Agriculture Notes

Managing wet soils: case study of subsurface drainage (1)

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In Alan Jefford's own words "You can not afford not to put in drainage". He is convinced about the profitability of sub-surface drainage for dairy pastures in high rainfall areas.

Alan decided to install sub-surface drainage rather than investing in additional land.

He believes that his land is productive in winter when not waterlogged and therefore wants to prevent waterlogging if possible.

Sub-surface drainage has allowed him to increase his winter pasture growth rates and reduce susceptibility to pugging, which purchasing additional land will not achieve.

Sub-surface drainage has allowed the calving pattern to be moved forward from spring to autumn and take advantage of higher winter milk prices.

Another large benefit of drainage is that silage can now be harvested when it is ready, wet soils do not limit the harvest date.

The land is much more trafficable than before drainage, and this assists with management.

Background

Alan and his family have been farming in Australia for 20 years, after migrating from England. They spent four years in the Hunter Valley and 16 years on the current farm at Cloverlea in west Gippsland (110 km east of Melbourne and 15 km south east of Warragul). Average annual rainfall is 1020 mm and can vary from 685 mm to 1250 mm. The entire farm area of 176 ha has now had sub surface drainage installed. Soils typically consist of clay loam topsoil up to 600 mm deep over clay subsoil. These heavy clay subsoils restrict the downward movement of surplus soil water frequently causing the topsoil to waterlog. Paddock size varies from 2.5ha to 8 ha.

Around 350 cows are calved down each year but only 200 of these are kept in the milking herd. Being a Friesian stud large numbers of females are sold each year. Many heifer and bull calves are reared each year and a large proportion are obtained through embryo transfer. Cows calve between January and September, with two main batches of cows implanted with embryos calving in April and August. Most of the later calving cows are used as recipients and are sold following calving. Calving the majority of the milking herd in autumn allows for a longer lactation and takes advantage of the higher winter milk prices. Cows are milked in a 28 platform rotary dairy.

To complement the operation crossbred store beef cattle are purchased and fattened. The overall stocking rate is approximately 2.4 cows/ha.

The normal fertiliser application rate is a custom mix of 6:6:6:7 at 250 kg/ha/year, usually applied in May. Pastures are limed each year.

Pugging

Pugging has been reduced through the installation of sub-surface drainage, which allows soil to drain freely and quickly. July, August and September are the months when pugging is most likely to occur on this farm. Alan estimates that drainage has reduced pugging to 25% of what it was 20 years ago when he first came to the farm.

Improvement of laneways and water trough surrounds has also assisted in reducing pugging. Pastures in this district normally become waterlogged in three out of four winters, 1995 and 1996 were wet years at this farm. 1997 to 1999 have been drier than average winters, with minimal pugging damage.

In addition to the usual benefits of reduced pasture and soil damage by preventing waterlogging, drainage has also meant less udder washing. Originally 90% of cows required udder washing before milking 20 years ago. Cows udders are no longer washed, which has resulted in a reduction of sediment in the milk.

Pasture management

A large proportion of the herd calve in autumn to better utilise pasture, maximise lactation length and capitalise on higher winter milk prices. Cows are grazed behind an electric fence with two moves per day throughout the lactation. Winter pasture growth has increased because of the drainage.

When pasture growth exceeds cows requirements paddocks are locked up and surplus is conserved as silage

or hay. By having increased winter growth rates from drainage, pasture can be locked up for silage and cut much earlier than previously. The paddocks are much drier and heavy machinery can be used on them. This early cutting of silage has associated benefits of better quality and faster pasture regrowth. Alan has found that pastures on his drained paddocks also persist longer because of much less pugging damage.

If soil is already wet and there is heavy rain cows may be offered a larger grazing area. Alan finds that under drainage only minimal pugging occurs and pasture recovers quickly. In extreme weather conditions milkers may be removed one to two hours earlier from the pasture and fed additional silage on the feedpad at milking time, but this is not a common practice.

Supplementary feed

Eleven to 14 ha are planted to maize for silage each year. It is fed to milkers on a feedpad close to the dairy. Maize is planted following the installation of drainage to assist with levelling of the paddock and to make it more trafficable for machinery. Maize is preferred over turnips as silage is stored and used as required. Drainage has allowed the maize crop to be sown earlier. The ground can be worked up four to five weeks sooner.
Hay and grass silage is fed on the driest areas of the paddocks. Wastage can occur in wet conditions. The feedpad is not designed for hay or grass silage as the coarser nature of the feed means that it can easily be pulled out of the troughs and trampled. Hay is fed between June and October and pasture silage from January to June. Maize silage is fed from March until October, as supplies allow. Drainage has allowed silage to be cut early and as a result some paddocks are cut 2 to 3 times in one season. In extremely wet conditions hay will be fed on the feedpad using a hay ring.

