Landscape indicators – "What your country is telling you"

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Summary

An agricultural landscape is comprised of many factors that need to be considered and understood before sensible decisions can be made about options for land management or development. Landscape factors can act as excluders or limiters of management and development options, for example an area may be too steep for ploughing, but could still be sown by direct drilling.

Many landscape factors can be easily seen and interpreted, others are less obvious and some need interpreting from related factors, such as the vegetation found in an area. Plants and plant associations can indicate production potential or soil or water problems and help us to read and understand a landscape.

Introduction

An agricultural landscape includes many things that can be seen, noted or measured. These things will affect your decision making or the management and development options for various landscapes on your farm.

Some landscape features are readily apparent and understood, other features are less obvious and using indicators such as the vegetation types can give clues to features such as soil and/or water factors. Some plants and plant communities have long been recognised as indicators of production potential and other features of a landscape. Understanding or reading the landscape for clues to problems and potential is usually well understood for the more obvious features. The linkages between plants and landscape features are "known" in some situations, but for other situations are rather or subject to anecdotes and "old wives' tales".

In the Tablelands, landscape features and plants (plant associations) are commonly used to interpret or read a landscape for potential exclusions or limitations to management or paddock development. The Landscan course offered by NSW Department of Primary Industries aims to teach farmers the ability to read both their landscape and soil test information for better farm management decisions.

Agricultural Landscape Features

Landscape features are more important in a highly variable landscape such as the Tablelands. Features such as topography and aspect are important in this hilly to steep landscape and even things such as climate or soil types will change rapidly with changes in altitude and topography (Clements *et al.* 2004)

In broad terms the common features of an agricultural landscape are:

- climate
- topography
- aspect
- geology and soils
- vegetation
- human influences

Each of these broad categories covers a number of factors or landscape features. To assess the implications of these factors, requires good observation skills and a broad understanding of how they will affect agricultural production.

Reading and Understanding Landscape Features

Landscape features provide a source of information on the limitations (or exclusions) of an area and some features can also indicate the natural potential or capability of an area for agricultural use. Reading or understanding what individual features and the various combinations of features means requires some thought and understanding.

Each of the main headings above can be broken down into their varius components and these are what determine landscape limitations or indicate production potential. Combinations of these components can also interact to affect decision making. For example, an area may have a 700 mm rainfall, but on steeper areas with low infiltration rates much of this will run off and if that soil is also shallow with a westerly aspect, then your choice of plant species to sow should come from types that are hardier and can survive in a much drier rainfall zone. A fault in many advisory publications is to recommend plant species based only on average annual rainfall.

Below are some very brief examples of landscape features, their components and how these may act as limitations or indicators:

Climate

- Total rainfall, seasonal rainfall pattern, temperatures, frosts, winds, etc;
- Can severely limit production despite other features, e.g. cold tablelands winters restrict pasture growth rates.

Topography

- Steepness and shape of the land;
- Major limitations to development and management are "trafficability" (can drive over land) or "arability" (can cultivate without erosion risk).

Aspect

- Compass orientation of the land;
- Aspect affects microclimate, e.g. westerly aspects are usually hotter and drier in summer.

Geology and Soils

- Soil depth, natural fertility, water holding capacity, surface stones, infiltration rates;
- Parent rock material is related to many of these features.
- Vegetation types are great indicators of many soil factors.

Human Influences

- Previous agricultural activities, fencing;
- Vegetation changes, increased erosion, agriculturally induced soil fertility or acidity changes

Vegetation

- Species, type and form, native, introduced;
- Plants and plant communities are often strongly associated with soil types and soil/water characteristics in a landscape.

Vegetation Indicators

Several types of vegetation can act as indicators of soil conditions and land capability. Trees, native grasses, introduced pastures and even weeds can offer some insight into a landscape. It is often revealing to watch the change in species along roadsides indicators of the natural soil type, for example peppermint trees (*Eucalyptus dives*) and an absence of red grass (*Bothriocloa macra*) or phalaris (*Phalaris aquatica*) on roadsides may indicate a naturally very acidic soil.

Reading vegetation indicators is not always easy, as it often relates to factors such as the position of plants in the landscape or the combinations of plants/plant communities rather than the presence or absence of single species. To be able to identify plants and learn or understand the association of various plants with landscape features, soil type and climate, requires time and familiarity with an area and its vegetation.

Trees

Trees can be excellent indicators of landscape and land capability. Bower *et al.* (2002) when speaking of eucalypts state that

"The range of each species depends primarily on climate, but their occurrence at sites within the overall range is determined by such factors as soil type, drainage, altitude and aspect. For example, yellow box Eucalyptus melliodora was used as a sign of high quality agricultural land during settlement in the nineteenth century."

This association between eucalypt species and altitude, aspect and soil type is also shown in a diagram by Bower *et al.* (2002).

In the central and southern tablelands, pasture establishment techniques and problems and pasture species selection have been linked to the native tree associations (Simpson, 1982).

Table 1 gives some examples of common associations of some trees of central tablelands with landscape and soil features.

Table 1. Some examples of trees of central tablelands with soil and landscape features

White Box (*E. albens*)	Well drained soil, usually red subsoil, good soil pH
Yellow Box (*E. melliodora*)	Deeper soil, good soil water, can be seasonally waterlogged, soil pH variable but usually good
Red Stringybark (*E. macrorhyncha*)	Shallow, low fertility, acidic soils
Broad leaved peppermint (*E. dives*)	Higher altitudes (>900 metres) strongly acid, low fertility soils
Tumbledown gum (*E. dealbata*)	Poor, shallow, often skeletal or stony soils
Kurrajong (*Brachychiton populneum*)	Non acid, well drained soil

Trees as indicators can sometimes be misleading however, as the remaining trees in paddocks may not be representative of the original tree cover. In some cases, the larger specimens and sometimes only certain tree species were left. Agricultural history or development of an area may also have changed some of the soil characteristics, for example agriculturally induced acidity and the remnant trees may now actually give a wrong impression.

