9

DEVELOPING A MANAGEMENT PLAN

Developing a soil health, nutrition and organic matter management plan.

This section provides a worksheet for developing a soil health, nutrition and organic management plan based on soil assessments, laboratory test results, and your farming objectives. It allows you to consider and choose management options you plan to adopt or trial, as well as set a timetable for implementing and monitoring the outcomes of different soil health management practices. A series of worksheets are provided to identify the most significant soil constraints on your farm and choose appropriate management options on a paddock by paddock or area basis.

It is suggested you store this guide as well as farm maps, soil assessments, soil laboratory test results, notes, completed planning worksheets, farm input and yield records, and other useful information (e.g. rainfall, notes about the season, etc) in a physical binder or, if you prefer, an electronic file.

Your farming situation and objectives

Every farm is different and there is no single 'right way' to manage soil health, just what is right for your farming objectives, system, soils and climate. The Healthy Soil Initiative suggests you are pragmatic and adaptable in the approach you take, and trial approaches on a small scale when you can to work out what is the most cost-effective way to improve and maintain soil health.

The Soil Health Initiative suggests the overall objectives of a Soil Health plan can be summarised as having a farm management system that achieves and maintains:

- Sufficient plant-available nutrients and water to produce the levels of yield you want to achieve.
- Soil structure that allows easy water infiltration, air flow and strong root growth to a depth of preferably at least 30-40 cm.
- Soil chemistry (nutrient availability, pH, sodicity/salinity, toxicities) that is beneficial and not hostile to root growth.
- A healthy and beneficial soil ecosystem that contributes to improved nutrient cycling, soil fertility, soil structure , disease suppression and deeper and healthier root growth.
- Management that uses favourable seasons to deepen soil and increase biomass returned to the soil.
- Management to protect soil health from extreme disruptions such as dry summers, drought and heavy tillage, and to repair soil after such disruptions.

The ways to achieve these conditions will vary depending on your farming situation. Generally, it is easier to build and maintain soil health under less intensive and disruptive production systems such as grazing and in areas with higher rainfall and milder climates. Continuous cropping systems in hotter and drier areas will often require strategic and deliberate interventions to maintain soil health.

Describing paddocks and areas

The worksheet shown in Table 9.1 is designed to quickly summarise the outcomes of the soil health assessment process outlined in Section 8. It is suggested separate worksheets are used for specific paddocks or similar areas on the farm. Tick boxes are provided to identify and give priority to different soil characteristics and constraints. Completing this form for all assessed and tested paddocks or similar areas allows priority to given to the critical soil constraints to be addressed in different areas. It is suggested the worksheet is also used to record periodic ;fid test' field observations and assessments of soil attributes (not including the soil laboratory testing). The need for, and frequency of, follow-up soil laboratory testing will depend on the intensity of production, yields and nutrient management practices. In low intensity farming systems, it may be sufficient to periodically apply some form of fertiliser to replace nutrients know to be naturally deficient in soil based on how much yield is removed and the appearance and productivity of pastures. In higher intensity systems, such as cropping, frequent soil laboratory testing can be used to ensure more efficient application of nutrient to replace those removed by yields.

Identifying options and actions

Table 9.2 is designed to consider management options detail the actions you intend to implement to address constraints. Suggested options can be selected and details of when they will be implemented recorded in the last column. Spaces are provided for other actions to be included. The Healthy Soils Initiative promotes a holistic management approach where initial actions will address the most significant constraint, but then on-going pasture and crop management practices to drive the Healthy Plant ⇆ Healthy Soil cycle that will maintain deeper and healthier soils and root systems.

Completing this worksheet for each paddock helps to address the critical soil constraints and keep records of what has been done and when. It also helps to identify possible soil constraints that may worsen over time if not monitored and managed, such as low to moderate nutrient deficiencies, soil acidification and low organic matter. Note that a common management option is the trial practices in test strips of limited areas to see whether there is enough of a productivity benefit to implement the practice more widely across the farm. Similarly, with any more widely adopted new practice, it is often good to leave a small untreated area to see what differences are achieved by the new practice. This can inform decisions about applying the practice to other parts of the farm and provide knowledge for other farmers.

