NSF - Principles & Applications

Introduction

Peter Andrews, is a third generation farmer who has been involved in farming and horse breeding for 60 years. He believes that heavy grazing of streambed banks following European settlement has, mainly by reducing vegetation, significantly increased stream velocities. This has resulted in gouging of streambeds and the lowering of water tables in floodplains.

Peter Andrews sees the effect of these changes in the landscape resulting in dry spells turning into drought conditions faster than they should, biodiversity being reduced, and in many instances fresh water that once sat on top of saline water being drained off, resulting in salt being released into the streambed.

Mr Andrews has developed, and is constantly refining, a system of farming based on his observations and interactions with a variety of natural landscapes. The insights he has gained are contained in the principles of Natural Sequence Farming (NSF).

While employing a holistic view of all the interactions in the landscape, Peter Andrews believes that the health of floodplains and their streambeds can be significantly restored by slowing the rate of water flow, especially after rain events, by a series of physical interventions in the landscape.

Implementing Natural Sequence Farming over a range of climatic regimes does not mean trying to take the landscape back to what it was pre-European settlement. Rather, NSF focuses on establishing how the natural system worked in a particular area and how it is working now.

Peter Andrews, uses some of the same natural techniques, and mimics others, to address soil and water degradation and loss of biodiversity. He does so by re-connecting natural sequences of activities within the NSF management approach.

Interest in the approach has grown recently. Record drought has highlighted the ability of NSF to contain salinity and generate water savings and minimise dependence on conventional irrigation extractions from streams.

A growing number of experts believe that this holistic approach to natural resource management can be applied on a day-to-day basis to property, catchment and landscape management across diverse regions, in harmony with the Australian environment.

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Natural Sequences

Natural sequences that can be harnessed by informed management include the movement of grazing animals, birds and insects from valley floors by day to higher levels on the valley sides at night and the transfer of fertility with them. There is a gradual movement of nutrients and seeds back down the valley sides via the water cycle, vegetation and soil processes, constantly refurbishing the fertility of the landscape.

In the process, various plants collect specific substances and the plant communities' change in predictable sequences. As part of the biodiversity of a property and catchment, these plants are also a part of multiple food chains and a key to enhancing fertility.

Nutrients contained in soil or water are mobile and can be quickly lost off-site. Nutrients contained in biodiverse living bodies are stable. NSF management keeps natural functions connected which allows for quick exchange and conversion of nutrients within ecosystems on properties.

Peter Andrews has found that even plants labelled as weeds can serve as pioneering species in inhibiting nutrient and soil erosion. They collect and supply essential substances for environmental health. Once slashed, fertility is built up and the weeds are replaced naturally by palatable grasses. To maximize production and conservation results requires a good understanding of interaction of the roles of clays and sands in the process.

This process is complemented by NSF property management when the initial erosion and fertility stabilising need has been met. The once degraded soils are then able to contribute to increased water use efficiency and optimal production levels through their increased organic content.

Areas such as floodplains, that collect large amounts of nutrients, can be harvested to redistribute some of the fertility. Like the daily migration of birds and animals, downpours flushing streams to a floodplain are a sequence in the periodic fertilisation and harvest cycle.

In this process, surface running water dissolves natural substances and collects sediments, algae, microbes and plant residues from all parts of the catchment. Re-connecting running water to the stepped land formation of the chain of ponds that used to dominate traditional Australian landscapes, slows water flow. This enhances the ability of growing plants, coupled with decreasing inclines, soils and sands, to filter the water feeding into streams running along the valley floor. This process, in turn, feeds plant roots from the sub-surface and caps saline groundwater from surrounding slopes by perching a freshwater lens above saline layers.

All substances are functional in this naturally managed environment. Salts managed as saline groundwater, where evaporation is excluded from concentrating and crystallizing the substances, allow plant, animal and water ecosystems to balance salinity in the landscape as a natural function. In this way a hillslope pasture or floodplain water meadow is re-created.

On the floodplain, hydrostatic pressure is maintained on the heavier lower saline layers though maintaining high freshwater tables in the perched chain of ponds. At the same time, the stream replenishes the floodplain and its meadows, through lateral transfer to the freshwater table just below the surface.

The floodplain is convex. The perched stream runs along the higher elevation or apex and the billabongs and back swamps are at the lower positions on the perimeter of the floodplain where it meets the valley sides. This shape is created by the natural flow of the stream and reinforced by heavier sediment being deposited on and near the stream-bed in flood.

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A farming system founded on working with nature

In many regions of Australia, floodplains are disconnected from creeks and rivers and natural flow regimes. This leaves them unable to store water to support productive farming and the growth of riparian vegetation.

Many of today’s floodplains are incised with deeply scoured gullies and gorges. These are channels that expedite the swift flowing removal of much of the land’s fertility and the carriage of increasing amounts of salt. The soil and its nutrients are highly susceptible to leaching and erosion owing to the application of inappropriate agricultural and pastoral practices creating depleted soils and vegetation cover.

