Methods for investigating soil fertility in mixed farming systems

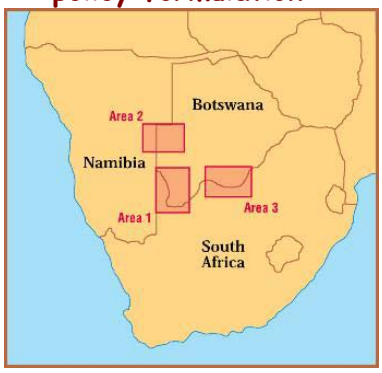
No. 1C

PANRUSA Briefing Notes

PANRUSA, Poverty Policy and Natural Resource Use in Southern Africa. A DFID funded research project at the University of Sheffield UK.

Key points

- Integration of participatory and environmental methods is required to provide sustainability assessments in mixed farming systems
- A focus on farmer decision-making enables the threats to livelihood sustainability to be identified
- Participatory nutrient flux models can aid extension advice and policy formulation



Research areas:

1 Arid southwest:

a) Mier, South Africa
b) SW Kgalagadi, Botswana

2. Semiarid northwest:

a) Ghanzi Dist, Botswana
b) Omaheke, Namibia

3. Dry sub-humid southeast:

a) NW Province South Africa
b) Barolongs, Botswana

This briefing outlines the way in which PANRUSA research has examined the sustainable use of soil resources. The quality of the soil, particularly in terms of the nutrients needed by crops, and the changes in these nutrients associated with farming practices, has been assessed using both laboratory-based measurements and quantitative assessments of nutrient movements within the farming system. This research approach has enabled both an assessment of environmental sustainability and the identification of the socio-economic factors affecting farmers' decision-making. This research has been applied in Area 3 where agriculture is based on mixed arable-pastoral systems.

Assessing the sustainable use of the land

Livelihood sustainability in mixed (arable and pastoral) farming systems depends directly on the ability to maintain soil fertility from year to year despite harvesting crops to consume or sell. On the margins of the Kalahari, the low levels of natural soil fertility, measured by the amounts of key nutrients in the soil, mean that crop yields from year to year are dependant, in addition to the effects of drought, on the annual inputs of nutrients that farmers are able to make. If the nutrients removed each year in crops are not replaced, for example by adding inorganic fertiliser or manure, then productivity will decline.

In order to assess sustainability, two types of information are needed. First, measurements of the levels of key nutrients (N,P,K) in the soil. Second, an understanding of the methods of fertility maintenance used by the farmers. These data can then be combined to assess the 'nutrient flows' affecting individual farms or even fields. It is also necessary to determine other factors, such as the acidity of the soil, soil loss by erosion, and the quantities of fertilisers etc that are added, to determine both 'nutrient budgets' on an annual basis and the longer term impacts of different farming strategies.

Data Collection & Interpretation

Baseline information

Data on farming livelihoods (see BN 1A) allowed the general strategies for farmers and their perceptions of the environment to be established. Visits to fields with farmers allowed the occurrence of soil erosion to be assessed, as well as the views of the farmers about the quality of the land and changes in yields to be understood. Together, this information permitted our research to focus on particular farmers and fields, in order for the range of conditions in the study area to be incorporated in our research.

Integrated sustainability assessments

Farmer discussion in study field

Interviews involved discussions of existing soil nutrient management practices and the perceived constraints, threats and opportunities faced by farmers in using these practices. Quantities of compost inputs, fertiliser additions and crop yields for the previous farming year were recorded. Discussions were then continued during field visits to selected study fields chosen by the farmers to represent different field characteristics.

Field visits allowed time for specific management issues to be discussed in a variety of settings and soil samples to be taken for subsequent analysis in the UK. The total content of the three main limiting nutrients, Nitrogen (N), Phosphorus (P) and Potassium (K) were determined. Soil acidity (pH) was measured too, since this is a further characteristic that can influence crop-growing potential, and it is known that the application of too much fertiliser can raise acidity levels, which itself can limit crop growth. (see BN 6 for discussion).The nutrient levels in different inputs (bags of inorganic fertiliser, manure, compost etc) were also determined. Together the values obtained allowed the annual budgets of nutrient losses/gains for each study field to be calculated. Overall, the aim was to determine values for a limited but critical number of variables, providing simple quantified data that could form the basis of nutrient budget calculations and feedback to farmers.

Farmer feedback

The final stage of research involved extension-style advice to farmers based on their specific soil analyses (see example sheet below) and the opportunity for discussion of wider research findings, including the longer term impacts of particular strategies, and ways in which these might be changed to reduce the costs of inputs/improve the quality of the soil.

Example feedback form

Name: *Osekeng Tsietso* Village: *Mokatako*

	Field 1 (Sandy)		Field 2 (Clay)	
Nitrogen (N)	185	Low	318	Medium
Phosphorus (P)	76	Medium	93	Medium
Potassium (K)	557	High	1303	Very high
pH	5.13	Strongly acidic	6.16	Slightly acidic

Comments

Compost needed to sandy soil to increase N and prevent acidification

Compound fertiliser addition to clay soil will increase N and P and yields (no acidity concern at present)

PANRUSA was funded by the UK Government Department for International Development, and conducted by researchers at the University of Sheffield, UK, in conjunction with researchers from Africa.

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