Results

The systematic mapping process

Details of the number of records retained through each stage of the review process are provided in Figure 1. A total of xxx potentially relevant records were identified across the xxx resources searched. A total of xxx unique records was screened for eligibility, with xxx eligible records following full text screening. The final systematic map database contains 524 studies from 347 articles.

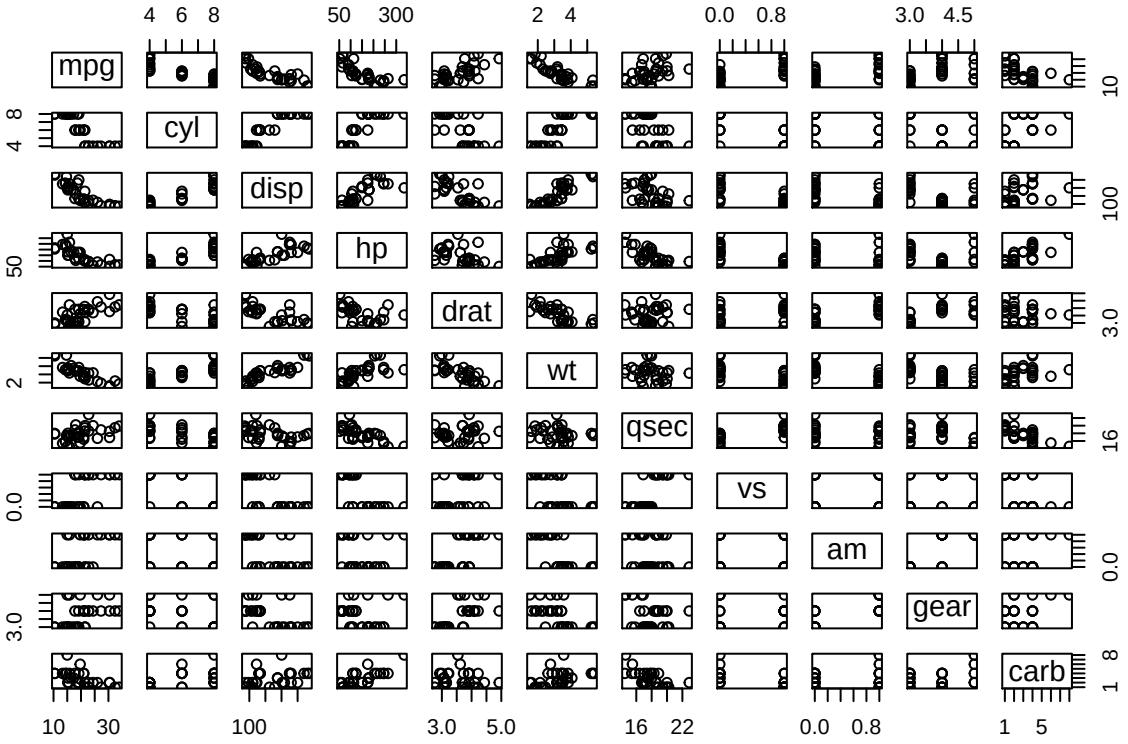

Figure 1: ROSES flow chart for the systematic map, showing the number of records retained at each stage of the review process. Produced using the ROSES Flow Chart App (Haddaway 2020).

The systematic map database and visualisations

Descriptive information

Publication year: As expected, there has been a significant increase in the number of published articles on the topic over the last 20 years (Figure 2). Interestingly, there may be

evidence of a reduction in publication rate over the most recent 5 years from 2014 to 2018. The earliest record in our database is from 1981. Since searches were performed in 2019, representation from this year is incomplete.

