FORMAS

Swedish Research Council

SLU

World Agroforestry

FACTSHEET - TECHNICAL GUIDELINES

SAVING FERTILIZERS AND IMPROVING SOIL QUALITY BY AVOIDING THE BURNING OF PLANT RESIDUES

Hanoi | March 2024

ABOUT THE PROJECT

The Project ***"Agroforestry: potential for sustainable development in the uplands"*** aims to contribute to sustainable development in sloping upland areas, with focus on evaluating agroforestry practices and systems addressing production and productivity, soil conservation, management practices such as nutrient application and weeding, and competitive effects between trees, crops and forage grass in young and mature agroforestry systems, study fruit value chains and market links, and assess opportunities and bottle-necks for wider agroforestry adoption and increasing of scale.

The Project (formally two projects) is funded by Formas, a Swedish Research Council for Sustainable Development and Vetenskapsrådet / Swedish Research Council, respectively. It is carried out between January 2020 and December 2023 (Formas), and December 2024 (VR), by SLU - Swedish University of Agricultural Sciences and the International Centre for Research in Agroforestry (ICRAF - also known as World Agroforestry) in Viet Nam, the Soil and Fertilizers Research Institute (SFRI) and the Departments of Agriculture and Rural Development from provinces of Dien Bien, Son La and Yen Bai.

ISSUE

Burning of crop residues leads to greenhouse gas emissions (GHG) which aggravates climate change. It creates smoke which contaminates air and negatively affects the health of humans and animals. Burning plant residue on the soil surface also kills most soil organisms, affecting soil properties and nutrient metabolism in the soil.

Carbon is the backbone of soil organic matter. The soil organic matter is decomposed over time, and must be balanced by inputs every year, mainly through plant material. Burning plant material leads to decreased inputs of organic matter and therefore decreased soil organic matter over time.

Soil organic matter is very important for soil quality. It enhances the soils´ structure and ability to intercept, drain and store water from precipitation and irrigation, and thus to supply crop roots with both water and air. This helps crops cope with both dry spells and (too) heavy rains. Conversely, decreased soil organic matter makes crops more vulnerable to drought and very wet conditions. Burning also increases erosion on slopes, both because of the loss of soil structure and loss of protection from plant material.

Burning leads to direct losses of plant nutrients in the smoke, and thus a need for higher fertiliser and soil amendment rates. The loss of soil organic matter also leads to decreased ability of soils to hold nutrients in a plant-available state in the soil, and nutrient management becomes more challenging.

There are few data on the extent of nutrient loss when burnt under the prevailing farmers´ management of crop residues and weeds in NW Vietnam. Such data are needed to identify paths to improved management practices.

Figure 1.
(top) Landscape of corn growing area on mountainous land in Northwest Viet Nam. (bottom) Burning to remove crop residue and weeds leaves the soil unprotected from wind and rainfall, at risk of erosion.

FARMERS' PRACTICE

Information on farmers´ management of crop residues and weeds was collected to design a relevant trial for determining the loss of carbon and nutrients during burning. This was done through a survey of 31 farmers in Son La.

Almost all of the farmers burn the crop residues and weeds in the fields but ca 36% first removed some residues (Fig. 2). Most farmers carried out burning once, shortly after harvest or before planting the new crop (Fig. 3). However, approx. one out of four farmers did it twice, both after harvest and before planting. Residues and weeds were either collected in heaps or rows before burning, or burnt scattered as they remained after harvest.

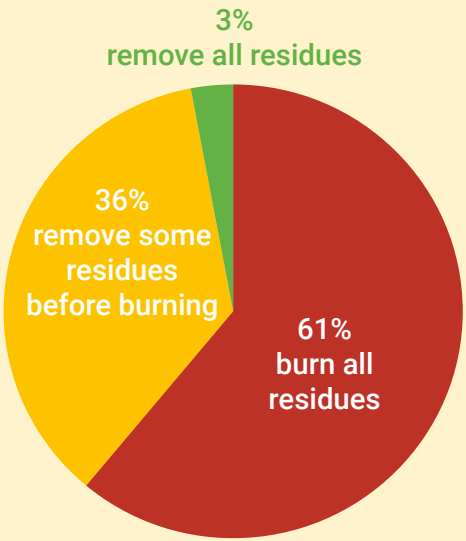


Figure 2a.
Farmers' management of crop residues.