NSF takes a holistic approach to natural resource management by re-establishing the stream’s connection to the surrounding landscape and restoring floodplains as ‘sponges’. Although most landscapes have unique qualities, the principles of landform and management are the same. The physics remains constant.

Peter Andrews’ interpretation of the landscape accepts that, pre-European settlement, the soil’s natural salt content was kept in check by slow sub-soil movements of fresh water.

Under natural systems that are replicated by NSF, movement of fresh water is by surface and sub-surface flows. The surface flow is by the stream which is perched at the highest level *of* the floodplain on an accumulation of sediment. Surface water is buffered at each narrowed step position in the chain of ponds. Under NSF, this is achieved by a naturalised ‘leaky weir’ of rocks, sediment, trees, branches, reeds and grass roots mimicking the original natural slowing impediments to flows.

In floodplains in their pristine form, water is stepped slowly down the stream valley floor from one end of a catchment to the other. The stream valley floor is segmented with steps. These steps are where a new floodplain starts and the up-stream one finishes, and below which, large reed beds form on recharge areas.

The floodplains are soil, vegetation and water-filled ponds, forming links in a chain as they progress through each step down the valley. They are joined at each step where the valley sides narrow. Stream water travels through each linked floodplain as a sequence in the stream valley. The stream meanders over each sequence. It covers the floodplain with sediments as it steadily descends the valley. Each floodplain has stream meanders, pools and riffles as well as wetland and water meadow filters.

Where an incised stream bed exists, during low to medium stream flows, the sides of the stream are contained by levee banks built up by flood deposits. The banks are protected from severe erosion by wetland plants such as Phragmites, other natural grasses, and streamside trees and shrubs, which have colonised the area.

At the same time, hydrostatic pressure from the perched water table in the stream prevents the lateral intrusion of salinity from the floodplain even in low flow periods.

To recreate the chain of ponds effect, NSF uses small secondary diversion channels to reconnect streams to their floodplains. These channels braid out through the lush meadows to the edges of the floodplain and water then returns to the main stream through surface and sub-surface flows. They pick up peak flows that are diverted by the leaky weirs which maintain normal base flow to downstream properties.

During high flows, as water spreads across the floodplain in the braided diversion channels, some water is absorbed through sandy intake beds, recharging the groundwater lens above saline layers and just below the plant root systems.

Another portion of the surface water is carried in the channels towards historic floodplain terraces on the edge of the floodplain to refresh hollows and billabongs, facilitating fish passage in the process.

During flood events, the reed buffers along the stream sides and at the narrow ends, where each pond is joined in the chain, lay down to laminate the ground surface with their protective mat but are ready to grow upright again when the flows have subsided.

The hydrostatic pressure of water in the topped-up meadow and billabong storages on the floodplain prevents the plants on the floodplain from ‘drowning’ in the short interval when the water is at a high level. This process can mitigate the impacts of salt ‘slugs’ that may have been scoured from saline deposits in uplands.

The stream water that is impounded in the recharged groundwater lens within the floodplain soils also provides a buffer against drought. There can be a period of several years of thriving plant growth before the water is fully transpired and the soil, which is heavily shaded by extensive vegetation cover, dries out. In normal years recharge from flooding would arrive earlier to restore the groundwater.

As part of NSF management, the farmer can divert flows between channels to dry out a meadow area for harvest while starting to produce increased growth in a new zone of the floodplain.

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Maximum natural outcomes with minimum financial and manufactured inputs

Peter Andrews' NSF concepts are being applied at project sites as diverse as those featuring upland fast-flowing water courses, to broad acre cropping areas, dry gullies, and salt encrusted degraded lands as well as broad stream valleys and wetlands. Where human-induced impediments to natural growth and production are gradually replaced by the system built around the natural sequences of plants, animals, water and soils, properties have a solid foundation for increased profitability and long term sustainability. Industry analysts have been particularly attracted by the lush growth produced during drought conditions under Peter Andrews' system.

Under NSF, natural water flows are reintroduced to alluvial soil plains. In many ways natural alluvial soil floodplains form the whole waterway down the valley whether through surface or sub-surface flow. In contrast, irrigation is the artificial application of water to the land. Invariably, the source of the irrigation water is from artificial storages and highly moderated streams with incised and eroded channels. These have generally been created by past poor environmental practices such as the removal of ground cover.

Owing to its base of natural processes, NSF achieves more sustainable outcomes than traditional pipe and pump irrigation systems as it does not incur large financial costs or create long-term environmental degradation, loss of biodiversity and increasing salinity, as often occurs catchments with highly regulated stream regimes. NSF employs few imported or manufactured inputs such as pesticides, herbicides and artificial fertilisers. In terms of financial capital and operating inputs, it is not an expensive system to introduce and it brings Greenhouse gas benefits through increasing carbon levels in the landscape.