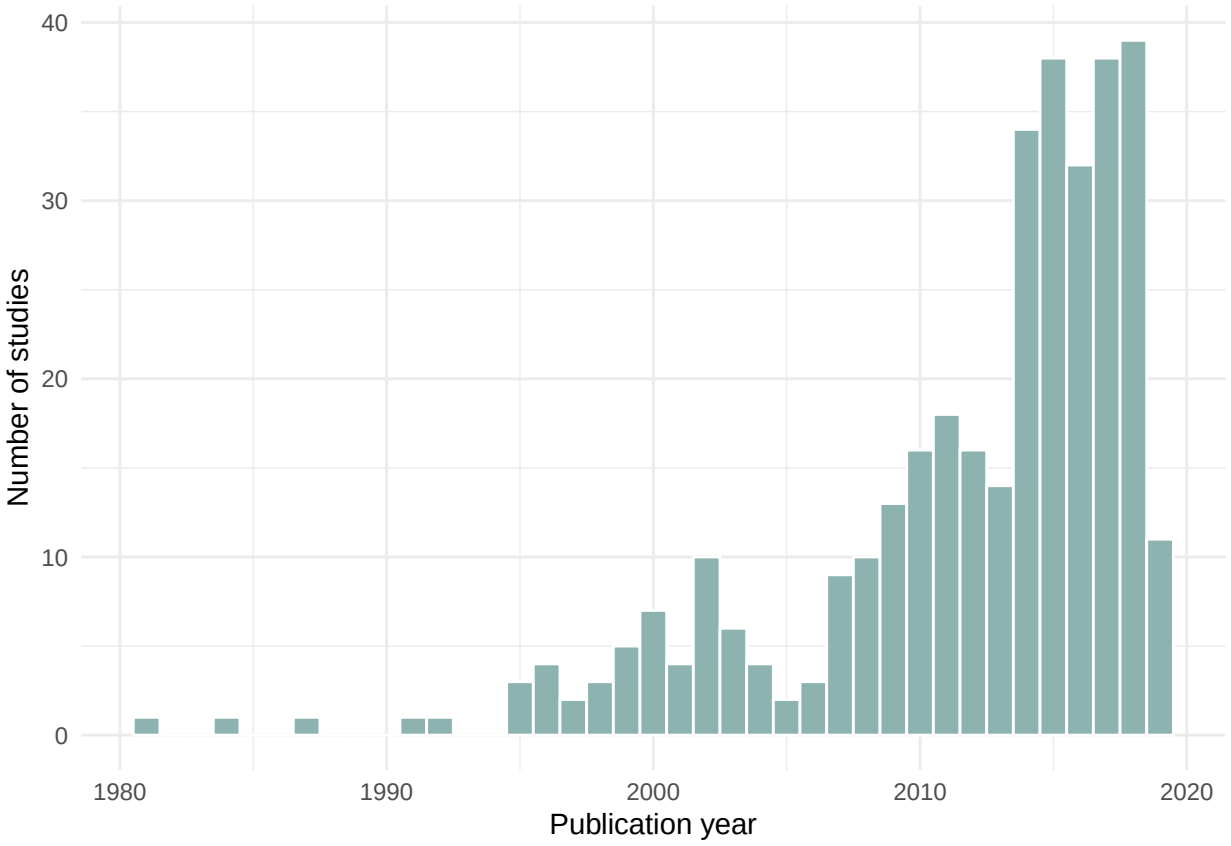

Figure 2: Plot showing the final number of articles included in the systematic map by publication year.

Publication type: Some 95% of articles in the map database are traditional research papers, with only 8 theses, 7 conference papers, and 1 report. This may in some degree reflect the ease with which traditional research articles can be discovered, but may also be the result of the complex and expensive GHG measurement equipment needed for this type of research: it may be unlikely that unpublished reports would be conducted on a local or organisation scale.

Country: The choropleth in Figure 3 displays the number of studies per country in the map. Some 3 countries each represented more than 10% of the total studies in the evidence base: United Kingdom (90), Australia (72), and USA (71). Much of the evidence came from Europe (a total of 227 studies).

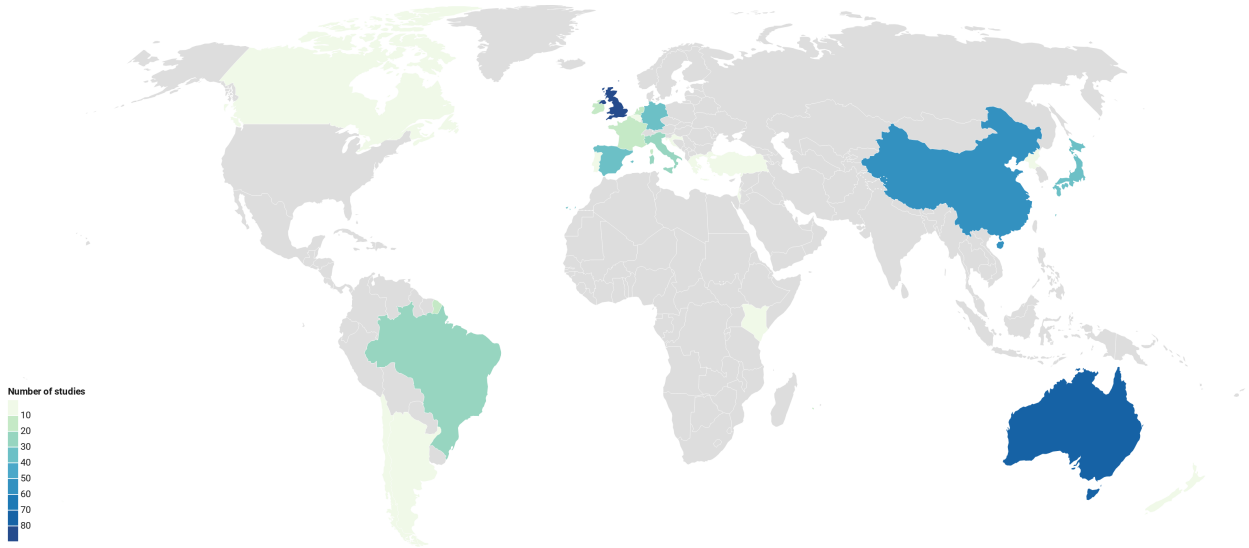

Figure 3: Choropleth showing the number of studies per country in the systematic map database.

Climate zone: Table 1 displays the distribution of studies across climate zones. The most frequently studied climate zone was Cfb with 228 studies. Cfa was the second most studied zone with 218 studies. Some integer(0) studies could not be located to a climate zone.

Table 1: Number of studies conducted in each eligible Köppen-Geiger climate zone. n indicates the number of studies.

