Indigenous Technology and Technology-Oriented Research: Implications for Research Methodology

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Abstract

A case study involving a review of research into crop production in the Transkei region, which shows that intercropping and nutrient supply practices are closely linked to the single-furrow planter technology employed by a large number of local smallholders, demonstrates that indigenous knowledge and technology indeed exist among African smallholders in South Africa, and that their discovery can add considerably to the relevance and social value of smallholder-oriented research, when used as a base to formulate technological research questions, which address the problems and needs of farmers. To discover indigenous knowledge and technology, agricultural researchers in South Africa are advised to expand their methodological tools beyond quantitative research techniques, and adopt techniques, which traditionally are the domain of social scientists in general, and anthropologists in particular. It is suggested that participant observation is particularly well suited for this purpose. Broadening the scope of the research methodology courses offered to agricultural scientists, to include qualitative research methods, is recommended.
Introduction

For a long time, research and technology development for smallholders in South Africa used insights obtained by means of experimentation as a basis to formulate innovations. This was deemed necessary because development of technology that addresses a particular agricultural problem effectively needs to be founded on an understanding of chemical, physical or biological processes responsible for the problem. However, in the formulation of technological options to address problems in smallholder agriculture, South African researchers have tended to ignore indigenous knowledge and technology. In most cases, technology design for smallholders in South Africa has followed one of three pathways. The first pathway involved the simplification of existing technology, which was originally developed for the modernizing commercial sector. One example was the introduction of overhead irrigation by means of a single moveable sprinkler system on smallholder irrigation schemes developed during the 1970s (Van Averbeke et al., 1998), which replaced surface irrigation practiced on projects designed during earlier times. The second pathway consisted of the direct transfer of modern technology to smallholders by means of organisational innovations aimed at providing them with access. This pathway was followed, for example, in the farmer support programmes of the Development Bank of Southern Africa implemented during the late 1980s (Singini and van Rooyen, 1995). The third pathway involved the designing of new technology specifically for use by smallholders. For example, the use of water harvesting (Reda, 2001) to improve water supply to annual summer crops in the Free State Province of South Africa. Irrespective of the pathway followed to develop or make available technology to smallholders, there was a belief among South African researchers and technology disseminators that knowledge was the domain of modern science. Consequently, it was expected from the science community to be the source of technological innovations.

In South Africa, technological intervention programmes in support of smallholders have not been very successful. Backwardness among farmers, and ineffective extension were often identified as the causes for poor adoption rates. During the past two decades, the adoption of a farming systems approach to research brought about the realisation that technology development needed to take into account the socio-economic circumstances of the intended end-users. The implication was that farmers were not to blame for poor adoption rates of technological innovations. Instead, the problem had to be either with technology itself, or with the way the technology had been disseminated. Usually, the (public) extension component of the technology transfer system was identified as the weak link. The farming systems studies by Bembridge (1984) and Steyn (1988) were but two examples of major studies in the Eastern Cape Province of South Africa, which arrived at such a conclusion. The regular calls for the re-training, re-structuring, privatisation or even elimination of the South African public extension system are evidence that all is not well with the process of agricultural technology dissemination in South Africa. However, to date, very few voices have questioned the overall approach by South African scientists to smallholder technology development. In this paper it is argued that the effectiveness of smallholder-oriented research in South Africa is likely to improve when scientist modify their overall R&D approach, and start paying more attention to indigenous knowledge and technology. This, in turn, requires scientists to adopt research methods, which do not form part of their conventional methodological toolbox. Crop production technology used by smallholders in the Transkei region of the Eastern Cape is used as a case study to support this argument.
The Transkei region is the largest consolidated area in South Africa where land is nearly all in the hands of African farmers. In 1995, it was estimated that the region counted about 3.6 million people (Erasmus, 1996), and about 590,000 households. Among the households in Transkei, about 215,000 were landless, and 375,000 had access to at least 0.1 ha of land for crop production (Van Averbeke et al., 2000). Among the households with land, 158,000 had access to at least 1 ha. The region is one of the poorest in South Africa (Erasmus, 1996, O’Leary, 1998), and its development has been identified as a priority. Agriculture has long been seen as one of the main ways in which economic development of the region can proceed. The combination of conditions characterizing the region has resulted in crop production by local farmers being aimed primarily at supplying food for home consumption. Maize is the main staple in the diet of the local people, and consequently it is by far the most important crop. However, household self-sufficiency in terms of maize production is rarely achieved, and most families have to purchase maize during some part of the year to meet their requirements (ISER, 2000). Most of the region enjoys favourable climatic conditions in terms of water supply, making it possible to produce dryland crops without much risk of crop failure due to drought. The relatively high climatic potential of the region contrasts starkly with the low average yields obtained by local farmers (Bembridge, 1984; Andersson and Galt, 1998). It has long been realised that technological interventions could play an important role in increasing crop yields and improving household food security among the local people.

