Development and transfer of conservation agriculture production systems (CAPS) for small-holder farms in eastern Uganda and western Kenya

A proposal submitted to the SANREM CRSP Phase IV Long-Term Research Program
By the University of Wyoming Department of Renewable Resources

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Technical Narrative

A. Introduction and Justification

Sub-Saharan Africa (SSA) faces formidable food security and environmental challenges. Population pressure, agricultural intensification, market distortions, an unevenly supportive policy climate, and inherently unproductive soils create a degradation spiral that underlies declining food security and environmental quality. While conservation farming systems capable of improving productivity have been developed, several broad constraints impede adoption for many of the 60 million smallholder farmers across SSA. We propose to develop field-scale farming system components through a participatory process that incorporates concepts of co-innovation and co-design among researchers, advisors, and men and women stakeholders in agriculture.

To address a spectrum of economic and environmental conditions in Eastern Africa, our project will be replicated in four areas: the Tororo and Kapchorwa districts in eastern Uganda and the adjacent Trans-Nzoia and Bungoma districts in western Kenya. Tororo and Bungoma are highly degraded lowlands with sandy soils of low fertility. In contrast, Kapchorwa and Trans-Nzoia are highlands with more commercial agricultural systems, but which face serious soil erosion challenges. Kapchorwa and Trans-Nzoia are generally more innovative and accepting agricultural systems, while in Tororo and Bungoma work on conservation tillage has been undertaken for quite some time using farmer field schools with limited impact.

Our approach incorporates components of co-innovation described by Rossing et al. (2009) in which end users of technology become active participants in its development through frequent interaction, monitoring, and redesign. Our on-station replicated trials combined with on-farm pilot plots in four districts of Kenya and Uganda will provide multiple settings for engagement and participation among the research team, regional and national officials, local community leaders, local/regional agricultural educators, and local farmers. This proven approach will foster broad participation for the basic redesign of agricultural livelihoods that is necessary for improvements in SSA. By structuring the pre-experiment survey and design activities to target both men and women in different types of households and agricultural settings we think that at least one prototype CAPS and one pilot farm in each study area will focus on particular issues faced by women farmers.

Our team combines experienced NGO and University partners in Kenya and Uganda with a soil scientist, an agroecologist, an agricultural economist, and two sustainable business management experts from the University of Wyoming, all eager to apply participatory design, analytical, and outreach approaches. The catalysts for this proposal are Kenyan directors of two well-established NGOs who are completing PhDs in agronomy and soil science at the University of Wyoming. Emmanuel Omondi is director of Manor House Agricultural Center (MHAC) and Eusebius Mukhwana is director of SACRED Africa and a recent recipient of a Borlaug LEAP fellowship. Both will complete PhDs that integrate cropping systems studies in the US and Kenya early in 2011, but already have many years' experience implementing agricultural training programs for small holder farmers in Kenya. They are each excited about this opportunity to apply new skills and build upon partnerships developed during their PhD programs. They have enlisted the highly effective Ugandan NGO, AT Uganda, and its director Rita Ojok along with professor John Okalebo of from Moi University and professor Bernard Bashaasha of Makerere University to round out the host-country team.

B. Problem Statement and Research Objectives

Population pressure, agricultural intensification, market distortions that limit access to inputs, an unevenly supportive policy climate, and unproductive soils create a degradation spiral that contributes to food insecurity in eastern Uganda and western Kenya. Conservation agriculture (CA) approaches that enhance productive capacity of soils and build upon local agricultural knowledge are needed in order to increase and stabilize food production, improve environmental conditions, and allow farmers to capitalize on soil health improvement by using practices that increase soil carbon. Capacity building of in-country agricultural professionals is key to long-term food security, and is the over-arching objective of this applied research project and is woven into all the research objectives. Research objectives include:

1. Assemble advisory group of stakeholders from selected study areas. Compile information for prototype CAPS development;
2. Define the traditional system and develop prototype CAPS for each area that build upon local knowledge and traditional practices, and that address agronomic and socio-economic constraints;
3. Evaluate agronomic, ecological, and economic sustainability of CAPS compared to traditional practices.

In addition, outreach and training objectives formulated for this proposal are described in detail under Outreach Plan and Training Plan headings below.

C. Literature Review

In their critical review of conservation agriculture in Africa, Giller et al. (2009) excellently describe constraints to adoption of zero-till-based farming systems by smallholder farmers. Many of these constraints apply to our study areas in Eastern Uganda and Western Kenya and underscore necessity for “co-innovation” (Rossing et al., 2009) and “co-design” (Cerf et al., 2009) approaches that integrate stakeholders into design, evaluation, and implementation of cropping systems. Giller et al’s. work also emphasizes problems with a purist perception of any “holistic” package of practices that ignores local customs, resource constraints, socio-economic, and cultural realities, such as very high soil organic matter turnover rates, open grazing, labor and input shortages, land ownership, decision making at the household level, diminishing farm sizes, and the value of crop residues for feed, fuel, building materials, and other uses. As put by Rossing et al. (2009), “Economically and agro-ecologically diversified livelihood options do not come as validated technology packages waiting to be adopted by farmers. Researchers can play a role in supporting the innovativeness of resource users. Researchers themselves learn by being able to analyze the many experiments that farm practices represent.”

This statement is echoed by Mukhwana (2000) who describes different, and often competing, soil fertility management recommendations being offered to farmers through a variety of outreach activities in Western Kenya and states that, ironically, due to a lack of flexible co-created and co-designed research and extension approaches, Western Kenya’s “basket” is full (to overflowing) but the smallholders’ kitchen cupboards are too often bare, particularly during the persistent “hunger months” of March, April and May. Work by Nkonya et al. (2005) in eastern Uganda supports this notion of inappropriate technology. In combined household and soil quality surveys of 58 farms they found, among other relationships, that contact with agricultural extension personnel correlates with soil nutrient depletion. They attribute that relationship to promotion of improved varieties without access to increased inputs.

For these reasons we adopt an outcome-based definition of CA that focuses on improving soil quality for increasing sustainable productivity by maintaining year-round soil cover, minimizing tillage, and utilizing crop rotations. In this definition, conservation agriculture production systems (CAPS) are sustainable with respect to productivity and soil and environmental quality in the context of local/regional socio-ecological and economic constraints. This definition acknowledges that improvement of soil quality supporting increased production may not be possible without policy interventions that provide economic incentives for change, restrict on-farm activities, and influence off-farm economic drivers (supply chains and/or markets). The project will also look at issues that affect the adoption and adaptation of CA technologies by different classes of farmers (i.e., wealth, gender) in the four target areas.

Soils and Agroecology

Agriculture in SSA, and in Kenya and Uganda in particular, is in a state of transition in which production systems must constantly respond to declining soil fertility and variable climate. One goal of CAPS development is to improve the capacity of farmers and their advisers to reassess practices and innovate by helping them to recognize changing conditions.

Much of the farmland in our study area was cleared of forest and savannah vegetation in response to needs for increased food production over the last 100 years (Kimetu et al., 2008). Tropical forest and savannah soils are inherently low in fertility because of a combination of often very old, highly weathered parent materials, warm, moist conditions that drive rapid mineralization of soil organic matter (SOM), and heavy seasonal rains that leach nutrients through soil profiles. Moreover, plowing recently cleared land exposes soil organic matter accumulated beneath forested ecosystems to rapid turnover and decomposition, resulting in a rapid but temporary flush of plant available nutrients that support high crop yields. Soon a generation of farmers saw plowing as a way to increase yields and habits were set. However, repetitive plowing continued mineralization of soil organic matter from shrinking SOM pools. For example, corn yields in Kenya’s Western Highlands decreased by 66 percent in 35 years after clearing (Kimetu et al., 2008). Though a great deal of research and experience shows that conservation of SOM in depleted soils is more beneficial than exploitation, farmers are materially and culturally invested in intensive cultivation. Understanding that their soils are very different from those of previous generations helps farmers to understand that farming methods should also change for optimal production.

Reduced tillage can conserve and increase SOM stocks in soils of many agricultural regions in Africa (e.g., Ito et al., 2007), but combinations of rapid turnover rates from microbes and soil fauna, open-range livestock, and uses of crop residues for other purposes mean that SOM in SSA continues to decline even if tillage is reduced or stopped (Giller et al., 2009). Reduced tillage combined with amendments of organic material does contribute to increased SOM (Gicheru et al., 2005), but additions of organic material increase needs for nitrogen (N) fertilizer as microbial populations respond to the increased substrate and shift the soil environment from one of net mineralization to net immobilization (Drinkwater, 2002; Sherrod et al., 2005). Kimetu et al. (2008) found that crop yields from soils amended with organic materials responded to N additions regardless of the quality of the organic material, with the most degraded soils responding the most. Other researchers working in SSA also advocate combinations of mineral and organic nutrient sources because of immobilizing effects of organic sources alone, and because of short supplies of organic sources (Okalebo et al., 2006; Rowe et al., 2006; Vanlauwe and Giller, 2006). Rowe et al. (2006) also point out that nutrient resources should be used to improve soils as well as yields.

Okalebo et al. (2006) describes an on-farm evaluation of eight different soil fertility improvement strategies in western Kenya, including combinations of legume, compost, and mineral sources. Farmer participants were encouraged to develop combinations of strategy components in a farmer "best bet" treatment compared to the other packages. Results suggest pre-packaged materials and recommendations like the PREP-PAC developed at Moi University and the MBILI package developed and tested by SACRED Africa increased returns and encouraged adoption of improved integrated crop production technologies. The authors note that variability in soil fertility on SSA farms creates a need for site-specific recommendations, but fertilizers packaged in field-sized bags are important for ease of use and purchase. Place et al. (2003) point out an opportunity for marketing both organic and mineral fertilizers as farmers become more aware of benefits. Variability in both needs and responses to nutrient inputs are described by Vanlauwe and Giller (2006), with fields farther from farm yards responding much more to fertilizers than the nutrient saturated in-fields, and by Siriri et al. (2005) who recorded nutrient differences across agricultural terraces in western Uganda. Many studies show that manure is far more beneficial than other types of organic inputs for increasing soil carbon (C) stocks and yields (Farage et al., 2007; Gicheru et al., 2005; Kapkiyaia et al., 1999). But even though it is currently underutilized, there is not enough manure available even at low rates (Kaizzi, et al., 2007; Mapfumo et al., 2007). Legumes are often considered to be the only option for poor smallholders on degraded soils (Kaizzi et al., 2006), but are most effective at improving soil quality when nutrient contents are already adequate (Kone´ et al., 2007). Nyende and Delve (2004) conclude that non-crop legumes improve soil quality in the Tororo District of Uganda but note that adoption any single-use technology is unlikely.

Climate change is another factor causing a changing agricultural context in SSA, one of the regions most impacted by global warming (Lal, 2009). One of the most variable terms in global greenhouse gas (GHG) budgets is flux from natural and agricultural systems (Holland et al., 1999). Agricultural sources are thought to constitute as much as 40 to 80 percent of the global inventory of these gases and are known to be dynamic. Unsustainable agricultural systems can result in loss of soil organic matter, but biochemical processes underlying this loss, together with the atmospheric consequences, are poorly understood (Galbally, 2008; Norton et al., 2008). The three gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), are of particular interest because of their overall content in the atmosphere, their ability to stay radiatively active for extended periods of time and therefore, their influence on the radiation balance in the atmosphere (Holland et al., 1999). All three biogenic gases are main players in estimation of global warming potential (GWP) and therefore, are major contributors to climate change.

Lal (2009) points out that climate change, and even SOM loss, present opportunities for a win-win situation if SSA governments can create an alternative income stream to provide incentive for farmers to increase soil C stocks. Carbon storage potential is considered to be equal to the amount lost due to management, so is considerable in SSA soils formerly covered by grasslands and forests. Increasing C stocks improves many of the soil properties necessary for improved production and food security.

Economics and Socio-Cultural Factors

SSA farming systems are comprised of complex and interdependent components that have evolved over many years in response not only to environmental challenges, but to economic and socio-cultural factors and constraints as well. If CAPS are to be successful, they must be developed with an awareness of these interdependencies and constraints. Proposals to use crop residues to boost soil organic matter, for example, must recognize the importance of crop residue as an input to other parts of the farming system and household (e.g. fodder for livestock, fuel for household use, and building material) (Giller et al., 2009). Similarly, proposals to use animal manure as fertilizer must recognize that some livestock are free-grazed on open range, particularly in the dry season, which makes it difficult to gather enough manure for use on crops.

Several economic factors, such as time-discounting, risk aversion, and market failure, will also influence the success of CAPS. CAPS that take several years to generate economically meaningful returns, for example, will not be adopted if farmers cannot afford to sacrifice short-term yield for long-term sustainability (Giller et al, 2009). Factors that exacerbate the tradeoff between short and long-term gains include prolonged drought, loss of off-farm income sources during economic downturns, negative incentives to innovate (Place et al., 2003), imperfect markets, which cause agricultural inputs to be distributed inefficiently in quantity, space, and time. All of these factors represent challenges to the design of appropriate CAPS.