Köppen-Geiger climate zone	n
Cfb	228
Cfa	218
Csa	51
Csb	19
DNC	5
	3

Soil texture: The most frequently reported soil texture information was from the USDA Natural resources conservation service soil texture classification system. Figure 4 shows the distribution of soil texture classifications across the evidence base. A large number of studies (125 of 524) did not report the soil texture classification. Table 2 displays the soil texture data reported for studies not reporting soil texture classification, showing that 74 studies provided no data from any of the three soil classification systems, hampering synthesis of these data.

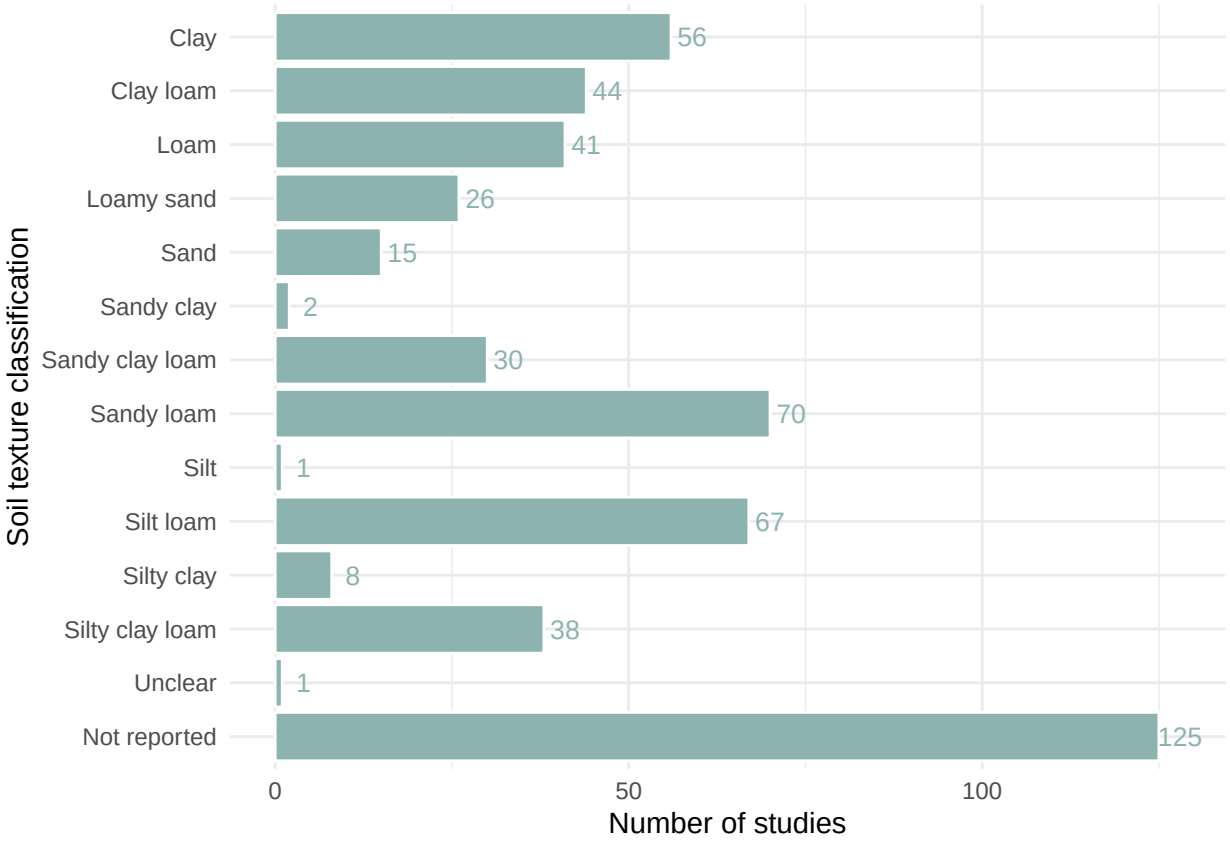

Figure 4: Soil texture classifications of studies in the systematic map

Table 2: Soil classifications of studies not using the USDA Natural Resources Conservation Service soil texture classification system. Blank cells indicate no data. n indicates the number of studies.

USDA soil classification	FAO soil classification	n
		74
Andisol		14
	Andosols	12
	Cambisols	6
	Acrisols	3
	Luvisols	3
	Ferralsols	2
Oxisol		2
Vertisol		2
	Arenosols	1
	Hapli-Cutanic Luvisols (IUSS-WRB, 2007)	1
	Nitisols	1
	Podzols	1
	Vertisols	1
Alfisol		1
Ultisol		1

Field history description: Just over half of the studies in the systematic map (305 of 524) provided a description of the previous management practices used within the experimental fields.

Study length: The duration of investigation was reported in 499 of 524 studies. Figure 5 shows the range of study durations used across the included studies. Median study length was 12 months.