**Purpose and Objectives**

The purpose of this paper is to encourage researchers involved in technology development for smallholder farmers to carefully consider indigenous technology, and the limitations it imposes, as a starting point for their research, and to direct work their research at developing ways in which indigenous technology can be used, and added to, to address important factors limiting the productivity of smallholder agriculture. The objective of the paper is to demonstrate by means of an example that efficient study of indigenous knowledge and technology requires the use of research methods, which do not form part of the conventional toolbox of agricultural scientists.

**Materials and Methods**

This paper is based on the review of a selection of existing research reports, which deal with crop production in the Transkei region. The contents of these reports were analysed for the link between intercropping and nutrient supply in crop production on the one hand, and the single-furrow planter technology employed by a large number of local smallholders on the other. The reason for this particular analysis was that the characteristics of the intercrop arrangement and the types and amounts of nutrients supplied to the crop, are largely determined by this particular planter technology.

**Results and Discussion**

During pre-colonial times the South-Nguni people who occupied the Transkei region relied on agriculture for their survival. The rearing of cattle for milk was the primary component of their farming system, which also involved production of crops and vegetables in small fields or gardens. To prepare the land, women made use of a digging stick, and the planting of crops started by broadcasting seed, before the land was prepared. They did not
use manure to fertilise their fields, despite its abundant availability in the kraals where cattle spent the night. Fallowing and shifting cultivation were the two main ways in which they addressed declining soil fertility and crop yields.

Colonisation brought new technology to Transkei, including the metal hoe and the animal-drawn plough. Compared to cultivating land using digging sticks, women equipped with metal hoes, or even better, a span of oxen drawing a plough, went about this task much faster, enabling larger areas of land to be cropped. Increasing pressure on the available land further encouraged the swing in the balance of the local farming system towards crop production. A report on agriculture in Transkei dating back to the 1920s, cited by ISER (2001), indicates that maize had replaced sorghum as the main grain crop; that maize was being intercropped with pumpkins, beans, sweet potatoes and melons; that the one-furrow ploughs pulled by four oxen were common in the area; and that manure was used to fertilise gardens, but not fields.

Whereas the ox-drawn plough arrived in Transkei at least 100 years ago, it is not certain when exactly the single-furrow planter was adopted by farmers in Transkei, but indications are that it was after WOII. The ox-drawn planter is a device designed to deposit seed and chemical fertilisers in a planting furrow. Seed and granular chemical fertiliser are held in separate hoppers, and delivery of the two components in the planting furrow is a mechanical process for which the energy is supplied by the rotation of the press wheel. The work by Bembridge (1984), conducted during the period 1979-81 in Transkei shows that it was commonly used by that time. ‘The vast majority of farmers used ox-drawn planters, which in most cases do not operate efficiently, as is evidenced by the low plant population’. With reference to the application of fertilisers, Bembridge (1984) reported that ‘although one in four farmers (26.1 %) used kraal manure on their lands, application per ha was extremely low, with 65 % applying less than 0.5 ton of manure ha⁻¹, because manure was often applied with the planter, which allows only for small quantities to be applied.’ This statement provides evidence that more than twenty years ago farmers had started to modify the use of the planter to deposit kraal manure instead of chemical fertilisers in the furrow at planting. On the subject of intercropping, Bembridge (1984) stated that ‘Despite the fact that this practice (intercropping) is not recommended by extension workers, intercropping of maize with beans and pumpkins is widely practised throughout Transkei’, and ‘Although spacing, patterns, and methods of inter-planting vary widely, field observations showed fairly high populations of pumpkins and beans. These statements indicate that the majority of farmers in Transkei had adopted a particular intercrop arrangement, which involved maize, beans and pumpkins, and that for some or other reason their practices resulted in a diversity of plant spacing arrangements. Bembridge (1984) provided no indication as to how the farmers established their intercrop, but he concluded his evaluation of this practice by stating ‘Whatever the validity of farmers’ perceptions of intercropping practices, there is enough evidence to suggest that local researchers should evaluate intercropping systems, with a view to improving intercropping technology adapted to present farming systems’. In response to this call, Austin and Marais (1986) conducted a replacement experiment with maize and beans at Fort Hare, but found that intercropping maize with beans did not provide a strategy for reducing risk in rainfed cropping in Ciskei, which is a lot drier than Transkei. In 1998, Silwana (2000) conducted a study into the intercropping practices of smallholders in six districts of Transkei. She found that 76.1 % of the 150 farmers she interviewed combined the use of organic (kraal manure) and inorganic fertilisers. She also reported that 91.3 % of
farmers who applied inorganic fertilisers, and 80 % of farmers who applied organic fertilisers, did so at planting. With reference to intercropping she reported that 76.4 % of farmers employed a three-crop mixture, usually involving maize, beans and pumpkins, and that 93.7 % of farmers planted these crops in rows. She also found that planting patterns in the rows varied widely. She proceeded by conducting two field experiments in which she investigated the optimum combination in which to intercrop maize with beans, and maize with pumpkins. Also during 1998, Mkile (2001) conducted a survey in three districts of Transkei to investigate their nutrient supply practices. He found that 72.2 % of farmers, who were all selected for owning livestock, band-placed manure every time they planted their gardens, and that 43 % also applied this practice when planting their fields. He described the practice as follows: ‘Small quantities of kraal manure are air-dried, crushed, and mixed with equally small amounts of chemical fertilisers and or Gromor (non-composted sifted broiler litter), and the seed of dry beans and or pumpkins. This mixture is placed in the fertiliser bin of the animal-drawn single-furrow planter, and the maize seed in the seed bin. This allows band-placement of the fertiliser and planting of maize, beans and pumpkin in a single operation.’

