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Public Health Aspects of the Daugherty Water for Food Institute Strategic Plan

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The University of Nebraska College of Public Health is committed to contributing to the research, service and education programs of the Daugherty Water for Food Institute. The College can offer a wide variety of expertise that can contribute to programs related to water, food and health. This document has been written to highlight the areas in which College faculty have particular interests, knowledge and experience to contribute.

1. The Role of Nutrition Quality in Health (T. Huang)

Poor diet is one of the most important determinants of health and disease [1]. The nutrition needs for health fall under 2 categories: food quantity (caloric intake) vs. food quality (biological effects independent of calories) [2]. Although food insecurity is a serious issue worldwide and deficiencies in both food quantity and food quality contribute to the global double burden of disease (i.e., high prevalence of both infectious and chronic disease), there is increasing evidence to suggest that addressing only food quantity and not food quality may lead to unintended health consequences. In the U.S., 15% of households are reported to be food insecure in 2011 [3], yet there is emerging to suggest that food insecure individuals are also more likely to be obese. The reason for this seeming contradiction is because Americans who are food insecure are less likely to suffer from calorie deficiency than from poor nutrition quality [2], suggesting that attention to the quality of diets beyond food quantity is warranted. Similarly, Chile has long been seen as a model of success for school feeding programs. However, there is evidence to suggest that Chile's school feeding program has had an impact on increased prevalence in childhood obesity [4]. Recently, Hall [5] showed that the oversupply of food in the U.S. has been chiefly responsible for driving the obesity epidemic. Collectively, these experiences suggest that agricultural and food policies must take a holistic view on both the quantity and quality of food produced and made available to populations.

The COPH has a wealth of expertise in the area of human nutrition, from basic science to clinical and population-based approaches. Partnership between the WFI and COPH will bring added value to the mission of WFI, as research can be undertaken to examine the specific dietary needs of populations in areas where food supply is scarce or under threat. Such information can inform both agricultural and nutrition policies at the local, national and regional levels, to ensure the optimal health of the populations being served.

References

1. Waxman, A. WHO global strategy on diet, physical activity and health. Food Nutr Bull 25.3 2004: 292-302.

2. Ludwig, DS, Blumenthal, SJ, Willett, WC. Opportunities to Reduce Childhood Hunger and Obesity Restructuring the Supplemental Nutrition Assistance Program (the Food Stamp Program). JAMA 2012; 308 (24): 2567-2568.

3. Coleman-Jensen, A, Nord, M, Andrews, M, Carlson, S. Household Food Security in the United States in 2011. USDA ERS Economic Research Report 2012; No. (ERR-141): 37.

4. Uauy, R, Albala, C, Kain, J. Obesity Trends in Latin America: Transiting from Under- to Overweight. J Nutr 2001; 131: 893S-899S.

5. Hall, KD, Guo J, Dore M, Chow CC. The Progressive Increase of Food Waste in American and Its Environmental Impact. PLoS ONE 2009; 4(11): e7940.

2. Water Allocation and Public Health (A. Kolok)

An equilibirum exists between agricultural demand for water and public health concerns, primarily based upon resource allocation. Some of water allocated toward public consumption is used for laundry, dishwashing and bathing leading to the production of greywater, some of which can be benignly used on crops. Use of water in sanitary systems however can result in water that may not be useful for irrigation due to the risk of water borne infectious diseases. Conversely, the runoff of surface water from agrichemical landscapes can deliver chemical residues into local water that can adversely impact drinking water with adverse public health outcomes.

Water availability is often temporally variable, as the supply of water and the agricultural demand for irrigation are both likely to vary seasonally. As such, the appropriate allocation of water resources toward one of or more uses is variable, requiring periodic assessment and reallocation. Effective monitoring programs can be established and maintained by agencies and communities to provide feedback that will influence their water allocation decisions, leading to an overall improvement in public health outcomes.

The College of Public Health has expertise in infectious disease and water quality assessment that can be brought to bear upon issues of water allocation. Futhermore, the College also has experience that can assist in the development of community based environmental monitoring programs, that can assess water quality from both the perspective of infectious disease as well as contamination of drinking water supplies with the chemical residues from agricultural water use.