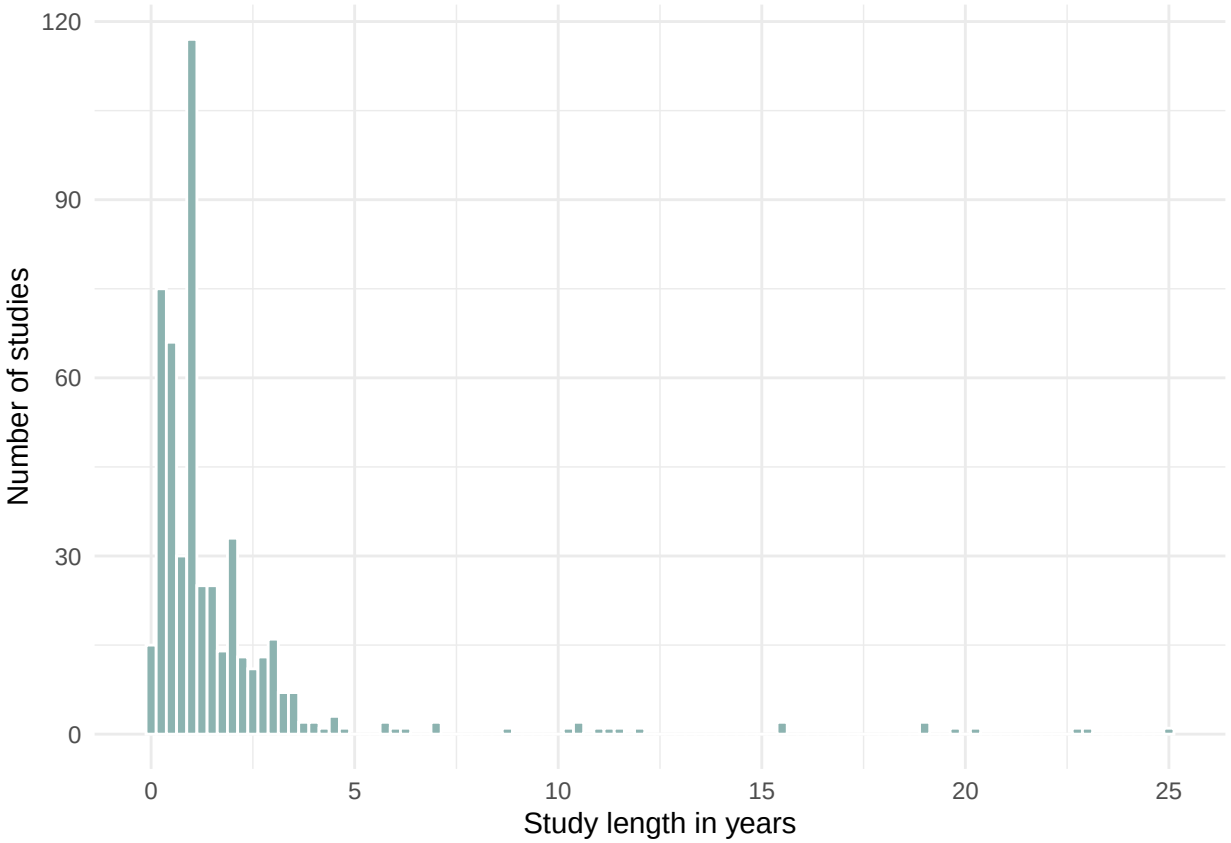

Figure 5: Study durations employed across the evidence base, collated into 6 month bins.

Season (for studies <1 year): For studies lasting less than 1 year (n = 198), the median study length was 5 months (see Figure 6).

