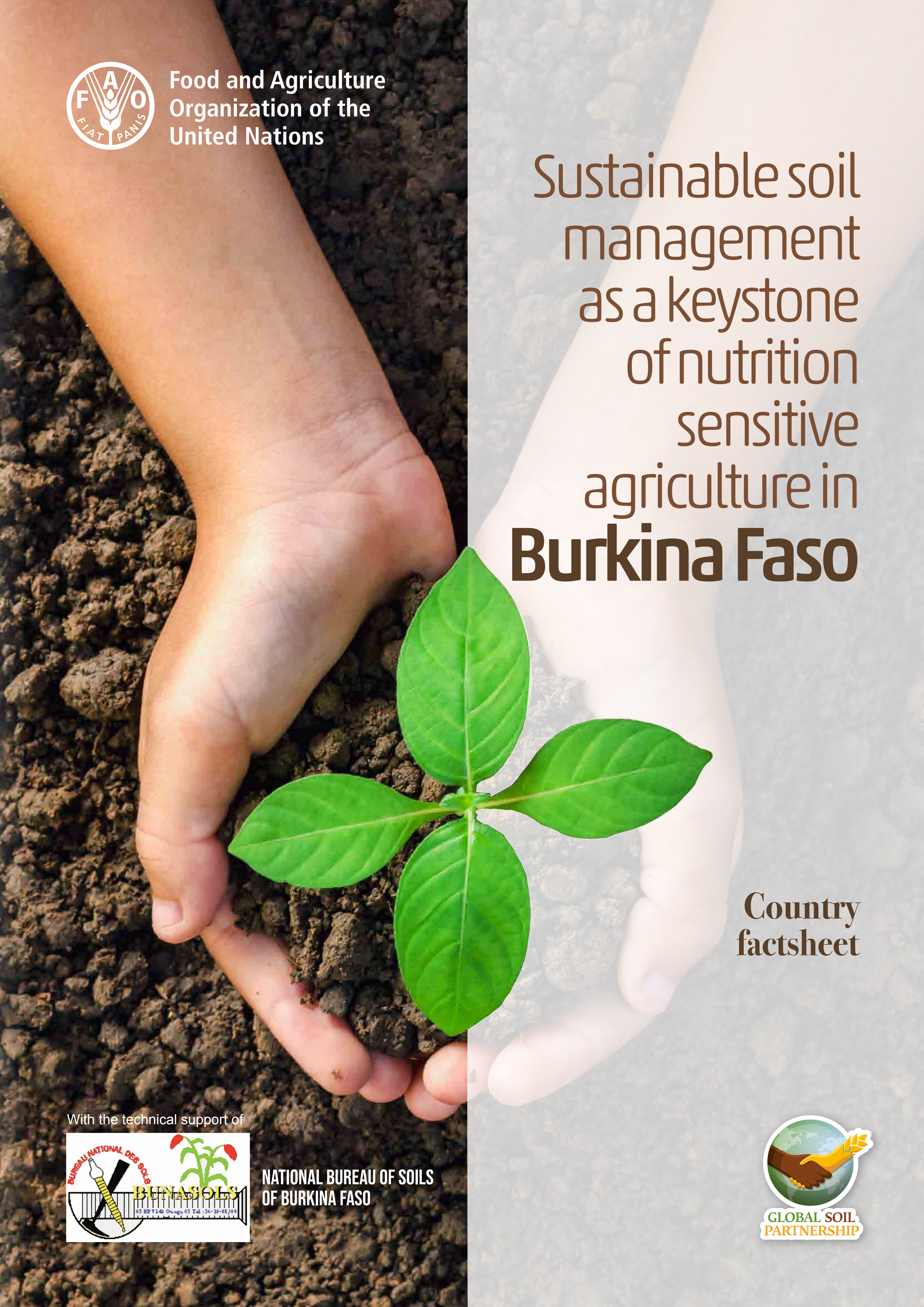

Food and Agriculture Organization of the United Nations

Sustainable soil management as a keystone of nutrition sensitive agriculture in Burkina Faso