Socio-cultural factors will also influence the adoption and success of CAPS. Out-migration from rural areas, disaggregation of rural kin systems, and HIV/AIDs, for example, reduce the availability of labor for weed control and other labor intensive practices associated with some CAPS (Giller et al., 2009). The roles of women and men in different stages of agricultural production are also important determinants of CAPS adoption. In many SSA households, women do much of the work required to produce maize, including planting, weeding, top dressing, staking, husking, and shelling, while men often control the consumption and sale of the grain. Researchers must therefore engage both genders in conversations to understand the implications of proposed conservation agriculture systems from field to market. The roles of women and men in agriculture are shifting in many SSA households. Women have increasing control over the use of their maize and the benefits that accrue from it (see the August 27th, 2009, edition of Economist Magazine). Such socio-cultural shifts may have important implications for the design of successful CAPS, and will therefore be explicitly recognized and incorporated in the proposed research and outreach efforts.

The Policy Environment

One of the major development policies of both the Kenya and Uganda Governments is to meet the food requirements of the population through improving food security. Over the last 40 years Government policies in both countries have identified food security and poverty alleviation as primary development objectives. Some of the strategies to address food production have included development of research capacity for technology development, provision of extension services, improvement of access to productive resources, irrigation development and development of marketing to boost production. Likewise, various institutions and institutional frameworks have been to try and improve food production and food security. Despite these initiatives and efforts the realization of food and nutrition security both for Kenya and Uganda remains elusive. Currently, an estimated 17 million people live below the poverty line and about 10 million Kenyans especially those in the medium and high potential areas are chronically food insecure.

It is clear from looking at the efforts so far and the little success achieved that a new paradigm shift is needed if Kenya and Uganda have to move towards improved food security especially for the rural populations. Studies from Zambia, a country with similar agro-ecological conditions show that use of CA can tremendously improve food productivity and the incomes of poor small scale farmers (Baudron et al., 2007). Project leaders in this project are planning to study Zambia's success in the use of CA and use this to introduce CA technologies in Kenya and Uganda. The project will also seek to engage policy makers both in Kenya and Uganda to develop programs that provide incentives for adoption by offsetting short-term losses from recovering SOM systems.

Participatory Research

Consistent with long experience on the effects of agricultural research and extension projects on innovation in production and marketing practices in sub-Saharan Africa (e.g., Franke and Chasin, 1980; MP/DEPP/RN 1985a, 1985b), recent reviews report that adoption failure rather than success is the norm (Giller et al., 2009). Failures of extension are usually due to a combination of a lack of locally relevant agronomic packages and technology; failure by research and extension to understand the logic of farmers' time-tested practices; failure to involve farmers in problem definition and solving; weak upstream (input) and downstream (output) market channels; and fragile linkages between extension, research, and farmers. However, also consistent with previous research syntheses (Arnould, 1990; Cerf et al., 2009; Rossing et al., 2009; Shaikh et al., 1988), it is known that non-linear, flexible approaches in disseminating improved resource and farm management practices, with emphasis on local capacity building and with room for adaptation to local conditions, coupled with a commitment to provision of short, medium, and long-term farmer benefits, and to sustained extension support can yield positive outcomes (Giller et al., 2009).

The time tested approach to developing improved resource and farm management practices is some combination of rapid rural appraisal or assessment methodologies linked to a farming systems management approach (Abalu et al., 1987; Beebe, 1982; Bradfield, 1981; Brush, 1986; Colinson, 1981; Galt, 1987; Shaner et al., 1982; Wilson and Morren, 1990). This project will use emergent "co-design" approaches in developing knowledge of existing systems, economic and impact analysis of alternative CA approaches, assessing and leveraging gendered knowledge, and developing technology networks for sustainable innovation involving CA. The primary objective is to develop in-country capacity to carry out these tasks in the future.

Background on Study Areas

Uganda and Kenya are among the poorest countries in the world. The population of Uganda increased from 9.5 million in 1969 to 24.2 in 2002. The 2008 mid-year projected population was 29.6 million (UBOS, 2008). With 3.4 percent population growth, Uganda has one of the highest rate of population increase in the world. As in Kenya, poverty is most pronounced in rural areas. The features of rural poverty are multidimensional and include food shortage, malnutrition of children, frequent illness with high rates of HIV/AIDS, and widespread illiteracy. The distribution of poverty is uneven, with areas in the east and north being the poorest. Households engaged in crop farming remain the largest group of the poverty-stricken population, accounting for about 38 percent of the households below the poverty line. On average, rural households derive nearly three-quarters of their income from crop farming. Smallholders dominate the agricultural sector with over 90 percent of crop production being produced on farms averaging less than 2 hectares.

Land degradation and low agricultural productivity are severe problems in Kenya and Uganda. The major forms of land degradation are soil erosion, soil fertility mining, soil compaction, water logging, and surface crusting (Nkonya et al., 2004; Zake et al., 1997). Top soil losses of as much as 5 tons per hectare being reported in some areas. With an estimated average annual rate of total nutrient depletion of 70 kilograms of nitrogen (N), phosphorus (P), and potassium (K) per hectare in the 1980s (Stoorvogel and Smaling, 1990), the rate of soil nutrient depletion is among the highest in Sub-Saharan Africa. Wortmann and Kaizzi (1998) estimated even higher rates of soil nutrient depletion for several farming systems in central and eastern Uganda in the mid-1990s. In some regions of Uganda, 60 to 90 percent of the total land area is affected by soil erosion (NEAP, 1992).

Land degradation contributes to the low and in many cases declining agricultural productivity. Farmers' yields are typically less than one-third of potential yields found on research stations, and yields of most major crops have been stagnant or declining since the early 1990s. This in turn contributes to food and nutrition insecurity. Soil nutrient depletion and erosion could also lead to deforestation and loss of biodiversity since farmers are forced to abandon nutrient-starved soils and cultivate more marginal hillsides and rainforests.

The overall implication of these impacts is increased poverty, which pose an enormous development challenge in Kenya, Uganda, and elsewhere in SSA. Finding ways to reverse these trends is an urgent need.

Eastern Uganda and Western Kenya Project Area

The Tororo and Bungoma Districts of Uganda and Kenya, with population densities averaging 129–456 persons per square kilometer (Wortmann and Eledu, 1999), are poorly endowed with natural resources. The soils are sandy, with low soil organic matter levels, highly susceptible to leaching, and consequently low in base saturation and rather acidic. Crop harvests and soil erosion are the major causes of nutrient losses at the crop and land use type (LUT) levels. Wortmann and Kaizzi (1998) found that estimated nutrient balances for small-scale farming systems in eastern and central Uganda were negative for all crops except for nitrogen (N) and phosphorus (P) in the banana-based LUT. Agriculture in this region shows productivity decline, as the rapidly growing population overexploits its land resources, resulting in recurrent food shortages and occasional famines. The most serious problems faced by smallholder farmers are related to the low land productivity that results in household food deficiencies and to low selling prices for crop products in good seasons. The adjacent Kapchorwa and Trans-Nzoia Districts of Uganda and Kenya lie on the northern slopes of Mt. Elgon with somewhat higher precipitation and better soils than the Tororo and Bungoma.

Tororo and Bungoma Districts

Tororo district is found in eastern Uganda bordering the country of Kenya to the East. The 2002 national census estimated the population of Tororo District at 398,601 with an annual population growth rate of 2.7%. Given those statistics, it is estimated that the population of the district in 2009 is approximately 480,321. Most of the district is flat, lying at an altitude of 1,097 to 1,219 m above sea level and a temperature range of 15.7° to 30.6° C. The annual rainfall is more than 1,200 mm per year. The district is well known for its highly unproductive sandy ferralsols (Miiro, R. et al), with low Carbon (C), Nitrogen (N) and phosphorus (P). Agriculture is the backbone of the district economy. Crops grown include: Millet, Cassava, Peas, Beans, Sweet potatoes, Simsim, Sunflower, Cotton, Onions, and Rice. Most of the district produce is consumed locally or sold in the urban areas within the district. The population density of Tororo is 280 persons per sq. km in comparison to the average national population, which is 87 persons per sq. km. This population pressure has caused the abandonment of practices such as fallowing. According to the Tororo district state of the environment report (DSOER, 1997), the low use of improved farm inputs and implements; lack of knowledge about agronomic practices and poor delivery of advisory (extension) services are some prevalent problems in the area.

Since 1997, various efforts by the National Agricultural Research Systems (NARS) and an international NGO, (Africa 2000 Network), have been in place to fight poverty of farm households by increasing food security through the promotion of integrated nutrient management technologies. This has been through a consortium involving civil society, NGOs, national agricultural research systems, international agricultural research systems and government, called the Integrated Soil Productivity Initiative through Research and Education (INSPIRE) project. The efforts of the consortia have been directed to Tororo District, because of its dense population of over 280 persons per square kilometer, poorly endowed natural resources, sandy loam soil type, often acidic and K deficient, and a reversion to mainly annual crop system. Soil erodibility and erosivity is moderate (Wortmann and Eledu, 1999 as cited by Miro R. et al, 2002). About 82 % of the district land is farmed making this area a high incidence poverty area (World Bank 1993).

Kapchorwa and Trans-Nzoia Districts

Kapchorwa district (which was recently split into two Districts when Bukwo was created) was earlier classified into 3 agro-ecological zones by CIAT at the Kawanda Agricultural Research Institute. The three zones have been named "Mt Elgon High Farmlands", "Kapchorwa Farm Forest" and "NE short grass plains with clay soils".

Mt Elgon High Farmlands is a very productive area with fertile soils, high rainfall and moderately cool temperatures. The landscape is steeply sloped and divided by many valleys. The soils are derived mainly from volcanic parent material and are typically red clay loam, well drained, highly leached, often acid (as indicated by the presence of bracken ferns), but of good nutrient supply. Soil erodibility is very low and rainfall erosive is moderately high. Most of the land is intensively cropped while about 20% is woodland. Rainfall is unimodal, with peaks in April and May but is generally more than 100 mm per month from March to November. (Rainfall 1200+ mm/yr). Average altitude 1466 m asl. Banana, bean and maize are the prevalent crops. Groundnuts are also important crops. Arabica coffee is the major cash crop.

Kapchorwa Farm-Forest is on the northern steps of Mt Elgon. The soils are generally highly productive. In the forest zone soils are primarily reddish-brown loam over deep clay loam sub-soil. In the farmland areas, much of the soil is derived from volcanic parent material; clay and clay loam soils are common and often acidic, but are of good nutrient supply. Much of this zone is forested; about 40% is used for crop production. The zone cool and sub-humid with a long wet season from April to October with a rainfall peak in April and May (Rainfall 1200+ mm/yr). Average altitude 1455 m asl. Maize and beans are the main crops, with beans produced in association with other crops. Banana is also an important crop.

North eastern short grass plains with clay soils occurs in the northern end of Kapchorwa and extends into other districts in the NE of Uganda. The landscape in the south is flat, sloping slightly towards L. Kyoga, but in the north is more varied and undulating. The soil is clay, often with vatic properties; calcareous soils are common on the very flat Sebei plain. The zone extends south to the lower steps, or terraces of Mt Elgon where the clay loam soils are more often acidic. Nutrient supply is good. Soil erodibility is high while rainfall is moderate. Most land is grassland with primarily Acacia/Setaria vegetation. The climate in this zone is semi arid with one rainy season and less than 1000 mm/yr.; April-August are the wettest months. Average altitude 1093 m asl. There is little crop production. Sorghum and maize are the more important food crops.

Loss of land productivity is most severe on steep slopes around Mt Elgon in the Mt Elgon High Farmlands AEZ. The soils there are classified as very low erodibility but because of cultivation on steep slopes and lack of soil conservation measures, soil erosion is occurring. Quantifiable indicators illustrating the scale of the problems are not available at present, but the public perception is that soil erosion is increasing and that fertility is declining. It is safe to assume that as population grows and farmers are forced to cultivate on marginal sites including steep slopes, the level of soil erosion is increasing. Erosion gullies are evident, and rivers are brown with soil sediment during the rainy season for long period of time. According to the Kapchorwa district state of the environment report (DSOER, 2004), the main causes of loss of land productivity identified during the district workshop in Nov 2004 and parish workshops in 1999 were: Poor farming methods, removals of tree cover on hillsides and riverbanks, animal trampling down hill for gracing and back up hill causing galleys, over grazing in the harvesting fields. The steep terrain accelerates this problem.

NGO Partners

Manor House Agricultural Center

Manor House Agricultural Center (MHAC) started in 1984 in Trans Nzoia district, western Kenya, Rift Valley Province. Compared to other districts in western Kenya, Trans Nzoia and neighboring Uasin Gishu districts have a relatively large number of semi-commercial farmers with farm sizes ranging from 2 to 40 hectares mostly "inherited" or bought from white settlers who vacated them after independence. The area receives reliable, bimodal rainfall between 1200 to 2000 mm per year but is dominated by highly weathered, nutrient-depleted soils (Sombroek et al., 1982). The farmers' main crops in western Kenya, as indeed the rest of the country are maize and beans, either in single stands or intercropped (Ariana, 2002). Apart from maize and beans, other market crops include tea and sugarcane sold to factories, and fruits and vegetables sold at local markets (Woomer and Mukhwana, 2004).