Some soil health management practices such as pH correction and application of nutrients can have immediate productivity benefits and will cover their costs within one or two years. Other practices, such as application of gypsum, compost or other soil conditioners or sowing and maintaining a green manure crop may take longer to repay the investment. More costly practices such as strategic tillage with deep soil amendment placement to alter the soil profile can take even longer to recoup costs. Appendix B provides a guide for deciding whether an investment in soil health is likely to produce an adequate return on investment over a 5-to-10 year period.

Printable versions of the worksheets are provided at: www.masg.org.au

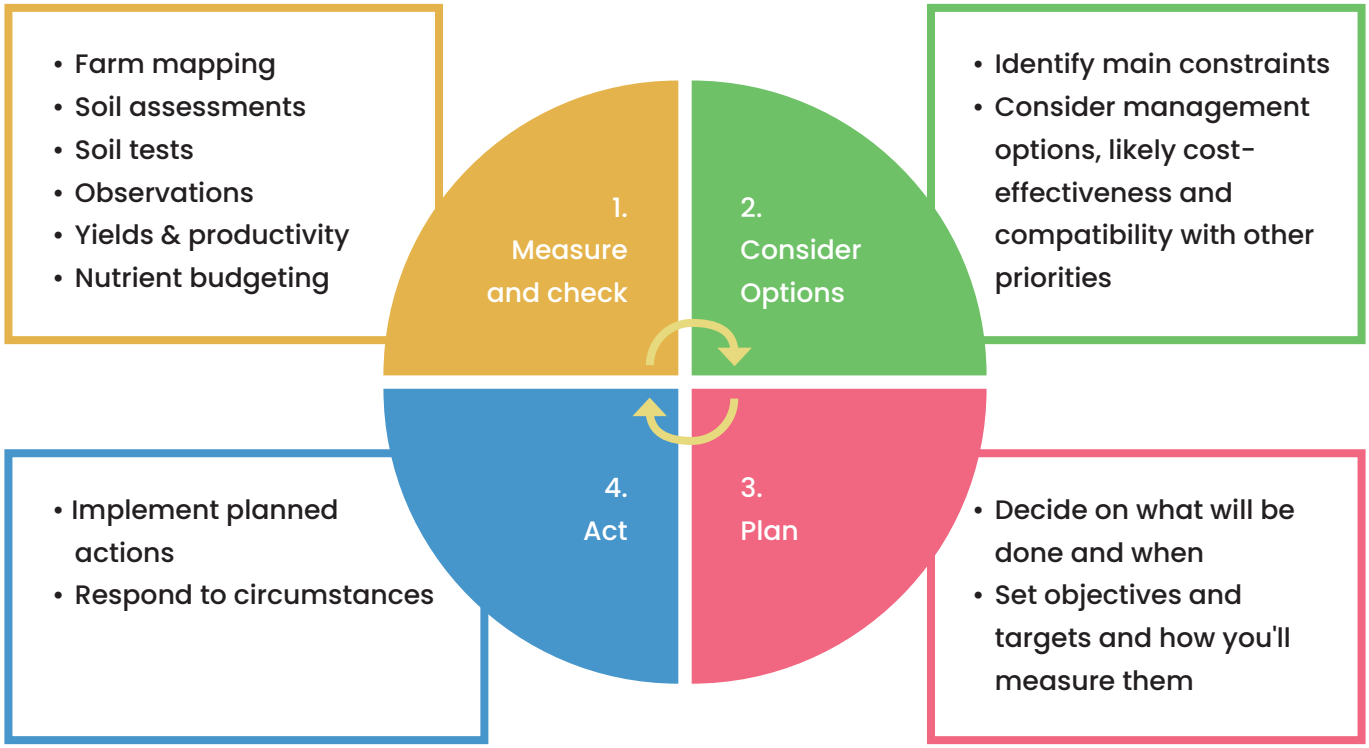
Monitoring and continual improvement

Building and maintaining soil health is an on-going process. The Healthy Soils Initiative promotes a 'Continual Improvement' approach as shown in Figure 9.1. This shows the stages:

1. Measure and check – this involves the soil assessment and testing undertaken using this guide, as well as on-going observations, monitoring of yields, productivity and nutrient management.
2. Consider options – this involves using the worksheets provided to identify the main soil constraints and options for managing these.
3. Plan – this involves using the worksheets provided to decide on which actions you will adopt and when you will implement them. The plan also considered how and when progress will be monitored and assessed.
4. Act – this is the implementation of the plan. In reality, changes in circumstance might change what is done when, and the plan can be modified to reflect this. The main value of the documented plan is to keep records of what soil assessments and tests have told you about the farm, the management options that have been considered and trailed or implemented, and what the outcomes of this process has been in terms of farm productivity and observed soil, plant and animal health.