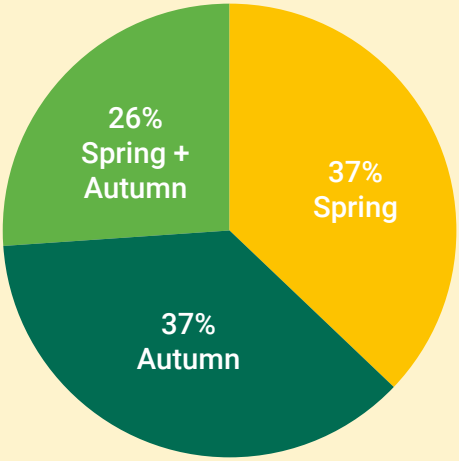


Figure 2b.
Burning frequency of crop residues.

LOSSES DURING BURNING

A trial was then carried out to test the carbon and nutrient losses during the dominating burning practices: scattered or heaped maize residues and weeds (Fig. 3). This was done twice, shortly before planting and shortly after harvest 2021.

Figure 3. *Test burning plant residue (corn stalks and weeds) stacked in piles or scattered on the ground*

Almost all carbon of the maize residues and weeds was lost during burning (Fig. 4), and over 90% of the nitrogen. The losses of phosphorus and potassium were lower and more variable. On average across the burning times, 25% of the phosphorus was lost and on average 45% of the potassium was lost.

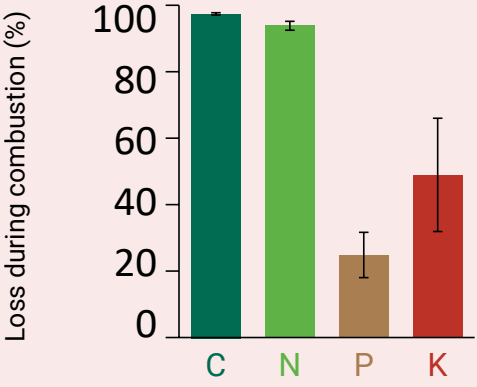


Figure 4.
Average nutrient loss of carbon (C), nitrogen (N), phosphorus (P) and potassium (K) during burning (± confidence interval). The confidence intervals for losses are 97-98% carbon, 91-94% nitrogen, 19-30% phosphorus and 34-55% potassium.

AMOUNTS OF C, N, P AND K LOST BY FARMERS THROUGH BURNING

The total biomass of maize and wild grass residues is about 6 tons/ha, used for the experiments. Maize residues are more abundant in autumn, while wild grass residues prevail in spring. The carbon loss through the burning corresponded to 2-2.5 tons per hectare for an average maize field in the area. This will lead to decreased soil organic matter levels and aggravated challenges in climate change adaptation and mitigation. To counteract this, several tons per hectare of organic fertilisers or soil amendments need to be applied to compensate for the C loss and retain the soils´ water and nutrients holding capacities.

