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Indigenous soil classification in four villages of eastern South Africa

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ABSTRACT

Ethnopedology has significantly contributed to understanding local perceptions of soil, and its uses and management, and has complemented technical (scientific) surveys. This study focused on indigenous soil classification of the Zulu and Xhosa ethnic groups of eastern South Africa. The study area comprised four villages, viz Khokhwane (104 ha) and Potshini (577 ha) in KwaZulu-Natal Province and Ntshiqo (629 ha) and Zalaze (80 ha) in Eastern Cape Province. Ethnographic methods were used to elicit general local knowledge of soils and ethnopedologic techniques to gain in-depth understanding of soil and theories associated with local taxonomy. Knowledgeable farmers were chosen (upon recommendation and/or based on interest and detail given during interviews) to produce participatory soil maps. These local maps were later compared with scientific soil mapping at 1:10000 scale using a free survey method. Local classification criteria reflected a detailed understanding of soil behaviour, use potential based on long-term observations, and experience with key soil morphological properties such as texture, consistence and colour. Local soil terminology was mostly different for all four villages as well as across ethnic groups. However, some differences between ethnic groups (e.g. Zulu-*isibomvu* and Xhosa-*obomvu*; Zulu-*ubumba* and Xhosa-*udongwe*) were mainly linguistic and did not indicate inherent differences in soil properties. Terrain features were important for both indigenous and scientific soil classification. Consequently, soil maps produced by local farmers in areas with distinct geomorphic units were generally closely correlated with scientific maps. Although on a floodplain the correlation was poor, the flexibility of the local classification was demonstrated as farmers manipulated the classification criteria to capture changes with distance away from the river. Farmers classified soils at higher levels than the two-tier system of the South African classification and so these could be incorporated as higher categories in the current South African classification system. Irrespective of the level of correlation between scientific and local maps, farmers' local classifications contained detailed pedological information that can contribute to the development of classifications systems that are both user-friendly and relevant for local needs.

1. Introduction

Conventional soil survey data are often presented in a format that is not user-friendly, and are thus commonly undervalued, and underutilized by non-specialists in making land use and management decisions (Grealish et al., 2015). Despite having advanced the understanding and classification of soils worldwide, internationally recognised classification systems such as Soil Taxonomy (Soil Survey Staff, 2014) and the World Reference Base (IUSS Working Group WRB, 2014), as well as national systems (e.g. South African; Soil Classification Working Group (SCWG), 1991), are general purpose. These classification systems use specialized terminology and language to classify and name soils, and their utilization requires considerable expertise and experience (Fitzpatrick, 2013). In order to improve the local relevance and impact of soil survey data, the knowledge of local land users needs to be considered (Sillitoe, 1998).

Local soil knowledge is widely recognised for its practical value and contribution to rational and sustainable soil management (Barrera-Bassols, 2000; Niemeijer and Mazzucato, 2003; Jyoti et al., 2015). It has been demonstrated in many countries and across many ethnic groups that integration of local soil knowledge in participatory soil surveys helps to address practical issues and provides culturally acceptable solutions appropriate to local contexts (Barrera-Bassols et al., 2009). Some studies have found poor correlations between local and scientific classifications (Schuler et al., 2006; Barrera-Bassols et al., 2009) while others have reported good correlations (Payton et al., 2003; Oliver et al., 2010). Such variation has often been attributed to differences in landscape structure in the areas studied.

Many rural people are pedologists (Barrera-Bassols, 2016) in that their knowledge and understanding of soil morphological properties has proven to be a solid base for soil use and management, at least at

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field-scale. Taxonomies of local vernacular classification systems are developed based on descriptive morphological soil characteristics important to the user (Sandor and Furbee, 1996; Habarurema and Steiner, 1997; Corbeels et al., 2000; Krasilnikov et al., 2009). Key soil morphological properties, such as colour and texture, are the main criteria for classification most commonly reported (Ettema, 1994; Shah, 1995; Talawar and Rhoades, 1998; Barrera-Bassols and Zinck, 2003; Sillitoe et al., 2004). Distinctions between soils are determined by the classifier's perceptions, assumptions and needs, as these are often not hierarchical schemes (Showers, 2006). This allows people to relate soils to one another in any way that seems appropriate to their needs (Sillitoe, 1998). Local soil classification thus goes beyond soil nomenclature and has formed the basis for local soil-crop systems.

Ethnopedological knowledge has the potential to provide an adequate description of complex and dynamic environments and the experiences of farmers and rural people in general (Niemeijer and Mazzucato, 2003). Soil indigenous knowledge should thus be considered as a complementary set of knowledge with valuable additions from the local experiences vital for improving the relevance of scientific knowledge to rural peoples' needs. Ethnopedological research must therefore consider land-user perceptions of soil use and management in the broadest terms. To capture the essence of farmers' pedological wisdom there is a need for an integral approach (Barrera-Bassols et al., 2006).