This brief review of research dealing with crop production in Transkei shows that over time local smallholders developed their own approach to intercropping and nutrient supply. Central to their approach, for at least the past few decades, has been the animal-drawn single-furrow planter, and the practices that evolved have been tailored to suit the technical capabilities and limitations inherent to this device. Intercropping, which may well be a practice dating back to pre-colonial times, has been adhered to, despite extension messages to the contrary. Over time, a preference for a three-crop mixture of maize, beans, and pumpkins appears to have evolved, suggesting that both the intercrops (beans and pumpkins) bring particular advantages to the overall arrangement. The proportions in which farmers mix the bean and pumpkin seed with the different types of fertilisers explains why there exists such a wide variety in planting patterns. The use of animal manure to increase the soil fertility of cropped land is without a doubt a fairly recent practice (not more than 100 years old), and chemical fertilisers appeared on the scene only after 1960. Yet over this relatively short period of time, farmers appear to have experimented with different fertilisers and their combinations. The available evidence suggests that the emerging trend is to apply a mixture of small quantities of crushed kraal manure (cattle, goats, or sheep), granular chemical fertilisers (usually an NPK mixture or super phosphate), and Gromor, which is a commercially available organic fertiliser consisting of non-composted broiler manure.

Considering the importance of single-furrow planter in the crop production system of smallholders in Transkei, the question arises why it took such a long time to be discovered by researchers, and consequently, why to date there has been no research aimed at addressing some of its limitations or at exploring some of its undiscovered capabilities? For example, an important limitation of the planter is that is applies the inorganic/organic fertiliser mixture at rates that are way too low to ensure optimum plant growth (Mikle, 2001), and one of its capabilities could be that it allows for the incorporation of lime or wood ashes into the seed and fertiliser mixture, which may alleviate the problem of soil acidity (Mandirigana et al, 2001) in the immediate vicinity of the plant. The answer to these questions must be sought in the approach adhered to by agricultural researchers in South Africa. This approach relies heavily on quantitative research methods, and the use of experimentation and surveys as data collection methods. Neither of these two methods is particularly suited to discover farmer
knowledge and technology. These require longitudinal studies involving qualitative methods of data collection, among which participant observation appears particularly well suited.

**Conclusions**

The case study presented here was intended to demonstrate that indigenous knowledge and technology indeed exist among African smallholders in South Africa, and that their discovery can add considerably to the relevance and social value of smallholder-oriented research when used as a base to formulate technological research questions, which address the problems and needs of farmers. To discover indigenous knowledge and technology agricultural researchers in South Africa are advised to expand their methodological tools beyond quantitative research techniques, and adopt techniques, which traditionally are the domain of social scientists in general, and anthropologists in particular. It is suggested that participant observation is particularly well suited for this purpose. Broadening the scope of the research methodology courses offered to agricultural scientists, to include qualitative research methods, is recommended.

**References**


