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Building Watershed Management Capacity in Nigeria: Expanding the Role of Agriculture Colleges

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Abstract: Developing countries face many critical social, agricultural, and natural resource-related issues where watershed management plays a prominent role. Short-term gains in productivity often occur at the expense of long term system resiliency needed to achieve sustainability. Post-secondary (tertiary) education institutions are underfunded and hampered by bureaucratic inertia limiting their relevance toward addressing emerging water resources concerns. As populations urbanize, rural constituencies continue to lose influence. Using the case of Samaru College of Agriculture, part of Ahmadu Bello University in north-central Nigeria, this paper identifies institutional challenges and suggests solutions to help similar institutions better address watershed management issues. Given current constraints, a watershed management curriculum could be built upon existing courses offered in related majors. Developing partnerships with an expanding private sector could help create opportunities for meaningful solutions to management issues and foster problem solving skills among students. Outside investment in increasing university capacity to address watershed education, including hiring staff focused on these issues, is justifiable given the humanitarian and security crises that have been afflicting northern Nigeria's vulnerable agricultural landscape.

Keywords: *climate change, counter insurgency, food security, hydrophilanthropy, Kaduna, Sahel*

Many developing regions across Africa face a common set of challenges encompassing issues of water supply and quality that directly threaten social stability. In Nigeria, a rapidly expanding and urbanizing population has long exceeded domestic food production capacity and is expected to more than double in the next 35 years (Adesina 2012). In an effort to restore food self-sufficiency, the Nigerian federal government, backed by domestic and international investors, has developed ambitious plans to increase production of primary food crops including rice, cassava, yam, sorghum, maize, groundnut, millet, common beans, and livestock. Presently, irrigation covers only seven percent of irrigable land. However, Nigeria is undergoing a rapid expansion in agricultural capacity development, including private investment (Adesina 2012). More lands are becoming productive in a step toward meeting the Nigerian food deficit. Drought, overgrazing, erosion, and gully formation are an ongoing threat to existing and expanding agricultural initiatives across Africa (World Bank 2012). Finally, security instability, most notably posed by Boko Haram, limits mobility and discourages investment in the institutions needed to address these problems.

Staff and administrators at Nigeria's tertiary agricultural institutions are acutely aware of the value of water and watershed management as critical to securing environmental and agricultural resiliency. However, facilities and curriculum are outdated and remain focused toward production and training protocols that were generally developed prior to the 1980's. Many of these challenges are common at agriculture colleges throughout the developing world (Maguire 2011; Baker et al. 2015). Additionally, unpredictable budgets, bureaucratic restrictions on curriculum reform, and a negative perception of agriculture as a career choice among aspiring young people are barriers faced by those hoping to build the

capacity developing nations need in order to address watershed management issues.

Threats to water supply and quality in developing countries are most successfully addressed through a broad adaptation strategy (Hurd 2012). Several projects pertinent to watershed management have been conducted throughout Nigeria, including water quality monitoring, agricultural system adaptation, and capacity development within government management agencies (Lal 1985; Igboekwe et al. 2008; Macheve et al. 2015). However, formal efforts to increase capacity through reform of existing post-secondary education programs have received little attention. This paper presents challenges and identifies opportunities faced by the federally-funded Samaru College of Agriculture, Ahmadu Bello University in expanding its own capacity to address key watershed management challenges in Nigeria and across West Africa. A strategy is presented to increase the role of Nigerian tertiary agriculture institutions in addressing the country's watershed management challenges as part of a larger strategy to make these institutions more broadly relevant to the agriculture industry and society as a whole.

Study Methods

The information presented here is based on documents and interviews conducted by the author at the request of Samaru College of Agriculture (SCA) in Zaria, Nigeria. A rigorous qualitative approach was used employing triangulation; including interviews, document analysis, and observation (McNiff and Whitehead 2006). All interviews were conducted on the SCA campus from July 31 to August 13, 2014 by the author with the assistance of Mr. John Iruaga of Winrock International. Group interviews with SCA academic departments were typically attended by greater than half of the teaching and support staff housed therein. Open-ended interviews typically lasted 60 to 120 minutes and included a preliminary SWOT (strengths, weaknesses, opportunities, and threats) analysis (Yin 1984; Merriam 1998). Discussions were sometimes continued during short tours of laboratories and other classroom facilities. Additionally, farms, administrative facilities, and the library were toured. At the time of the interviews, security concerns, as ascertained by university personnel, restricted the interviewer's mobility to the campus, university farms, and closely surrounding environment. Enrollment data were provided by SCA Student Affairs office and curriculum summaries by the respective academic departments.