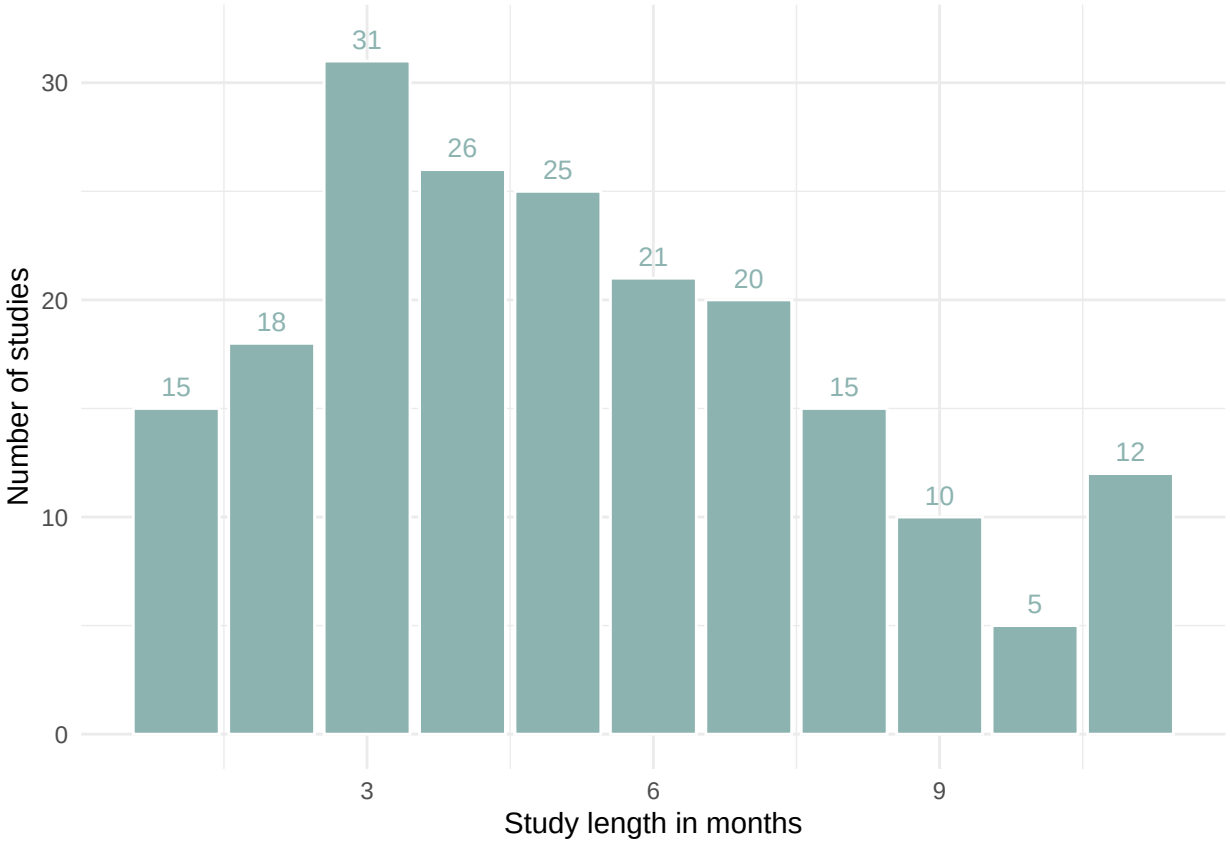

Figure 6: Study durations for investigations less than 1 year in length.

Study design: The most frequently employed study design across the evidence base was control-impacts (n = 520 studies). Before-after was much less common (n = 3). Study design was not reported in 1 study.

Experimental design: The most commonly used experimental design in the included studies was 'Randomised complete block', with 309 studies, with 'Split/strip plot' the next most frequent (n = 125). Figure 7 displays the frequency of all experimental designs. The experimental design was not reported or unclear in 12 and 1 studies, respectively.

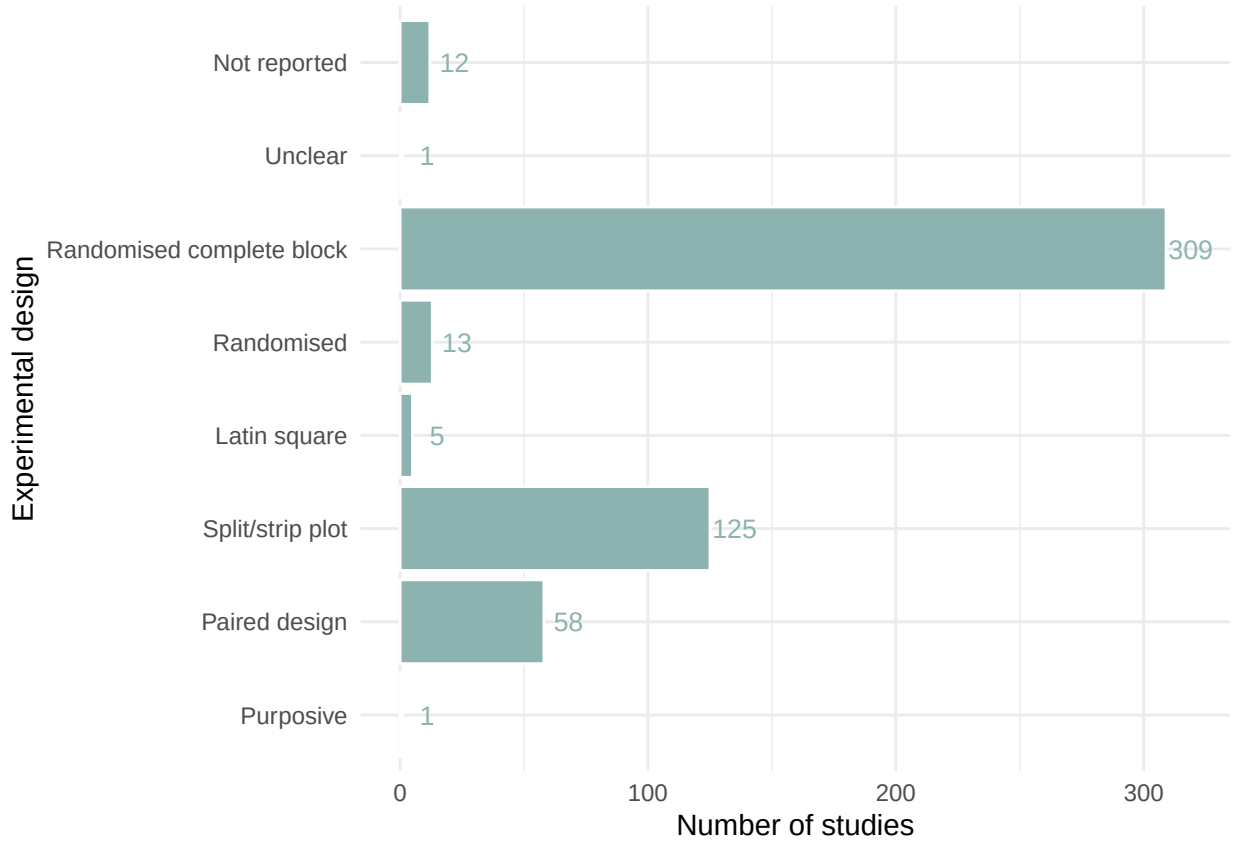

Figure 7: Experimental designs employed across studies in the systematic map.