A three year drought in early '80s that caused severe hunger in many areas of rural Kenya precipitated the need for new approaches to farming. These concerns were raised in 1981 during a United Nations sponsored conference in Nairobi on New and Renewable Sources of Energy (UNEP, 1987), as a result of which Manor House Agricultural Center (MHAC) was established and registered as a non-profit Trust. MHAC conducts a two-year residential associate degree equivalent program for 12th grade equivalent graduates, farmer workshops, and extension outreach activities in Trans Nzoia and four surrounding districts including Uasin Gishu, Mount Elgon, West Pokot, and parts of Bungoma.

MHAC currently promotes Bio-Intensive Agriculture (BIA), a low cost sustainable agricultural technology suited to small-scale farmers, composting to improve soil fertility, deep soil preparation to enhance growth, mulching to conserve moisture, close spacing to increase productivity and biological pest control to manage plant diseases (Jeavons, 2002).

SACRED Africa

SACRED Africa (The Sustainable Agriculture Center for Research and Development in Africa) started in March 1997 as a small rural-based agricultural research and development organization meant to confront African agricultural problems with an "African mind and approach," operating in tandem with the scientific, technical and socio-cultural realities of the African continent. SACRED Africa works with poor rural communities in Kenya to improve their lives by increasing agricultural productivity, food security and incomes while protecting and enhancing the environment.

SACRED Africa was established with the major objectives of improving the livelihoods of resource-poor farmers, promoting the sustainable use of natural resources, and agro-biodiversity that seek to enhance food security and family incomes. These objectives are being addressed through projects that help farmers to sustainably improve soil fertility, access superior seed and market their produce profitably. To make a meaningful impact in facilitating development interventions and empowering communities in order to alleviate poverty, SACRED Africa has been working in partnership with individuals and organizations both within Kenya and beyond.

The organization considers itself as having a calling to make a tangible contribution with its partners in bringing about lasting change amongst impoverished African communities by responding to their priority needs in a holistic manner. In Kenya, SACRED Africa operates in seven administrative Districts with an approximate population of 3 million people. The organization has been expanding over time.

Appropriate Technology (AT) Uganda

AT Uganda Ltd. is a Ugandan NGO involved in implementation of a number of large projects related to agricultural development in Uganda. AT(Uganda) was registered as the national branch office of Appropriate Technology International (ATI) in 1994. In the interest of sustainability, in 2002 AT (Uganda) established an independent local board of directors and registered with the Ugandan Registrar of Companies as a Company Limited by Guarantee under the name of AT Uganda Ltd. NGO registration was also renewed in the name of AT Uganda Ltd. in 2003. The Mission of AT Uganda is: “To empower rural households in Uganda by facilitating access to support services needed for productive, sustainable agriculture and related profitable enterprises.”

AT Uganda Ltd. has established a proven track record as an uptake pathway for agricultural research. Since 1994 AT Uganda Ltd. has been involved in provision of agricultural extension services, agro-processing promotion, agro-input distribution facilitation, collective marketing linkages, and business development services to some of the poorest, remote and under-served districts of Uganda. More than 85,000 farmers and 2,500 rural non-farm micro-level enterprises have benefited from AT Uganda’s programs since 1994. More than 50% of the participants have been women.

AT Uganda sponsored the establishment of the Uganda National Agro-Input Dealers Association (UNADA), a professional member association of private sector input dealers. AT Uganda is working with UNADA and the Alliance for a Green Revolution in Africa (AGRA) to implement a new program titled "Agro dealer network strengthening for Uganda" to strengthen supply and demand for improved seed and other agricultural inputs among smallholder farmers in Uganda. AT Uganda is an active member of the Inspire Consortium for Integrated Soil Fertility Management In Eastern Uganda. AT Uganda is registered as a research provider with the National Agricultural Research Organization and has had three research grants on soil fertility management and dairy nutrition funded through NARO.

D. Methods and Approaches

Our approach applies parallel survey, CAPS development, evaluation, and dissemination techniques to four areas as described previously; two highland areas with relatively productive soils and progressive agricultural systems, and two lowland areas with degraded, low-fertility soils and subsistence farming systems that have historically resisted change to conservation tillage practices and other modern farming technologies.

A core objective of the research is to facilitate training and capacity building on central components, including participatory co-innovation, scientific analyses of fundamental components of sustainability, and effective dissemination that supports adoption.

RESEARCH OBJECTIVE 1 (Pre-experiment): Compile information for prototype CAPS development. Assemble advisory group of stakeholders from each area.

Summary Three broad goals of this pre-experiment objective include: 1) familiarizing our team with regional CAPS development efforts; 2) compiling relevant local knowledge from the four study areas; and 3) assembling stakeholder advisory teams in each area. Team members will begin exploring and contacting organizations and individuals involved in agricultural development in the region as soon as project funding is assured. Next, a baseline survey of at least 100 small-holder farmers in each study area will provide information on constraints and opportunities for CAPS to increase sustainable agricultural production. The surveys will be supplemented by participatory rural appraisal (PRA) exercises at farmer meetings in each area that will build upon household level surveys data with more general information on farming systems, farm labor profiles, market constraints and opportunities (see section on Market Issues), and determinates of wealth ranking in the community. PRA data will be triangulated by age, gender and socioeconomic status.

Approach

Information gathering in support of developing complete CAPS will include three tasks:

1. Gather information on local/regional CAPS development programs:
    a. Survey past and ongoing agricultural development work in/near the four study areas, including visiting and meeting with area university representatives, agricultural institutes, NGOs, and others.
    b. Visit successful ongoing program(s) in agronomically similar SSA regions (e.g., Zambia) to discuss process and innovations with leaders.
2. Develop detailed survey instrument and carry out baseline field interviews, including cursory soil fertility and crop yield/quality samples from fields farmed by a subset of interviewees. Bi-gender teams from collaborating NGOs will interview male and female small-holder farmers using a detailed survey instrument as well as a participatory rapid rural assessment approach (that will also include social mapping, matrix ranking and venn diagramming) designed to collect information on current farming practices, local knowledge of conservation agriculture approaches, and perspectives of biophysical, cultural, and economic constraints to adoption of sustainable practices in two formats:
    a. Formal interviews and/or focus group discussions with men and women recognized as opinion leaders in their communities (also to support advisory groups, see item 3, below;
    b. Formal quantitative interviews of a randomly selected sample of representative male and female farmers stratified by location, gender and wealth ranking;
    c. PRA exercises at one or more meetings in each area;
    d. Summarize and analyze baseline information to identify socio-economic and agronomic constraints that must be addressed by prototype CAPS;
3. Identify and enlist members of stakeholder advisory groups in each study area based on existing relationships of NGOs and host-country universities, and on people met during baseline interviews.

The survey will utilize and build upon networks of community leaders and small-holder farmers developed by SACRED Africa and MHAC (in Kenya) and AT Uganda (in Uganda) for targeted interviews. Gender-specific knowledge will be gathered during PRA consultations and less formal interviews in locations where women or men traditionally gather, such as community wells and markets. NGO collaborators will develop advisory teams from each area (in Kenya and Uganda) comprised of select smallholder farmers, women, youth, community leaders and farm input suppliers.

The survey approach will seek input from community members on how to develop a program that results in positive changes with respect to food production, environmental quality, and carbon sequestration. The approach uses components of the "co-design" approach defined by Cerf et al. (2009) by seeking to describe:

1. how local people invent solutions to achieve change;
2. what are the limits of acceptable change in each situation;
3. what knowledge must be embedded in prototype solutions;
4. what scientific, technical, and local knowledge must be available to expected users of new CAPS.

The information will be compiled and summarized by the host-country teams by July of 2010 for use in Objective 2.

Outcomes, Objective 1

- Past and Current CA practices documented and evaluated;
- Advisory groups identified and assembled;
- Sample farmers chosen and profiled;
- Summary of baseline household production & marketing strategies clustered by key; demographics or on-farm variables based on interview and survey work;
- Summary of PRA outcomes.

Timeline, Objective 1

We propose to complete this information gathering phase by July 31, 2010.

RESEARCH OBJECTIVE 2 (Pre-experiment): Define the traditional system and develop prototype CAPS for each area that build upon local knowledge, traditional practices, and address agronomic and socio-economic constraints.

Summary The research team and farmer-advisory group will use data from the survey in Objective 1 to jointly refine and/or design CAPS. Prototype CAPS will incorporate, where appropriate, crop rotations, minimum tillage, organic and inorganic amendments, integrated nutrient management and integrated pest management. They will also build upon local knowledge of environmental, resource, and economic constraints, and consider limits to acceptable change. This process will foster two-way learning as farmers teach PIs reasons for traditional practices and resistance to change, and are taught soil processes underlying CA approaches.

Approach

In each study area, focus groups led by NGO-partner representatives from each area and comprised of stakeholder advisory groups and U.S. and host-country research team members, will meet at least three times to 1) develop a "traditional farming system" for each area, and 2) design two CAPS thought to be capable of improving soil quality and sustainable productivity, subject to resource and socio-economic constraints, with sensitivity to gender-specific perspectives and issues. The meetings will achieve five specific tasks:

1. Present and discuss baseline survey results; educate farmers and other stakeholders on soil science concepts underlying traditional and CA approaches, and discuss the need for (and limits to) change;
2. Define a traditional system for each area (to be used as controls in Obj. 3).
3. Define two complete CAPS for each area using pairwise ranking, matrix ranking, and other group consensus activities;
4. Identify inputs and tools needed to test the CAPS, and determine how to obtain or manufacture them;
5. Identify three pilot farms in each area where on-farm trials will be established.

Outcomes, Objective 2

- Improved understanding of agronomic concepts and issues by key stakeholders;
- Improved understanding of constraints and opportunities by the research team;
- Detailed agronomic/socio-economic description of traditional systems by study area;
- Co-designed prototype CAPS that address agronomic and socio-economic constraints as well as gender-specific and wealth-ranking issues.

Timeline, Objective 2

We propose to complete this participatory CAPS co-design phase between August 1 and September 30th, 2010.

RESEARCH OBJECTIVE 3 (Experiment): Evaluate agronomic, ecological, and economic sustainability of CAPS compared to traditional practices.

Summary This phase of the study will generate data on the performance of prototype CAPS, and provide outreach and training opportunities. CAPS will be implemented alongside traditional production practices, as replicated plots, on university and/or government research institute farms, and the farms of cooperating NGOs and small holders in Uganda and Kenya. Parameters evaluated will include: 1) soil biological, physical, and chemical properties; 2) trace gas emissions; 3) crop and forage growth, yield and quality; 4) labor requirements; 5) economic viability; and 6) adoption and adaptation of CA technologies and approaches. Following initial trials, during pilot farm visits and outreach activities, on-the-ground university and NGO reps will encourage more farmers to establish on-farm plots, with less intensive data collection, to generate more feedback from “early adopter” farmers, and increase the project’s visibility within the farming community. Project teams will develop feedback loops in the co-design process to ensure that any new knowledge of relevance is incorporated in the ongoing project.

Approach

Structure of interaction among researchers and on-site participants

Structured meetings will generate “co-design feedback loops” for responsive implementation and improvement of prototype CAPS as follows:

1. Fortnightly during each growing season, local NGO coordinators will visit each pilot farm to monitor progress, provide support, and conduct outreach activities.
2. Monthly, local teams (including NGO partners, students, university representatives, local extension agents, participant growers, and others) will hold meetings at each of the four study sites. These may also be facilitated by teleconferencing when necessary;
3. Four times per year (i.e. at least once per growing season), training activities targeted toward stakeholder groups such as farmers, agricultural educators, suppliers, buyers and others will be held at each area by the university and NGO partners;
4. Every six months, 1) stakeholder advisory group “reflection workshops” led by NGO partners; and 2) internal project planning meetings to review progress led by project director Norton and involving all university and NGO participants. Tele- and/or video-conferencing will be used as necessary;

CAPS Research Design

On-station replicated trials: Three replications of two prototype CAPS, and a traditional system as a control, will be established on 3- x 6-m plots in a randomized complete block design to facilitate demonstration purposes. For rotations, each phase will be represented each year. A CAPS with a four-year rotation, for instance, would cover four 3- x 6-m plots, each starting with a different phase of the rotation in Year 1 (Figure 1). Plots will be located on land controlled by cooperating universities, government research institutions or NGOs.

On-farm pilot plots: Simultaneous with on-station trials, one replication of each prototype CAPS will be established on at least three farms in each area. We will strive for at least one farm in each area to be controlled by a woman. Farmers will provide labor for on-farm pilot, but local area coordinators from the research team will visit each pilot farm at least once every two weeks during growing seasons. Additional on-farm plots will be established in subsequent years with interested farmers who can assure availability of land and labor. On-farm trials will be sampled for yield, and a subset of agronomic and economic parameters will be monitored. Plots established in subsequent years will be monitored for yield and a more cursory set of parameters.

Traditional system (2-yr rotation)	**Phase 1**	**Phase 2**	**Phase 1 (demo)**	**Phase 2 (demo)**
CAPS 1 (3-yr rotation)	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 1 (demo)**
CAPS 2 (4-yr rotation)	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**

Figure 1. Schematic layout of one replication (or block) of an on-station trial showing comparison of 2, 3, and 4 year rotations as examples. Each square represents one plot planted to one phase of each crop rotation. "Demo" means that the plot would be planted to crops from the corresponding system but measurements would not be taken. In this example, measurements would be taken from nine plots in each of three replication blocks, for a total of 27 plots in each on-station trial.