The SCA campus is situated within the Guinea savanna region of northern Nigeria with annual rainfall averaging 1211 mm (Climate-data.org 2016). From its origin in 1921 as an Agricultural training center focused on increasing cotton and groundnut exports from the region, the college was formally named in 1932 and evolved under the supervision of the agricultural research arm during British colonial rule and, subsequently, the government of the Federal Republic of Nigeria. In 1962, the newly-founded Ahmadu Bello University (ABU) absorbed SCA and quickly grew to become one of the largest universities in Africa. In 2006, SCA came under the authority of the National Board of Technical Education (NBTE). Since that time, there is a perceived disconnect reported by SCA personnel between the traditional SCA mission and the decisions rendered by NBTE regarding proposed curricular content, changes, and enrollment caps. Presently, the college has a total of 40 full-time academic staff and 544 students enrolled in National Diploma and Higher National Diploma programs across several traditional agriculture disciplines.

The student body is drawn from across Nigeria and beyond, in part attracted by the ABU university environment. Agriculture career paths are perceived as undesirable among many students attending university because they rarely see its relevance to future personal prosperity. Many students enroll at SCA with little commitment to pursuing the agriculture curriculum, instead planning to re-apply for more preferred, and competitive, programs elsewhere at ABU.

Student extracurricular activities are largely limited to participation in general student government and social organizations. There are few special interest and professional development clubs as compared to U.S. colleges of agriculture of similar size. The college has several teaching laboratories varying greatly in adequacy of equipment, but the new agriculture engineering

facility, including an irrigation hydrology lab, stands out above others. Farm facilities are extensive, serving as teaching tools and revenue generators by selling grain crops, primarily maize. Planting and tillage are mechanized with other aspects of production using labor from surrounding villages. A pasture seed facility is under development with the hope of generating revenue from seed sales. Additional arable land is available to dramatically expand seed and row crops for market or to help increase the college's existing animal production operations.

The practical agriculture curriculum at SCA prepares students for middle level employment upon entry into the workforce. All curricula are approved by NBTE and reflect a balance between theoretical and practical knowledge. Students and staff consistently express a desire for more hands-on practical exercises that are relevant to the current state of the industry. Critical equipment for these are, in many instances, partially functional, non-functional, or non-existent. The curriculum guides specify a large amount of rote memorization and suggest little opportunity for development of higher-level creative problem solving skills. In-class training lacks audio-visual support resources in almost all classrooms. Fortunately, there are many opportunities for field trips in Zaria and these are portrayed by staff as a significant part of the student training experience. However, staff lament the removal of agricultural extension and de-emphasis of field trips by NBTE.

Prior to graduation, students serve a compulsory internship (Attachment) supervised by SCA staff and typically hosted by industry and government agencies. Staff must periodically travel to the location of the Attachment to assess the student's progress and speak with supervisors. In some fields, there appears to be disconnection between Attachment content and host and the actual employers of graduated students. In particular, many Attachments take place in government ministries where little relevant experience is gained. Given the potential for regular interaction between SCA staff and attachment hosts, there are many missed opportunities to use Attachments as a means for establishing the kinds of university-industry partnerships and collaborations that benefit U.S. agricultural universities.

At the time of writing, the Nigerian economy is severely weakened by low petroleum prices. Consequently, sizeable internal investment in education, including new program development, is unlikely to occur in the near term. However, much may be accomplished with presently available resources to increase focus on watershed management while setting the stage for broader institutional growth if additional resources become available. Following are suggestions to increase university capacity to address watershed management in a manner that is realistic within present constraints and priorities.