3. Climate Change, Agriculture, and Public Health (A. Jameton)

Due to the centrality of agriculture to human welfare, dozens of major agencies have published significant reports on agricultural aspects of climate change, together with related health consequences. An important source, because of its recency and authority, is the draft National Climate Assessment published January 11, 2013, which forms the main basis of these notes.

The effects of climate change on agriculture are highly evident in a global and 2050-to-2100 year time frame. All reports agree that the effects are highly likely to be negative, consequential, and increasingly problematic as the decades pass. However,

the dynamism of climate change introduces major uncertainties regarding more specific effects on particular crops and animals, on the overall rate of agricultural change, and on the relative ratio of specific effects. Moreover, regional and local effects (such as in Nebraska and the High Plains) and shorter term effects (in the present decade or so) are less definite and some may be in the balance positive. Still, the literature agrees that the balance of regional and local climate effects tends increasingly toward the negative as temperatures rise. These include disruptions of most crops and livestock through heat waves, floods, excessive rainfall, events wind, ground level ozone, multi-year droughts (leading to aquifer depletion), sea level rise or glacial ice melt in some regions, and soil degradation (dust storms during droughts), together with increased weeds, insects, and plant and animal diseases. Moreover, changes in the seasonal cycle will likely affect plant and animal growth; the timing of seasons can affect vulnerable stages of development; and life cycles of pollinators may change in timing with impacts on productivity. A few regions may become more productive with warmer weather and/or wetter growing seasons, and a few plants may receive growth benefits (but not necessarily nutritional improvements) from increased atmospheric carbon dioxide, but these effects are likely to be far outweighed by negative effects.

Policies to mitigate climate change (such as carbon taxes raising the costs of fossil fuels) are also likely to affect agriculture and food prices, especially fossil-fuel intensive U.S. agriculture, together with possible reductions in crop growing area as agricultural land may be turned to ethanol crop production. Besides affecting crops and husbandry, climate changes and attempts to mitigate it will likely also affect the stability, investment in, and prices of food storage, refrigeration, transportation, retailing, food safety, and food security. Meanwhile, competition with agriculture for scarce water resources, such as for fuel crops, drinking water, species conservation, and industry, is likely to increase. Reductions of agricultural capacity in the Earth's tropical and subtropical regions are likely to spur pole ward human migration, which is already having major demographic effects in temperate regions. And, hotter more humid weather will make outdoor agricultural work less efficient and more dangerous to health.

Also notable is that fossil-fuel-based agricultural production and animal husbandry tend to aggravate climate change. Not often noted, but also highly important, are the impacts of nitrates used in agriculture on climate change, and agriculturally driven nitrate pollution on lakes, rivers, and coastal areas.

Many reports point to promising technological adaptations — such as plant and animal genetic diversification, redistribution, and modification; switching to perennial crop sources (allowing deep roots to reach the water table); reduced fossil fuel inputs; exploitation of migration-based cultural exchanges; food waste reduction; localization of production; irrigation efficiency; carbon sequestration; and trade. Curtailing red meat consumption from ruminants is often strongly recommended as having significant climate and health co-benefits, but is in Nebraska economically challenging. Meanwhile, if overall global CO2 production continues at anywhere near present rates, in the long run (50 years and more) no adaptations can possibly keep pace with the degree of change.

Public health needs to monitor such agriculture related factors as caloric intake (the obesity epidemic could ebb or worsen under food scarcity), micronutrient deficiencies, increased pesticides in food, food storage safety, air and water pollution, farmer and

farm laborer occupational health, family dietary effects, cultural aspects of food, health aspects of agricultural policy and adaptation, conflicts over resources, urbanized and localized food production, cultural diversification, gender impacts; livelihood; income inequality, psychological effects of poor nutrition, childhood growth stunting, reduced immunities, disease burden, population resilience, effects on long-term population health research methods, and related animal and human health effects. Public health can help to identify vulnerable populations in need of protection, such as cultural subpopulations with unique dietary patterns (in the Central High Plains Native Americans on reservations may have limited choices) and the poor facing rising food and fuel prices. Drawing attention to problematic health consequences through two generations (that is, children and grandchildren; grandchildren born in 2010 could easily be living in 2090) can help to draw diverse populations together via a common set of concerns and motivate needed policy changes.