Soil properties: J.B. Norton, U. Norton, J.R. Okalebo, E.C. Omondi, and E.J. Mukhwana

Studies of cropping systems show distinct impacts of tillage, rotation, and soil amendments on SOM dynamics and on recovery of SOM lost during long-term conventional cropping (Grant et al., 2002; Sherrod et al., 2005; Six et al., 1998) and suggest that SOM dynamics change with altered management. There is a well-documented time lapse between the initiation of organic inputs and enhancement of soil quality (e.g., Delate and Cambardella, 2004; Drinkwater, 2002; Tu et al., 2006). At first, as organic materials are added to the depleted soils, rapidly growing microbial communities immobilize nutrients and can suppress yields, or, in reduced-input systems, increase needs for fertilizer over the previous conventional approach (Drinkwater, 2002; Sherrod et al., 2003). As SOM content stabilizes at higher levels, nutrient-supplying capacity increases and the SOM pool forms a season-long nutrient supply.

Soil sampling and analyses procedures will provide a rich setting for training of project participants both in Africa and at the University of Wyoming. Laboratory analyses will be split among host-country universities and the University of Wyoming depending upon laboratory capabilities and how analyses are divided among the theses of the MSc student at Moi University and the PhD student at the University of Wyoming (see training plan).

Soil Sampling Procedure: Sampling will be led by graduate students with assistant from host-country university technicians and on-site NGO representatives. Fifteen sampling points will be located at random distances from even intervals along a transect across each of the plots. Each point will be used throughout the study. Soil sampling will include:

1. Soil cores (0 to 15 cm) collected from 15 points and composited for each plot. Composite samples will be thoroughly homogenized. Ten-g subsamples will be field-extracted with 0.5*M* K_2SO_4 and stored on ice along with the remainder of the soil sample. These extracts will be filtered and analyzed for nitrate (NO_3^-), ammonium (NH_4^+), and dissolved organic carbon (DOC) contents, which are components of the active SOM pool;
2. At the beginning and end of the study 2-m soil cores will be collected from each plot by six depth increments: 0-15, 15-30, 30-50, 50-75, 75-150, and 120-200 (or by observed soil horizons). These samples will be treated the same as the 0- to 15-cm samples for analysis of basic soil quality and SOM dynamics parameters.

Basic soil quality: Basic soil properties will be quantified by standard analysis methods once at the beginning and at the end of the study on the 0- to 15-cm depth and soil profile samples and in the extensive study samples. Analyses include particle-size distribution by the hydrometer method (Gee and Bauder, 1986) (once in year 1 only), bulk density by the core method (Blake and Hartge, 1986), pH and electrical conductivity (EC) by electrode (Thomas, 1996), cation exchange capacity (CEC) (Sumner and Miller, 1996), total C and N by Carlo Erba combustion on an EA1100 Soil C/N analyzer (Carlo Erba Instruments, Milan, Italy), inorganic C by modified pressure-calcimeter (Sherrod et al., 2002), total phosphorus (P) by alkaline oxidation (Dick and Tabatabai, 1977), available P (Olsen and Sommers, 1982), exchangeable Ca, Mg, and K by NH_4OAc extraction (Knudsen et al., 1982) and gravimetric moisture.

Labile-pool SOM: To quantify available and readily mineralizable C and N, 10-g subsamples will be extracted with 0.5M K_2SO_4 and analyzed for NO_3^- and NH_4^+ by spectrophotometry. Dissolved organic C will be measured using a UV-persulfate TOC Analyzer (Phoenix 8000, Tekman-Dorhmann, Cincinnati, OH). Microbial biomass will be analyzed on fresh, refrigerated soil samples within 72 hours of collection by fumigation-extraction (Horwath and Paul, 1994). Mineralizable C and N will be analyzed by aerobic incubation (Zibilske, 1994). These temperature-, moisture-, and substrate-dependent properties will be measured in the 0- to 15-cm depth three times seasonally each year, and on soil profile samples in years one and four.

Physical fractionation of SOM: SOM fractions known to respond to changes in management will be quantified by separating light, intra-aggregate (protected), and mineral-associated SOM fractions via density fractionation (Sohi et al., 2001). The fractions separated by this method are chemically distinct and correspond to active, slow, and passive SOM pools (Sohi et al., 2005). Total C and N in fractions and whole soils will be measured by Carlo Erba combustion and inorganic C will be subtracted from total C to determine total organic C. These relatively stable SOM pools will be analyzed in 0- to 15-cm depth and the soil profiles at the beginning and end of the study and also in the extensive study samples.

Trace gas emissions: U. Norton and E.J. Mukhwana

Trace gases are important indicators of agroecosystem health and resiliency. Measurements of primary trace gases (CO_2, N_2O and CH_4) from traditional cropping systems and prototype CAPS will provide much needed information that can vary greatly during the year and across land use practices. Among many abiotic and biotic factors influencing GHG emissions to the atmosphere are temperature, moisture, SOM and plant residue, pH, texture and mineralogy. Cultivation and conservation practices also have important impacts on GHG emissions (Paustian and Babcock, 2004). Carbon dioxide is primarily derived from metabolic activity of heterotrophic soil microbes and during root respiration. Plant residues remaining in soil are quickly decomposed and turned over to CO_2, with a small fraction sequestered in the soil (Schlesinger, 1990). Decomposition of SOM and microbial respiration are therefore, major sources of CO_2 in the global C cycle. Nitrous oxide is produced in soil by denitrification and nitrification, microbially mediated processes carried out by anaerobic heterotrophs or chemoautotrophs, which are ubiquitous in most soils. The process of nitrous oxide production is not limited to saturated environments as was previously thought. It occurs in any soil in which oxygen-depleted microsites are temporarily created (Sextone et al., 1985) or in dry soils as an end product of autotrophic nitrification. Methane emissions are produced mainly by methanogenesis in saturated soils. Conversely, dry soils are considered to be one of the globally important sinks for C as they assimilate significant quantities of CH_4 via methanotrophy and measurable rates of CH_4 assimilation have been documented in a variety of environments (Mosier et al., 1991).

Measuring trace gas emissions: Trace gas monitoring should be performed biweekly during the wet seasons and once a month during the dry periods of the year. An enclosure technique for measuring changes in gas concentration in headspace will be used for this experiment (Mosier and Mack, 1980). Specifically, we will install PCV rings 25-cm diameter and 10 cm high inserted in the ground (2 to 5 cm deep). These rings will serve as bases for chambers periodically installed on plots for monitoring trace gas evolution. Area within the bases will be left undisturbed for the duration of each season. Trace gas flux measurements will be taken by using static chambers deployed on the soil surface for a period of 30 minutes (Hutchinson and Mosier, 1981). Sampling will be performed by drawing a single air sample from chamber headspace using 30-ml syringe secured with a stopcock at 0, 15 and 30 minutes after the chamber is sealed. Twenty-five ml aliquots of these gas samples will then be injected into previously evacuated 12-ml tubes sealed with butyl rubber septa. Best fluxes will be estimated from the rate of change of the gas concentration in the chamber headspace. Soil samples (0- to 10-cm depth) will be collected at the end of the last day of monitoring from randomly selected locations adjacent to the trace gas chambers. Composite soil samples will be homogenized in the field, all visible coarse fragments (greater than 4 mm) removed, and subsamples drawn for immediate field extraction in 2*M* KCl and analysis for available N as described above. The remainder of the composite samples will be bagged and stored on ice for transport to the lab for estimation of potentially mineralizable N, dissolved organic C, and gravimetric water content.

The tubes will be shipped to Sustainable Agriculture Research Lab at the University of Wyoming for analysis on an Automated Gas Chromatograph (Schimadzu GC-2014) equipped with thermo-conductivity, flame ionization and electron capture detectors to capture CO_2, CH_4 and N_2O respectively (Mosier and Mack, 1980), unless this can be done in host countries.

Crop and forage growth, yield and quality: U. Norton, J.R. Okalebo, E. Omondi

Yield and quality of harvested crops are the ultimate tests of long-term sustainability. Forage, grain, and other crops will be harvested and analyzed for yield, test weight, grain or forage protein, and other crop-specific attributes of quality. Rainfall, soil temperature, and soil moisture will be monitored at each on-station trial via HOBO tipping bucket rainguages, temperature sensors, moisture sensors, and data loggers (Onset Computer Corp., Pocasset, MA).

Biogeochemical Modeling: U. Norton

Field data collection will be especially important in developing and testing inferential biogeochemical models. Process-based models that we will consider include, but are not limited to, the CENTURY model (e.g., Parton et al., 1987) and similar types of "systems" models (e.g., Ise & Moorcroft, 2006; Xu et al., 2006). Testing simulation models against collected data will better define important interactions between the soil C and N cycles, soil properties, and microbial, plant community, and productivity dynamics. The data from the field and laboratory studies will also be simultaneously analyzed by employing hierarchical Bayesian (HB) statistical models (Clark, 2005; Clark & Gelfand, 2006; Ogle & Barber, 2008). One outcome of this HB data-model integration is a process model that is fully parameterized with the diverse data sources (Hong et al., 2005; Ogle & Barber, 2008). These tasks will be accomplished by graduate students pursuing the degree in Agronomy in affiliation with Urszula Norton's Sustainable Agriculture Research Lab at the University of Wyoming.

Economic viability: D.E. Peck, R. Laker-Ojok, B. Bashaasha

The relative economic performance of CAPS is influenced by several important factors, including labor requirements, competing uses for animal manure and crop residue, the opportunity cost of using land for green manure rather than a food crop, and the cost of herbicides, pesticides and inorganic fertilizers (Giller et al., 2009; Kaizzi et al., 2006; 2007). On-station team members and on-farm participants will therefore record information about the quantity and opportunity cost of these and other inputs for each CAPS and traditional system in each study area. This data will be used to construct an enterprise budget for each system. These budgets will provide estimates of total revenue, total factor cost, and net revenue for each system. Janosky et al. (2002) provide an example application of this approach. Kaizzi et al. (2006; 2007) use a similar approach in Uganda. Net revenue for the alternative systems will then be compared to determine the relative profitability of CAPS versus traditional systems. Because crop and input prices can vary widely both within and across years, budgets will be recalculated using a variety of prices, which will be based on recent historical prices in the respective study areas. This "sensitivity analysis" will provide insights about the variability of net revenue for each system, and hence their relative riskiness. Because labor is often a limiting resources, return to labor will also be computed for each system. This will enable farmers to consider their household's unique labor constraints when comparing the potential profitability of various CAPS. The economic analyses will be conducted in a participatory manner with farmers. Their feedback on whether the realized net revenues are sufficient to offset any changes in labor requirements will be sought. Transaction costs related to input acquisition and output marketing will be assessed, along with impacts on gender dynamics and food security.

Market issues and opportunities: E. Arnould, M. Press, R. Laker-Ojok, B. Bashaasha

Small farms in sub-Saharan Africa face daunting challenges in meeting their subsistence requirements and producing surplus crops that can respond to market demand in an ecologically sustainable fashion. Challenges for developing alternative value chains for farms in sub-Saharan Africa include 1) policy and regulatory environments that tend to be punitive of small farm innovation; 2) lack of tools and technology for sensing market demand in innovative or emerging markets 3) logistics bottlenecks; 4) high post harvest loses; 5) inadequate storage infrastructure; and sometimes 6) long-term contractual relationships, e.g., debt or production quotas, that restrict ability to create or exploit new opportunities. These issues will be explored by collecting primary and secondary data. Secondary sources will include local, national (e.g., Uganda Bureau of Statistics), development projects, producer organizations, and other sources. Primary data will be collected by questioning a sample of leading farmers and various marketing agents so that comparisons can be made across approaches. We expect this research to give us a clearer grasp of the strengths, weaknesses, opportunities, constraints and profitability potentials that farmers face in alternative cropping systems, crops, value chains, and markets.

<u>Outcomes, Objective 3</u>

- Co-designed, gender responsive CAPS tested and promoted;

- Effects of traditional system and alternative CAPS on soil processes and quality quantified and compared;
- Carbon sequestration and global-warming potential of traditional systems and alternative CAPS quantified and compared;
- Economic performance of traditional systems and CAPS quantified and compared;
- UW PIs in collaboration with NGO teams quantify and compare marketing issues associated with supplies (upstream) and sales (downstream) of traditional systems and alternative CAPS quantified and compared;
- CAPS promoted through pilot farm plots and focus group co-design process.

Timeline, Objective 3

Year 1: Pilot On-station and on-farm plots established beginning September 30, 2010, and planted in spring, 2011. Baseline soil and socio-economic data collected.

Year 2: Establish and monitor field trials.

Procure supplies and equipment	October-January, 2011
Training workshop	January-February, 2011
Land preparation for planting	January-February, 2011
Planting	February-March, 2011
Visit on-farm trials to assist, monitor	Every two weeks
Soil sampling, econ data collection	Feb, June, August, 2011
Harvest, yield data collection	August, 2011
Field day	April or May, 2011
“Reflection workshops”	July/August, 2011, January 2012

Year 3-5: Repeat schedule from Year 2, with the following additions: reflection, re-design, and monitoring of CAPS; mid-project and end-of-project impact evaluations to assess adoption and income/yield impacts on adopters compared to the baseline and to non-adopters.