Native Grasses

Native perennial grasses are also excellent guides to land capability. In conjunction with some information from the remaining trees or in situations with no trees the species, density and landscape position of native grasses can give excellent clues to soils and potential productivity.

Native pastures have generally developed from grassy woodlands or natural grasslands and the species that are now commonly found are the result of the combined effects of agricultural history (grazing, fertiliser use, etc) and the special adaptations of those species. Lodge & Whalley (1989) postulated changes in the dominant species of native pastures in response to changing land management practices in the northern tablelands.

While many species are commonly found in a native pasture, the species variability is often associated with landscape and soil/water features. Native species often appear to form mosaics across a paddock or area with different species dominating the areas to which they are most suited. Langford *et al.* (2004) and Lodge *et al.* (1990) offer descriptions of the various native grasses and the situations, both landscape and agricultural, which suit them.

After major disturbances (drought, fire, cultivation, severe overgrazing, etc.) or even less sudden changes to conditions (e.g. changed soil fertility due to fertilisers and clover) the native grasses found may give a false impression of an area. It may take many years for grass species to move across the landscape and colonise or re-colonise the areas that are suitable for them.

Introduced Pasture Species

Some of the commonly sown pasture plants used in the tablelands can also act as indicators of soil characteristics and land capability. Dominance or absence of a species (i.e. survival) in parts of a landscape can indicate the soil/water or landscape characteristics of an area.

How useful this information is will depend on several factors such as:

- what species or combination of species were originally sown into an area;
- the pasture management regime (grazing and fertilisers) since sowing; and
- the time since sowing to allow for species to decline in areas where they are not adapted; and /or dominate those areas to which they are adapted.

It can be interesting to inspect variable paddocks where "shotgun" pasture mixtures were used and

Table 2. Some examples of native grass species and the soil and landscape features indicated by their dominance

Corkscrew (*Austrostipa scabra*)	Shallow or sandy, low water holding capacity and low fertility soils
Wire grass (*Aristida ramosa*)	Very low fertility soils, usually strongly acidic, often sandy soils
Weeping grass (*Microlaena stipoides*)	Higher rainfall (>650 mm) or favoured landscape situations, moderate soil fertility, highly tolerant of acid soils
Red anthered wallaby grass (*Joycea pallida*)	Higher altitude (>700 m), very low fertility, acidic, often skeletal sedimentary soils
Red grass (*Bothriochloa macra*)	Low to moderate soil fertility, not strongly acidic soils (pH > 4.6)

Table 3. Some examples sown pasture plants with soil and landscape features

Phalaris (*Phalaris aquatica*)	Good soil depth, moderate to good soil fertility and not very acidic
Cocksfoot (*Dactylis glomerata*)	Often dominates acidic soils or low to moderate fertility areas, does not tolerate waterlogging
Fescue (*Festuca arundinacea*)	Found in wetter areas, good soil depth, tolerates soil acidity
Lucerne (*Medicago sativa*)	Deeper more fertile soils, not acidic or waterlogged

see the decline or dominance of the species, for example the fescue in the wetter areas, phalaris in the deeper soil areas and cocksfoot on the poorer, more acidic ridges.

Some pasture species are not very good indicators as they are adapted to a wide range of situations and soil types, for example, subterranean clover (*Trifolium subterraneum*). However, even these ubiquitous species can in some circumstances give clues to soil conditions, for example leaf spotting or discoloration of leaf margins on sub-clover can indicate a potassium deficiency which is also related to soil type, being much more common on sandy soils.

Weeds and Other Plants

Apart from the plant groups already discussed there are many other plants, some natives, some naturalised volunteers and some weed species that are regarded as indicator plants because of their adaptations and ability to colonise suitable areas. The dominance or even the presence of some of these plants can indicate certain soil or landscape conditions.

Many species can tolerate or even require wet conditions, so that their presence usually means abundant or too much water in the landscape, i.e. a seepage area, low lying area or sub surface water. Some of these types of plants are: Yorkshire fog grass (*Holcus lanatus*); sedges (*Cyperus* spp.); a native grass called matgrass (*Hemarthria uncinata*); water couch (*Paspalum paspaloides*); paspalum (P. *dilatatum*); rushes (*Juncus* spp.) and tussock sedge (*Carex appressa*).

Some species are regarded as salt tolerant and along with other visual clues, often indicate the presence of a salinity problem, for example: couch (*Cynodon dactylon*); annual beard grass (*Polypogon monspeliensis*); sea barley grass (*Critesion marinum*); or sometimes strawberry clover (*Trifolium fragiferum*).

Low soil fertility and acid soils are often associated with some common broadleaf plants such as: catsear (*Hypochoeris radica*); sorrel (*Rumex acetosella*) and even sifton or biddy bush (*Cassinia arcuata*). These associations may only be tenuous, particularly for the sorrel and catsear, as they may just indicate a lack of pasture or a poor uncompetitive pasture, but this itself may have been caused by the low fertility, acidic soils.

These are just some examples of associations of common of plants with various landscape features. Hennessy (2002) produced a list with some attributes of around 60 common plants of the Central Tablelands and there are probably many hundreds of other soil/landscape and plant associations for both the tablelands and other areas.

Conclusion

Reading and understanding a landscape helps to assess the strengths and weaknesses of an area. Appropriate development and/or management options can be determined by the exclusions or limitations imposed by a landscape and the use of vegetation indicators.

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