Multiple benefits from carbon farming

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Australian farmers are ideally placed to play a large part in carbon reduction and storage.

Collectively they are the largest land managers in the country and control the health of the environment by their decision making.

Carbon farming or carbon capture offers an opportunity for the farming sector or even individuals to work with heavy polluters to compensate for carbon dioxide emissions.

Carbon capture may not work for every landowner but it is worth investigating the options because it has potential to help improve farming enterprises' 'bottom line' and improve the environment for all of us.

One of those options is to establish a carbon sink using native plant species of trees and woody shrubs.

This will involve challenging existing activities on the property and reviewing current land uses to see where it might be feasible to establish a 'carbon sink' of native vegetation. It is about replanting good cropping or grazing land with native species.

Challenging existing management will involve a review of the physical nature of the farming operation and related finances. These two aspects are inseparable.

Considering a change of land use on a farm involves finding a balance between the capability of the land and the financial affordability and returns of the option under consideration.

When considering opportunities for carbon capture using native vegetation as part of a farm business, the first step is to review the property to determine land capability in each area.

There are eight recognised land classes (see **Table 1**) but some landowners may have subsets of these.

This table is a general guide, and for ease of planning some of the classifications can be grouped on the basis of the equipment or techniques needed to manage them or their ability to retain soil cover.

When exploring the potential for carbon storage it is essential to understand the different land classes so the available resources are focused on areas that will provide the greatest returns.

THIS MURRAY MALLEE PADDOCK IS LAND CLASS III - ARABLE LAND WITH MODERATE LIMITATIONS. THE SANDHILL IN THE BACKGROUND IS LAND CLASS V - NON-ARABLE LAND SUITABLE FOR IMPROVED PASTURES OR ESTABLISHMENT OF NATIVE VEGETATION.

Carbon capture may not work for every landowner but it is worth investigating.

Knowing the percentage of each land class will make economic planning easier.

Potential

Over the next few years there will be many opportunities for the farming sector to join forces with the corporate world to invest in re-establishing vegetation on land that is no longer viable for farming. Some of these areas may be best placed back to perennial vegetation types for short terms or much longer periods.

The practical cost of establishing a carbon sink using perennial vegetation can vary greatly depending on:

1. Complexity of the planting – e.g. single species or a mixture of species.
2. Location and conditions.
3. Soil type.
4. Pre- and post-planting maintenance.
5. Establishment techniques.
6. Number of plants per hectare.

Establishment

Seedlings are generally seen as the safest establishment option but the best method will depend on soil type, rainfall and the experience and confidence of the people involved in the project.

The number of plants per hectare will vary depending on the site and the species mix planted.

Using a combination of seedling planting and direct seeding will provide flexibility in the process and improve the chances of having all species represented in the planting.

Costs

The size and location of the project, and the on-site conditions, landscape will determine actual costs.

The more complex the planting and species mix the higher the cost, with the cost of establishing a 'biodiversity planting' with a mixture of trees and shrubs around double that of establishing trees only.

Machinery

Tree planting machines do exist but a team of tree planters is just as effective as a machine and can deal with most sites without too many problems. Each person can plant 1,000 to 1,500 plants a day.

TABLE 1. LAND CAPABILITY CLASSIFICATIONS

Land Class	Description	Looks like
I	Arable land with no significant limitations. Suitable for agriculture production on a permanent basis.	Flats or depressions (not saline, sandy or rocky). OK to crop on a regular basis.
II	Arable land with slight limitations. Simple modifications are required to improve crop performance, which may slightly reduce productivity.	Flats with sandy topsoil < 500mm deep and slight rises. Can crop most seasons.
III	Arable land with moderate limitations. Needs careful planning. Moderate productivity reductions.	Flats and sand > 500mm deep. Susceptible to erosion if cropping program not well planned.
IV	Semi-arable land not suitable for cultivation or cropping on a regular basis. Best not to cultivate, may drift or erode.	Good for perennial pastures. Includes rocky slopes and sand hills with a slope < 10%. ***Carbon-sink planting option. Dryland forestry, native vegetation plantings, alternative crops.***
V	Non-arable, suitable for improved pastures or perennial horticulture using specialised techniques.	Shallow soils, can drive over with safety. ***Carbon-sink planting option. Dryland forestry, native vegetation plantings.***
VI	Standard equipment does not cope. Native pastures such as native grasses.	Steep slopes, rocky or sometimes sandy. Cannot drive over very easily. ***Carbon-sink planting option. Native vegetation plantings.***
VII	Land with extreme limitations. Best used for perennial vegetation.	Sand dunes, boggy marsh, steep, rocky. May include creeks and native vegetation. ***Carbon-sink planting option.***
VIII	Land with no agricultural value.	Saline / samphire, sheet rock, steep sand dunes, areas of rising water tables. ***Carbon planting option.***