Selected References

1. Frank Ackerman and Elizabeth A. Stanton (2013 February) **Climate Impacts on Agriculture: A Challenge to Complacency?** Tufts University, GDAE Working Paper No. 13-01. [http://ase.tufts.edu/gdae]
   From Tufts Report abstract: "Within a few decades, business-as-usual climate change would reach levels at which adaptation is no longer possible."

2. FAO (2011, February) **Climate Change, Water, and Food Security.** Rome: FAO Water Reports No. 36. [http://www.fao.org/docrep/014/i2096e/i2096e00.htm]

3. National Climate Assessment and Development Advisory Committee (NCADAC) (2013 January) **Third National Climate Assessment Report: Draft for Public Comment.** [http://ncadac.globalchange.gov]
   Chapter 6: Agriculture
   Chapter 9: Health
   Chapter 19: Great Plains

4. USDA (2013, February) **Climate Change and Agriculture in the United States: Effects and Adaptation.** USDA Technical Bulletin 1935. [http://www.usda.gov/oce/climate_change/effects.htm]

5. Anthony J McMichael, John W Powles, Colin D Butler, Ricardo Uauy (2007) Energy and Health 5: Food, livestock production, energy, climate change, and health. **Lancet** 370:1253–63. [DOI:10.1016/S0140-6736(07)61256-2]

4. Modeling Sustainable Systems in the College of Public Health (O. Araz)

Today's world changes with great uncertainty and faces dynamically growing challenges. These challenges force us to develop sustainable solutions for meeting basic human needs in a resource constrained world. Global warming, water scarcity,

loss of biodiversity and the health crisis with an increasing global population are the major complex system problems which require interdisciplinary collaboration and thinking. As many of these issues are directly and some indirectly interconnected with broad disciplines of public health, the College of Public Health at UNMC has developed a capacity to generate innovative solutions to these problems through our research. In our Systems Sciences track, a broad and multidisciplinary approach is taken to model sustainable systems. These systems include economic, ecological and environmental, socio-political, population health systems. All of these come together to help measure sustainability of systems via quantitative models and outcomes of these are then integrated into decision sciences framework for assisting policy decision making.

Our capacity includes developing ***System Dynamics Models*** to analyze complex behavioral dynamics of aforementioned systems with a top-down approach. This capacity also allows us to interconnect these models to a geographical information system (GIS) to simulate through, not only by time, but also by space. This type of integration represents a cutting edge Decision Support System, with parameter estimation and optimization modules performed simultaneously. It is more often necessary to model sustainable development by examining underlying behavioral decisions rather than mechanistic inter-linkages at the aggregate level of major sectors [1]. System dynamics is a widely used modeling methodology that is designed for large-scale, complex socio-economic systems [2]. This methodology combines traditional management sciences with the science of feedback control, and has been applied into various fields. These include, but are not confined to, global environmental sustainability, regional and rural sustainable development issues, environmental management, water resource planning and ecological modeling, agricultural sustainability, regional environmental planning and management, national development programs, transport and land use [2].

Another approach for modeling complex systems is the bottom-up approach to analyze the evolution of system behaviors which can be performed by defining autonomous entities interacting with each other as well as with their environment. This type of modeling is called ***Agent Based Modeling*** (ABM). ABM is a powerful tool to model individual decision making that also makes it possible to incorporate behavioral heterogeneity and interaction feedbacks [3]. Through ABM techniques we can use various behavior theories or models, e.g., econometric models and bounded rationality theory to model human decision making and behavioral dynamics. Despite the fact that computationally ABMs are more expensive to build, it is technically a smoother method to couple human and natural systems in an artificial modeling environment [3]. In the College of Public Health, we also have the capacity to construct these types of micro-simulation models to understand sustainability of complex systems.