E. Expected Outcomes

In addition to outcomes listed under objectives above:

1. CAPS that local community leaders and members have had a stake in developing, that address gender-specific perspectives and issues, and that speak to constraints to improved yields and sustainability.
2. Improved yields and soil quality as small-holder farmers adopt science-based CAPS.
3. Increased capacity of agricultural educators, and host-country NGO/university partners;
4. Bases for policy review, revision, and development that encourages adoption of CAPS.

F. Evaluation of Results

Results will be evaluated and CAPS refined in an iterative re-design loop in Objective 3, both on Ugandan and Kenyan research stations and on small-holder farms in both regions. Final evaluation will assess extent of adoption by participating farmers and potential for replication and sustainability of interventions. Acceptability by different categories of farmers will be assessed, including careful gender analysis.

G. Use of Results and Outcomes

Small-holder farmers will use the results and outcomes to make decisions about adopting CAPS. NGOs and government extension programs will use them in ongoing farmer education programs and demonstration projects. Mechanisms to promote commercial availability of CAPS technologies through private sector input dealers will be sought.

H. Outreach Plan

Outreach activities that target smallholder farmers in the study areas through equitable, inclusive channels are the key of a successful project. An inception meeting will be planned in the study region for the research team plus local farmer/leaders, extension personnel, and others from each target area to introduce the project. The outcomes of the meeting will be increased awareness in the target communities and refined plans for each step of the project to be most effective in each location. Our proposed outreach plan begins with the initial survey, which will also serve as an outreach tool. Other activities and material will include:

Year 1:

- Inception meeting in early 2010 initiates working relationships and capacity building;
- Contacts with other organizations/projects;
- PRA survey/meetings double as information gathering and outreach about projects;
- Focus group meetings double as farmer training about CAPS concepts and researcher training about local knowledge;
- Publish educational bulletins/posters on results of baseline survey and CAPS design.

Years 2, 3, 4, 5:

- Experiment establishment encourages farmer engagement on station and on farm;
- Reflection workshop in April for review of prototype CAPS;
- Field Day at each field area in May and October;
- Fortnightly visits to pilot farms encourage engagement with neighbors;
- Farmer training brochures printed and disseminated to participating farmer groups and available on the website.
- Exchange visits from non-beneficiary farmer groups, extension staff, and other interested NGOs and stakeholders encouraged.
- Begin radio messages to stimulate debate and inform public as early as year 3.

Year 5:

- CAPS conferences in Kenya and Uganda to engage decision makers after July, 2014.
- Educational posters on project results and CAPS principles;
- Radio broadcasts on regional stations about soil management and project results;
- How-to bulletins based on results and targeted at extension agents, NGO representatives, other agricultural educators, as well as producers in each study area;
- Peer-reviewed journal articles on biophysical and socio-economic results.

I. Potential Pitfalls

The long distance between the US research team and the host-country team and sites poses the highest potential for difficulty. This will be overcome by scheduling frequent assessment and planning meetings and maintaining open lines of communication from the outset.

J. Limitations of Methods and Approaches

Experimental rigor is sacrificed in order to accommodate more sites representative of agroecological and socio-economic conditions in SSA. Careful planning to block replication on similar soils in on-station experiments and frequent monitoring of both on-farm and pilot plots will yield broadly applicable principles.

K. Environmental Impacts

Pesticides will be used according to label restrictions to prevent environmental impacts. All personnel and farmer participants will be trained on safe use and handling of all materials.

L. Contribution to USAID Mission Objectives

Calls and emails to USAID Missions and country desks for Kenya and Uganda unanswered.

M. Training Plan

Training activities that target professional agricultural educators from extension services, private entities, NGOs, and other groups will seek to improve capacity to facilitate, evaluate, and sustain innovation and adoption of CAPS.

Year 1: Recruit students to start classes in 2010-2011 academic year and start working with team ASAP: Four graduate students total will be recruited for the project. Female and minority students will be actively recruited and encouraged to apply.

- Economics/marketing student(s) from Uganda or Kenya at UW. Ph.D. student in Agronomy/agricultural economics or two M.S. Ag Econ/business students;
- Soil science PhD student from Uganda or Kenya at UW;
- Ugandan economics/marketing M.S. student at Makerere University;
- Kenyan soil science M.S. student at Moi University.

Year 2-5:

- Quarterly training workshops engage extension and ag business personnel to address needs revealed during baseline survey;
- Cross-training, capacity-building exchange visits by PIs and grad students from host countries to US and vice versa;
- Sabbaticals by academics from host countries and US leveraged with SANREM funding.

N. Schedule of tasks and outcomes

Please see enclosed Year 1 plan of work and completion dates/outcomes for each task under D. Methods and Approaches.

O. Roles and Responsibilities of Key Personnel and Partner Organizations

<table>
<tr><th colspan="2" rowspan="2">Task</th><th colspan="3">Roles</th></tr>
<tr><th>Coordination</th><th>Implementation</th><th>Support</th></tr>
<tr><td rowspan="4">Objectives 1 & 2 (Pre-experiment)</td><td>Review of existing CAPS</td><td>Mukhwana; Omondi;Laker-Ojok;</td><td>Mukhwana; Omondi; Laker-Ojok; Technicians</td><td>All team members</td></tr>
<tr><td>Baseline interviews & samples (socio-economic & agronomic)</td><td>Laker-Ojok; Okalebo</td><td>Laker-Ojok; Okalebo; Bashaasha; Technicians</td><td>All team members</td></tr>
<tr><td>Stakeholder advisory group formation, initial interactions</td><td>Laker-Ojok; Mukhwana; Omondi</td><td>Laker-Ojok; Okalebo; Bashaasha; Technicians</td><td>All team members</td></tr>
<tr><td>Definition of traditional systems & co-design of CAPS</td><td>J. Norton; Okalebo</td><td>Stakeholders; All team members; Technicians</td><td>All team members</td></tr>
<tr><td rowspan="6">Objective 3 (Experiment)</td><td>Establish & manage on-station and on-farm trials; collect data</td><td>Mukhwana; Omondi; Laker-Ojok;</td><td>Laker-Ojok; Okalebo; Mukhwana; Omondi; Technicians; Students</td><td>Bashaasha; US team members</td></tr>
<tr><td>On-going feedback between research team & stakeholder advisory groups about CAPS</td><td>Laker-Ojok; Mukhwana; Omondi</td><td>Laker-Ojok; Mukhwana; Omondi; Technicians; Students</td><td>US team members</td></tr>
<tr><td>Soils/agronomy data analysis</td><td>J. Norton; Okalebo</td><td>J. Norton; Okalebo; U. Norton; Students</td><td>Mukhwana; Omondi; Technicians</td></tr>
<tr><td>Economic data analysis</td><td>Bashaasha; Peck</td><td>Bashaasha; Peck; Students</td><td>Laker-Ojok</td></tr>
<tr><td>Market data analysis</td><td>Arnould; Press</td><td>Arnould; Press; Student</td><td>Laker-Ojok; Bashaasha</td></tr>
<tr><td>Outreach activities & publications</td><td>J. Norton, Laker-Ojok; Mukhwana; Omondi</td><td>Laker-Ojok; Mukhwana; Omondi; Bashaasha; Okalebo; Technicians; Students</td><td>US team members</td></tr>
</table>

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Education

Ph.D. Forestry/Soil Science: The University of Montana (2000)

M.S. Agronomy/Soil Science: Iowa State University (1996)

B.A. Geology: The University of Montana (1985)

Employment History

2006-present Assistant Professor of Soil Fertility & Cooperative Extension Specialist, Department of Renewable Resources, University of Wyoming.

2002-2006 Cooperative Extension Director & Farm Advisor, University of California, Tuolumne County, California.

2001-2002 USDA-NRI Postdoctoral Research Associate, Utah State University Plants, Soils, & Biometeorology Department and USDA-ARS Forage & Range Research Laboratory.

1996-2000 NSF Research Associate & Project Manager, Department of Agronomy, Iowa State University.

1993-1995 Teaching and research assistant, Department of Agronomy, Iowa State University.

1991-1992 Soil Scientist, Earth Tech, Inc., Waterloo, Iowa.

1984-1990 Soil Conservationist, Missoula and Mineral County Conservation Districts and Natural Resource Conservation Service.

Grants Received and Project Director/Program Manager Experience

2009-2012 Co-PI, USDA-Organic Agriculture Research and Extension Initiative: Marketing opportunities and constraints confronting organic farming operations in the high plains; $500,000;

2008-2012 PD, USDA-AFRI Agricultural Prosperity for Small and Medium-Sized Farms Integrated Grant: Economic and environmental sustainability of conventional, reduced-input, and organic approaches on western crop-range-livestock farms; $500,000; 19 co-PIs and many growers in long-term on-station, on-farm research;

2008-2011 PD, University of Wyoming School for Energy Resources Matching Grant: Effects of Natural Gas Well Development and Reclamation Activities on Topsoil Properties; $150,000;

2008-2009 PD, University of Wyoming Cooperative Extension Competitive Grant: Reclaiming Wyoming: An Educational Workshop for Professionals Reclaiming Ecosystems Impacted by Energy or Mineral Extraction; $60,000

2007-2009 PD, NRI soil processes seed grant: Effects of cropping-system-related soil moisture and nutrient dynamics on the sustainability of semiarid dryland agriculture; Six co-PIs, grad student, $100,000;

2007-2010 PD, AES competitive grant: Effects of cropping-system, irrigation method, and soil properties on soil nitrogen and organic matter dynamics in the Big Horn Basin; Seven Co-PIs, grad student, $60,000;

2005-2007 PD, Kearney Foundation: Soil organic matter and land use in upper montane and subalpine mountain meadows; Six collaborators, two grad students, $40,000

2004-2007 PD, Kearney Foundation/USFS: Fire management, erosion, & nutrient cycling in wildland interface shrublands; Five collaborators, three techs, $230,000;

2002-2006 Director, Tuolumne County CA UC Cooperative Extension. Eight employees;

1995-2000 Project Manager, NSF ecosystems studies: Soil fertility renewal in long-term Native American agriculture; Five PIs, four grad students, up to 10 employees; $500,000.

Publications, 2004-Present

Refereed Journals

Norton, J.B., T.A. Monaco, and U. Norton. 2007. Mediterranean annual grasses in western North America: Kids in a candy store (invited commentary). Plant and Soil 298:1-5

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2005-2007	PETSMART Distinguished Professor, Retailing and Consumer Sciences, University of Arizona, Tucson, Arizona
2003-2005	E.J. Faulkner College Professor and Interim Director CBA Agribusiness Programs, University of Nebraska, Lincoln, Nebraska
2000-2005	Professor of Marketing, University of Nebraska, Lincoln, Nebraska
1999-2000	Associate Professor of Marketing, University of Nebraska, Lincoln, Nebraska
1994-1998	Associate Professor of Marketing, University of South Florida, Tampa, Florida, (tenured 1996)
1991-1994	Associate Professor of Marketing, California State University, Long Beach.
1989-1991	Assistant Professor of Anthropology, University of Colorado at Denver.
1986-1989	Research Associate, Bureau of Applied Research in Anthropology and Research Scientist, Office of Arid Lands Studies, University of Arizona, Tucson, Arizona.
1983-1986	Specialist in Social Impact Evaluation, Planning Ministry, Niger Republic and Institute for Development Anthropology, Binghamton, New York.
1976-1980	Research Assistant and Field Supervisor, Niger Natural Resources Planning Project, University of Arizona and Service Départemental du Plan, Zinder, Niger Republic.

Consulting Experience

24 Short and Long-term Consulting Projects in 11 West and East African nations, as well as in the US; 29 Consulting Reports (author and co-author) in the areas of integrated rural development, natural resources management, agribusiness, and tourism for USAID, UNEP, CARE, TransFair USA, and consulting firms including Abt & Associates, Chemonics, DAI, IRG, and Office of Arid Lands Studies, University of Arizona. Recent consulting on in-bound retail telephony, demand side energy management, and qualitative data analyses for CVS, Vertical Communications, H.J. Heinz, J.C.Penney, Dongguk University (Korea).

Education Highlights

1982-1983 Post-doc in Marketing, University of Arizona
1982 Ph.D.; 1975, M.A. Social Anthropology and Archaeology, University of Arizona
1969 B. A. Social Sciences, Bard College, Annandale, New York

Languages

English, French, fluent; Hausa, functional

Other Professional Highlights

Publications: over 30 Refereed Journal Articles, 4 Edited and Co-authored Books, 20 Book Chapters, 14 Published Conference Proceedings, 15 Published Book Reviews; Service on 10 Academic Journal Editorial Review Boards

Conferences: Co-chaired 2 International Conferences; made 60 National and International Conference Presentations; organized 11 National and International Conference Sessions

Relevant Teaching Experience

Served as Member or Chair of 8 Doctoral Committees. Taught 6 different undergraduate courses in marketing and anthropology; 9 different Master's/ MBA courses in marketing, cross-cultural marketing, and qualitative research; 4 different Ph.D. level seminars in behavioral theory, resource theory, and qualitative data analysis

Awards: Numerous small grants, small awards for professional service, outstanding research, and conference presentations. Largest grant co-PI, $500,000 USDA OREI grant.