Country factsheet

With the technical support of

NATIONAL BUREAU OF SOILS OF BURKINA FASO

GLOBAL SOIL PARTNERSHIP

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Key messages

- In Burkina Faso, despite the important efforts made, malnutrition in all its forms persists. In particular, iron deficiency anaemia affects about 65 percent of all woman and children in the country.
- Burkina Faso has 9 million hectares (ha) of soil resources, 31 percent of which are impacted by the effects of degradation, resulting in poorly fertile soils with little organic matter and a poorly developed structure.
- Agricultural yields are very low and in addition, production is not diversified, with 64 percent of all crops being cereals, leading to significant food and nutritional insecurity.
- In response to the threat of food and nutrition insecurity, the Government of Burkina Faso has established the National Strategy for Soil Restoration, Conservation and Recovery in Burkina Faso 2020–2024 (MARAH, 2019). for which the recommendations of this policy document represent a valuable complement.
- Results from the Sustainable soil management for nutrition-sensitive agriculture in sub-Saharan Africa and South East Asia (Soils4Nutrition) project have shown that sustainable soil management (SSM) practices (including crop rotation and integrated fertility strategies), increase soil organic matter and ensure balanced amounts of macro- and micronutrients in the soil. These strategies maintain crop yields while reducing the need for chemical fertilizers relative to the recommended fertilizer rate.
- The recommended practice of adding organic matter and micronutrients in addition to mineral fertilizer resulted in 29 percent higher grain yields and a 55 percent higher return on investment for cowpea and sorghum.
- Overall, there was a 10 to 50 percent increase in micronutrients in soil, plant parts and seeds through using the different treatments.
- The implementation of the Global Soil Doctors Programme (GSDP) has proven to be very effective in promoting the adoption of SSM linked to improved nutrition. In Burkina Faso, the Global Soil Partnership (GSP) has trained 20 trainers and selected 45 farmers as "Soil Doctors" to explain and disseminate knowledge on SSM and soil health to the final beneficiaries.

Background

In Burkina Faso, the infant mortality rate is 65 per thousand and about 40 percent of the population lives below the poverty line (MAAHM, 2020).

Seventy-four percent of the population is rural, with agriculture being the country's largest economic sector and employer. Eighty-six percent of the working population are employed in the sector (RGPH, 2019). While cereal production (which occupies more than 64 percent of cultivated land), theoretically covers the food energy needs of the inhabitants, more than half of households do not have access to a diversified diet. The main causes of this situation are the high seasonality of food prices and the high cost of a quality diet (FAO, 2011).

In Burkina Faso, despite the efforts made, acute malnutrition, underweight and chronic malnutrition are still ongoing (although very slightly decreasing between 2009 and 2021), indicating a persistence of malnutrition in all its forms. This phenomenon is more severe among children under five and young women. The prevalence of chronic malnutrition among children under five years of age has decreased from 35 percent in 2009 to 22 percent in 2021 (FAO et al., 2022).

In addition, micronutrient deficiencies are still a concern. According to the results of a national survey on iodine and anaemia in Burkina Faso conducted in 2014 (Brown et al., 2021), 83 percent of children under five years of age suffered from anaemia, together with 68 percent of school-age children and 62 percent of non-pregnant women.

Faced with this situation, many national strategies such as food fortification and supplementation have been implemented to combat the various nutritional deficiencies, but the prevalence remains critical in Burkina Faso, and more action is needed, especially among the populations most at risk.

Moreover, the food and nutritional security of households are constantly affected by structural and cyclical factors that contribute to increasing their vulnerability. Factors such as the natural poverty of soils – in terms of basic mineral elements and their continuous degradation – further weaken this socioeconomic category, especially the land tenure situation in rural areas, which is characterized by increased and conflicting competition between actors.

Agriculture in Burkina Faso is practiced using abundant soil resources, estimated at 9 million ha of arable land, 233 500 ha of irrigable land and 500 000 ha of easily developed lowlands. In addition, agricultural production is accompanied by a potential of about 1 200 water bodies allowing for the development of irrigation, fishing and aquaculture (SP/CPSA, 2017). Overall, the soils are not very fertile (MAAHM, 2018).

Between 105 000 and 250 000 ha of land is washed away every year in Burkina Faso, mainly caused by physical processes. This soil degradation is accompanied by the loss of organic, mineral and biological matter (See Box 1).