TABLE 2. SEEDLINGS VERSUS DIRECT SEEDING

	Seedlings	Direct seeding
Soil type	Deep sand or heavy clay	Gravel, rocky, loam, sandy loam
Threats	Rabbits, kangaroos, livestock, birds, hares, etc.	Rabbits, livestock, red legged earth mite
Pre-treatment of site after fencing	Deep rip. Remove weeds	Remove topsoil or spray strips to remove weeds
Planting time	May to September	June to August
Pre-treatment	Seedlings may be sprayed with water to reduce frost impacts	Different seeds need different treatments. Wattles are hot water treated, native pine need to be chilled, some Eucalyptus species can be cold-water treated
Survival risks	Frost, soil moisture whilst establishing a root system	Rainfall after seeding and soil moisture during first four months.
After 12 months	Aim for 80% survival. Seedlings will usually double in size in 12 months	Germinated plants will still be small but will overtake seedlings in about year three
Advantages	• Know exactly how many plants per ha planted • Know mix of species • Can immediately see results	• Faster • Usually cheaper • No tree guards • Root system develops before top growth
Disadvantages	• Usually need tree guards • Slower to plant same area • Cost more per ha to establish • May be limited by nursery capacity	• Relies heavily on good site preparation • Relies heavily on rainfall for germination and soil moisture retention during germination • Needs lots of seed • Seed viability varies greatly between species and seasons • Understanding seed germination principles is an advantage

AN EXPERIENCED TREE PLANTER CAN PLANT UP TO 1,500 PLANTS A DAY.

Containers

The container type is important consideration when using seedlings; not only because of cost but because the container in which a plant is established can impact on its ability to survive in the field. Most species can be grown in a 'hiko' tray of 40 plants.

Benefits of this container are:

- Easy to fill with propagation mix.
- Rapid early growth.
- Good for large numbers of single species.
- Can be moved around easily.
- Easy to handle in the field.
- Can be reused.

Disadvantages of this container are:

- Must be watered every day.
- Plants must be planted in the year grown.
- Need to 'pop' or loosen the plants prior to delivery to the planting team.

Establishing seedlings

The Southern Australian summer can be very harsh. To give seedlings the best possible start:

1. Select the right plants and the right mix of plants.
2. Grow a cover crop that can be used as a mulch.

SELECTING THE RIGHT CONTAINER IS IMPORTANT.

TABLE 3. SEEDLINGS – COST* PER LIVING TREE AFTER THE FIRST SUMMER

Requirement	Low density	High density
Tree or shrub purchase	0.7	1.2
Site preparation	0.5	1
Contract planting	0.6	1.1
Water x 3 times	1.5	3
Tree guard	0.3	1
Placement of guard	0.7	1.5
Cost per plant in ground	$4.30	$8.80
Plants per ha (500) – trees only	$2,150.00	$4,400.00
Plants per ha (900) – biodiversity type	$3,870.00	$7,920,00

*THESE COSTS DO NOT INCLUDE PLANNING, FENCING OR VERMIN CONTROL.

3. Prepare the site well and remove any weeds within a metre of the planting line two weeks before planting.
4. Ensure the soil is moist. Do not plant in dry soil.
5. Plant only quality plants. Discard any suspect plants and don't plant them.
6. Water seedlings heavily on the morning of the day they are to be planted. This is best achieved by submerging the container in water for a period to ensure saturation.
7. Deep rip the planting rows, even in sand. This will enable the root system to be positioned slightly below the existing soil surface into moist soil.
8. Water the seedling immediately after planting and if possible water twice more a few weeks apart if conditions are very dry.
9. Protect the plant from vermin and livestock.
10. Use a fertiliser in poor soils.

Direct seeding

Direct seeding can be more risky than using seedlings, especially in deep sands and very dry environments, but with good management can enable large-scale plantings to be established at less than half the cost of using seedlings.

Successful direct seeding requires clean, viable seed, moist soil and good technique, with the amount and frequency of rainfall after seeding a major factor.

In general, the better the rainfall after seeding the more likely a complex range of species will survive the first summer. Drier conditions after seeding will result in more *Acacia* and *Dodonea* with far less of other species such as *Eucalyptus* and *Melaleuca.*

For farmers using direct seeding to establish native plantings, a good general rule is to sow the native seed after seeding of grain crops has been completed.

Mixed plantings of native species are usually direct-seeded at a rate of 1.5kg of seed per hectare. This is based on a row length of approximately three kilometres per hectare to be revegetated and 500g of mixed seed per kilometre of plant row.

