Theme 1
Status and trends of global soil nutrient budget

Hidden nutrient leaks in agricultural soils

Rocio Portocarrero, Cristina Biaggi, Alejandro Valeiro
Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina.
email: portocarrero.rocio@inta.gob.ar

INTRODUCTION

More accurate nutrient balances are a key tool for keeping soils healthy and land use sustainable. In Argentina, macro-balances with only two components: the input of nutrients via synthetic fertilization and the output via grain harvest (Table 1), underestimates nutrients´ extraction through grazing, biomass harvesting, residues, and losses during grains´ storage and transport.

Table.1. Average harvest/planting ratio from MAGyP, Estimaciones agrícolas 2009/2019

Crop	Ratio (%)
Corn	78
Feed barley	15
Malting barley	92
Oat	21
Sorghum	75
Rye	14
Bread wheat	94
Rice	98

The study proposes an extended nutrient balance equation, and estimates the proportion of N, P, K and S extracted from soils in these unaccounted factors for 12 grain crops in the period 2009-2019.

METHODOS

From the conventional nutrient balance equation (Roy et al.; 2003), this study further developed the RMΔt factor as follow:

$$RM\Delta t = MHp + SHp + H2R + BER1 + L2Sto + L2Tra$$

where:
RMΔt= Nutrients extracted by crops and residues in the Δt interval (ton)
MHp= Nutrients extracted by the main harvested product (ton)
SHp = Nutrients extracted by the harvested by-product or secondary product (ton)
H2R = Nutrients extracted by harvest secondary residues (ton)
BER1= Nutrients extracted in the biomass of primary residues (ton)
L2Sto = Nutrients extracted in secondary storage losses (ton)
L2Tra= Nutrients extracted in secondary transport losses of the main product (ton)

A database was built including the Ministry of Agriculture, Livestock and Fisheries´ information on areas planted, harvested, and their production and yields. Volumes of stubble and forages produced, and losses in grain storage and transport were estimated for each of the value chains, based on local bibliographic references.

RESULTS

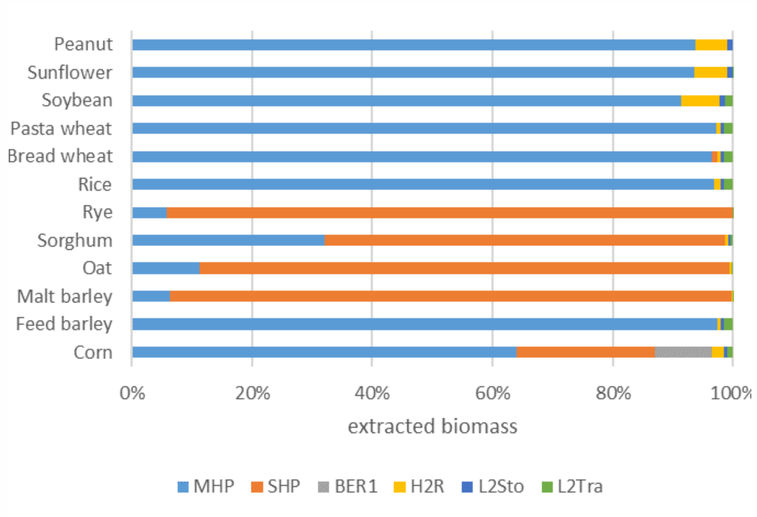

Fig.1. Average annual proportion of biomass extracted by component and crop, 2009-2019