The phenomenon of degradation is experienced country-wide and is estimated to affect 31 percent of the territory (MAAHM, 2018). It is more pronounced in the administrative regions of the Sahel, the North, the North-Centre and the Central Plateau of Burkina Faso (MAAHM, 2020).

Box 1. Soil resources in Burkina Faso

The National Bureau of Soils (BUNASOLS) has identified nine soil classes in Burkina Faso. These soils are poor in organic matter and phosphorus with a poorly developed structure. They have a low agronomic value and a large proportion (more than 28 percent) have a high acidity (pH between 5.1 and 5.5).

Of these types of soils, the most common are:

- Soils with iron and manganese sesquioxides or ferruginous soils are the most dominant soils in the territory (40 percent) (see Figure B1.1). They have a low fertility and a low water retention capacity. Major constraints: depth is often limited by induration in the form of a duricrust and a high sensitivity to erosion.
- Poorly-developed soils occupy about 26 percent of the territory. They are moderately deep with limited organic and mineral fertility. They are of little agricultural and pastoral interest. Major constraints: poorly fertile soils and poorly developed structure.
- Hydromorphic soils are deep soils and represent about 13 percent of the territory and are mainly located in the drainage network. The texture is silty-clay to clayey and the water retention capacity is quite good. The agronomic value is average. Major constraints: asphyxiating soils for crops that do not require much water, such as small millet, sesame and fonio (a form of small-grained millet).

The least common soil classes are brown soils (4.8 percent), vertisols (5 percent), sodic soils (4.9 percent), crude mineral soils (2.5 percent), and ferrallitic soils (1.9 percent).

Figure B1.1. Ferric Lixisol (Balé province)

Figure 1. Heavy water erosion in the minor bed of a river

Two causes of soil degradation have been identified in Burkina Faso: natural and anthropogenic. Natural factors include water erosion (Figure 1) and wind erosion (deflation), which is more prevalent in the Sahelian region. Anthropogenic factors include essentially poor cultivation practices such as the overexploitation of agricultural land, mining activities and construction activities.

The consequences of soil degradation are social, such as rural exodus and economic, environmental or political issues (MAAHM, 2018).

A favourable legal and institutional framework has been created through the development and implementation of policies, strategies, plans and action programmes, marked by the adoption of the National Strategy for Soil Restoration, Conservation and Recovery in Burkina Faso 2020–2024 (MARAH, 2019). At the institutional level, a fairly significant range of policy and strategy documents are being developed and adopted on an ongoing basis to support stakeholders and facilitate their interventions in the fight against soil degradation and for the sustainable fertilization of the country's soils and crops.

Efforts have been made by the National Bureau of Soils (BUNASOLS) in Burkina Faso to gain a better knowledge of soils, which will ensure their rational use and protection for future generations. The soil training of students, managers and agricultural producers contributes to a large-scale application of good practices for SSM (see Figure 2).

In Burkina Faso, some reference documents regulate the use of fertilizers and micronutrients. The import and use of fertilizers are the responsibility of the Ministry of Agriculture and governed by the provisions of Law No. 026-2007/AN, which institutes fertilizer control in the country. This control concerns quality, labelling and packaging standards, and marketing and export. In addition, the micronutrient composition standards of certain foods are defined by the Ministry of Health of Burkina Faso (Ministry of Health, 2005).

Soils4Nutrition project

With the support of the German Ministry of Food and Agriculture, the Government of Burkina Faso (through BUNASOLS) and FAO's GSP have made a major effort in highlighting the critical role of SSM in nutrition through the Soils4Nutrition project, implemented in Burkina Faso, Malawi and Bangladesh. Using the Voluntary Guidelines for Sustainable Soil Management (FAO, 2017) and the International Code of Conduct for the Sustainable Use and Management of Fertilizers (FAO, 2019) as a basis, this initiative took stock of the existing scientific knowledge in the country and made strong and operational recommendations for SSM in Burkina Faso.

