Natural Sequence Farming (NSF)

Overview

Introduction

Natural Sequence Farming (NSF) is an agricultural system based on understanding landscape and ecological processes and implementing vegetation, land and water management practices compatible with these processes to achieve sustainability (CSIRO 2002). It was developed by farmer Mr Peter Andrews, on the property "Tarwyn Park", in the Upper Bylong Valley in the headwaters of the Hunter River catchment, New South Wales.

Principles

There are 4 fundamental principles that underlie the NSF system, as advocated by Peter Andrews.

1. Restoring fertility held by nutrients and organic matter improves the biological function of soils.
2. Reinstating hydrological balance increases groundwater storage in the floodplain aquifer, increasing freshwater recharge and hence reducing saline groundwater discharge.
3. Re-establishing natural vegetation succession through pioneer species promotes the healthy growth of native plant communities.
4. Understanding the hydrological and biogeochemical processes that drive the natural landscape system allows their management to restore ecological function.

Setting

Over modern time (<1,000 years), development of the landscape (drainage network and hillslope morphology, discharge of water and sediment) is contingent upon the factors of climate, vegetation, geology, relief, runoff and sediment yield. The most significant and widespread historical change to either the flow or sediment regimes of upland rivers is an increase in sediment inputs, through increased erosion (Young *et al.* 2001). Discontinuous streams or gullies, such as the 'chain of ponds' and 'valley fill' types, were once widespread prior to European settlement. Under natural conditions, vegetation changes diverted flows into perched palaeo (pre-European) distributary flow paths, or from one distributary to another. Flow regimes have changed in historical times with increased run-off, and small headwater streams have become more defined, incised and faster flowing. The drainage or incision of streams has occurred following degradation resulting from past management practices. Flow regimes have also changed during this time because of climate variations, resulting in long periods of flows above and below the longer-term average. What were once swampy meadows with chain of ponds have become well-connected and continuous drainage networks (Eyles 1977). This has lead to significant impacts on sediment load, base flows, salinity, groundwater recharge and riparian vegetation.

Benefits

The NSF approach can achieve stream health and floodplain sustainability by the rehabilitation of a pool-riffle or chain of ponds type aquatic habitat and inundated floodplain wetlands. This enables the recreation of a distributary flow system through the use of secondary floodplain channels and in-stream diversion structures, combined with the effect of riparian vegetation changes, providing morphological complexity. The perched nature of the distributary flow system can allow the hydrostatic pressure of fresh water to prevent saline intrusion. The outcomes are raised bed levels, arrested bed and bank erosion, increased surface and shallow ground water levels, and creation of waterholes and backwaters in a pool-riffle or chain of ponds sequence.

According to the CSIRO Expert Panel Report (CSIRO 2002), the following major environmental and agricultural issues are addressed by the implementation of NSF:

- low floodplain productivity;
- elevated salt export;
- salt intrusion into the root zone of floodplain soils;
- channel erosion;
- hillslope erosion;
- low functional diversity of pastures;
- poor nutrient retention in plant-soil system; and
- altered surface-groundwater hydrology.

As a result, the benefits of implementing NSF can be described as:

- decreased salt fluxes;
- increased sedimentation;
- increased shallow aquifer recharge;
- decreased water velocities;
- maintained high water tables;
- effective subsurface irrigation;
- increased pasture productivity;
- increased soil organic carbon levels;
- increased residence time of nutrients;
- minimised soil erosion and compaction; and
- maintained soil structure.

Features

The implementation of NSF is evident as a combination of structural and non-structural management measures that have altered the water, salt and nutrient balances, and that have increased farm productivity (CSIRO 2002). The structural measures of NSF include:

- grade-control structures in the stream line;
- contour banks on the floodplain and at the hillslope-floodplain break of slope; and
- contour channels diverting water away from the stream line.

These structural measures provide increased residence time of water by diverting floodwaters from the stream to the floodplain, and hence increasing shallow aquifer recharge, and by decreasing water velocities in the channel and on the floodplain (CSIRO 2002). The management of the hydrologic regime allows substantial recharge, limits deep drainage, and allows maintenance of high water tables across the floodplain.

The non-structural measures include:

- avoidance of surface (spray) irrigation;
- avoidance of herbicide use;
- minimal use of chemical fertilisers;
- avoidance of ploughing on hillslopes;
- avoidance of storing water in dams on saline areas;
- minimisation of cultivation on the floodplain;
- redistribution of nutrients onto hillslopes and to the head of the floodplain; and

- grazing regime managed to promote a succession of pasture species from a dominance of less palatable annual broad-leaf species to a dominance of more palatable perennial grasses.

These non-structural measures provide increased pasture productivity, increased soil organic carbon levels, and increased residence time of nutrients (CSIRO 2002). The improved ground cover and minimal cultivation helps to minimise soil erosion, avoids soil compaction and maintains soil structure.

References

CSIRO (2002) 'The natural farming sequence.' CSIRO, Expert Panel Review, Canberra.

Eyles RJ (1977) Changes in drainage networks since 1820. *Australian Geographer* **13**, 377-387.

Young WJ, Schiller CB, Harris JH, Roberts J, Hillman TJ (2001) River flow, processes, habitats and river life. In 'Rivers as ecological systems: the Murray-Darling Basin'. (Ed. WJ Young) pp. 45-99. (Murray-Darling Basin Commission: Canberra)