References

1. Moffatt I, Hanley N. Modelling sustainable development: system dynamics and input-output approaches. Environmental Modelling and Software 16 (2001) 545-557.

2. Shen Q, Chen Q, Tang B, Yeung S, Hu Y, Cheung G. A system dynamics model for the sustainable land use planning and development. Habitat International 33 (2009) 15-25.

3. An L. Modeling human decisions in coupled human and natural systems: review of agent-based models. Ecological Modelling 229 (2012) 25-36.

5. Community Engagement (C. Fisher)

The COPH has a firm commitment to community engagement, community collaboration in education and other programming, and community-based participatory research (CBPR). The state of science surrounding collaboration between communities and academia has demonstrated over the past several decades the power of the aforementioned practices in 1) strengthening long-term sustained partnerships among collaborators [1], 2) providing culturally relevant answers to perplexing problems through sound scientific practices(Cheatham-Rojas & Shen, 2008), 3) mobilizing partners for advocacy of effective policy based in practical research [2], 4) developing and delivering relevant educational and other intervention programming to redress health inequities [3], and 5) providing assurances of a broader ecological, systems approach to program and research efforts [1]. Each of these outcomes has occurred in projects related to water and food systems [5] and environmental issues [6] as they relate to health.

The COPH is well situated to facilitate the processes of community engagement, collaboration, and participatory research within and through DWFI. Several faculty have expertise in these areas (i.e., Drs. Margalit, Johansson, Fisher, Tibbits, Anthony, and Watanabe-Galloway). Several centers within the college have foci based in these processes (Great Plains Public Health Leadership Institute, Center for Rural Health Education Network, Center for Reducing Health Disparities, and the Great Plains Public Health Training Center). The college also provides a graduate level introductory course on CBPR to begin being offered online in Fall 2014 and is home to the Plaza Partnership (www.plazapartnership.org) which is currently developing an online program to facilitate the development of community-academic research teams through an online training program. Finally, the governing faculty will soon enact a standing Community Engagement Committee which in part is charged with leveraging greater synergies among the above-mentioned individuals, centers, and programs.

Collectively, the COPH can provide the necessary support to DWFI in relation to community based programs that address the social and cultural dimensions of increased food production and empower communities to make decisions, or at least know the facts, and support interactions between communities and other stakeholders. Specific goals to this end include: 1) identify and align appropriate faculty and center staff with DWFI to provide guidance and support in conducting community engagement, collaboration, and CBPR; 2) leverage existing databases at the college to maintain an updated roster of potential collaborators within the college; and 3) develop a mechanism for linking DWFI projects with existing community partners through the college.

References

1. Israel, B., Shulz, A., Parker, D., Becker, A, Allen, A., & Guzman, J. (2008). Critical issues in developing and following CBPR principles. In M. Minkler & N. Wallerstein (eds.), *Community-based participatory research for health: From process to* outcomes (pp.47-66). San Francisco: Jossey-Bass.

2. Cheatham-Rojas, A. & Shen, E. (2008). CBPR with Cambodian girls in Long Beach, California: A case study. In M. Minkler & N. Wallerstein (eds.), *Community-based participatory research for health: From process to* outcomes (pp. 121-136). San Francisco: Jossey-Bass.

3. Shepard, P., Vasquez, V. & Minkler, M. (2008). Using CBPR to promote environmental justice policy: A case study from Harlem, New York. In M. Minkler & N. Wallerstein (eds.), *Community-based participatory research for health: From process to* outcomes (pp. 323-334). San Francisco: Jossey-Bass.

4. Orkin, A., VanderBurgh, D., Born, K., Webster, M., Strickland, S., & Beardy, J. (2012). Where there is no paramedic: The Sachigo Lake Wilderness emergency response education initiative. *PLOS Medicine, 9*(10), e1001322.

5. Vasquez, V., Lanza, D., Lavery, S., Facente, S., Halpin, H., & Minkler, M. (2008). Addressing food security through policy promoting store conversions: The role of a CBPR partnership. In M. Minkler & N. Wallerstein (eds.), *Community-based participatory research for health: From process to* outcomes (pp.355-370). San Francisco: Jossey-Bass.