Figure 2. Training of MARAH agents from the North-Centre region of Burkina Faso

Healthy soils: the basis for healthy crops and better nutrition

The Institute of Environment and Agricultural Research (INERA) compiled a non-exhaustive list of good practices that can contribute to SSM for nutrition-sensitive agriculture. These biophysical and biological practices are listed in Box 2.

Box 2. Biophysical and biological practices recommended by the Ministry of Animal Resources and Fisheries

The National Bureau of Soils (BUNASOLS) has referenced the following recommended practices in Burkina Faso and their benefits for soils.

Biophysical practices

1. Stone anti-erosion fences to limit the loss of nutrients and organic matter carried away by the wind or water.

2. Manual half-moons to retain water, nutrients and organic matter.

3. Mechanized half-moons to retain water, nutrients and organic matter.

4. Manual *zaï* pits to retain water, nutrients and organic matter.

5. Mechanized *zaï* pits to retain water, nutrients and organic matter.

6. Subsoiling to allow water infiltration and avoid waterlogging.

7. Filtering dam to limit the loss of nutrients and organic matter, and allow for water infiltration.

8. Irrigation to maintain soil moisture.

9. Water storage to retain water and maintain soil moisture.

Biological practices

1. Mulching to limit evapotranspiration.

2. Grassed strips to retain water, nutrients and organic matter and increase biodiversity.

3. Herbaceous cover to retain water, nutrients and organic matter, and increase biodiversity.

4. Reforestation to retain water, nutrients and organic matter, and increase biodiversity.

5. Assisted natural regeneration to retain water, nutrients and organic matter, and increase biodiversity.

6. Defensive hedge to limit the loss of nutrients and organic matter carried away by the wind or water.

7. Composting to provide organic matter and nutrients.

8. Compost + biochar to provide organic matter, nutrients and carbon.

Source: MARAH (Ministry of Animal Resources and Fisheries). 2019. Stratégie Nationale de Restauration, Conservation et Récupération des Sols au Burkina Faso 2020–2024 [National Strategy for Soil Restoration, Conservation and Recovery in Burkina Faso 2020–2024]. Ouagadougou. https://www.agriculture.bf/jcms/pv10_102918/fr/strategie-nationale-de-restauration-conservation-et-recuperation-des-sols-au-burkina-faso-2020-2024?details=true

During the consultations conducted during the project, five priority sustainable SSM practices were selected for the production of micronutrient-rich foods in Burkina Faso.

Table 1. Practices selected for recommendations on sustainable soil management

No.	SSM practices	Advantages
1	Micronutrient-enriched composting	Sustainable effect on soil health. Medium-term improvement in soil and crop micronutrient status.
2	Micronutrient-enriched mineral fertilizers	Fairly common availability. Short-term improvement in soil and crop micronutrient richness.
3	Crop association and rotation	Limitation of soil depletion by crops.
4	Natural mineral amendments	Effectiveness of natural materials for SSM.
5	Water and soil conservation and restoration	Effectiveness of natural materials for SSM. Effectiveness of these technologies in protecting soils against erosion.

The right rate, time, place, and source of micronutrients

Trials were conducted over two years (2019 and 2020) at two sites in the municipalities of Léo and Dapélogo to evaluate and characterize the status and level of micronutrients in the soil as well as in sorghum (Flagnon variety) and cowpea (Tiligré variety) grains. The physical characterization of the soils showed a weakly developed structure and a superficial biological activity. Chemical analyses indicated low nutrient and organic matter levels, meaning that the soils were deficient and needed their nutritional balance restored.

Effects of treatments on soil zinc levels

The initial value of zinc measured in the soil before the tests was 6 to 7 mg/kg while the final value, after application of the treatment with addition of zinc (as zinc sulphate [ZnSO4]) was 15 to 29 mg/kg.

Effects of treatments on zinc content

Analysis of the results shows an increase in the use of chemical fertilizer plus zinc of about 25 percent for cowpea and 74 percent for sorghum (see Table 2).

Table 2. Effects of treatments on micronutrient content of cowpea and sorghum seeds

Treatments	Zinc in cowpea (mg/kg)	Zinc in sorghum grains (mg/kg)
Control	42	41
Practice recommended by the government (PV): 100 kg/ha of NPKSB	42	40
Practice with micronutrients (PM): 100 kg/ha of NPKSB + 50 kg/ha of $ZnSO_4$	52	71

Note: NPKSB stands for nitrogen, phosphorus, potassium, sulphur and boron.