CV FOR MOI UNIVERSITY COLLABORATOR-

Okalebo J. R

FAMILY NAME: OKALEBO
OTHER NAMES: John Robert
DATE OF BIRTH: 20th July, 1940
COUNTRY OF BIRTH AND NATIONALITY: Uganda; Ugandan
MARITAL STATUS: Married with 6 children (all adults now)
CONTACTS: Tel: 254 – 053 – 63257
Cell phone: 254 – 0727 – 819 – 023
Fax: 254 – 053 – 63257
Email: rokalebo@yahoo.com

AFFILIATIONS:
B.Sc., (Chemistry, Physics, and Mathematics), University of East Africa, 1966, Nairobi, Kenya.
M. Sc., (Spectroscopy), Manchester University, U.K.
M.Sc (Soil Science), Mc. Gill University, Canada
Ph.D., (Soil Science), University of Nairobi, Kenya

EMPLOYMENT:

1. Full Professor of Soil Science from 2007 to date
2. Associate Professor, Soil Scientist, Moi University, Eldoret, Kenya, 2002 to 2007
3. Senior Research Officer, KARI, Muguga, 1973 – 1995, also Head of Soil Chemistry Division
4. Research Officer/Senior Research Officer – East African Community 1967 – 1977.

PROFESSIONAL ACTIVITIES

- Full Professor of Soil Science, Moi University, Eldoret, Kenya.
- 2007 to date: Head of Department and Soil Testing Laboratory, Moi University
- 1973 – 1977: Head of Soil Chemistry Laboratory, KARI, Muguga.
- 1973 to date: Research and teaching missions in: soil chemistry, fertility and plant nutrition; but with emphasis on nutrition of phosphorus in cereals and legumes in the East African region.
- I have a teaching experience of 2 years at Kenya Medical Training Institute, Nairobi, Kenya and the past 15 years to date, teaching undergraduate and postgraduate students at Moi University, including external examining duty for East African, South African and U. K. Universities.
- very keen interest on extension and outreach activities

DISTINCTIONS

- Recipient of the Ugandan Government, ODM/UK, GTZ (Germany), CIDA (Canada) scholarships towards university education.
- Recipient of "Man of the Year, 2005" Award from the American Association of Biological Sciences.
- Recipient of 5 certificates form the Soil Science Society of East Africa (2002 – 2004) as one of the founder members of this society and excellent services to it, including "best" paper presenter at their Annual Conference in 2004.
- Council member of the African Crop Science Society.
- Head, Department of Soil Science, Moi University from 2002 to 2007 (as above).
- Recipient of research grants from ACIAR (Australia), GTZ (Germany), ARF (World Bank / USAID), 6 Rockaffeller Foundation training grants,
- AGRA (PASS & SHP), IMPHOS (France), VLIR-UOS (Belgium) GRAIN PULSES / CRSP (USAID), Cornell University, McKnight Foundation.

REFEREES : 1) Dr. Andre Bationo, Deputy Director AGRA, Ghana Office
2) Prof. Nancy Karanja, University of Nairobi,Dept. of Soil Science, Kabete Campus, Kenya.

- Won grants/sponsorships to attend International Conferences in Canada, Brazil, Mexico, France, Bangkok, Japan, South Africa, Morocco, Uganda, Kenya and Tanzania.

OTHER FUNCTIONS

- Member of the Soil Science Society of East Africa (32 years).
- Member of the African Crop Science Society (15 years).
- Member of the International Union of Soil Science (6 years)
- Member of Aloe Vera Growing association, Uganda (3 years)
- Member of the editorial committee of the East African Agriculture and Forestry Journal (KARI) (18 years).
- Member of the editorial committee of the African Crop Science Journal (5 years).
- Member of the VLIR (Belgium) Project for Moi University (one year so far).
- Member of the Senate Committee for Graduate Studies, Research and Extension (8 years), Moi Universit.

THESIS TUTORIAL

- M. Phil/M. Sc. theses, 30 from 1995 to date
- D. Phil/Ph.D. theses, 10 from 1997 to date.

BIBLIOGRAPHY

- 184 publications in review with a reading committee, 66 as first author, 116 presentations in international conferences.

THE MOST IMPORTANT PUBLICATIONS

1. Woomer, P. L., Okalebo, J. R., Maritim, H. K., Obura, P. A., Mwaura, F. M., Nekesa, P., and E. J. Mukhwana (2003). PREP-PAC: A nutrient replenishment product for smallholders in western Kenya. Agriculture Ecosystems, and Environment 100, 295 – 303.
2. Okalebo, J. R., (2003). Inorganic resource management for sustainable soil productivity. E. Afr. Agri. For. J. 69, 119, 129.
3. Waigwa, M. W., Othieno, C. O., and J. R., Okalebo, (2003). Phosphorus availability as affected by the application of phosphate rock combined with organic materials to acid soils in western Kenya. Expl. Agric. 39, 395 – 407.
4. Nekesa, P, Maritim, H. K., Okalebo, J. R., and P. L., Woomer, (1999). Economic analysis of maize-bean production using a soil fertility replenishment product (PREP-PAC) in western Kenya. African Crop Sci. J. 7, 585 – 590.
5. Okalebo, J. R., Palm, C. A., Gichuru, M., Owuor, J. O., Othieno, C. O., Munyampundu, A., Muasya, R. M., and P. L., Woomer, (1999). Use of wheat straw, soybean trash and nitrogen fertilizer for maize production tin the Kenya highlands. African Crop Sci. J. 7, 423 – 432.
6. Mutuo, P., Smithson, P. C., Buresh, R. J., and J. R. Okalebo, (1999). Comparison of phosphate rock and triplesuperphosphate on a phosphate deficient Kenyan soil. Comm. Soil Sci and Plant Anal. 30, 1091 – 1103.
7. Shepherd, K. D., Ohlsson, E., Okalebo, J. R., and J. K., Ndufa 1996). Potential impact of agrofrestry on soil nutrient balances at the farm scale in the East African highlands. Fertilizer Research 44, 87 – 99.
8. Okalebo, J. R., Probert, M. E., and J. K., Lekasi, (1991). The effect of placement of phosphate fertilizer on the responsiveness of maize in eastern Kenya. Tropical Agric. (Trinidad), 71, 226 – 231.
9. Okalebo, J. R., Keter, J. K. A., and H. Ssali (1989). Sorghum responses to N and P fertilizer in four semi-arid sites of Machakos and Kitui districts, Kenya. E. Afri agric. For. J. 54, 131 – 145.
10. Okalebo, J. R., (1985). A simple wet ashing technique of P, K, Ca and Mg analysis of plant tissue in a single digest. Kenya J. Sci. Technol. (B) 6, 129 – 133.
11. Okalebo , J.R. 2009. Recognising the Constraints of Soil Fertility Depletion and Technologies to Reverse it in Kenyan Agriculture – Inaugral Lecture, 26 March, 2009.

CURRICULUM VITAE: Bernard Bashaasha

CURRENT ADDRESS:
Department of Agricultural Economics and Agribusiness, Makerere University, P.O Box 7062, Kampala - Uganda .Tel: (256) 414-543880 or (256) 414-531152 (office) or +256-772-627249 (cellophone)
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NATIONALITY Ugandan

EDUCATION: September 1998, Ph. D. (Agricultural Economics, The Ohio State University Columbus, Ohio, U.S.A; **December 1995**, M.A. Economics, The Ohio State University; **February 1990**, Master of Economics, Seoul National University, South Korea; **January 1986**, BSc. (Agriculture, Hons) Makerere University.

WORK EXPERIENCE

Makerere University, Dept of Agricultural Economics and Agribusiness: July 2008-current: **Associate Professor**; Nov.2000 – June 2008 **Senior Lecturer and Head**, Feb 199-Oct 2000; **Lecturer National Agricultural Research Organization (NARO**) 1993 – Jan 1999: Research Officer/ Soci-Economist.

SELECTED PUBLICATIONS

1.**Bashaasha, B.** S.M. Kasozi and G. Diiro (2008). "Tenure System and the Value of Agricultural Land in Uganda". *Journal of Food, Agriculture and Environment*, Vol.6, No. 1.
2.Ainembabazi, J.H., **B. Bashaasha**, J. Mugisha and T.S. Hyuha (2007). "Technological Change and Efficiency under Transactions Costs: The Case of Smallholder Sorghum Production in Eastern Uganda". *International Journal of Environment and Development,* Vol. 4., No. 1., pp. 33-44.
3. Kraybill, D. and **B. Bashaasha** (2006). "The Potential Gains from Geographical Targeting of Anti-Poverty Programmes in Uganda". African Journal of Agricultural and Resource Economics (AfJARE) Vol. 1 No.1; 37-48.
4. Bamwerinde W**., B. Bashaasha**, W. Ssembajjwe and F. Place (2006). "The Puzzle of Idle Land in the Densely Populated Kigezi Highlands of SouthWestern Uganda". *International Journal of Environment and Development,* Vol. 3., No.1., pp.1-13.
5. Kasozi S.M., **B. Bashaasha** and V. Ochwoh (2005). "Economics of Sorghum Production and Soil Fertility Management in Kabale Highlands, Uganda". *Journal of Food, Agriculture and Environment*, Vol.3, No. 3 & 4., pp.105-109.
6. Bashaasha. B., D. Southgate and D.S. Kraybill (2001). "Land Use Impacts of Agricultural Intensification and Fuelwood Taxation in Uganda". *Land Economics*, Vol. 77., No. 2., pp. 241-249.

RELEVANT PROFESSIONAL EXPERIENCE

Team Leader, Uganda Cotton Sub-sector Study. Commissioned by Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), Entebbe and Implemented through the PMA (October 2008 – ***ongoing***).
Senior Adviser on Economic Issues to the World Food Programme (WFP) Country Director, WFP Kampala Office, Uganda. July 9th 2008-**todate**.
Specialist in Seed Distribution and Input Supply Systems. A Countrywide Study of the Opportunities and Limiting Factors Related to the Development of Effective Seed Systems in

Africa: Consultancy Commissioned by the Bill and Melinda Gates (BMG) Foundation in Conjunction with the Rockefeller Foundation (*completed November 2006*).

MEMBERSHIP **A**frican Association of Agricultural Economists, International Association of Agricultural Economists (IAAE) and Uganda Agricultural Economics Association.

SCHOLARSHIPS: Government of the Republic of Uganda, BSc. 1982-85; Government of the Republic of Korea. MSc. 1987-90; Government of the Netherlands. Two short courses, 1990 and 1993; The Rockefeller Foundation. MA. and Ph.D. , September1993- 1998.

Graduate Advisors

1. Prof. Douglas Southgate, Department of Agricultural, Environmental & Development Economics, The Ohio State University, 2120 Fyffe Road Columbus, Ohio 43210, U.S.A. Phone: (614) 292-2432 Email: Southgate.1@osu.edu
2. Prof. David S. Kraybill, Department of Agricultural, Environmental and Development Economics, The Ohio State University, 2120 Fyffe Road Columbus, Ohio 43210, U.S.A. Phone: (614) 292-8721 E-mail: Kraybill.1@osu.edu
3. Prof. Luther Tweeten, Department of Agricultural, Environmental and Development Economics, The Ohio State University, 2120 Fyffe Road Columbus, Ohio 43210, U.S.A. Phone: (614) 292-8721 E-mail: Tweeten.1@osu.edu

Postdoctoral Sponsors.

The Rockefeller Foundation, Avenue of The Americas, New York, New York, USA.

Postdoctoral Research Project: Impact of Current Sorghum Cultivation Practices on Household Welfare and Natural Resources in South-Western Uganda. African Career Awards (ACA) Post-Doctoral Research Project, Supported by the Rockefeller Foundation – 1999.

Ph.D. Thesis Advosor:

Prof. Douglas Southgate, Department of Agricultural, Environmental & Development Economics, The Ohio State University, 2120 Fyffe Road Columbus, Ohio 43210, U.S.A. Phone: (614) 292-2432 Email: Southgate.1@osu.edu

Postgraduate Scholar Sponsor:

The Rockefeller Foundation, Avenue of The Americas, New York, New York, USA.

Name: Eusebius J. Mukhwana
Current work: Director, SACRED Africa/Graduate Student
Profession: Soil Science
Employment SACRED Africa
Mucai Drive, Off Ngong Road
Po Box 8771-00200, Nairobi, Kenya
Phone: 011-254-20-2710285/2730709
Cell: 254-721-339381
Email: sacred@africaonline.co.ke

1.0 ACADEMIC TRAINING

1.1 PhD in soil science (on-going, University of Wyoming, USA)
1.2 MSc Environmental Toxicology and Pharmacology (University of Nairobi, 1995)
1.3 B.Sc Veterinary sciences (University of Nairobi, Kenya, 1993).

2.0 EMPLOYMENT HISTORY AND LEADERSHIP

2.1 2008- Present: Graduate Assistant, University of Wyoming.
2.2 1997-2008: Director, Sustainable Agriculture Ctr for Research and Development in Africa (SACRED Africa).
2.3 1995-1997: Lecturer, Faculty of Agriculture, Moi University, Kenya (Teaching sustainability of smallholder agricultural production systems).
2.4 1993-1995: Director, Organic agriculture training and extension centre, Manor House Agricultural ctr, Kitale, Kenya.