6. Farquhar, S. & Wing, S. (2008). Methodological and ethical considerations in community-driven environmental justice research: Two case studies from rural North Carolina. In M. Minkler & N. Wallerstein (eds.), *Community-based participatory research for health: From process to* outcomes (pp.263-284). San Francisco: Jossey-Bass.

6. An integrated Human Centered approach to Public Health Informatics interventions in Global settings (A. Joshi)

Public health informatics is defined as systematic application of information and computer science and technology to public health practice, research, and learning [1]. It is an interdisciplinary profession that applies mathematics, engineering, information science, and related social sciences to important public health problems and processes [2]. Risk assessment tools have been developed to gauge the harmful effects of environment on health of the populations. Such tools allow assessment of pesticide use, exposure to harmful chemicals, contaminants in food and water, and toxic pollutants in the air. These tools complement vital statistics data systems and morbidity data systems by providing information on factors earlier in the causal chain leading to illness, injury, or death [3].

An integrated informatics approach to integrate disparate sources of public health data is needed. These data sources include (a) socio-demographics, (b) environmental factors, (c) disease factors and (d) knowledge attitudes and practice. The challenge is to process these various sources of data into meaningful information so that timely recommendations can be determined to improve public health decision making.

We have developed human centered Geovisualization approach to integrate various data sources both subjective and objective using physiological sensors through web enabled, cell phone based and also stand alone electronic kiosk systems (4, 5). These systems have been deployed and evaluated in urban, rural and other geographically disadvantaged settings (6, 7). The platform has several components including:

- Multi-dimensional risk assessment
- Tailored risk profile
- Personalized self management strategies
- Continuous progress monitoring
- Health communication and shared decision making
- Interactive health education

The approach can integrate water, environment and health data from various sources, process and represent data into meaningful format and disseminate and communicate the findings to various stakeholders in a format specific to meet the needs of the various stakeholders to influence public health decision making.

References

1. O'Carroll PW, et al. Public health informatics and information systems, Springer, 2002.

2. The role of public health informatics in enhancing public health surveillance. MMWR Supplements July 27, 2012/61 (03); 20-24.

3. O' Carroll, Powell –Griner, Holtzmann, and Williamson, GD (2003). Risk factor information systems. In P.O.' Carroll, W. Yasnoff, M. Ward, L. Ripp and E Martin (Eds). Public Health Informatics and information systems (pp 316-334). New York: Springer-Verlag.

4. Joshi Ashish et al. Designing human centered geovisualziation application-the SanaViz for telehealth users a case study. Technol Health Care. 2012;20(6):473-88.

5. Joshi et al. A human centered geovisualization framework to facilitate visual exploration of telehealth data: a case study. Technol Health Care. 2012;20(6):457-71.

6. Ashish Joshi, Douglas Marcel Puricelli Perin and Mohit Arora. Feasibility of electronic health Kiosks to assess chronic disease status in remote areas of developing countries. Paper accepted at "The First International Conference on Global Health Challenges 2012, October 21 – 26, 2012 – Venice, Italy.

7. Ashish Joshi et al. Using Portable Health Information Kiosk to assess chronic disease burden in remote settings. Rural and Remote Health 2013 (paper in press).

7. Communication and risk management (S. Medcalf)

The impact of risk communication on the outcome of any disaster (including floods) has been researched. Emergency risk communications stress that messages should be developed to be prompt, to be credible and to be accurate. Crisis communication is based on the need to communicate during a public health emergency such as floods, hurricanes, and other natural disasters. It is designed for two major purposes; first to protect the health and safety of the public; second to ensure the public's confidence in the response community's ability to manage an event. This may involve the use of local resources or the request for state and federal assistance.

Experts from the College of Public Health have experience in assisting public health districts in Nebraska with foundational risk communication strategies for early emergency preparedness activities post 9/11. As a new public health infrastructure was forming throughout the state, the CoPH assisted with communicating the importance of a well-prepared response network of healthcare and public health responders. Community members were informed of how they would be engaged by public health and emergency management in disaster planning. Preparing households for pandemic influenza proved that strategic risk communication to resident populations make communities more resilient to any disaster.