Spatial replication: Figure 8 shows the range of spatial replication across all studies. This demonstrates an overall very low level of true replication (no study used greater than 8 spatial replicates): this is likely hindered by challenges in replicating field- or farm- scale experiments. The median level of true spatial replication was 3 replicates.

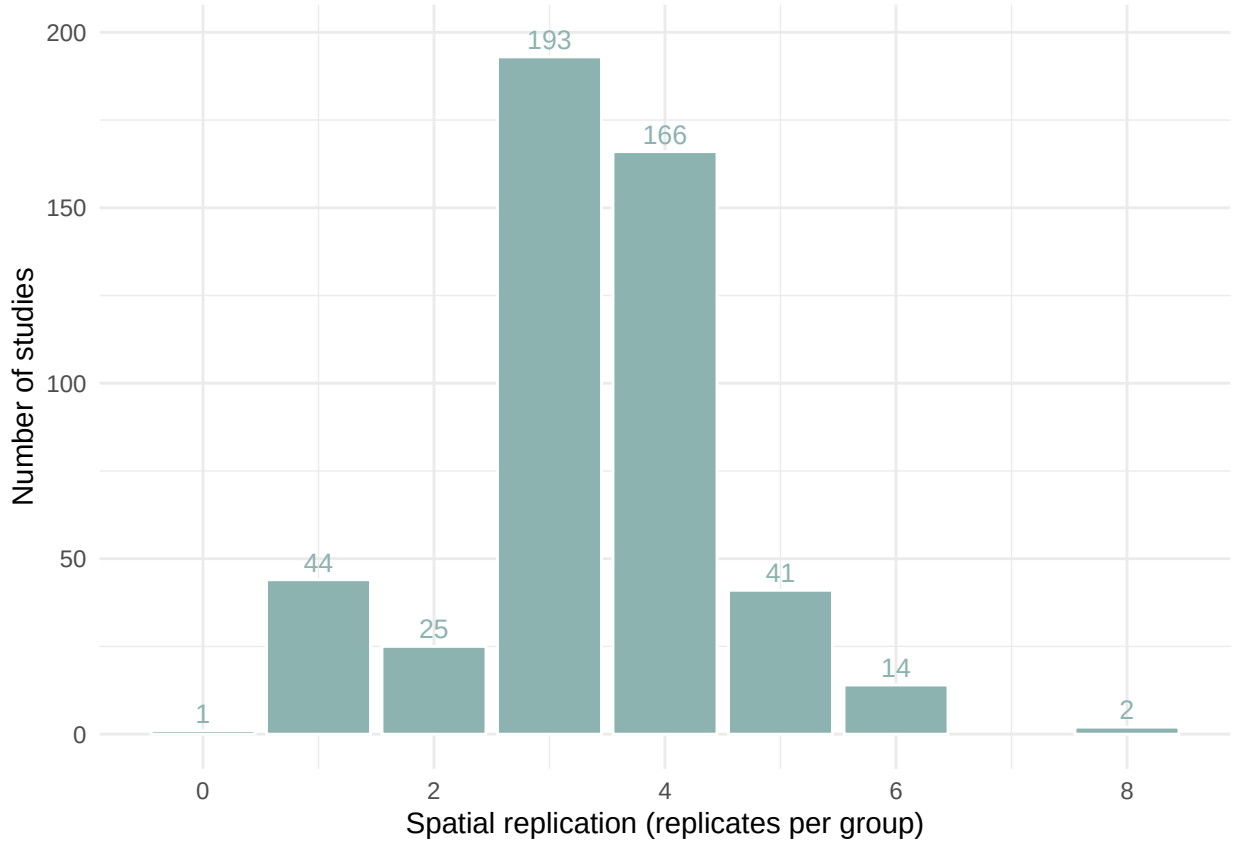

Figure 8: Study spatial replication (replicates per treatment group) across included studies in the map.

Temporal replication: Most studies in the map did not take measurements at more than one time point (n = 472): 27 studies did employ temporal replication, and 25 studies did not report this information.

Interventions: Figure 9 shows the types of interventions investigated in the evidence base. A total of 290 out of 524 studies examined multiple interventions together. The top three most frequently studied single intervention types were chemical fertiliser (n = 97), tillage (n = 67), and organic fertiliser (n = 29). Across all intervention types, the top three most frequently studied were: 1) chemical fertiliser (n = 301); 2) organic fertiliser (n = 159); 3) tillage (n = 153); 4) nitrification inhibitor (n = 70); and, 5) cover crops (n = 49).

