SINGLE-IMPACT FICHE
INTERCROPPING

IMPACT: SOIL NUTRIENTS

Data extracted in May 2021
Fiche created in December 2023

Note to the reader: This fiche summarises the effects of Intercropping on SOIL NUTRIENTS. It is based on 2 synthesis papers[1], including 29 and 180 primary studies.

1. WEIGHT OF THE EVIDENCE

CONSISTENCY OF THE IMPACT

Intercropping of multiple crop species (i.e., crop mixture cropping), as compared to monoculture, led to an overall positive effect on soil erosion (**Table 1**).

The table below shows the number of synthesis papers with statistical tests reporting i) a significant difference between the Intervention and the Comparator, that is to say, a significant statistical effect, which can be positive or negative; or ii) a non-statistically significant difference between the Intervention and the Comparator. In addition, we include, if any, the number of synthesis papers reporting relevant results but without statistical test of the effects. Details on the quality assessment of the synthesis papers can be found in the methodology section of this WIKI.

- crop mixture cropping: from a total of 2 results, 2 were positive as compared to monoculture.

Out of the 2 selected synthesis papers, one included studies conducted in Europe (see **Table 2**).

Table 1: Summary of effects. Number of synthesis papers reporting positive, negative or non-statistically significant effects on environmental and climate impacts. The number of synthesis papers reporting relevant results but without statistical test of the effects are also provided. When not all the synthesis papers reporting an effect are of high quality, the number of synthesis papers with a quality score of at least 50% is indicated in parentheses. The reference numbers of the synthesis papers reporting each of the effects are provided in **Table 3**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase soil nutrients	Soil nutrients	Crop mixture cropping	monoculture	2	0	0	0

QUALITY OF THE SYNTHESIS PAPERS

The quality of each synthesis paper was assessed based on 16 criteria regarding three main aspects: 1) the literature search strategy and primary studies selection; 2) the statistical analysis conducted; and 3) the evaluation of potential bias. We assessed whether authors addressed and reported these criteria. Then, a quality score was calculated as the percentage of these 16 criteria properly addressed and reported in each synthesis paper. Details on quality criteria can be found in the methodology section of this WIKI.

2. IMPACTS

The main characteristics and results of the 2 synthesis papers are reported in **Table 2** with the terminology used in those papers, while **Table 3** shows the reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**. Comprehensive information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices, are provided in the **summaries of the synthesis papers** available in this WIKI.

Table 2: Main characteristics of the synthesis papers reporting effects on soil nutrients. The references are ordered chronologically with the most recent publication date first.

Reference number	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Ref3	Grain legumes and cereals	Africa	180	Grain legume and cereal intercropping	Monoculture	Total nitrogen concentration	Intercropping increased significantly the total nitrogen (by 16%) in the topsoil. intercropping can increase soil fertility.	62%
Ref6	Cereals and legumes	Global	29	Intercropping	Monoculture	Dinitrogen (N_2) fixation and Soil-derived N acquisition	The meta-analysis confirms and highlights that intercropping consistently stimulates complementary N use between legumes and cereals by increasing N_2 fixation by grain legumes and increasing soil N acquisition in cereals. Based on the results of this analysis it would be suggested that cropping systems diversification via intercropping can be used for simultaneous production of both cereals and grain legumes, while increasing the use of N-sources and reducing external inputs of N fertilizers, thereby enhancing the sustainability of agriculture.	88%

[1] Synthesis research papers include either meta-analysis or systematic reviews with quantitative results. Details can be found in the methodology section of the WIKI.

Table 3: Reference numbers of the synthesis papers reporting for each of the results shown in **Table 1**.

				Statistically tested			Non-statistically tested
Impact	Metric	Intervention	Comparator	Significantly positive	Significantly negative	Non-significant	
Increase soil nutrients	Soil nutrients	Crop mixture cropping	monoculture	Ref3 and Ref6			

3. FACTORS INFLUENCING THE EFFECTS ON SOIL NUTRIENTS

Table 4: List of factors reported to significantly affect the size and/or direction of the effects on soil nutrients, according to the synthesis papers reviewed.

Factor	Reference number
Crop/cultivar combinations	Ref6
Fertiliser application	Ref6
Method used to quantify Nitrogen fixation	Ref6

4. KNOWLEDGE GAPS

Table 5: Knowledge gap(s) reported by the authors of the synthesis papers included in this review.

Ref Num	Gap
Ref3	Studies that focus on indigenous African grain legumes or cereals should be encouraged because, with the exception of cowpea and teff, most past studies have focused on non-native species.

5. SYNTHESIS PAPERS INCLUDED IN THE REVIEW

Table 6: List of synthesis papers included in this review. More details can be found in the summaries of the meta-analyses.

Ref Num	Author(s)	Year	Title	Journal	DOI
Ref3	Daryanto, S; Fu, BJ; Zhao, WW; Wang, S; Jacinthe, PA; Wang, LX	2020	Ecosystem service provision of grain legume and cereal intercropping in Africa	Agric Syst 178, 102761	10.1016/j.agsy.2019.102761
Ref6	Rodriguez, C; Carlsson, G; Englund, JE; Flohr, A; Pelzer, E; Jeuffroy, MH; Makowski, D; Jensen, ES	2020	Grain legume-cereal intercropping enhances the use of soil-derived and biologically fixed nitrogen in temperate agroecosystems. A meta-analysis	Eur J Agron 118, 126077	10.1016/j.eja.2020.126077

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