Many ethnopedological studies have, however, been mainly descriptive and focused in Latin America, Africa and Asia with few in Europe and the Pacific areas (Barrera-Bassols and Zinck, 2003; Capra et al., 2015). Despite Africa's significant contribution to ethnopedological studies, very few of these have come from South Africa despite its broad linguistic and ethnic diversity (Nethononda and Odhiambo, 2011; Buthelezi et al., 2013; Manyevere et al., 2014). While land use planning decisions make use of the South African soil classification system, soil knowledge of indigenous people is ignored, with negative effects on local relevance of such decisions. This study aimed to explore indigenous knowledge related to soil classification systems and criteria used by the Zulu and Xhosa ethnic groups in eastern South Africa and the level at which they classify their soils. To achieve this, the soils in the study areas were identified and mapped using both local and scientific (SCWG and WRB) classifications and the spatial coincidence between them measured. Another main aspect of the study was to investigate if the local classification schemes could be integrated with the current scientific classifications to produce a system for use at the local farmer level.

2. Materials and methods

2.1. Study areas

The study was conducted at Potshini and Khokhwane villages in KwaZulu-Natal (KZN) (predominantly Zulu ethnic group) and Ntshiqo and Zalaze villages in the Eastern Cape (EC) (predominantly Xhosa ethnic group) Provinces of South Africa (SA) (Fig. 1). Zulus and Xhosas were chosen because they are two of the three major ethnic groups unique to SA.

Potshini (28.8145°S, 29.3679°E) is located in the foothills of the Drakensberg Mountains, northwestern KZN at about 1300 m.a.s.l. The mean annual rainfall is 700 mm and maximum and minimum mean annual temperatures are 34 °C and −4 °C, respectively (Kongo et al., 2010). The underlying geology is characterized by a horizontal succession of Permo-Triassic fine-grained sandstone that alternates with shale, siltstone and mudstone of the Beaufort and Ecca Groups of the Karoo Supergroup (Dlamini and Chaplot, 2012). The natural vegetation is classified as Northern KwaZulu-Natal Moist Grassland (Mucina and Rutherford, 2006). The village is predominantly a smallholder farming area (mainly crop production and unimproved grazing).

Khokhwane (29.7014°S, 30.1039°E) is located in central KZN about 53 km north of Pietermaritzburg at about 1300 m.a.s.l. Shale of the Ecca Group dominates the underlying geology and the vegetation in the area is characterized by Moist Midlands Mistbelt (Camp and Hardy, 1999). The area receives an average annual rainfall of 750 mm with maximum and minimum average annual temperatures of 22.8 °C and 9 °C, respectively. Similar to Potshini, this area is mainly used for small-scale agricultural production.

Ntshiqo (31.2774°S, 28.7068°E) is located in the wild coast region of the EC about 47 km north-west of Mthatha at about 945 m.a.s.l. The area receives an average annual rainfall of 749 mm and has maximum and minimum mean annual temperatures of 26.5 °C and 3.2 °C, respectively (Calmeyer and Muruven, 2014). The area is underlain by sandstone of the Beaufort Group with post Karoo dolerite intrusions. Mthatha Moist Grassland (Mucina et al., 2000) dominates the vegetation. Small-scale agricultural production constitutes the main land use in the area.

Zalaze (33.0332°S, 27.0544°E) is located on the coastal plateau of the Keiskamma River catchment near Peddie at 320 m.a.s.l. The area is characterized by semi-arid climate with an average annual rainfall of 450 mm and maximum and minimum mean annual temperatures of 26.8 °C and 7.6 °C, respectively (Mhangara and Kakembo, 2012). The underlying geology is dominated by fine-grained mudstones of the Beaufort Group. The natural vegetation is Eastern Thorn Bushveld (Mucina et al., 2000) with livestock and subsistence agriculture as predominant land uses (Kiguli et al., 2009).

2.2. Indigenous knowledge collection

In all the villages both ethnographic and ethnopedological investigations were conducted to acquire local soil information. These investigations followed an iterative process involving a progression of questioning from a broad descriptive approach to a more detailed analysis. Different ethnographic techniques including questionnaires, free listing, interviews, transect walks and participatory mapping were used to explore local soil knowledge (Oudwater and Martin, 2003). In each village, initially questionnaires were administered to 50 randomly selected farmers to obtain a general overview of local soil knowledge. The questionnaire included a free listing exercise as the core inquiry into local soil terminology used. Ten of the 50 farmers were chosen for detailed semi-structured interviews based on their level of soil knowledge and practical experience shown during the questionnaire stage or on recommendation of other farmers. Farmers selected for the interviews fell within two age groups (i.e. 41–60 years (a total of 17 farmers) and > 60 years (23 farmers)). For the Zulu ethnic group, these comprised a total of nine males and 11 females whilst the Xhosa group had eight males and 12 females. Interviews were coupled with on-farm transect walks to obtain more detailed information on soils. Information collected included ethnopedological information such as detailed descriptions of soil properties for each soil type provided during free listing, as well as land use and management. Each farmer was only asked about soils with which they were familiar i.e. soils they cultivated in their own fields. When farmers mentioned similar soils, theme identification and word repetition were used to analyse the soil descriptions provided by farmers to establish if those were indeed the same soils. Both questionnaires and interviews were conducted at each individuals' house.

2.3. Participatory soil mapping

A group of five farmers from each village were chosen from the ten previously selected for detailed interviews. In Potshini and Khokhwane five males and five females were involved in mapping. In Ntshiqo and Zalaze seven males and three females were chosen. These farmers had proven to have a detailed knowledge and understanding of the local soils in the previous interviews. Farmers were provided with an aerial photograph to map boundaries of soil types within their village using