Using Modernized Relic Technology to Better Enable Sustainable Agricultural Practices in Developing Countries: A Philosophical and Practical Reorientation for Mali’s Farmers

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Abstract
Sustainable agriculture is important because it is a vital business component practiced by forward-thinking entrepreneurs (Geraci, 2004), including smallholder farmers and the industries that complement their work. Accordingly, the purpose of this paper is to share how the use of scale appropriate, relic agricultural technology may offer a viable approach for improving or further developing sustainable agricultural practices in a country with limited resources such as Mali. By using existing animal husbandry skills combined with education to use innovative relic technology, animal powered farm equipment, Malians can achieve an increase in food production, meaningful cottage industry development, and maintain their existing rural society. The approach shared is critical for a country that has essentially no oil resources and limited funds. The authors propose introducing low cost technology to provide sustainable food production and drive the creation of complementary businesses. The long-term sustainable outcome would be stacked-entrepreneurial enterprises (McDonald, 2008) built on serving the agricultural and related employment needs of Mali’s rural villages.

Keywords: agricultural education, relic technology, sustainable agriculture
Introduction

Mali is a Sub-Saharan, West African nation. It has a rich diversity of cultures, varied geography, and limited resources. Less than 4% of its 1.22 million sq km of land is arable (U.S. Central Intelligence Agency, 2008). Although encroaching desertification and recurring droughts are constraints, Mali seeks to raise its people’s standard of living by increasing the capacity for food production and concurrently developing markets for agricultural exports. In order to develop a picture of the scope of the population’s needs, particularly, as they pertain to food production, two of the authors made two visits to Mali in 2007. During those visits they conducted extensive listening sessions and interviews with farmers, agricultural systems specialists, educators, and cognizant government officials.

This paper describes the selected outcomes of that field research and proposes a course of action that could help Malian farmers maximize their efforts while utilizing available resources. Initial indicators of Malian interest for this course of action include formal letters of support from the University of Bamako (Mali’s national university), the Ministry of Agriculture, and representatives of the Malian Symposium on Applied Sciences.

Mali produces very little fossil-based fuel. Most of its farmers have essentially no money for the purchase of commercial fertilizers, herbicides, or genetically modified seeds. Agricultural power is generally provided by manual labor and draft animals. Based on initial field research, the coupling of Malian farmers’ knowledge of cropping practices and animal husbandry with modernized, animal-powered equipment built on the “template of relic technology” appeared to be worthy of exploration. For the purpose of this paper, “relic technology” implies the use of contemporarily manufactured, animal-powered farm implements that incorporate historically superior design principles. These tools are constructed with modern improvements that extend their utility and longevity if, in concert, the technical expertise required for their optimal use is provided to the adopting farmers.

Purpose/Objective

Sustainable agriculture is important because it is a vital business component practiced by forward-thinking entrepreneurs (Geraci, 2004), including smallholder farmers and the industries that complement their work. Accordingly, the purpose of this paper is to share how the use of scale appropriate, relic agricultural technology may offer a viable approach for improving or further developing sustainable agricultural practices in a country with limited resources such as Mali.

Theoretical/Philosophical Themes

Since the mid 1960s, a renewed interest in relic technology that uses draft animal power for scale appropriate applications has emerged in the United States (Hynes, 2005). Organic gardening (using farm-produced effluent), logging, haying, and tillage for small operations are touted as economically feasible when large inputs for equipment and fuel are not necessary or optimal. Shi (2004) noted that sustainable agriculture promotes “self-sufficiency . . . rural employment and income generation to alleviate poverty” (p. 114). “The philosophical core of this emerging practice is economic development and environmental protection that could be coordinated” (Shi, p. 114).

For the purpose of this paper, scale appropriateness also encompasses labor, i.e., what one person can accomplish alone versus what can be done with a tool, or a tool and the means to power it. Modern manufacturers of equipment for small scale farmers are found throughout the
United States (Hynes, 2005). Their products include animal-powered equipment ranging from augers to washing machines—much of which could be useful in a country where most of the heavy-lifting associated with agriculture is done by hand. (See Table 1 for examples of equipment suitable for agricultural production in Mali.)