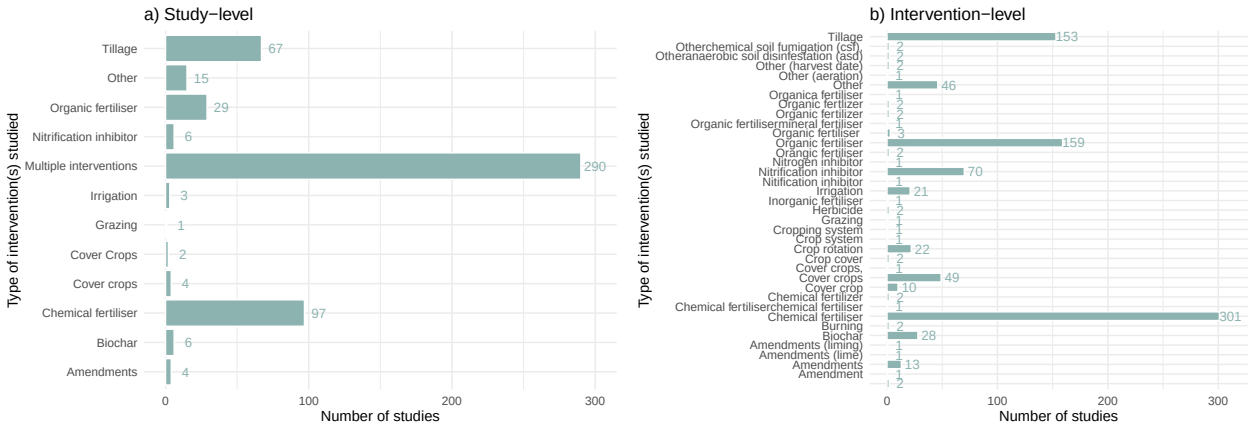

Figure 9: Intervention types investigated in the studies within the systematic map: a) the number of studies investigating each type of intervention, and b) the number of intervention types investigated across studies.

Treatments: Within intervention types, studies often investigated multiple treatment levels/types (see Figure 10). The median number of treatments was 4.

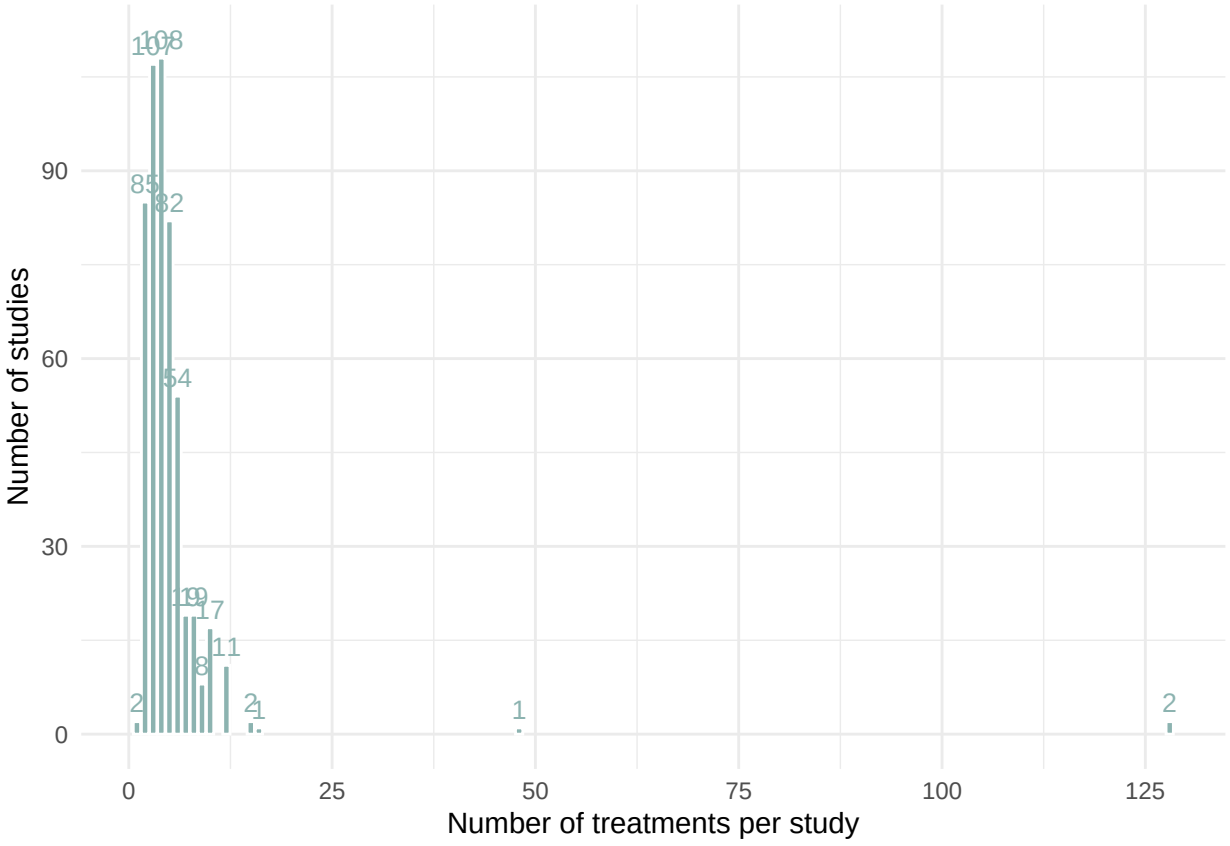

Figure 10: Number of treatments investigated in studies included in the systematic map

Outcomes: Tables 3 and 4 show the measured outcomes across all studies in the map, across outcomes and where outcomes were measured together, respectively. All three outcomes were reported in 57 studies. The next most commonly co-measured outcomes were CO_2 and N_2O (n = 56) and CH_4 and N_2O (n = 43).