Effects of treatments on yields

Overall, there was an increase in yields compared to the control at both sites (see Table 3). It should be noted, however, that the yields obtained are extremely low compared to the production potential of the varieties. In this case, it is difficult to assess the yield benefits provided by micronutrients.

Table 3. Effects of treatments on grain yields of cowpea and sorghum

Treatments	Cowpea yield (kg/ha)	Sorghum yield (kg/ha)
Control	474	360
*PV: 100 kg/ha of NPKSB	492	767
**PM: 100 kg/ha of NPKSB + 50 kg/ha of $ZnSO_4$	432	904

Note: NPKSB stands for nitrogen, phosphorus, potassium, sulphur and boron.

If the results are compared with the INERA recommended protocol, it can be seen that the fertilizer input was insufficient to show significant differences with the addition of micronutrients (see Table 4). It can also be concluded that the soils respond very well to biofertilizers and that this option should be included in the recommendations established by the government.

Table 4. Effects of treatments on grain yields of cowpea and sorghum with INERA recommendation

Treatments	Cowpea yield (kg/ha)	Sorghum yield (kg/ha)
Control	333	636
T1: Complete fertilizer NPK (200 kg)	695	1 348
T2: Complete fertilizer NPK (200 kg) plus Zn (50 kg)	808	1 566
T3: Complete fertilizer NPK (100 kg) plus biofertilizer (100 kg)	1 300	

Note: NPK stands for nitrogen, phosphorus and potassium.

Economic return of micronutrients fertilization investment

By calculating the benefits obtained in relation to the amount invested, it can be seen that the addition of micronutrients (zinc and boron) for an additional USD 1, leads to a profit of USD 2.4 to USD 5.7.

For the investment to be profitable, the best practices previously mentioned should be followed. It is recommended to combine the application of micronutrients with sufficient amounts of major elements nitrogen, phosphorus, potassium and sulphur as well as organic matter and crop diversification, including pulses.

Recommended fertilization practices

The following practices are recommended:

- organic matter added at 15 000 kg/ha;
- NPK (14-23-14) added at 100 kg/ha;
- zinc sulphate (Zn SO4) with 18 percent sulphur and 34 percent zinc added at 50 kg/ha; and
- application time: 15 to 20 days after sowing, in accordance with the crop calendar of the application area.

Technology dissemination and capacity development

The implementation of the Global Soil Doctors Programme (GSDP) was developed in collaboration with BUNASOLS as a farmer-to-farmer training strategy. As the national promoter, BUNASOLS has a key role in ensuring the long-term sustainability of the programme and in providing knowledge of the local context, while FAO provides relevant educational materials. In line with the project's objective of promoting the adoption of SSM linked to improved nutrition, this first pilot proved to be very effective, training 20 trainers and selecting 45 farmers as "Soil Doctors" to explain and disseminate knowledge on SSM and soil health to the final beneficiaries (Figure 3).

Figure 3. The Soil Doctors programme in the field

Recommendations and way forward

- Recommendations related to SSM for nutrition-sensitive agriculture are to:
- Establish standards for the interpretation of micronutrient reference values in the soil evaluation manual.
- Ensure a rational use of organic and mineral fertilizers in combination with micronutrients by associating with fertilizer distributors to make fertilizers available that are enriched with micronutrients (zinc, copper and iron).
- Develop technical, financial and normative tools to promote the increase of soil organic matter with the objectives of promoting soil health, crop nutritional value and climate change mitigation.
- Implement a national strategy to combat micronutrient deficiencies based on sustainable agricultural soil management within the framework of nutrition-sensitive agriculture.
- Encourage the use of agroecological practices such as half-moon pits, *zaï* pits and organic matter inputs, as they can increase micronutrient levels in plants and soils by 50 to 60 percent.