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Selected Field Equipment Options Suitable for Agricultural Production in Mali</th>
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<tr>
<td>Equipment</td>
<td>Purpose</td>
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<tr>
<td>Plows</td>
<td>Primary Tillage</td>
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<td>Discs</td>
<td>Primary/Secondary Tillage</td>
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<tr>
<td>Harrows</td>
<td>Secondary Tillage</td>
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<td>Cultivators</td>
<td>Secondary Tillage</td>
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<tr>
<td>Forecarts</td>
<td>Multi-purpose tool</td>
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The concomitant training received by farmers has the potential to build social capital (Rainey, Robinson, Allen, & Christy, 2003) for the larger Malian society. The indigenous knowledge and existing skills of Malian farmers could be reoriented regarding animal power such that Mali’s agriculture sector is less dependent on the petroleum-based fuel products it does not have access to. It could also help the country’s economy by fostering a variety of complementary cottage industries that would produce and/or service implements for local farmers. This approach would support what Röling (as cited in Navarro, 2008) described as the “co-creation of knowledge,” which recognizes, appreciates, and uses the learning and wisdom of local people. These cottage industries would include harness manufacturers, wheelwrights, and blacksmiths. To that end, Matlay (2001) has suggested there is a tendency for smaller economic units to respond and compete in both emerging and niche markets.

**Proposed Process**

The authors propose the introduction of low-cost, sustainable staged-innovation into Mali’s food production system, by using simple mechanical tools that require no fossil-based fuels and are powered by existing draft animals. Malian farmers already grow feedstuffs for the draft animals used in agricultural production. The draft animals reproduce themselves, thereby negating the necessity of importing costly fossil fuel-powered units such as tractors. Agricultural power is generally provided by manual labor and draft animals. The coupling of farmers’ knowledge of cropping practices and animal husbandry with modernized, animal-powered equipment built on the “template of relic technology” or what some have called modernized relic technologies (MRT) could provide a staged-innovation platform on which to improve the efficiency of Mali’s agricultural sector.

By better utilizing MRT, Malian farmers would increase their productivity, provide local employment through complementary businesses, grow crops organically, and augment a more
sustainable food production system. The long-term sustainable outcome would be *stacked-entrepreneurial enterprises* (McDonald, 2008) built on serving the agricultural and related employment needs of Mali’s rural villages.

The *stacked-entrepreneurial enterprises* could take many forms: instead of plowing, planting, cultivating, and harvesting by hand, the authors propose to offer an alternative system reliant on MRT that would allow many community members to participate and earn sustainable livelihoods. When community members combine their local resources, more diverse economic avenues are realized, including greater opportunities for employment. Conceptually, a new framework for entrepreneurial development begins and a stacked enterprise ensues.

In the case of Mali, there could be several positive repercussions as a result of the introduction of MRT that would encourage entrepreneurial development. The existing markets for draft animals to operate MRT equipment would expand, creating additional business opportunities. Harness designs would need to change in order to accommodate the new implements. New trades would be learned. A means (forecart) to use the equipment with draft animals would be introduced. A variety of “modernized” but “scale appropriate” implements adapted to the unique cropping needs of Mali would be emphasized. A machine shop would produce parts for equipment, assemble the pieces, and become a distribution point in the community. Each of these activities is dependent on the enterprises that precedes and succeeds it. All would grow in terms of employment opportunities as the innovation cluster (Rogers, 2003) is adopted and promulgated. Carter (2001) called this approach “portfolio entrepreneurship,” i.e., multiple business activities of farmers using small business growth strategies where economies of scale can be achieved at low levels of inputs. Implications of MRT adoption have the potential to expand beyond traditional farmer activities. Initially, equipment would be manufactured locally. Thereafter, differentiation frequently occurs and one or more parts of Mali may become a hub of manufacturing for animal-powered farming implements. “Trade” or technical schools would be needed to provide training for individuals interested in manufacturing. This powerful process helps ensure sustainability by providing a constant pool of trained workers.

While manual labor can be an effective means of accomplishing production agricultural, it is important to recognize the impact manual labor can have on the health of the individual. More efficient utilization of draft animals can have a positive influence on the quality of life in a community. There is a plethora of newly designed implements from grain grinders to refrigeration units that can ease the daily drudgery and numerous ills associated with intensive manual labor. One example is the use of a simplified gear box and power take-off shaft to improve production efficiencies. These tools could be made locally and include multiple enterprises adaptable to a variety of purposes and inter-related livelihoods.

**Projected Outcomes**

The authors suggest that training Malian farmers to use modernized, animal-powered tools for agricultural production would make a significant difference in their lives. Improved and more efficient single donkey/oxen-pulled toolbars, plows, disks, and harrows (See Table 1) would find ready use in a country where land cultivation is often done by hand or with a tractor shared by several villages. By providing training in the manufacture, maintenance, repair, and use of relic implements, farmers could better sustain themselves without relying on a tractor, which may have unreliable availability as well as untenable expenses and obligations.

In addition, the effort to improve farming techniques through the introduction of MRT could have sociological implications. Farmers who are currently emigrating away from home to
find work, seasonally or otherwise, may be more likely to remain in their communities due to improved farming productivity, better economic livelihoods, and fresh opportunities generated as a result of the introduction of the new technologies.