3.0 RESEARCH ACTIVITIES, INTERSTS AND SERVICE

3.1 Researching about the economic and environmental sustainability of smallholder production systems (in Africa).
3.2 Sustainable alternatives for soil fertility management practices for smallholders in Africa.
3.3 Effects of different cropping systems on soil (physical, biological and chemical) properties and the economic sustainability of winter wheat production in Wyoming
3.4 Effects of different cropping systems on soil properties and the economics of irrigated sugar beet production in Wyoming.
3.5 Chair, Food and nutrition security committee, Ministry of Agriculture, Kenya.

4.0 HONORS AND AWARDS

4.1 Selected as a **Fellow** for the Leadership Enhancement in Agriculture Award (LEAP) of the Norman E. Borlaug International, 2009)
4.2 Head of state commendation for exemplary work of helping poor small scale farmers by the president of Kenya (2005)
4.3 Won a UN (United Nations) Award for exemplary and innovative projects of lifting small scale farmers in Africa from poverty.

4.4 Distinguished Founder of the sustainable agriculture Ctr for Research and development in Africa (SACRED Africa), One of the most successful indigenous African NGOs.
4.5 Serving Associate Editor of the Agronomy Journal of America (2009-2011)

6.0 PUBLICATIONS AND BOOKS

1. Mukhwana, E.J (2008): Facing the African soil fertility Challenge. Crops, Soils and agronomy news of America Vol.53 (11): 16-18.

2. Mukhwana, E.J and Norton J.B (2009): Feeding and protecting the soil secures our future. Reflections: University of Wyoming College of Agriculture annual Publication of outstanding Research. Vol 211: 40-45.

3. Mukhwana E. J. and Musyoka M. (2003): Extension Participatory of integrated soil fertility management practices in Kenya: In: Extension of Organic Resource management Practices in Kenya; Perspectives and Guidelines. United Nations Press, Nairobi, Kenya. Pp. 233-246.

3. Mukhwana E. J.(2003): Teaming up to Conserve the Biodiversity of Western Kenya. Journal of Tropical Conservancy and Biodiversity, 3 (1) pp 2 – 8.

4. Woomer P. L., Mukhwana E. J. and Lynam J. (2002): On-farm Research and Operational Strategies in Soil Fertility Management in Africa. In: B. Van Leuwe N. Sanginga, J. Diels and R.Merckx (eds): Integrated Plant Nutrient Management in Sub-Saharan Africa. CABI, Wallingford, U.K. pp 313 – 331.
5. Mukhwana E. J. (2000): Food Security and the Impact of Agricultural Development in Kenya: ODI, Agren – Research and Extension Newsletter 41. (21 – 26), London, United Kingdom.

6. Mukhwana E. J., Tungani O. and Woomer P. L. (2002): MBILI is number One: A handbook for innovative Maize-Legume Intercropping in Africa, SACRED-Africa, Kenya. 59 pp.

7. Woomer P. L., Mukhwana E. J., and Savala C. N. (2003): Best Bet Comparisons of Soil Fertility Management Recommendations in Kenya, SACRED-Africa, Kenya 59 pp.

8. Mukhwana E. J., Woomer P. L. and Omare M. N., (2003): The operations of Rural Self-Help Group. In: C.E.N, Savala and P. L. Woomer (eds): Sustainable Community Development in Sub-Saharan Africa. SACRED-Africa, Kenya. Pp 123 – 148.

Emmanuel Chiwo Omondi

Curriculum Vitae

918 Reynolds Street, Laramie, Wyoming 82072, U.S.A.
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Home Tel: 307 460 3718
Office Tel: 307 766 4853
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EDUCATION

2008 – Present **University of Wyoming, U.S.A.**
PhD in Agronomy (on-going)

2005 – 2007 **University of Wyoming, U.S.A.**
MS in Agronomy

1987 - 1990 **University of Nairobi, Kenya**
BS in General Agriculture

PROFESSIONAL EDUCATION

2005 **Community Development Resource Association (CDRA), Cape Town, South Africa**
Certificate in Horizontal (Peer, Action) Learning and Development Course

2002 **Galillee College, Israel**
Diploma in Environmental Management

1995 **PREMESE - Catholic Diocess of Machakos**
Certificate in Participatory Development Education and Leadership training (DELEPA).

1994 **Ecology Action, Willits, CA., U.S.A.**
Certificate in Biointensive Agriculture

WORK EXPERIENCE

2005 – 2007 **University of Wyoming, U.S.A.**
Graduate Assistant

1996 – Present **Manor House Agricultural Centre (MHAC)**
Director (on study leave)

1992 – 1996 **Manor House Agricultural Centre (MHAC)**
Head of Crops Department; Training Coordinator

MEMBERSHIPS AND HONORS

2006-present Gamma, Sigma, Delta Honor Society of Agriculture, University of Wyoming Chapter

2007-present Agronomy Society of America - 2007-present

2008-present Western Society of Crop Science

PRESENTATIONS AND PUBLICATIONS

Nov 2007 The potential of managing iron and zinc deficiency in dry beans with interplantings of annual ryegrass. *In* ASA-CSSA-SSSA International Annual Meetings, New Orleans, U.S.A

July 2006 Potential of biologically intensive agriculture for feeding people in Kenya: A case study of MHAC Activities. *In* The 18th World Congress of Soil Science, Philadelphia, U.S.A.

Nov 2003 Promotion of indigenous open pollinated seed and seed banking. *In* MHAC/ FORMAT Symposium, MHAC, Kitale, Kenya

June 2001 Extension methodologies for dissemination of Biointensive agriculture. *In* National Agricultural and Livestock Project (NALEP) Workshop Procceedings, Thika, Nairobi, Kenya.

April 2000 Biointensive Agriculture (BIA) in Kenya - a Case Study of the Adoption of BIA in Bungoma and Lugari Districts in Western Kenya. *In* Soil, Food, and People Conference Proceedings, UC, Davis, U.S.A.

1994 The Smallest Possible Area to Grow Food and Feed - an Investigation into Sustainable Diet and Dairy Production. Ecology Action Publication, California, U.S.A.

PROJECTS AND GRANTS

Sep 2007 Potential of managing iron and zinc deficiency in dry beans with interplantings of annual ryegrass, at UW SAREC. Western SARE Graduate Student Fellow Grants in Sustainable Agriculture, U.S.A. – $18,928

1996-2006 General BIA activities at MHAC, Kenya. Noyce and Irving Foundation U.S.A., U.S.A.; International Foundation, U.S.A. – $450,000,

2005-2006 Community Resource Centre establishment at MHAC and among contact communities – a project designed to introduce internet centers in the rural areas. Tudor Trust, U.K. and the Rotary Club of Palo Alto, U.S.A. – $55,000

Integrated Community Development through Mini-Training Centres project at MHAC. Conservation Food and Health Foundation, U.S.A. and Tudor Trust U.K. – $79,539

Strengthening the MHAC's extension outreach through the established community mini-training centers. Tudor Trust, U.K. – $108,700

1998-2000 Improvement and expansion of MHAC training and seminar facilities (hostels). Tudor Trust, U.K. – $153,850

1999 Strategic Capacity Enhancement Program: Implementation of a five-year strategic plan. Irving Foundation - U.S.A. – $50,000

Dr. Rita Laker-Ojok

Title / Position:	**Executive Director AT Uganda Ltd.**
Years of Experience:	**23**
Country Experience:	**Uganda, Tanzania, Zimbabwe**
Citizenship:	**American**
Postal Address:	**P. O. Box 8830 Kampala, Uganda**
Telephone:	**Work: 256-(0)772-550958 Home 256-(0)414-266759**
Fax:	**256-(0)414-285564** E-mail**: rojok@atuganda.or.ug**

KEY QUALIFICATIONS

- Economist – interests focus on collective marketing, resource economics, sub-sector analysis, cost-benefit analysis, agricultural policy, and farming systems research.
- Excellent facilitation and training skills
- Experienced Financial Controller, overseeing NGO budget of up to $3 million per year from multiple donors. Conducts monthly budget monitoring for computerized accounts kept in Accpac. Prepares year end financial reports for audit.

EDUCATION

Ph.D., Michigan State University, Agricultural Economics, 1994
MSC. Michigan State University, Agricultural Economics, 1981
B.A., Concordia College, Psychology/Sociology, 1974

PROFESSIONAL EXPERIENCE

AT Uganda Ltd., Executive Director. (2002-Present) Patron and founding member for an independent local NGO with its own board of directors. Responsible for fund raising, programme design, implementation, and management of the organization. Project activities focus on: 1). Facilitating development of commercial agro-input distribution networks in rural areas of Uganda, 2). Facilitating the growth and development of 20 farmers' collective marketing associations in Eastern Uganda. 3). Enhancing farmer capacity to adopt improved production practices including soil and water conservation, farmer to farmer multiplication of improved planting materials, savings mobilization, and farming as a business training. 4). Strengthening availability of appropriate rural agro-processing and production technologies on a commercial basis.

Patron, Uganda National Agro-Input Dealer's Association. (2002-Present) Founding member and Advisor to this professional association for agro-input stockists.

AT (Uganda), Senior Country Director for Enterprise Works Worldwide (1994-2001). Responsible for overall design, implementation and management of the Uganda Country Program. Fund raising and management of project portfolio.

External examiner for the Department of Agricultural Economics, Faculty of Agriculture, Makerere University, Kampala Uganda since 1995.

Michigan State University, Specialist, Uganda. (1991-94) Uganda In-Country Researcher under the Agricultural Technology Impact Assessment Add-On to the Food Security in Africa Cooperative Agreement between MSU and USAID.

Agency for Cooperation and Research in Development (ACORD), Country Representative, Uganda. (1990-91). **Agency for Cooperation and Research in Development (ACORD), Programme Coordinator, Gulu Rural Development Promotion Project, Uganda.** 1986-90. **Michigan State University, Fullbright Dissertation Scholar Uganda.** 1985-86, **Instructor.** 1983-84

SELECTED PAPERS:

Shaun Ferris and Rita Laker-Ojok. "Growth Prospects for Services Within Selected Agricultural Sectors in Uganda". Consultancy report to the World Bank, as part of the Uganda Country Economic Memorandum. 14th July, 2006.

Jonathan Coulter and Rita Laker-Ojok, "Scoping Study on Input and Output Markets", consultancy report prepared for DFID Uganda. September 2005.

Laker-Ojok, Rita. "Contract Template Field Studies", Consultancy report to Business Services Market Development Project. May 2005.

Godfrey Kayobyo and Rita Laker-Ojok, "Enhancing the Impact of Technology Transfer for Poor Households: Lessons from The Livelihoods Initiatives for Eastern Uganda (LIFE) Project" A Paper prepared for the NARO Conference, September, 1-4, 2004, Kampala.

Beatrice Okello and Rita Laker–Ojok. "The Potential Contribution Of Irrigation Technology To The Conservation Of Wetland Bio-Diversity And Enhancement Of Agricultural Productivity In Uganda - A Policy Analysis" 2020 Vision Network For East Africa, IFPRI. 2003.

Laker-Ojok, Rita. "Constraints to Improved Oilseed Production in Uganda" paper presented at the National Stakeholders Meeting for the COMESA Vegetable Oil/Protein Systems Improvement Network. February 14, 1996.

Laker-Ojok, Rita. "Managing Input Supplies for Small Farmers in Uganda: A Problem of Institutional Change" in Uganda, Landmarks in Rebuilding a Nation P. Langseth, J. Katorobo, E. Brett and J. Munene Editors. Fountain Publishers, Kampala, Uganda, 1995.

Laker-Ojok, Rita. "The Edible Oils Subsector in Uganda, Can it Compete?" Unpublished PhD. Dissertation. Michigan State University, Department of Agricultural Economics. March 1994.

_______ "The Use of Rate of Return Analysis for Agricultural Research Priority Setting: Examples from Uganda." African Crop Science Conference Proceedings, Kampala, 14-18 June 1993. Faculty of Agriculture and Forestry, Makerere University.

_______ "The Potential Returns to Oilseeds Research in Uganda: The Case of Groundnuts and Sesame." MSU International Development Working Paper No. 54, 1995. Department of Agricultural Economics, Michigan State University, East Lansing, MI.

_______ "The Rate of Return to Agricultural Research in Uganda: The Case of Oilseeds and Maize." MSU International Development Working Paper No. 42, 1994. Department of Agricultural Economics, Michigan State University, East Lansing, MI.