Watershed Management and the Role of Agriculture Colleges

A first consideration is educating the public about the critical linkages between improvements in agriculture and natural resources management and securing a prosperous future. Agriculture colleges and career paths are already burdened by negative attitudes among prospective students and their families that are in place prior to university enrollment (Rivera 2011). Education initiatives should help students recognize the importance of sanitation, soil and water conservation, and water conflict that are pertinent to agriculture and to Nigeria as a nation. Introducing students to watershed issues, management, and technologies prior to university matriculation could contribute toward overcoming the agriculture stigma held by potential students. Prospective students also need to see themselves as having options for success in these critical areas as evidenced by clear and reliable education and career paths. Outreach efforts targeted toward secondary school students and broader society could positively influence attitudes regarding agriculture-related disciplines as relevant and desirable. The SCA staff currently employed within the extension program would be natural leaders in this arena provided they are able to adapt their communication strategies targeting the traditionally rural audiences they served earlier in their careers toward strategies reflecting the interests and sensibilities of increasingly urban populations. These outreach efforts could target intended audiences through available media outlets (Baker et al. 2015). Post-secondary

schools could pursue campaigns independently, as a consortium, or collaboratively with NGOs, such as Global Environment Facility and United Nations Environment Program World Water Day activities, to build awareness regarding the link between watershed management and daily life. The next step would be promoting realistic education paths to help potential students address these issues (Rivera 2011).

Once on campus, students face many barriers toward receiving training focused on watershed management issues. Appropriate host degree programs containing elements relevant to watershed management do exist, particularly in the areas of range and pasture management and irrigation agronomy (soil and water engineering). However, these degree programs are highly prescriptive in terms of course requirements. Increasing flexibility within existing programs to permit student focus on watershed management would help graduates better respond to watershed management problems while avoiding the challenges inherent to restructuring academic departments. Leadership, or at least increased support, from NBTE encouraging curriculum revision and new academic program development teaching practical problem solving approaches to emerging challenges would help facilitate such initiatives at SCA and in other agriculture institutions nationally.

Any new approaches to education and research programs would be aided by hiring staff from universities or work environments already supporting such programs. This would require a significant deviation from current hiring practices that reward students who complete their academic training at SCA and ABU with permanent employment on the teaching staff. Even if staff hired from outside eventually seek employment elsewhere, influx of new staff to replace them would continue institutional exposure to new ideas and initiatives. While all staff should be encouraged to innovate, younger staff tend to have greater interest and aptitude for pursuing new initiatives. These individuals would be the best candidates to lead university efforts in these areas if properly incentivized.

Agriculture industry is expanding rapidly in Nigeria. Experience elsewhere in Africa suggests that increased productivity could be accompanied by myriad problems associated with higher runoff, erosion, and sedimentation rates. Agriculture colleges, with their technical expertise, could serve as leaders in helping ensure that producers are able to sustain increased productivity while applying principles of sound watershed management. At this time, there is little engagement between SCA, government agencies, and agricultural industries to pursue such productive partnerships (Rivera 1995; Rivera 2011). This is despite the fact that university staff routinely supervises students pursuing their Attachments. As of summer 2014, ABU was building a large conference facility that would be well-suited to serve as a regional meeting place to facilitate industry/stakeholder engagement. The value of partnerships to increase research potential and ensure that classroom material is current, a model well-developed in the U.S., is enthusiastically received by SCA staff and regional industry, alike. However, this approach strongly differs from the compartmentalized status of education that remains deeply ingrained in many old world universities. Expanding partnerships had been previously identified as a key recommendation for tertiary education institutions in Nigeria (Baker et al. 2015).

SCA curriculum guides suggest that many courses potentially relevant to watershed management-centered studies are already available (Table 1). However, actual course content is geared toward memorization of facts and presently lacks the critical thinking skills needed by students to address emerging and complex problems. This approach to post-secondary education is deeply rooted in colonial and early post-colonial education philosophies (Teferra and Altbach 2004). A dialogue is needed among agriculture colleges, NBTE, and stakeholders in both public and private sectors to modernize curricula so that graduates are better able to identify and solve unique and emerging problems throughout their careers (Davis et al. 2008). The physical facilities on and off campus and some potential partnerships are already in place. Encouraging the pursuit of problem-based teaching among staff who rose through the ranks under the present system poses a more formidable challenge. However, the presence of instructors exposed to problem-based education earlier in their training offers a starting point for reform.

Table 1. Courses presently available to students at Samaru College of Agriculture that would have special relevance to a Watershed Management course of study.

