Design principles for healthy waterways on cotton farms

Cotton Catchment Communities CRC

***Neek Morawitz** of 'Argoon' Emerald, 2005 ACGRA Grower of the Year, has constructed a central sump (pictured, also showing vegetated taildrain) as the gathering point for all tailwater on his farm. A 2000ML storage is adjacent to the sump and holds all sediment-free tailwater, rainfall runoff and flood harvest from the river (Scott Fanshawe, Emerald, kindly provided this photograph).*

Well designed irrigation storages and water courses on cotton farms can aid in the removal of sediment, nutrients and pesticides from irrigation water and enhance their habitat value for native plants and animals. This brochure outlines key principles for increasing the water use efficiency, water quality and habitat value of cotton farm watercourses and storages.

The brochure aims to inform cotton growers and consultants of the environmental and economic benefits that can be achieved easily, cheaply and within their own time frame. It is not prescriptive, but more a collection of concepts and ideas that can be adapted for different circumstances and outcomes desired by landholders.

Aquatic Plants

Aquatic plants are essential for healthy aquatic ecosystems. They provide food and shelter for invertebrates, frogs, reptiles, fish and waterbirds. They also reduce the amount of sediment in the water, increase the oxygen content of the water, remove nutrients and enhance pesticide breakdown. The end result is cleaner water for native fauna and farm staff alike.

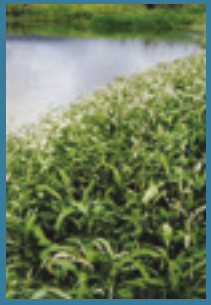
Aquatic plants don't necessarily use more water than open ponds. This is particularly the case for submerged or floating attached aquatic plants, whose surface area available for transpiration is not more than the surface area for evaporation. Large, emergent plants like cumbungi and phragmites will use water quite rapidly, but if planted as windbreak strips they can offset total water losses by reducing evaporation from open water.

Be aware that some aquatic plants can grow quite rapidly if given suitable conditions (e.g. cumbungi, clubrushes) and may cause obstructions and slow the flow of water in channels. Deep, regularly flooded channels will prevent plants from establishing where they may cause problems, such as around pump sites and in areas where rapid water movement is required.

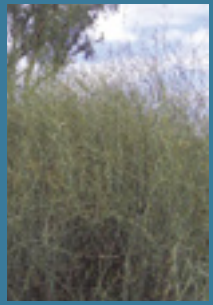
CUMBUNGI
(*Typha orientalis, T. domingensis*)
Grows to 4 metres tall, withstanding water depths up to 2 metres. An important source of food and nesting habitat for native birds, and can reduce water losses and erosion if planted as windbreak/shading strips along shorelines. Can establish and grow rapidly via underground rhizomes and may obstruct water flow, but can also be grazed by stock.

PHRAGMITES
(*Phragmites australis*)
Grows to 4 metres tall, withstanding water depths up to 2 metres. Similar attributes to cumbungi, in that it is a source of food and nesting habitat for native birds, is good for preventing erosion if planted along shorelines and can be grazed by stock.

WATER COUCH
(*Paspalum distichum*)
A rapidly-growing, native perennial that forms dense mats in water up to one metre deep. Wet water couch pastures are strongly favoured by aquatic invertebrates and feeding waterbirds. Excellent at filtering sediments from slow moving water and can reduce evaporation losses compared to open water.



KNOTWEED/SMARTWEED
(*Persicaria* spp.)
Often forms dense mats along margins of waterbodies, but can grow in water up to 1 m deep. Can remove herbicide residues from water by plant uptake. Seeds are an important food source for smaller birds. *Persicaria* spp. provides good groundcover for frogs and can withstand long drying periods.



LIGNUM
(*Muehlenbeckia florulenta*)
A rambling native shrub up to 3 m high and wide. Common on inland floodplains and can withstand wet and dry conditions. Lignum provides excellent habitat for native fauna, particularly smaller birds. However, because it can grow quite densely it may also shelter introduced pests.

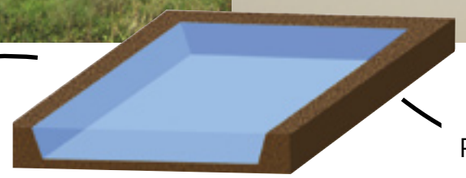
Waterbird and wildlife habitat

Edge vegetation for animal shelter and food; sloped sides for greater plant diversity.

Areas of shallow water and mudflats for wading birds.

Islands and reedbeds for different bird species, protection for frogs and invertebrates.

Open storage, cleared edges, steep sides. Discourages wildlife.

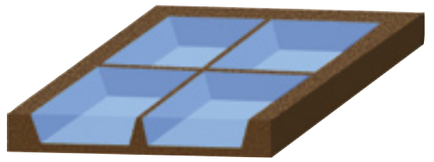


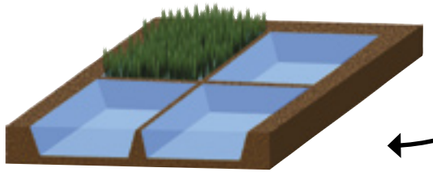
Standing trees (dead or alive) for water-birds and snags for aquatic animals.

Open storage, cleared edges, steep sides. Pesticide break-down by microbes limited.

Water quality

Smaller, divided storages to limit water loss and increase bottom surface area for pesticide break-down.





Aquatic plants to increase sedimentation and break-down herbicides.

Sub-surface filters of wood-chip, gin-trash or crop stubble to filter sediments, nutrients and insecticides.

Put clean water in areas of high diversity for passive use by native species, keep dirty water separate.