Biographical Sketch

Urszula Norton

Education

Ph.D. Forestry/Soil Science: The University of Montana (2000)
M.S. Soil Science (Soil Management): Iowa State University (1995)
M.S. Horticulture (Ornamental Plants): Warsaw Agricultural University (1990)
B.S. Horticulture: Warsaw Agricultural University (1988)

Interests and Expertise:

Soil biogeochemistry, soil organic matter dynamics, disturbance effects on ecosystem functioning, trace gas emissions and soil processes, nutrient cycling in semiarid and arid environments,

Research Design and Implementation Skills

- ◊ Field sampling including trace gas fluxes, soil and vegetation data collection;
- ◊ *In-situ* field experimentation using ^{15}N isotope dilution, buried bag, ^{15}N enriched plant material and water pulse methods;
- ◊ Laboratory analyses in chemical (N, C, Ca, P, K, organics) microbial (biomass C and N, respiration, gross N mineralization, net nitrification, various assays for C and N pools estimates) and physical properties of soil and plant material requiring laboratory equipment and wet chemistry methods;
- ◊ Experience in field/laboratory/greenhouse research design;
- ◊ Statistical analysis using SAS program;
- ◊ Quantitative soil-vegetation-ecosystem analysis using Biome-BGC model;
- ◊ Model manipulations of soil C mineralization under different vegetation types

Employment History

2009-present: Assistant Professor of Agroecology, Plant Sciences Department, University of Wyoming, Laramie, WY

2007-2009: **Adjunct Assistant Professor**, Renewable Resources Department, University of Wyoming, Laramie, WY
ESS-1000 Instructor (Wyoming in Earth Systems), 2 credit class;
Soils/AECL 4140/5140 Instructor (Soil Microbiology), 4 credit class;

2004-2007: **Research Associate step VIII (LAWR, UC Davis, CA)**
Developed and participated in multi-agency funded research projects that investigate C sequestration and C and N flux from shrublands and managed woodlands of Sierra Nevada foothills, CA.

2003-2004: **Post-doctoral Research Ecologist.** High Plains Grassland Research Station, USDA ARS, Cheyenne, WY/Ft.Collins, CO. Developed and carried out water-pulse research component of an interdisciplinary project studying the responses of rangelands to management and climate change.

2000-2002: **Post-doctoral Research Scientist** Department of Biology and the Ecology Center, Stable Isotope Analysis Lab, Utah State University, Logan, UT. Collaborated on an NSF Ecosystem Studies project investigating pulses of plant-available moisture and nitrogen in Great Basin plant communities: interactions of microbial processes, root depth distribution and hydraulic lift (http://psb.usu.edu/rushvalley/).

1996-2000: School of Forestry, University of Montana, Missoula, MT. Research, Teaching Assistant and Forest Soils Lab Manager.

Researched general forest vegetation ecology, soil biochemistry, microbiology and fertility of previously fire-suppressed and recently fire reintroduced forest ecosystems. Investigated the role of understory vegetation and plant litter on microbial processes and soil C and N mineralization.

1992-1995: Department of Agronomy, Iowa State University, Ames, IA. Research Assistant.

1991-1992: USDA ARS and Polish Department of Agriculture, Warsaw, Poland. Project Assistant and Interpreter

Memberships:

Ecological Society of America: since 1997
American Geophysical Union: since 2003
Agronomy-Crop Science-Science Society of America: since 1994
Gamma, Sigma, Delta Chapter of Agriculture, Iowa State University: 1995
Sigma Xi, University of Montana: 1998

Honors and Awards:

2007: Best Paper Award (co-author). ASA-CSA-SSSA meetings, Division S-7;
2006: Best Paper Award (first author): ASA-CSA-SSSA meetings, Division S-7;
2005: Best Paper Award (co-author): ASA-CSA-SSSA meetings, Division S-7;

Scholarships:

1997: Bertha Morton Scholarship, University of Montana ($1,500);

1997: Soroptimist Club of Missoula scholarship ($500);

1996: Bertha Morton Scholarship ($1,500);

1996: George Bright Scholarship, University of Montana ($3,000);

1987-1990: International internship awards to study and conduct research in The Netherlands, Hungary, Italy and Norway.

Conference and Workshop presentations:

Since 1994 actively participated in annual ASA-CSA-SSSA meetings where co-authored at least 25 posters and 6 oral presentations. In addition, presented at ESA and AGU annual meetings, C Sequestration International Conference (2005) and participated in a number of workshops.

PUBLICATIONS (Last 5 years)

Hooker, T.D., J.M. Stark, **U. Norton**, A.J. Leffler, M. Peek, and R. Ryel. 2008. Distribution of ecosystem C and N within contrasting vegetation types in a semiarid rangeland in the Great Basin, USA. **Biogeochemistry** 90:291-308;

Norton, U., A.R. Mosier, J.A. Morgan, J.D. Derner, P.D. Stahl, and L.I. Ingram. 2008. Trace gas emissions and soil C and N dynamics following moisture pulses in native grassland and cheatgrass-dominated sagebrush grasslands. **Soil Biology & Biochemistry:40:1421-1431;**

Norton, J.B. T. Monaco, and **U. Norton. 2007.** Mediterranean grasses in the American West: Kids in a Candy Store. **Plant and Soil 298: 1-5;**

Blumenthal, D.B., **U. Norton**, J.D. Derner, and J.D. Reeder. 2006. Long-term effects of tebuthiuron on *Bromus tectorum*. **Western North American Naturalist 66:420-425;**

CURRICULUM VITAE: DANNELE E. PECK
August 2009

Address
Department of Agricultural and Applied Economics
University of Wyoming
Laramie, WY 82071
Phone: (307) 766-6412
Email: dpeck@uwyo.edu

Employment History

August, 2006 – present. Assistant Professor, Department of Agricultural and Applied Economics, University of Wyoming (50% research, 50% teaching)

Areas of Specialization

Agricultural production economics, Decision-making under risk and uncertainty, Water resource economics, Natural resource and environmental economics

Education

Ph. D. Agricultural and Resource Economics – Oregon State University, 2007. Dissertation Title: "Economics of drought preparedness and response in irrigated agriculture"

M. S. Agricultural and Applied Economics – University of Wyoming, 2002. Thesis Title: "Opportunity costs of short-term water leasing in the Laramie Basin, Wyoming: Irrigation, Instream Flow, and Wetland Considerations"

B. S. Wildlife Biology (Minor: Economics) – University of Wyoming, 2000

Study Abroad – Boston University's School for Field Studies, Kenya, Jun-Jul 1998. Research Project: "Human-wildlife conflict on the Kimana Group Ranch, Kenya"

Select Grants Received

Peck, Rashford, Coupal. "Economic impacts of brucellosis, and benefits of an improved vaccine, under current vs. split-state regulatory frameworks." University of Wyoming, College of Agriculture, Agricultural Experiment Station Special Projects Program. 2009-2011. Budget: $21,400.

Peck, Ritten, Rashford (Co-PIs). "Cost to cattle producers and outfitters of brucellosis management alternatives." Wyoming Wildlife/Livestock Disease Research Partnership and the Office of the Governor, State of Wyoming, Federal Natural Resources Policy Account. 2009-2011. Budget: $139,250 ($139,250 to AGEC).

Norton (PI), Arnould, Franc, Hess, Hewlett, Kelleners, Kniss, Krall, Latchininsky, Mount, Paige, Paisley, Peck, Press, Rashford, Smith, Stahl, Ward, Wilson (Co-PIs). "Economic and environmental sustainability of conventional, reduced-input, and organic approaches on western crop-range-livestock farms." NRI Agricultural Prosperity for Small and Medium-Sized Farms Program. 2009-2013. Budget: $500,000 ($40,000 to AGEC).

Norton (PI), Mesbah, Peck, Franc, Reddy, U. Norton, Frost, Gill (Co-PIs). "Effects of cropping-system, irrigation method, and soil properties on soil nitrogen and organic matter dynamics in the Big Horn Basin." University of Wyoming Agricultural Experiment Station Competitive Grants Program. 2008-2010. Budget: $60,000.

Norton (PI), Stahl, Kelleners, Krall, Peck, Mount, Frost (Co-PIs)."Effects of cropping-system-related soil moisture and nutrient dynamics on the sustainability of semiarid dryland agriculture." USDA CSREES National Research Initiative Competitive Grants Program. 2008-2009. Budget: $100,000.

Select Publications

Strauch, Peck, Held. A case study of fall versus spring calving for the Rocky Mountain West. *Journal of Farm Managers and Rural Appraisers* (in review).

Peck, Adams. Farm-level impacts of prolonged drought: is a multiyear event more than the sum of its parts? *Australian Journal of Agricultural and Resource Economics* (in press).

Adams, Peck. 2008. Effects of climate change on water resources. *Choices* 23(1): 12-14.

Peck, McLeod, Hewlett, Lovvorn. 2004. Irrigation-dependent wetlands versus instream flow enhancement: economics of water transfers from agriculture to wildlife uses. Environmental Management 34(6): 842-855.

Adams, Peck. 2002. Drought and climate change: implications for the west. Western Economics Forum, Fall 2002, 1(2): 14-19.

Adams, Peck. 2009. Effects of climate change on drought frequency: potential impacts and mitigation opportunities. *In* Dinar and Garrido (eds.) Managing water resources in a time of global change: mountains, valleys and flood plains. Routledge Press: Oxford.

Select Presentations

Peck, Rashford, Frankowski, Reeves. 2009. "Using NAADSM to model foot-and-mouth disease in a rangeland setting: challenges and insights." 12th International Symposium on Veterinary Epidemiology and Economics, Durban, South Africa, Aug 10 – 14.

Peck, Adams. 2008. "Influence of incentives and property rights on future water demand and disputes." Invited paper at EXPO 2008 Spain, Thematic Week 7: "The role of market instruments in integrated water management," Zaragoza, Spain, Jul 28 – Aug 1.

Peck, Adams. 2007. "Persistence of drought impacts across growing seasons: a dynamic stochastic analysis." 101st Seminar of the European Association of Agricultural Economists: "Management of Climate Risks in Agriculture," Berlin, Germany, Jun 5 – 6.

Peck. 2005. "The importance of 'local context' in the resolution of water management conflicts." Invited seminar at the International Water Management Institute, Colombo, Sri Lanka, Oct 23 – 28.

MELEA PRESS
Assistant Professor of Marketing and Sustainable Business Practices
University of Wyoming, Department of Management and Marketing, Dept. 3275
1000 E. University Ave., Laramie, WY 82071
Tel: (307-766-2223) Email: mpress@uwyo.edu

RECENT POSITIONS

2008-	Assistant Professor of Marketing and Sustainable Business Practice, Department of Management and Marketing, University of Wyoming
2005 –2007	Instructor, Department of Marketing The Pennsylvania State University
2003 – 2007	Research Assistant, Department of Marketing The Pennsylvania State University
2000 – 2003	Co-Owner Akira Consulting, LTD Seattle, WA
1999 – 2000	Development Coordinator/Instructor The Hope Project New Delhi, India

INVITED TEACHING

MBA Course; Environmental Economics and Management, with Prof. Dr. Rudi Kurz, Pforzheim University Business School, Pforzheim, Germany, Winter Term 2008-2009

PUBLICATIONS

Press, Melea and Eric J. Arnould (2009), "Constraints in Sustainable Energy Consumption: Marketing System and Public Policy Challenges and Opportunities," Vol. 28 Issue 1 (Spring), p102-113.

WORK IN PROGRESS

Press, Melea and Eric J. Arnould (being revised for resubmission at the Journal of Consumer Research), "Transformational Consumer Experiences: Identification Formation and the Reconfiguration of Consumer Choice"

Press, Melea and Eric J. Arnould (in progress), "Revealing Details: How Community Supported Agriculture Programs Communicate Transparency," Intended for the Journal of Macromarketing

Press, Melea, Caires, Matt, and Tracey Patton, (in progress), "Campus Sustainability Through Civic Engagement," Intended for Sustainability: The Journal of Record

CONFERENCE PRESENTATIONS/ PROCEEDINGS

Melea Press (2009), "Co-Creating Alternative Markets" Consumer Efficacy in Risk Abatement," in Advances in Consumer Research Volume 36, eds. Ann L. McGill and Sharon Shavitt, Duluth, MN : Association for Consumer Research.

Oneto, Stephanie and Melea Press, "Introducing Sustainability Into the Classroom," Presented at the Society for Macromarketing Conference, Clemson, SC, June 2008

Press, Melea, "Alternatives to Mass-Consumption: Personal Relationships and Information Disclosure as expressed through Community Supported Agriculture," Presented at the Society for Macromarketing Conference, Washington, D.C., June 2007

INVITED PRESENTATIONS

Panel on Community Supported Agriculture, Wyoming Consumer Issues Conference: Food Safety, Security and Sources – A Recipe for Tough Times, Laramie, WY, September 2009

"Theoretical and Practical Issues in Sustainability Research," Portland State University, Portland, OR, June 2009

Panel on Community Supported Agriculture, Local Foods Symposium, Laramie, WY, April 2009

Panel on Evolving Trends in Food and Agriculture, University of Wyoming, March 2009

GRANTS AND AWARDS

CSREES' Organic Agriculture Research and Extension Initiative for the proposal titled, "Marketing opportunities and constraints confronting organic farming operations in the high plains," awarded three-year funding starting August 2009

School of Energy Resources (SER) Matching Grant Fund, from the University of Wyoming "Drivers of Electrical Energy Demand in the Rocky Mountain Region," Spring 2009

NRI Agricultural Prosperity for Small and Medium-Sized Farms Program for the proposal titled, "Economic and environmental sustainability of conventional, reduced-input, and organic approaches on western crop-range-livestock farms," awarded four-year funding, starting January 2009

Faculty Growth Award, 2008-2009

Kaiser Ethics Project Grant, 2008-2009

International Travel Grant, Fall 2008

EDUCATION HISTORY

2007	Ph.D., Business Administration: Marketing, The Pennsylvania State University, University Park, PA
1996	B.A., Art History and German Wellesley College, Wellesley, MA