The investment required is in training for the landholder to interpret the natural processes of the landscape and time spent by the farmer in 'reading the country' and applying the NSF principles to the particular property and landscape features of their region. It is no surprise to find that Peter Andrews grew up on a property near Broken Hill area and spent much time with his stockman father and members of the Aboriginal community learning to read country.

In most cases, Peter Andrews finds that resources available on-site only require intelligent redistribution for natural processes to work in favour of productivity and a reversal of human-induced environmental imbalance and degradation, as most of the naturally developed 'infrastructure' is still there.

In working with nature, NSF requires very low maintenance inputs. Where outside inputs are employed on a farm they can be targeted. Small amounts can be applied to specific areas or species where the system is temporarily out of balance owing, in most cases, to factors outside the property boundaries. NSF harmonises modern technology with natural plant progressions to achieve a resilient model of farming.

Where neighbouring landholders in a sub-catchment adopt NSF, even more rapid progress to increased profitability and environmental sustainability can be achieved, as NSF adopts a whole-of-catchment approach to farming.

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NSF applied to Grazing

Under NSF, many forms of grazing are appropriate if a vigorous perennial plant community can be maintained. If c ell-grazing methods are used, especially across valley segments from ridge to ridge, protection of the riparian zone needs to be considered. Over the medium to long term, weed control, nutrient balances and pest management can be managed by using Natural Sequence Farming methods.

The improved groundcover and reduced cultivation under NSF not only minimises farm costs but also reduces erosion, avoids soil compaction and maintains a soil structure with increased water holding capacity.

The use of water balances within NSF, brings the most increases in productivity and sustainability. Costs are also minimised, as water storage is in the groundwater lens rather than expensive above-ground dams, prone to siltation and with high evaporation rates when the water is needed most. Pasture is fed naturally from the roots rather than requiring extensive capital investments in pumps, pipes, irrigation gantries or feeder networks.

Traditional livestock husbandry methods can be complementary to Natural Sequence Farming. Under NSF, livestock are considered as a major tool in land management, including for transferring fertility and controlling weeds. However, feedlot methods of production and other methods of confining herds or flocks need to be well-sited in the catchment to utilise self-removal and self-collection of residues for fertility management.

Once the initial phase of re-establishment to natural sequences is well on the way, which in most cases only takes one or two years with low cost inputs, monitoring and the application of NSF principles in harmony with Nature achieves continuing sustainable production.

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NSF applied to Agriculture

Under NSF, cropping is best suited to methods complementary to retaining significant areas of season-specific perennial pastures. If needed, cultivation may be confined to soils on valley slopes rather than floodplains but it can be worth exploring direct-drill minimum-till broadcast methods first.

Horticulture can be sited off flood plain areas, with careful transfer of valley floor fertility and water within the NSF system.

NSF harmonises well with organic approaches to producing premium farm produce for a growing domestic and export market. Increasing numbers of consumers and vendors are demanding products produced with environmentally sustainable systems coupled with farm accreditation and certified produce before acceptance.

The use of outside inputs or recycling farm produce on the property can be part of managed fertility transfer, both on the farm and in the sub-catchment. For instance, hay making of legume-rich pasture can be rotated around various areas of a property to work in with weed reduction needs and fertility management.

Irrigation is best-suited on valley floors although most areas managed with NSF require minimum supplementation of water transfers already naturally occurring on and beneath the floodplain.

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Sustainable Landscape Outcomes under Natural Sequence Farming

Under Natural Sequence Farming, a sustainable farm landscape evolves where:

- Stream water is carried on the highest formed land on a flood plain, which includes not only the stream channel and wetlands but also water meadows fed by subsurface flow and braided channels.
- The wetlands and meadows evolve a form of periodic harvest through NSF practice to maintain ecological balance and promote biodiversity
- Farm managers factor in flood inundation as a beneficial part of the natural sequence.
- Floodplains are maintained by fresh water-filled subsurface flows through porous soil intake beds.
- Erosion is balanced by sedimentation.
- Polluted stream water is filtered as it moves through the chain of ponds, its wetlands, lush floodplain meadows, sandy groundwater intake beds and reed beds along the length of the stream valley floor.
- Whole-of-farm ground cover is at a high ratio, with season specific perennial and annual plants maintained in a balance of natural sequences in turn confining weeds to a small percentage of the plant community.
- The farming system and livestock movement is harmonised with the periodic harvest sequence of crops, grasslands and water meadows to maintain habitat and nutrient balance in the landscape.
- Biodiversity is maintained at a high level with the diversity of habitats created by the natural vegetation and aquatic sequences**.**

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Overview

Preliminary research suggests that Natural Sequence Farming offers a cost-effective approach for dealing with a national challenge – the management of landscapes that are prone to leach salts into water courses and to lose fertility owing to unsustainable cropping and grazing practices.

NSF has the potential to offer significant environmental, economic and social returns to landholders and communities.

Early adopters and entrepreneurs, such as Gerry Harvey, see Natural Sequence Farming based on re-creating the core of the past to manage the present, as the future foundation for Australian farming.

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