

# Highlights

## CIAT in Africa

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### Resource flows and nutrient balances as tools for better understanding of farmers' decision making in soil fertility management

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FUTURE HARVEST



This case study highlights how farmers in Eastern Uganda used farm and resource mapping techniques to plan activities and experiments designed by themselves to improve their agricultural resources use, and then evaluate changes in soil fertility management. The objectives of this study were to:

1. Examine the movement and management of resources in and out of the farm system.
2. Estimate the nutrient balances at farm and farm sub-system levels and their impact on the sustainable productivity of this farming system.

Eighteen farmers representing three soil fertility management classes (1=good, 2=average and 3=poor managers), in three villages, were chosen as test farmers for intensive on-farm resource flow mapping.

#### Resource flow mapping

Farmers from each of the self-classified soil fertility management classes drew seasonal resource flow maps, planning and evaluation maps (Figure 1) as a means of understanding how they manage their agricultural resources. These maps further enabled them to quickly and effectively visualize the way they manage their soil fertility and enabled them identify potential areas and options for improvement.



Figure 1. Farmers drawing a resource flow map

Resource flow mapping helped farmers in learning to:

1. Properly plan for their limited land resources e.g. through crop rotation.
2. Make priorities and allocate resources for fertility improvement.
3. Allocate labour resources to various farm enterprises and in a timely manner.
4. Estimate quantities of resources entering (inputs) and leaving (outputs) the farm every season.
5. Reflect on balancing their resource use against their resource needs.



Figure 2. Evaluation map

The map shows three main destinations for nutrients:

1. Crop produce sold at market, i.e. nutrients definitely removed from the farm.
2. Domestically consumed crop produce – nutrients ending up in pit latrines and household refuse.
3. Crop residues removed from the field in various forms and taken to the compound to be used for other purposes, e.g. fuel, animal fodder, thatching and composting material.

These maps then formed a basis for nutrient flow analysis using the Resource Kit computer package (Defoer and Budelman, 2000).

### Nutrient flow analysis

Nutrient flows and balances were conducted for the crop and animal production systems and the household system over five seasons. The total N, P and K balances for all soil fertility management classes were negative. However, farmers classed as good soil fertility managers had higher negative nutrient balances than farmers classed as poor soil fertility managers (Table 1). This is because class 1 farms extracted more nutrients from the soil when they produce and sell more.

System	Average net flow for 5 seasons					
	Class 1			Class 3		
	N	P	K	N	P	K
Crop production system	-13.6	-1.4	-23.9	-3.6	-0.1	-5.4
Animal production system	+5.0	+0.5	+5.0	+1.9	+0.2	+2.1
Household production system	-2.9	-0.3	-1.0	0.0	+0.1	-0.2

Only the animal production system showed net gains of N, P and K due to imported feed and concentrates for livestock feeding. The crop production system showed large losses of nutrients. This is particularly true for K, due to large sales of bananas.

### Developing action plans

Many farming systems are becoming unsustainable because population pressure results in more being asked of the system than it can offer. Unfortunately, farmers do not clearly visualize the problems of nutrient mining.

The key to increasing the productivity and sustaining the productivity of this farming system lies in strategic management of the agricultural resources in the crop production system. Farmers first need to understand and then adopt or adapt a variety of nutrient recycling practices, such as:

1. Leaving residues to decompose on the fields.
2. Collecting residues from leguminous crops to other crop fields (bio-mass transfer).
3. Improving quality of compost produced from crop residues by adding animal waste.
4. Limiting residues used for fuel by using energy saving cooking facilities.

The nutrient balances for the crop production system, which is the major determinant of crop nutrition, also offer clues as to where farmers could improve their soil and water conservation strategies.

During the resource mapping exercise, farmers, extension providers and researchers identified the following strategies for mitigating the nutrient depletion effects:

1. Use of farmyard manure, compost and mulching.
2. Use of legume cover crops (green manure).
3. Digging soil conservation trenches and use of grass band/leguminous shrub hedges.
4. Practicing improved fallow technologies.