Reference

Reynolds, B., and Matthew, W.S. "Crisis and Emergency Risk Communication as an Integrative Model." *Journal of Health Communication* 10, no. 1 (2005): 43-55.

8. Impact of policy decisions on water and food supply and demand (J. Stimpson)

The myriad of water and food issues around the globe could benefit from a focus on supply and demand, such as the variability of water supply and the impact of climate change; managing demand to improve water and energy efficiency in food production (getting "more crop per drop"); and improving the entire supply chain (from "field to fork"). Addressing the challenges related to water and food security, through the entire chain from production to beneficial use and waste, calls for a focus on a wide range of technical, economic, financial, institutional, governance and political issues that balance economic development, environmental sustainability, and social justice. The complex relationships and balance between these issues requires policy action, which are authoritative decisions and guidelines that direct or influence behavior toward a specific goal through various mechanisms such as laws, regulations, and judicial precedents. Applied to the global problem of food and water security and safety, policy decisions can make a sustained impact on an entire nation (or area within a nation) by securing access to water rights, protecting water and soil quality, reusing and recycling water and

wastes, reducing the amount of food that is lost and wasted from harvest to consumption, integrating different production systems, encouraging diets that require fewer resources to produce, and fortifying water and food resources with vitamins and minerals. The power of policy is best applied when democratic processes involve multiple stakeholder input to balance priorities and effects on society of water and food policy.

The UNMC College of Public Health is uniquely positioned to assist with policy education, research, dissemination, and translation. The college's faculty are actively involved in the evaluation of health promotion and disease prevention programs to determine what works and what does not. The college also has a major center focused on agricultural safety and health – Central State Center for Agricultural Safety and Health – which is engaged in several research, education, and prevention initiatives that can be translated into policy action. Some recent research projects in the college related to food and water policy and prevention include, but are not limited to, the following:

- Surveillance of agricultural injuries and creation of a national safety database
- Testing a novel preventive health services model for farm families
- Prevention of stress and mental health among Latino farmworkers
- Education of health workers on health policy through the Health Policy Academy
- Tracking and evaluating interventions to reduce environmental bioaerosols
- Evaluation of land use and its impact on water quality and environmental health
- Identifying sources of occupational injuries and musculoskeletal trauma
- Designing the ecological environments of communities to reduce obesity

9. Evaluation (M. Tibbits)

Evaluation plays a key role in the successful design, implementation, and sustainability of public health initiatives (Windsor, Clark, Boyd, & Goodman, 2004). Needs assessment evaluation serves to inform initiative development by identifying areas of greatest need and potential impact. Process evaluation sheds light on implementation to ensure initiatives are delivered as designed and provides a context for interpreting outcomes. Outcome evaluation highlights successful and unsuccessful elements of initiatives to enable appropriate modifications and increase impact. Finally, economic evaluation enables the examination of the benefits of initiatives relative to the costs.

The COPH is well-positioned to collaborate with DWFI to provide high-quality, initiative- and community-appropriate evaluations relevant to water, food, and health. The COPH has a core of evaluation experts with extensive experience conducting needs assessment, process, outcome, and economic evaluation studies relevant to these topics with academic and non-academic partners (e.g., local health departments, state agencies, and non-profits). Further, the COPH routinely engages in interdisciplinary collaboration to conduct comprehensive evaluations that ensure diverse perspectives are represented, which would be an asset to DWFI. To facilitate successful partnership between the COPH and DWFI, the COPH will: 1) identify and engage faculty and staff with expertise and interests relevant to DWFI; and 2) maintain a

database of existing COPH faculty and staff that details evaluation expertise and interests.

Reference

1. Windsor, R., Clark, N., Boyd, N.R., & Goodman, R.M. (2004). *Evaluation of health promotion, health education, and disease prevention programs, 3rd edition*. New York, NY: McGraw-Hill.