Department	Course Title	Contact Hours Per Week
Animal Production Technology	Pasture and Range Management	5
Agriculture and Bio-Environmental Engineering	Land Clearing and Development	3
	Soil Mechanics	5
	Land Law	2
	Principles of Surveying and Farm Buildings	5
	Tillage and Planting Machinery	5
	Engineering Properties of Biological Materials	3
	Farm Machinery Design and Construction	4
	Farm Waste Management	4
	Agricultural Engineering in Development	2
Pasture and Range Management	Range and Pasture Plant Identification	3
	Principles of Range Management	3
	Sown Pastures Production	TBD
	Advanced Range Management	3
	Range Utilization Systems	2
	Range Patrol Management	TBD
	Range Inventory Evaluations and Improvement	3
Agriculture Engineering	Irrigation and Drainage	4
	Soil and Water Conservation	2
Mechanical Engineering	Computer-Aided Design and Drafting	3
	Technical Drawing	4
Agricultural Technology	Introduction to Soil Science	2
	Introduction to Farm Woodland Management	4
	Principles of Crop Production	4
	Industrial Crop Production I and II	8
	Annual Crops	3
	Agroclimatology	2
	Soil Fertility and Crop Nutrition	4
	Farm Soil Management	4
	Farm Management	5
	Agricultural Extension and Rural Sociology	2

Administrators and staff at SCA, and undoubtedly others in similar positions in Nigerian institutions of higher learning, could pursue some meaningful incremental changes in watershed management given current capacities. However, increased and long-term investments are needed to support education overhaul to include effective principles of watershed management appropriate for a country that is growing, both as an urban society and as an agriculture producer. Instituting specific programs addressing watershed management, such as forestry/natural resources management, would be welcomed by SCA administrators. Improving computer/GIS facilities, internet connectivity, and increased power supply reliability would also be productive. Internal allocation of resources

at ABU tends to underestimate the value of agriculture as more prominent programs in newer fields of technology compete successfully for funds. Nationally, economic realities make this unlikely to be an internally generated initiative. Public universities throughout Nigeria face a large number of serious challenges, made worse by serious macroeconomic challenges, suggesting that meaningful education reforms will be slow to happen if dependent upon internally-generated funds (Iruonagbe et al. 2015).

World investment in Nigerian education and conservation agriculture should be given serious consideration, both on a humanitarian basis and in the interest of promoting global security, since terrorist groups have proven adept at exploiting tensions between grazers and farmers (OECD 2013). Changing land use patterns across Africa coupled with land degradation, precipitation variability, and policies to encourage sedentary agriculture are increasing grazing pressure at the expense of soil and field crop productivity. In turn, farmers are expanding operations or compensating for degraded lands by establishing row cropping on lands traditionally used for grazing, typically by using pre-conservation agriculture practices. Resulting runoff and gully development imperil downstream lands and communities. Insurgents capitalize on local tensions and grievances, including those rooted in water and land resource management, to increase their influence over the rural territories they use to support their logistical operations (Benjaminsen 2008; Aduku 2015). Natural resource sustainability and resiliency through improved watershed management should be part of a broader security strategy that increases government capacity and in turn builds trust among the otherwise disaffected rural populations. In this way, watershed management education and technology transfer could be a meaningful part of a broader strategy to help prevent armed conflicts in this highly populated country and beyond (Lowi 1999; Miller 2011; Groninger and Ruffner 2014). Recently, USAID has supported an initiative to increase grant writing capacity among SCA staff. Hopefully, these efforts will ultimately support changes and potential solutions pertinent to those closest to the challenges.

Conclusion

Productive watersheds and abundant water resources are important to the success of a rapidly growing Nigeria. Tertiary agricultural institutions are necessary for students and society to prepare for a future that includes more effective watershed management to protect and efficiently use water and land resources. Broader institutional relevance is challenged by an education system that is highly bureaucratic, insular, and slow to respond to societal changes. However, many of the challenges encountered in Nigeria higher education are shared by their counterparts in the U.S. Both parties would gain immensely from sharing perspectives and strategies to address these common problems, while setting the stage for mutually beneficial collaboration. Maintaining open lines of communication and providing opportunities for bilateral professional exchanges among technical personnel and leaders in academic, development, and security sectors could help address watershed related issues that span regional and global scales.

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