

# Highlights

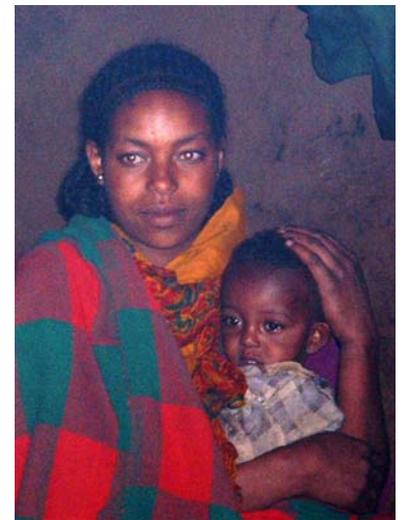
## CIAT in Africa

No. 23  
June 2005

The Highlights series summarises research results and policy implications from the work of CIAT and its partners in Africa

### Boosting human nutrition through land use modelling

Many farmers in Ethiopia's highland cereal and root crop systems face food shortages as well as imbalanced nutrition. Even in food sufficient regions about 45% of children are stunted, underweight, or deficient in zinc, calcium and vitamin A. Better nutrition through livestock products is rarely possible for these farmer families because of poverty. This study aims to understand the potential of these farming systems and current landholding size to supply the required nutrients to farming households, if farmer decision-making on enterprise allocation is adjusted. The hypothesis for this work is that highland root crop farming systems found in Areka in Wolaita, southern Ethiopia and cereal-livestock-fallow crop systems found in Ginchi's high altitude plateau can feed the existing local population and enhance nutrition if cropping strategies are modified to provide the micronutrients required.



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#### The approach

- Identify households with diverse resource endowments and production systems.
- Use participatory monitoring to quantify household and farming system parameters (farm & household size, land allocation to different enterprises, and food items consumed in different seasons).
- Quantify nutrient amounts and type per farm, and distribution per household consumption unit (CU).
- Compare nutrient amounts and type available from farm per CU with World Health Organisation (WHO) recommended daily allowance (RDA) and identify excess and deficit nutrients.
- Find land allocation strategies that fulfill nutritional demands throughout the year. Consider cultural preference, resource base and inputs using "optimisation models."
- Negotiate with communities on possible land reallocation favouring crops which can provide greater nutrition to farming households.

#### Initial findings

- Under current cropping practices in both systems, household food production meets the nutritional needs of families for only 9 months out of the year.
- The minerals zinc and calcium and vitamins A and C were found to be in deficit. Vitamin C deficiency was most prevalent, even in the root crop system where one would expect to find high levels of the vitamin.
- Poor farmers were found to have energy deficits while wealthier farmers had enough energy, but suffered mineral and vitamin deficits.
- Due to high land pressure the only option for addressing current nutritional deficits is farming system intensification.

NUTRIENTS	RDA		AREKA				GINCHI			
	Households:		Resource-poor		Resource-rich		Resource-poor		Resource-rich	
	Current	Optimised	Current	Optimised	Current	Optimised	Current	Optimised	Current	Optimised
Energy (kcal)	2000	1294	2000	2284	4758	1398	3329	2082	3696	
Protein (g/kg)	38	8	9	17	36	32	40	42	43	
Zinc (mg/kg)	15	4	6	7	15	7	15	20	21	
Iron (mg/kg)	8	21	37	36	82	26	78	34	69	
Calcium (mg/kg)	528	179	362	310	759	163	694	195	547	
Thiamine (mg/kg)	0.92	0.21	0.35	0.41	0.89	1.17	1.08	1.52	1.30	
Vit. A (ug/kg)	10.00	0.18	10.00	2.54	10.00	0.25	12.51	1.45	20.80	
Vit. C (mg/kg)	25.42	2.98	14.95	9.08	2.41	0.54	1.62	0.01	2.61	

Table 1: Household nutrient budgets at Areka and Ginchi, current and after optimisation

### Optimisation models

To determine whether current nutritional deficits could be addressed with existing resource endowments and cropland allocations, optimisation models were developed for each system. Findings from this analysis (see table 1 above) illustrate important opportunities for improving household nutrition through land reallocation and system intensification:

- Maintaining current farm size but changing the amount of land allocated to different crops can provide a balanced diet and adequate food.
- In the root crop system, an increase in the land allocated to beans, enset (false banana) and cabbage and a decrease in land allocated to maize and sweet potato can satisfy household nutritional needs. However, yields of these crops must increase, especially for poor farmers.
- For cereal-based systems, an increase in the land allocated to enset, beans and potato and a decrease in the land allocated for barley can satisfy household nutritional needs.

### Response from communities

To determine the viability of the above recommendations in terms of cultural acceptance, farmers were consulted on the barriers that they would face if they implemented the proposed solutions.

- Women in Areka said that expansion of enset will demand more labour, so they would prefer to continue allocating a higher proportion of land to sweet potato.
- The model did not favour cash crops (such as Tef).

### Implication of crop reallocation

#### Soil erosion

A shift from one cropping system to another may have a considerable effect on soil loss and nutrient management.

In the root crop-based system, a shift from the root-crop/cereal mix to more enset/beans improved the crop factor at farm level (farm erosivity index) by 42 %, indicating that soil erosion could be significantly minimised. The same applies for the cereal-based system, in which the farm erosivity index was improved by 45 %. This would result from an increased proportion of enset, a perennial, in the system. Such changes are likely to have significant implications for household labour and resource use efficiency in the system.

#### Soil fertility management

The expansion of enset at the expense of cereals may improve the nutrient budget of the system by encouraging farmers to intensify soil fertility management options, such as composting and better manure management.

#### Household labour

Adoption of the suggested cropping system may need further support from research and extension systems to deal with the additional labour burden. There is also a need to integrate high biomass producing, nitrogen-fixing herbaceous legumes that could be used for biomass transfer and composting in order to improve yields without cash outlay. However, this option is costly in terms of labour.

### Conclusions

Farmers' available resources and choice of livelihood strategies substantially influence cropping choice decisions and, subsequently, resource management outcomes. Any suggestion for a change in cropland allocation should be carried out through negotiations at individual farmer and community levels in order to consider local preferences by diverse social groups (as defined by wealth, gender or age). Nutrition can be enhanced and erosion can be reduced by half through cropland reallocation, favouring crops with high nutritional quality. Reallocations would improve food security in both types of systems, in particular if accompanied by technological interventions aimed at increasing yield.