The continual improvement process is a cycle, with a return to the Measure and Check stage to monitor how well the Soil Health plan is working, and then through the other stages to modify and improve the plan as needed. For example, test strip trials of lime, zinc or copper might show good results, so the plan can be modified to spread these across all areas where soils are overly-acidic or deficient in zinc and copper.

Figure 9.1: A continual improvement approach to soil health management



Conclusion

This guide has outlined a process for assessing soil and plant health to identify significant soil health constraints and provided information about how to manage these.

The guide has focused on the importance of the Healthy Plant ⇆ Healthy Soil cycle and the need to address the physical, chemical, biological and climatic constraints to deeper and healthier root growth. This has recognised that all farms are different and presents a range of possibly management options.

It is strongly suggested that you seek further information and advice as needed as you develop and implement your soil health management plan. Some suggested sources of information, tools and local sustainability groups are detailed in Appendix C. Mount Alexander Sustainability Group continues to support the Healthy Soils Initiative and Mount Alexander Regenerative Agriculture Group. For further information, email: info@masg.org.au or call 0407 882 070.

Area of farm: Date of assessment:

Field observations	
Upper soil	Subsoil to 60cm
Surface cover ☐ High ☐ Medium ☐ Low **Signs of nutrient deficiency in plants** ☐ N ☐ P ☐ K ☐ S ☐ Ca ☐ Zn ☐ Cu ☐ Mo ☐ B ☐ Others _____ **Surface sealing or cracking** ☐ Smooth/sealed, little cracking. ☐ Some cracking ☐ Friable/crumbly **Upper soil depth** = _____cm **Colour** ☐ Dark ☐ Brown ☐ Red ☐ Yellow ☐ Grey ☐ Pale grey/yellow/brown	Note depth of changes in colour and texture. **Colour** ☐ Dark ☐ Brown ☐ Red ☐ Yellow ☐ Grey ☐ Pale grey/yellow/brown **Texture** ☐ Fine sand/silt ☐ Coarse sand ☐ Sandy loam ☐ Loam ☐ Clay loam ☐ Cracking/structured clay ☐ Dense unstructured clay **Structure/porosity** ☐ Good ☐ Heavy ☐ Very dense/poor
Texture ☐ Fine sand/silt ☐ Coarse sand ☐ Sandy loam ☐ Loam ☐ Clay loam ☐ Cracking/structured clay ☐ Dense unstructured clay **Structure/porosity** ☐ Good ☐ Heavy ☐ Very dense/poor **Water infiltration** ☐ Low ☐ Moderate ☐ High	**Water infiltration** ☐ Low ☐ Moderate ☐ High **Slaking and dispersion test** ☐ Stable aggregates ☐ Slaking, but no/low dispersion ☐ Mildly dispersive ☐ Strongly dispersive **pH (if measured)** Root growth/health ☐ Strong ☐ Moderate ☐ Weak
Slaking and dispersion test ☐ Stable aggregates ☐ Slaking, but no/low dispersion ☐ Mildly dispersive ☐ Strongly dispersive **pH (if measured**) _____ Root growth/health ☐ Strong ☐ Moderate Weak **Earthworm numbers or evidence of activity** ☐ High ☐ Medium ☐ Low	**Earthworm numbers or evidence of activity** ☐ High ☐ Medium ☐ Low
Other (list)	**Other (list)**

Area of farm: Date of assessment:

Laboratory testing		Main constraints (list)
Upper soil	Sub soil to 60cm	
Likely/possible nutrient deficiencies **Signs of nutrient deficiency in plants** ☐ N ☐ P ☐ K ☐ S ☐ Ca ☐ Zn ☐ Cu ☐ Mo ☐ B ☐ Others _____ **pH** ☐ Too acidic (<5.5) ☐ Acidic /potentially acidifying (5.5-6.0) ☐ 'Neutral' (within 6.0-8.0) ☐ Overly alkaline (>8.0)	**Likely/possible nutrient deficiencies** **Signs of nutrient deficiency in plants** ☐ N ☐ P ☐ K ☐ S ☐ Ca ☐ Zn ☐ Cu ☐ Mo ☐ B ☐ Others _____ **pH** ☐ Too acidic (<5.5) ☐ Acidic /potentially acidifying (5.5-6.0) ☐ 'Neutral' (within 6.0-8.0) ☐ Overly alkaline (>8.0)	
Cation exchange capacity ☐ Low ☐ Medium ☐ High **Organic matter/carbon levels** ☐ Low ☐ Medium ☐ High **Exchangeable ions** ☐ Low exchangeable Ca to Na ration (sodic) ☐ Low exchangeable Ca to Mg ratio (magnesic) ☐ High Al ☐ High Fe	**Cation exchange capacity** ☐ Low ☐ Medium ☐ High **Organic matter/carbon levels** ☐ Low ☐ Medium ☐ High **Exchangeable ions** ☐ Low exchangeable Ca to Na ration (sodic) ☐ Low exchangeable Ca to Mg ratio (magnesic) ☐ High Al ☐ High Fe	
Other (list)	**Other (list)**	

Table 9.2: Planner

Area Main constraints	Actions	Details and Timing (write when and. if it is something that needs to be repeated or monitored. how often this will be undertaken)
Upper soil compaction/ poor structure	☐ Assess and monitor levels of upper soil compaction at different times of the year ☐ Manage vehicle and livestock traffic to minimise compaction. ☐ Use low intensity strategic tillage to loosen soil to allow more root growth and to integrate organic matter and soil amendments into the soil. ☐ If soils are sodic and dispersive, or strongly magnesic, use gypsum or lime (on acidic soils) to provide Ca ☐ Retain more crop and pasture biomass to increase soil organic matter to promote better aggregate formation. ☐ Grow plants with 'clay breaking' roots and manage these (e.g. through strategic rotational grazing) to allow plants to grown and maintain deeper roots. ☐ Apply compost or other humic materials to promote better soil aggregation and structure ☐ Other (add details)	
Shallow subsoil compaction/poor structure	☐ Assess and monitor levels of sub soil compaction at different times of the year ☐ If soils are sodic and dispersive, or strongly magnesic, use gypsum or lime (on acidic soils) to provide Ca ☐ Use strategic deeper tillage to break up hardpans, incorporate soil amendments, and loosen sub-soil to promote deeper root growth. ☐ Grow plants with 'clay breaking; deep roots and manage these to so they can grow and maintain deeper roots. ☐ Use sub-soil amelioration to apply soil amendments such as gypsum, lime (on acidic subsoils), fertiliser, compost or organic matter to improves soil structure and promote deeper root growth. ☐ Other (add details)	

Area Main constraints	Actions	Details and Timing (write when and. if it is something that needs to be repeated or monitored. how often this will be undertaken)
Nitrogen deficiency ☐ **Critically low** ☐ **Low** ☐ **Moderate** ☐ **High/no constraint**	☐ Include legumes in pastures and cropping rotations. ☐ Correct nutrient deficiencies and pH issues that reduce legume plant and root growth and nitrogen fixation. ☐ Conduct test strips of sources of N to assess the responsiveness of crops and pasture. ☐ Apply N fertiliser at appropriate rates. ☐ Apply manures or other sources of N fertility at appropriate rates. ☐ Use strategic grazing rotations to promote legumes and nutrient cycling. ☐ Increase soil organic matter to improve nutrient cycling and holding properties of the soil. ☐ Address subsoil constraints to allow deeper root growth. ☐ Monitor how much N is being removed by yields. ☐ Monitor soil N levels through soil testing. ☐ Other (add details)	