Design principles

1 Engineering design principles

a. During construction, ensure soil for embankments is at the optimum water content for proper compaction and stability. Place water storages and channels on impermeable soils to limit deep drainage.

b. Split larger storage areas into smaller, deep cells that can be filled one at a time, to minimise evaporation.

c. Mitigate wind action causing waves by including a centre island where feasible; edge vegetation such as phragmites can provide further protection against erosion and can minimise evapotranspiration.

d. In operation of dams, minimise structural stresses and erosion by avoiding rapid draw down. This also has benefits for habitat.

2 Pesticide removal principles

a. Remove sediments carrying pesticides and nutrients by slowing water flow in sullage ponds, filter beds of wood chip, cotton trash or gravel, or mat-forming aquatic plants like water couch, milfoil, pondweed; reduce turbulent resuspension with emergent aquatic plants (clubrush, cumbungi, phragmites) to slow wind.

b. Increase surface area of submerged substrate by compartmenting storages, constructing earth baffles and establishing aquatic plants - this increases microbial biofilms and pesticide breakdown.

c. Retain some areas of open water for pesticide breakdown by sunlight.

3 Wildlife and waterbird principles

a. Establish aquatic vegetation as it is important both as food and as habitat for waterbirds' prey.

b. Construct gradual slopes in water storages for different water depths and plant communities.

c. Provide shallow areas and mudflats for wading waterbirds.

d. Provide refuges from aerial predators (i.e. deep water to dive under).

e. Provide refuges from land-based predators, for resting adult birds (reedbeds and other plant species, logs, standing trees/shrubs and islands in the water).

f. Provide refuges from predators for nests, eggs and young (tall aquatic vegetation; vegetated islands; trees in water).

g. Maintain water levels if breeding events are noticed.

h. Provide corridors for movement of native animals between floodplain and riparian zone by removing pest species and planting natives.

4 General recommendatons (where possible)

a. Reduce pesticide sprays near sensitive water courses by planting organic or Bollgard cotton.

b. Separate 'clean' and 'dirty' water, putting 'dirty' water in storages less attractive to wildlife eg steep sides, open water or reed/cumbungi monoculture.

c. Identify and record the range of wildlife species within farm watercourses. This would be a good task for children! Such records are invaluable for tracking the effect of changing management practices on farm biodiversity.

See the Cotton CRC website www.cotton.crc.org.au for more details and related information.

Fauna

The fauna most often seen on storages are the many birds that depend on water for their feeding or breeding. These diverse waterbird species include waterfowl (swans, geese and ducks), egrets, herons, spoonbills, ibises, pelicans, darters, cormorants, coot, swamphen, moorhen, native hen, waders and plovers. These species feed on a diversity of foods, and require several different habitats and resources. Most waterbirds move between wetlands readily and frequently to find the resources they need. Some species (e.g. ibises) are important because they eat insect pests such as locusts; some (e.g. several ducks) are hunted for sport and food. Some species (e.g. brolga, magpie goose, freckled duck) are rare in NSW or nationally; and all are valuable components of Australia's biodiversity. Irrigation storages now form over half the wetland area in the cotton-growing districts of NSW, and could be managed to play a valuable role in biodiversity conservation and to demonstrate the sustainability of cotton farming.

BLACK DUCK

These are very abundant and highly mobile ducks. They feed on seeds and aquatic invertebrates by plucking at seed-heads and filtering mud and water through their bills, trapping floating seeds and invertebrates. They prefer to feed in shallow (<0.5m) water or amongst aquatic plants. They rarely nest on irrigation storages, unless there are islands with dense vegetation to hide their nests.

MAGPIE GEESE

These uniquely Australian waterfowl were exterminated in the southern states soon after European settlement. They have since re-established in NSW and Victoria on a few wetlands including one or two well-vegetated irrigation storages. Magpie geese feed mainly on the bulbs and seed-heads of some aquatic plants. They need nesting sites secure from foxes and dogs.

Image © Ian Montgomery

PLUMED WHISTLE-DUCK

These tropical ducks occasionally visit northern NSW and flocks of several hundred may use irrigation storages especially for resting. They favour storages with islands that provide secure resting sites.

SACRED OR WHITE IBIS

Sacred ibis feed in pastures and naturally open habitats, eating grasshoppers, locusts and other large insects, probing the soil for grubs or catching adults. They nest colonially in swamps with dense vegetation (cumbungi or lignum, for example), or on vegetated islands or in trees standing in water, where water will keep out dogs and foxes.

YELLOW-BILLED SPOONBILL

Spoonbills wade in wetlands, sweeping their unique bills through the water to sieve large invertebrates from the mud and water; thus they favour storages with extensive shallows. They also roost and nest in trees in water or on islands.

Image © Ian Montgomery

Putting it all together

A number of design principles have been offered and although some of them can be conflicting with respect to their purpose, most are synergistic. Two of the main outcomes are:

1. Breaking larger storages into networks of smaller storages is beneficial. Smaller storages can be filled one at a time to decrease evaporation losses and their larger surface area to volume ratio increases pesticide breakdown. Furthermore, compartmented storages allow for the separation of 'dirty' and 'clean' water. 'Dirty' water can be held in an open storage dam with steep sides and no plants to deter wildlife. 'Clean' water can be put in storages with attractive features.

2. Diversity in design means diversity in wildlife and faster pesticide breakdown. Include where possible areas of fast drying and areas of slow drying, shallow areas and deep areas, vegetated areas and open areas, flowing water and still water, islands, baffles and rocky areas.

Contact Details and further information

Further information can be obtained from the following;

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