Training farmers in the appropriate use of modernized, relic implements could further Mali’s long range goal of meeting its food sufficiency requirements through domestic agricultural production (Millennium Challenge Corporation, 2006). The goal of the project is to introduce implements that would be constructed with modern designs extending their usefulness and longevity and providing the technical training required for optimal use to the farmers. What is being proposed would improve the production efficiency of Malian farmers in scale appropriate, sustainable ways.

Another projected outcome of this reorientation of farmers’ practices would be to lay the groundwork for entrepreneurial training of Malians who would manufacture the modernized farming implements. These “cottage industries” would strengthen local villages by providing employment and enable the start-up of “light manufacturing” enterprises. These actions would reduce the need for villagers to seek work in Mali’s urban centers, which are frequently under-resourced and ill-prepared to absorb seasonal influxes of the unemployed.

Increasing the efficiency and sustainability of farmers’ practices and raising the prospects of agricultural businesses has the potential to stimulate village economies, thereby increasing the likelihood of Mali’s rural communities remaining intact. Martinot, Chaurey, Lew, Moreira, and Wamuonya (2002) noted that melding rural entrepreneurship and sustainable development led to improved agricultural practices, more small industries that provided economic stimulus for rural household incomes, and enhanced social services. Jack and Anderson (2002) suggested that social-embedding, i.e., being a part of a community, enabled entrepreneurs to better recognize opportunities for economic growth. Frequently, the alternative is social disruption that begins with out-migration from the countryside to the city by jobseekers and often ends with the degradation of rural society. In addition, the potential for greater stress on urban centers that are already unable to provide many basic services for their citizens may be mitigated as a result of these actions.

Unintended Consequences and Other Counterfactual Concerns

Rogers (2003) warned that the possibility of “unintended consequences” occurring is associated with the introduction of any new innovation or practice into an existing social system, including outcomes that may be undesirable. (The chance that unforeseen but desirable consequences could emerge also exists.) For example, if the use of MRT were to become prominent in a given Malian community, would a reduction in the need for hired manual laborers in agriculture also occur? That possibility is rather likely. So, a “spike” in unemployment, albeit unintended, would be propagated among some local residents as a result of farmers adopting the MRT. Change agents and other cognizant officials concerned with the well-being of said community would need to consider that result or consequence as well as other possibilities that may be undesirable. Impacts and consequences involving the draft animals that would be associated with farmers adopting MRT would need consideration as well, e.g., potential changes in animal breeding systems, elevated nutritional requirements, and increased health care needs.

On the other hand, it is envisioned that longer term impacts of the technologies, as described earlier (e.g., stacked entrepreneurial enterprises and new employment opportunities associated with them), would be sufficiently robust and multiplicative to more than offset short term downsides. However, the immediate loss of livelihood by those individuals affected is very
real and should be mitigated through related social programs delivered in concert with the introduction of new technologies.

In addition, change agents should anticipate the likelihood of some “re-invention” (Rogers, 2003) occurring as adopters of the MRT seek to make meaning of it per their unique “lenses” and that of their wider culture and social system. This calls for the change agents and others involved in the diffusion process to understand and mitigate the tendency of many to hold a pro-innovation bias (Rogers, 2003) for the innovation. Moreover, opting to explain or “rationalize” re-invention, immediate rejection, or later discontinuance of the MRT by adopters (or potential adopters) solely through a prism of individual blame bias (Rogers, 2003) should be avoided as well.

Conclusions

By deliberately attempting to capitalize on a country’s strength, in this case livestock, crop production, and existing social networks, the approach described could lay the groundwork for a more sustainable food production system in Mali. The authors suggest that innovations be promoted that do not require massive amounts of fossil-based fuels or international development assistance. The proposed initiative would educate Malian farmers by building upon their indigenous knowledge and skills (Navarro, 2008), utilizing scale appropriate equipment, and seeking to establish self-sustaining cottage industries to serve their communities. The authors believe this approach is in the long-term best interests of the Malians and may serve as an exemplar for similar farming populations in other developing nations.

The authors’ next direct interaction with Malian agricultural producers, farm equipment specialists, and agricultural technical school teachers and students is scheduled to occur in March 2009 in Mali. The philosophy, techniques, and technical suggestions espoused in this paper will be presented in detail to those stakeholders for their consideration, reaction, and input. The “co-created” understanding intimating from those encounters will better inform the authors regarding feasibility of the reorientation described in this paper and next steps related to a planned training for select Malian stakeholders in the United States as well as future funding proposals and research projects.

References


