12.2. All farming systems
12.2 All farming systems

Based on the collated evidence, what is the current assessment of the effectiveness of interventions on all farming systems for enhancing soil fertility?

<table>
<thead>
<tr>
<th>Likely to be beneficial</th>
<th>• Control traffic and traffic timing</th>
</tr>
</thead>
</table>
| Trade-off between benefit and harms | • Change tillage practices  
| | • Convert to organic farming  
| | • Plant new hedges |
| Unknown effectiveness (limited evidence) | • Change the timing of ploughing |

Likely to be beneficial

- Control traffic and traffic timing
  - Biodiversity: One randomised, replicated study from Poland found higher numbers and bacterial activity under controlled traffic. One replicated site comparison study from Denmark found higher microbial biomass when farm traffic was not controlled.
  - Erosion: Five trials from Europe and Australia (including three replicated trials, one controlled before-and-after trial, and one review) found a higher number of pores in the soil, less compaction, reduced runoff and increased water filtration into soil under controlled traffic. One controlled, replicated trial in India found increased soil crack width when traffic was not controlled.
Enhancing Soil Fertility

- **Yield**: One replicated trial from Australia found increased yield under controlled traffic.
- **Soil types covered**: clay, loamy silt, sandy loam, silty, silty clay, silt-loam.
- **Assessment**: likely to be beneficial (effectiveness 55%; certainty 62%; harms 18%).

http://www.conservationevidence.com/actions/899

### Trade-off between benefit and harms

#### Change tillage practices

- **Biodiversity loss**: Nine studies from Canada, Europe, Mexico, or the USA measured effects of reduced tillage on soil animals or microbes. Of these, six (including three replicated trials (two also randomized and one also controlled) found more microbes, more species of earthworm, or higher microbe activity under reduced tillage. One replicated trial found increased numbers of soil animals and earthworms under reduced tillage. Two (including one controlled, replicated trial), found no effect of reduced tillage on earthworm activity or microbe activity.

- **Compaction**: Five studies from Australia, Canada, and Europe measured the effect of controlled traffic and reduced tillage on compacted soils. Of these, two (including one before-and-after trial and one replicated trial) found reduced compaction and subsequent effects (reduced water runoff, for example) under controlled traffic, and one also found that crop yields increased under no-tillage. Three replicated trials, including one site comparison study, found higher compaction under reduced tillage.

- **Drought**: Three replicated trials from Europe and India (one randomized) found the size of soil cracks decreased, and ability of soil to absorb water and soil water content increased with conventional tillage and sub-soiling.

- **Erosion**: Ten replicated trials from Brazil, Europe, India, Nigeria and the USA, and one review showed mixed results of tillage on soil
erosion. Seven trials (one also controlled and randomized) showed reduced soil loss and runoff under reduced tillage compared to conventional ploughing. One trial showed no differences between tillage systems, but demonstrated that across-slope cultivation reduced soil loss compared to up-and-downslope cultivation. Two trials, showed that no-tillage increased soil loss in the absence of crop cover.

- **Soil organic carbon**: Twelve studies from Australia, Canada, China, Europe, Japan and the USA compared the effect of no-tillage and conventionally tilled systems on soil organic carbon. All (including two randomized, five replicated, two randomized, replicated, and one controlled, randomized, replicated) found higher soil organic carbon in soils under a no-tillage or reduced tillage system compared to conventionally tilled soil. One review showed that no-tillage with cover cropping plus manure application increased soil organic carbon. One randomized, replicated trial from Spain found greater soil organic carbon in conventionally tilled soil.

- **Soil organic matter**: Twelve studies from Canada, China, Europe, Morocco, and the USA measured effects of reduced tillage on soil organic matter content and nutrient retention. Of these, six studies (including three replicated, two site comparisons (one also replicated) and one controlled) found maintained or increased soil organic matter and improved soil structure under reduced tillage. Four trials (including two replicated and two site comparison studies) found higher nutrient retention under reduced tillage. One controlled, replicated trial from the USA found less carbon and nitrate in no-till compared to conventionally tilled soil, but conventionally tilled soil lost more carbon and nitrate.

- **Soil types covered**: anthrosol, calcareous silt-loam, chalky, clay, clay-loam, fine sandy loam, loam, loamy clay, loam/sandy loam, loam silt-loam, loamy silt, non-chalky clay, sandy, sandy clay-loam, sandy loam, sandy silt-loam, silt-loam, silty, silty clay, silty clay-loam, silty loam.

- **Assessment**: trade-offs between benefit and harms (effectiveness 61%; certainty 72%; harms 46%).

  http://www.conservationevidence.com/actions/906
**Convert to organic farming**

- **Biodiversity**: Four studies in Asia, Europe, and the USA (including two site comparison studies and three replicated trials) found higher numbers, diversity, functional diversity (see background) or activity of soil organisms under organic management.

- **Soil organic carbon**: Two replicated trials in Italy and the USA showed that organically managed orchards had higher soil carbon levels compared to conventionally managed orchards. One randomised, replicated trial in the USA found soil carbon was lower under organic management compared to alley cropping.

- **Soil organic matter**: One replicated trial in Canada found that soil nutrients were lower in organically managed soils.

- **Yield**: One replicated trial in Canada found lower yields in organically managed soils. Two replicated trials in the USA (one also randomised) found that fruit was of a higher quality and more resistant to disease, though smaller or that organic management had mixed effects on yield.

- **Soil types covered**: clay, clay-loam, fine sandy loam, loam, sandy loam, sandy clay-loam, silt, silty clay, silt-loam.

- **Assessment**: trade-offs between benefit and harms (effectiveness 55%; certainty 52%; harms 64%).

  http://www.conservationevidence.com/actions/895

**Plant new hedges**

- Five studies in Slovakia, Kenya and Thailand measured the effects of planting grass or shrub hedgerows on soil animals and soil fertility. All five found hedgerows to maintain or improve soil fertility and soil animal activity. Of these, three replicated studies found reduced soil erosion and higher soil organic matter levels. Another replicated trial found a higher diversity of soil animals near to the hedgerows. One of the replicated studies and one review found that adding woody species to the hedgerows improved many factors contributing to soil fertility.

- **Soil types covered**: alluvial, clay, sandy loam.
• Assessment: trade-offs between benefit and harms (effectiveness 49%; certainty 45%; harms 20%).
  
  [Link](http://www.conservationevidence.com/actions/744)

**Unknown effectiveness (limited evidence)**

- **Change the timing of ploughing**
  - *Nutrient loss:* Two replicated site comparison studies from Denmark and Norway (one also randomised) found reduced erosion soil loss and nitrate leaching when ploughing was delayed until spring.
  - *Soil types covered:* Sandy, sandy loam, silty clay loam.
  - *Assessment:* unknown effectiveness (effectiveness 46%; certainty 38%; harms 33%).
  
  [Link](http://www.conservationevidence.com/actions/712)