Area Main constraints	Actions	Details and Timing (write when and. if it is something that needs to be repeated or monitored. how often this will be undertaken)
Other 'macro' and 'micro' nutrients: **P ☐ Critical ☐ Low ☐ Moderate** **K ☐ Critical ☐ Low ☐ Moderate** **S ☐ Critical ☐ Low ☐ Moderate** **Ca ☐ Critical ☐ Low ☐ Moderate** **Cu ☐ Critical ☐ Low ☐ Moderate** **Zn ☐ Critical ☐ Low ☐ Moderate** **Mo ☐ Critical ☐ Low ☐ Moderate** **B ☐ Critical ☐ Low ☐ Moderate** **Se ☐ Critical ☐ Low ☐ Moderate** **Mn ☐ Critical ☐ Low ☐ Moderate** **Other:** **☐ Critical ☐ Low ☐ Moderate** **☐ Critical ☐ Low ☐ Moderate** **☐ Critical ☐ Low ☐ Moderate**	☐ Correct pH factors that may make some nutrients less available to plants. ☐ Address subsoil constraints to promote deeper root growth. ☐ Conduct test strips of different nutrient sources to see how crops and pastures respond P ☐ K ☐ S ☐ Ca ☐ Cu ☐Zn ☐Mo ☐B ☐ Se ☐Mn ☐ Others ☐ Apply appropriate fertilisers or other sources of deficient nutrients. P ☐ K ☐S ☐Ca ☐ Cu ☐Zn☐ Mo ☐ B ☐ Se ☐Mn ☐ Others ☐ Use foliar spray fertilisers is plants show signs of deficiencies P ☐ K ☐ S ☐ Ca ☐ Cu ☐ Zn ☐ Mo ☐ B ☐ Se ☐ Mn ☐ Others ☐ Use livestock feed additives or lick blocks to avoid livestock dietary deficiencies. ☐ Increase soil organic matter to improve nutrient cycling and holding properties of the soil. ☐ Monitor/estimate how much nutrient is being removed by yields. ☐ Monitor soil nutrient levels through soil testing ☐ Monitor deficiencies and imbalances through plant tissue testing. ☐ Other (add detail)	

Area Main constraints	Actions	Details and Timing (write when and. if it is something that needs to be repeated or monitored. how often this will be undertaken)
pH **☐ Strongly acidic (<5.0)** **☐ Slightly overly acidic with risk of acidification (5.0-5.5)** **☐ Acid-neutral (5.5 – 7.0)** **☐ Neutral -alkaline (7.0-8.0)** **☐ Overly alkaline (>8.0)** **Potential toxicities on acidic soils:** **☐ Al** **☐ Fe** **☐ Mn** **☐ P immobilisation**	☐ Use lime to correct overly acidic pH ☐ Use rock dust with known liming effect ☐ Manage N and other nutrients to reduce risk of acidification ☐ Improve aeration/porosity of soil to reduce the build-up of unoxidised free hydrogen ions ☐ Increase soil organic matter to buffer pH ☐ Apply compost to buffer pH ☐ Other	
Potential P buffering/draw down	☐ Neutralise pH ☐ Adjust P application rates to allow for some P buffering losses ☐ Promote active soil biology ☐ Other:	
Sodic (heavy clays with high exchangeable Na relative to Ca) or Magnesic clay (heavy clays with high exchangeable Mg relative to Ca. Note: this is more significant when combined with sodicity)	☐ Add sources of exchangeable calcium ☐ Increase soil organic matter ☐ Sow plants with hardy deep rooted 'clay breaking' roots ☐ Add compost ☐ Strategic tillage to ameliorate ☐ Where magnesic soils are self-mulching or cracking when dry apply amendments to get down these cracks ☐ Other:	
Potential salinity (high Na and EC)	☐ Identify soaks and salt scald areas ☐ Improve soil water infiltration in these areas as well as higher areas ☐ Plant deep rooted perennials on likely recharge areas above soaks/scalds ☐ Plant soaks and scalds with salt tolerant and deep-rooted plants ☐ Other:	

Area Main constraints	Actions	Details and Timing (write when and. if it is something that needs to be repeated or monitored. how often this will be undertaken)
Low organic matter	☐ Retain more of existing crop and pasture biomass/residue. ☐ Deliberately grow high biomass crops and retain more of this residue. ☐ Deliberately grow/promote deeper rooted plants in cropping and pasture rotations. ☐ Use strategic rotational grazing to promote biomass production and deeper roots growth under pasture. ☐ Monitor levels of visible organic matter at different depths in soil ☐ Conduct soil testing to determine organic matter levels ☐ Other	
Poor water infiltration	☐ Address compaction constraints (above) ☐ Slow rate of stormwater run off through contouring or tilling across rather than up and down slopes ☐ Slow rate of stormwater run-off by reducing bare ground through retention of stubble and other dead biomass ☐ Maintain organic matter at the surface to avoid crusting ☐ Other	
Poor water holding	☐ Increase organic matter levels ☐ On sandy soils, consider integration of some sub-soil clay or use of 'wetters' ☐ Other	
Poor plant water availability	☐ Increase organic matter levels ☐ Improve soil porosity and root access to water ☐ Other	
Other		