References

Brown, A.T., Adossi, D., Maurel, M. & Timmer, A. 2021. *Analyse situationnelle du programme d'iodation universelle du sel au BURKINA FASO: Étude de cas [Situational analysis of the universal salt iodization programme in BURKINA FASO: Case study].* Ottowa, Canada, Iodine Global Network (IGN) & New York, USA, United Nations Children's Fund (UNICEF). https://www.ign.org/p142003827.html?cmsaction=get_document&page_id=142003829

FAO (Food and Agriculture Organization of the United Nations). 2017. *Voluntary Guidelines for Sustainable Soil Management*. Rome. https://www.fao.org/3/bl813e/bl813e.pdf

FAO. 2019. *The International Code of Conduct for the sustainable use and management of fertilizers*. Rome. https://www.fao.org/documents/card/en/c/ca5253en/

FAO, IFAD (the International Fund for Agricultural Development), UNICEF (the United Nations Children's

Fund), WFP (the World Food Programme) & WHO (the World Health Organization). 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable.* Rome, FAO. https://www.fao.org/3/cc0639en/online/cc0639en.html

IGB (Burkina Geographic Institute). 2002. *Land Use and Database (LODB).* Ouagadougou. https://www.igb.bf/?page_id=85#

MAAHM (Ministry of Agriculture and Hydro-Agricultural Development). 2018. *Baseline situation of degraded lands and SWC in Burkina Faso, Final report*. Ouagadougou. https://www.agriculture.bf/upload/docs/application/pdf/2020-07/rapport_situation_ref_vf1_10_02_201919_version_finale_07082019.pdf

MAAHM. 2020. *Stratégie nationale de stockage des réserves nationales de sécurité alimentaire (2021-2025) [National strategy for storing national food security reserves (2021-2025)].* Ouagadougou. https://summitdialogues.org/wp-content/uploads/2021/10/VOIE-NATIONALE-DU-BURKINA-FASO_V5.pdf

MARAH (Ministry of Animal Resources and Fisheries). 2019. *Stratégie Nationale de Restauration, Conservation et Récupération des Sols au Burkina Faso 2020–2024 [National Strategy for Soil Restoration, Conservation and Recovery in Burkina Faso 2020–2024].* Ouagadougou. https://www.agriculture.bf/jcms/pv10_102918/fr/strategie-nationale-de-restauration-conservation-et-recuperation-des-sols-au-burkina-faso-2020-2024?details=true

MARAH. 2022. *First ordinary session of the Comité de Prévision de la Situation Alimentaire et Nutritionnelle (CPSA), of the year 2022, Ouagadougou March 28–29, 2022, Summary Report*. Ouagadougou. https://sisa.bf/1ere-session-du-comite-de-prevision-de-la-situation-alimentaire-et-nutritionnelle-cpsa-de-lannee-2021/

Ministry of Health (Burkina Faso). 2005. *Edition et vulgarisation d'une table de composition des aliments couramment consommes au Burkina Faso* [*Publishing and popularising a table of the composition of foods commonly consumed in Burkina Faso*]. Ouagadougou. http://www.burkinadoc.milecole.org/Pieces_Jointes/PDFs/Agriculture_durable/Alimentation/Tables_composition_nutritionnelle.pdf

INSD (National Institute of Statistics and Demography). 2019. *5e RGPH : Cinquième Recensement Général de la Population net de l'Habitat du Burkina Faso [5th RGPH : Fifth General Population and Housing Census of Burkina Faso].* Ouagadougou. http://www.insd.bf/contenu/documents_rgph5/Rapport%20resultats%20definitifs%20RGPH%202019.pdf

SP/CPSA (Permanent Secretariat of the Integrated Water Resources Management Action Plan). 2017. *Second National Rural Sector Programme (PNSR II) 2016-2020*. Ouagadougou. http://spcpsa.bf/wp-content/uploads/2018/11/Deuxieme-Programme-National-du-Secteur-Rural-PNSR-2-2016-2020.pdf

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The Global Soil Partnership (GSP) is a globally recognized mechanism established in 2012. Our mission is to position soils in the Global Agenda through collective action. Our key objectives are to promote Sustainable Soil Management (SSM) and improve soil governance to guarantee healthy and productive soils, and support the provision of essential ecosystem services towards food security and improved nutrition, climate change adaptation and mitigation, and sustainable development.

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