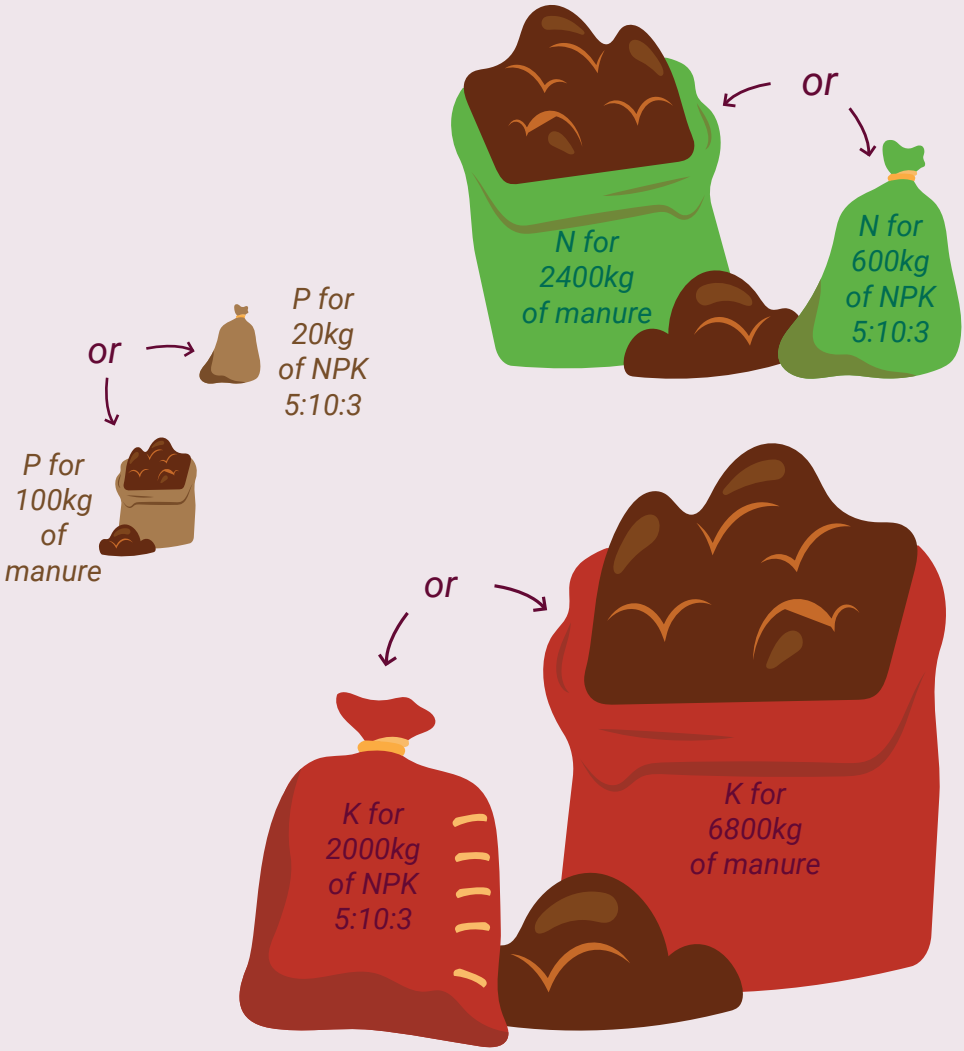
Around 30 kg per ha nitrogen and potassium was lost during the burning and 1 kg per ha of phosphorus. Large applications of e.g. mineral fertiliser or manure are needed to replace these nutrients, at considerable costs for purchasing and application. The additional losses of nutrients which may occur e.g. through erosion from the burnt land may increase the need for nutrient application further. Thus, burning plant residue directly wastes farmers' money.

Figure 5.

An example of mineral fertilizer (NPK 5:10:3) or manure is needed to replace nutrients lost during the burning of corn residue and weeds, calculated for an area of 1 hectare.

Compost is one of the commonly used mineral fertilizers in the study area and the P and K ratio is calculated from P2O5 and K2O.

Manure was calculated based on analytical data of 25 types of compost collected from households in the study area..



NOTES

WE HOPE THAT THIS DOCUMENT IS USEFUL

FORMAS

Swedish Research Council

SLU

World Agroforestry

CONTACT

Viet Nam Coordinator: PhD. La Nguyen, ICRAF Viet Nam,
E-mail: l.nguyen@cifor-icraf.org | *Phone:* +84 (0)962021472

PhD. Do Van Hung, ICRAF Viet Nam, Swedish University of Agricultural Sciences,
E-mail: d.hung@cifor-icraf.org | *Phone:* +84 (0)977843201

MSc. Pham Huu Thuong, ICRAF Viet Nam, Swedish University of Agricultural Sciences,
E-mail: p.thuong@cifor-icraf.org | *Phone:* +84 (0)912755998