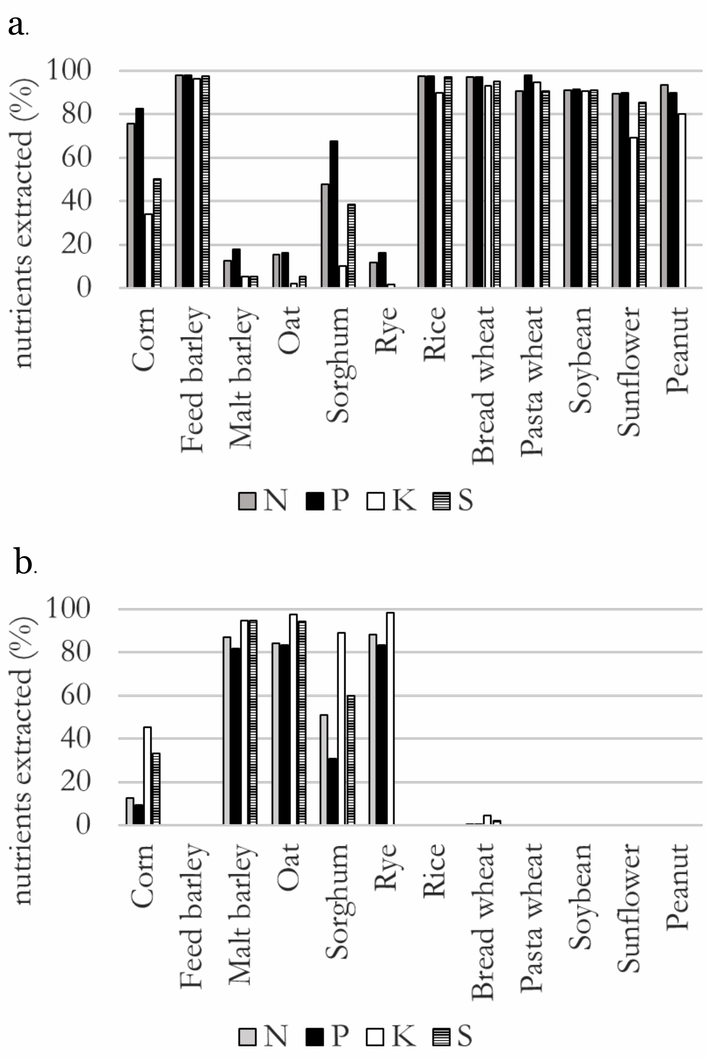

Fig.2. Average annual percentage of nitrogen (N), phosphorus (P), potassium (K) and sulfur (S) extracted in principal products (a) and secondary products (b) for the considered crops during the period 2009-2019

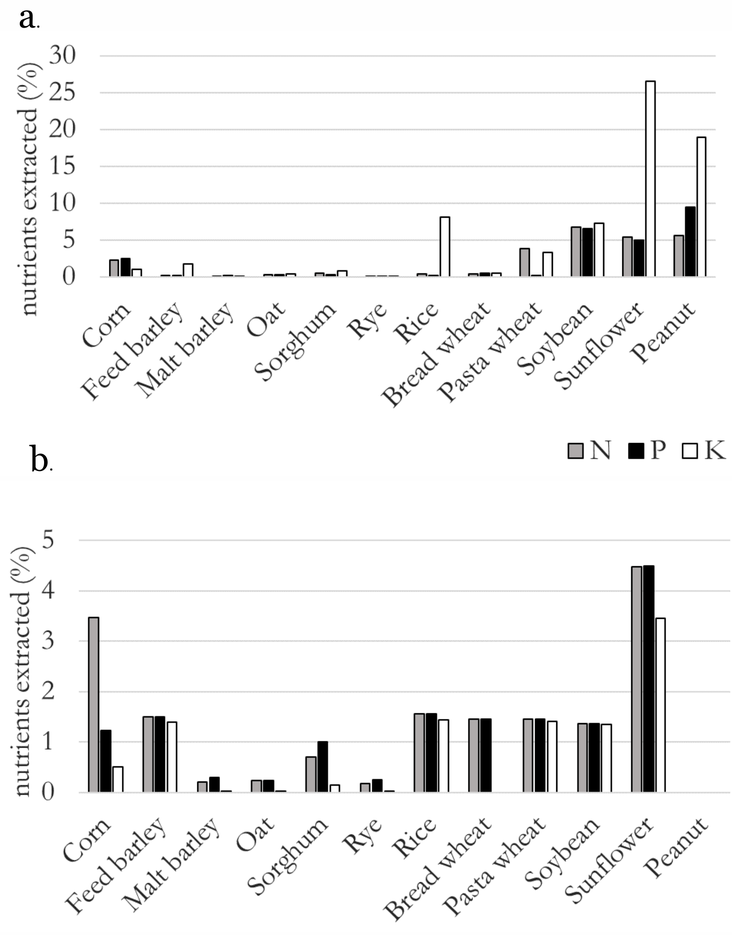

Fig.3. Average annual percentage of nitrogen (N), phosphorus (P) and potassium (K) extracted in secondary harvest residues (a) and secondary storage losses (b)

CONCLUSIONS

There is enough evidence that the deficit of nutrients is a central sustainability problem for Argentinian agriculture.
Crops could be grouped in three categories regarding the usefulness of production statistics for calculating nutrient balances:
1) those crops in which the nutrient output can be directly assimilated to the production figures (≥95%) such as wheat, rice and malting barley;
2) the ones in which the volume of harvested grain partially explains nutrient exports (≥50% - ≤95%) like soybeans, corn, sunflower and peanuts; and
3) crops like sorghum, rye, oats or forage barley in which it would be incorrect to use the grain harvested as an indicator, since the amounts of green biomass (stems, leaves) extracted (e.g. for cattle feed) from the field are those defining the main nutrient output

REFERENCE
Roy, R. N., Misra, R. V., Lesschen, J. P., and Smaling, E. M.. (2003). Assessment of soil nutrient balance. Approaches and methodologies. FAO Fertilizer and Plant Nutrition Bulletin, 14. http://www.fao.org/3/y5066e/y5066e00.htm