Machinery

Most direct-seeding is done with a single-row machine but there are some three-row seeders.

DEEP RIP AHEAD OF PLANTING AND PLACE THE SEEDLING LOW IN THE FURROW LEFT BY THE RIPPER.

The keys to success with a direct seeding are:

1. Good seed-soil contact.
2. Correct depth of seed placement.
3. Accurate metering of the different seed types.
4. Appropriate seed treatments.

Seed type

Native plant seeds come in many different forms; some of which are difficult to use in conventional seeding machines because of awns, hairs, pods, other attachments or odd sizes.

Most seeds fall into about five types:

1. Grasses and sedges; e.g. ***Austrodanthonia*** (wallaby grass), ***Phragmites australis*** (common reed).
2. Paper flowers and daisies – Olearia.
3. Woody fruits; e.g. ***Eucalpytus*** sp., ***Melaleuca, Hakea, Allocasuarina*** (sheoak), ***Callitris*** (native pine).
4. Plants with pea-like pods; e.g. ***Acacia, Kennedia*** (running postman).
5. Fleshy fruits; e.g. ***Enchyleana, Kunzea, Dianella.***

Some of these would not be sown in a direct seeding program because the seeds are difficult to collect or in short supply. If a desired species is in limited supply it is best to propagate it in containers and hand-plant seedlings of it into the direct-seeded rows.

Approvals should be sought before collecting seed from the wild.

Seed storage

Seed quality is important for success with direct seeding. After collecting seed:

- Dry it in a shed or building where there are no rodents to eat it seed.
- Clean it by removing sticks, pods and other waste.
- Store it at a low temperature in air-tight, rodent-proof containers.

TABLE 4. DIRECT SEEDING ESTABLISHMENT COSTS

Input	Low density	High density
Mixed seed	450.00	750.00
Seed treatment per seed batch / viability testing	100.00	200.00
Contract seeding	300.00	500.00
Weed control	100.00	250.00
Totals	$950.00	$1,700.00

- Label it with the location and time of collection and the storage date.

Seeds do not remain viable forever. As a general rule fresh seed is best. If the project is large, with several batches of seed being used, viability testing of each batch is recommended.

Seed treatments

Key seed treatments to improve seed germination include:

- *Calltiris* sp. (native pine) – refrigerate at 2°C for four weeks prior to sowing.
- *Acacia* (wattles), *Dodonea* (hop bush) and legumes – pour very hot water over them and leave for 12 hours. Drain and allow to air dry before sowing. It may take two days before the seed is dry enough to flow through the seed box.
- *Eucalyptus* – in very dry conditions, pre-soak with cold water for 12 hours and allow to air dry before sowing.

There are many other treatments that can be used. A good reference book for pre-sowing seed treatment is 'What Seed is that?', by Neville Bonney.

Sowing depth

As a general rule, the depth of soil over the seed should be equal to half the diameter of the seed. With fine seeds such as *Melaleuca* (tea trees) that is very difficult, so they should be placed on top of the soil, as should *Eucalyptus* sp. Both need contact with the soil but require light to germinate and will not germinate if sown too deep.

Acacias and other seeds from pods are sown at a depth of about 5mm. In sandy soils this depth is critical because it maximises the chance of the seed finding soil moisture to continue the germination process initiated by the seed treatment.

SETTING UP A SINGLE-ROW SEEDER FOR THE NEXT RUN.

Callitris sp. (native pine) and *Allocasuarina* (sheoak) should be sown just under the soil profile at a depth of 2mm.

Direct seeding process

To maximise the chances of success with direct seeding:

1. Plan the project, understand the soils and weeds at the site and identify potential threats.
2. Control unwanted pests.
3. Prepare the site well but DO NOT rip or cultivate before direct seeding. *Eucalyptus* and *Melaleuca* seeds will be placed too deep in cultivated soil.
4. Establishing then spraying out a cover crop ahead of seeding will provide mulch on light sandy soils.
5. Weed control to a metre either side of the row is essential.
6. Sow seeds when the soil is moist. Timing is critical. Seeds sown late are unlikely to be successful without additional summer rainfall via a thunderstorm.
7. Use clean, fresh seed.
8. Is the right pre-seeding treatment.
9. Sow seed at the right depth.
10. Maintain weed control after seeding and prior to summer. This may require application of a herbicide, using a sprayer that will shield the germinating native plants from spray drift.

Whether direct seeding or planting seedlings, the goal is to treat the native species as a new crop that will provide an alternative additional source of income from areas not well suited to cereal cropping as part of an overall environmental improvement program.

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