Table 3: Outcomes measured across studies in the systematic map. n indicates the number of studies.

Outcome	n
Nitrous oxide	427
Carbon dioxide	206
Methane	105
Not reported	1

Table 4: Outcomes measured together in studies measuring multiple outcomes in the systematic map. n indicates the number of studies.

Outcomes	n
Methane, Carbon dioxide, Nitrous oxide	57
Carbon dioxide, Nitrous oxide	56
Methane, Nitrous oxide	43
Methane, Carbon dioxide	2

Outcome measurement methods: The most commonly reported measurement method was 'static chamber' (n = 240) (see Figure 11). A substantial proportion of studies (n = 258) did not report the outcome sampling methods used.

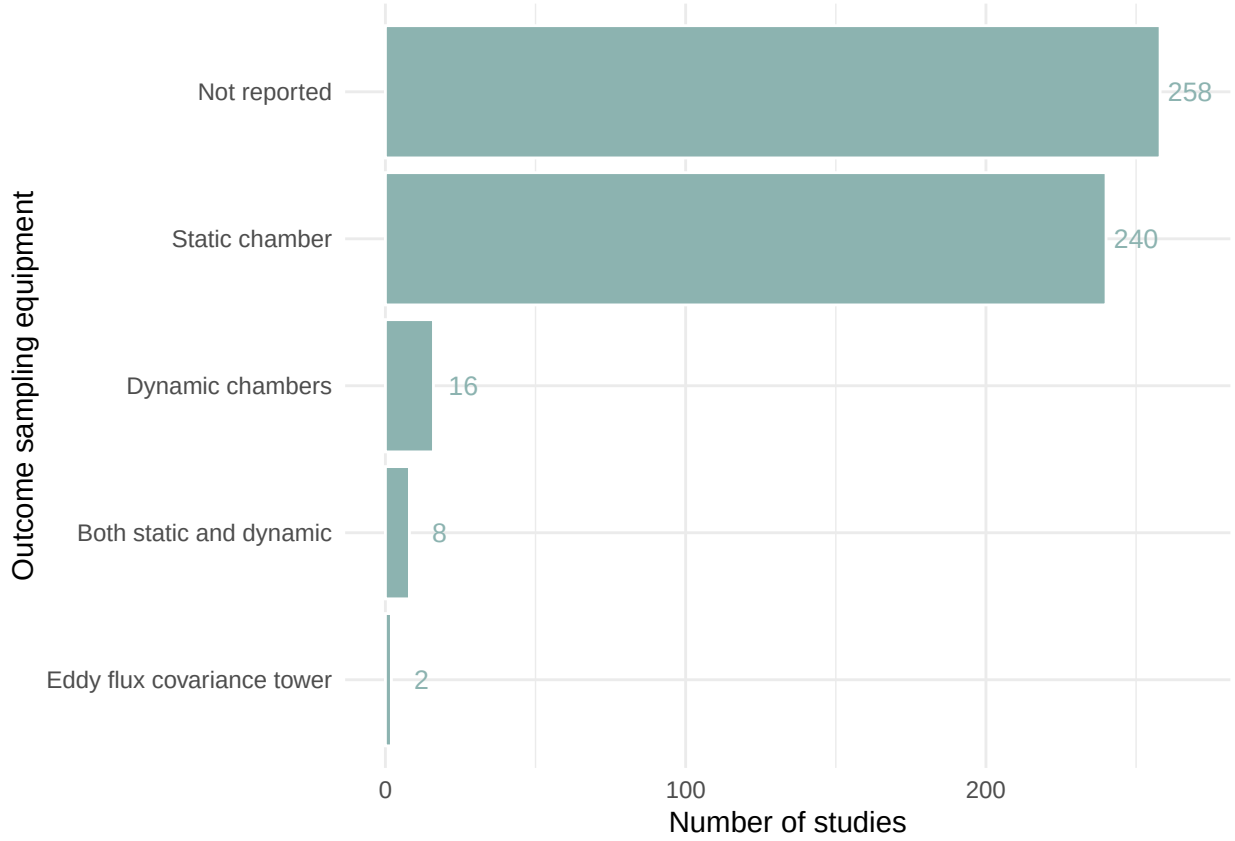

Figure 11: Experimental designs employed across studies in the systematic map.

Open chambers were used in 17 studies, whilst closed were used in 226 (it was not possible to ascertain this information for the remaining studies). Opaque chambers were used in 139 studies, whilst transparent were used in 10 (it was not possible to ascertain this information for the remaining studies).

Heat maps