faculty, and partners. This annual assessment will include exit interviews and follow-up of students graduating from the program and participatory (qualitative) assessment by both project beneficiaries in the field and participating faculty.

Appendix 1: Participant List

The One Health Center has benefited from the planning and participation of 261 faculty members from the following campuses: UCD (190), UCR (41), UCB (12), UCSF (2), UCSC (5), UCSB (1), UCLA (3), UCI (4), and UCSD (3)

Internal Participants:

UCD College of Agricultural and Environmental Sciences
UCD College of Biological Sciences
UCD College of Engineering
UCD College of Letters and Sciences
UCD School of Education
UCD School of Law
UCD School of Medicine
UCD School of Veterinary Medicine
UCR Bourns College of Engineering
UCR College of Humanities, Arts, and Social Sciences
UCR College of Natural & Agricultural Sciences
UCB School of Population and Public Health
UCB College of Letters and Sciences (Anthropology)
UCB School of Law
UCB College of Engineering
UCSF School of Medicine
UCSC Biological Sciences
UCSC Division of Social Sciences
UCSB Marine Sciences Institute
UCLA Health System
UCLA School of Engineering and Applied Science
UCI School of Biological Sciences
UCI School of Engineering
UCSD School of Medicine
AIDS Clinical Trials Unit
Agricultural Issues Center
Aquatic Toxicology Laboratory
Berkeley Water Center
Biotechnology Program
California Animal Health & Food Safety Laboratory System
California Center for Environmental Law and Policy
California Institute of Food and Agricultural Research
California National Primate Research Center
Center for Animal Disease Modeling and Surveillance
Center for Aquatic Biology and Aquaculture
Center for Disease Vector Research
Center for Food Animal Health
Center for Health and the Environment
Center for Health & Nutrition Research
Center for Health and Technology
Center for Information Tech for the Improvement of Society
Center for Integrated Water Research
Center for Produce Safety
Center for Public Policy Research
Center for Vectorborne Diseases
Center for Watershed Sciences
Clinical and Translational Science Center
Crocker Nuclear Laboratory
Dairy Food Safety Laboratory
Institute on Global Conflict and Cooperation
Institute for Research on World Systems
International Laboratory of Molec. Bio. for Tropical Diseases
International Learning Center

International Zinc Nutrition Consultative Group
Lawrence Berkeley National Laboratory
Program in International & Community Nutrition
Sustainable Agricultural Research and Education Program
USDA Economic Research RIDGE Program
Western Center for Agricultural Health and Safety
Western Institute for Food Safety and Security
Wildlife Health Center

External Partners:

African Centre for Water Research, South Africa
American Water Works Association, Washington DC
Asian Development Bank, Philippines
California Department of Public Health
California Regional Water Quality Control Board
Centre for Water Resources, Anna University, India
Eawag Zurich (Swiss Fed Inst Aquatic Science & Tech)
Engineers without Borders – International & USA
ETH Zurich (Swiss Fedl Inst of Science and Technology)
Faculty of Science & Technology, Universities of Mali, Mali
Groundwater Research Center, Khon Kaen Univ, Thailand
International Centre for Insect Physiology & Ecology, Kenya
International Food Policy Research Institute, Washington DC
International Union for Conservation of Nature
International Water Association, U.K.
International Water Management Institute, Sri Lanka
IPR/IFRA, Mali
IRC International Water and Sanitation Centre, Netherlands
La Jolla Institute for Allergy and Immunology
Lawrence Livermore National Laboratory
Loma Linda University (Department of Global Health)
Los Alamos National Laboratory
Mexican Institute of Water Technology
Mosquito and Vector Control Association of California
Mosquito & Vector Control Dist: Coachella Valley, Greater LA, Northwest, Orange, Riverside & West Valley
Municipal Water Dist: Eastern, Inland Empire, Metro of So-Cal, Orange Co, San Bernardino Valley, and Western
National Water Quality Monitoring Council, Washington DC
NIH/Fogarty Global Infectious Diseases Training Program
Riverside County Department of Environmental Health
RIVM, Bilthoven, Netherlands
Sandia National Laboratories
Santa Ana Watershed Project Authority
Saybrook Graduate School and Research Center
Sokoine University of Agriculture, Tanzania
State Water Resources Board, California EPA
Stockholm International Water Institute, Sweden
University of Bamako Medical School, Mali
Water Resources Develop & Mgmt Cent, Indian Inst Tech
Water Resources University, Vietnam
Water Supply & Sanitation Collab Council, Switzerland
Water Technology Centre, Indian Ag Research Institute
Water Technology Centre, Tamil Nadu Ag Univ, India
Wildlife Conservation Society, over 50 countries
World Bank, Washington, DC
World Health Organization, Switzerland
World Water Assessment Programme of the UN, France
World Water Council, France
Yolo County Health Department