Cows are fed 6kg of wheat and 2kg of canola meal in the dairy. Depending on price, lupins or maize may also be fed. The grain portion of the diet is determined by selecting best available option for the price. Alan feeds his cows to appetite so that little is wasted.

Feedpad

The feedpad was built nine years ago to make feeding maize silage easier. It allows cows to be fed as they leave the dairy. Previously cows would go on to wet paddocks empty and hungry, and being discontented, walk around causing more pasture damage. At the morning milking half the herd eat while the other half are being milked. They are then swapped over. Cows spend up to one and half-hours on the feedpad. Theoretically there is enough space (150m trough face) for 200 cows to eat at one time. Allan prefers to feed half the herd at a time to allow more room for heifers to eat. Only in extremely rough weather will the cows be fed at both milkings with silage.

Alan and his son Edward built the feedpad for about $13,000. This included the adjoining concrete based silage pit (for winter access). The pad has a concrete base and has three 50-metre troughs, of two designs. Concave metal sections are joined to form one type of trough. The other type is a square ridge of concrete approximately 150 mm high (similar in appearance to the standard concrete kerbing). The pad is fenced with an electric wire fence. It took four people two days to build the pad.

The site was selected between the dairy and the existing silage pit. Soil excavated when building the new silage pit was used to level the site for the feedpad. Effluent is pushed into a manure pit using a tractor and blade. A contractor spreads the effluent over a different paddock each year. Allan is a strong believer that the manure is a real asset for the paddock. He had considered concreting a section of the lane close to the dairy and installing troughs along the side with parallel vehicle access, but decided the above option was preferable.

Drainage

Sub-surface drainage on the farm consists of a combination of tile (agi-pipe) and mole drains. Installation began in 1985, one year after moving to the farm. Alan had knowledge about the effectiveness of drainage from his experience in England. Alan's confidence in the suitability of sub-surface drainage for his farm was boosted when he found that one of his neighbours had installed mole drainage on a similar soil type in the 1960's,and they are still working today. Support was also accessed from a local drainage contractor prior to installing the tile (agi-pipe) and mole drainage. One paddock was drained the second year of farming at Cloverlea as a trial to test its effectiveness. The rest of farm was then drained over the following years. Alan said the real proof that drainage works "is the amount of water running out of the six inch outlet, it runs full bore".

Mole drains are installed when the surface soil is dry but the sub soil must be moist to form a stable mole, if too wet the mole will collapse. Mole drains are normally installed on this farm from December to February. Alan has his own mole plough and uses his own tractor to install moles. Moles are pulled through the collection drains to provide an outlet for the moles. He does not find the procedure expensive just the use of the tractor, some diesel and time. There fore Alan likes to re-pull moles every few years before they break down. A commercial drainage contractor designs and installs the collector drains. These collector drains are constructed by digging in a trench to the appropriate depth, laying slotted agricultural pipe and backfilling with 300 mm of scoria. The outlets from the collector drains discharge into a natural watercourse on the farm.

From experience Alan has found that for effective operation of this system type you need deep outlets and sufficient fall (ideally 1 in 700 meters) to enable the drains to run freely. Collector drains are usually installed at about one meter deep, mole drains are installed 3m apart. Collector drains have a 150 mm outlet. Further from the outlet the pipe diameter is 100 mm, because of the lower flow rates. Drainage installation has been refined over the years to meet farm requirements. Usually drains will start running in June and can continue until December depending on the season.

Alan estimates that milk production has increased by a factor of four since the first year on the farm. This is partly attributed to the installation of drainage, in combination with soil testing and appropriate fertiliser application, application of lime and improving pasture species. As a result cow numbers have been increased from 80 to 200. Drainage has allowed Alan to move forward his calving to take advantage of the higher winter milk prices. This is a result of increased pasture growth in winter and spring from better drained soils, leaving more suitable conditions for root growth. Less pasture renovation is required, as sub-surface drainage has reduced the incidence of serious pugging which damages pasture. He wanted to maximise use of pasture, as it's the cheapest feed source.

Alan made the decision not to purchase additional land but rather to install sub-surface drainage. He knew he had good land when it was not waterlogged in winter and wanted all his land to be trafficable. The decision was made to spend money on drainage rather than additional land. Even with twice the land under wet conditions winter growth would be seriously limited. An added benefit of drainage is that the total cost is deductable as an expense in the year of installation.

Drainage has given the farm more flexibility. Alan can put cows in any paddock on any day. (Many people allow a period of 24 hrs for the drains to remove water from the topsoil and therefore reduce susceptibility to pugging). Allan said that he was extremely happy with the drainage system. If he had to improve the system he would probably have a detailed map of where all the outlets are.

The Water Act

The Water Act (1989) provides guidance for the management of waterways and swamps. Before considering draining a wet area you should contact your local Catchment Management Authority for advice, as a permit may be required.

Figure 1. Feedpad showing the two types of trough

Figure 2. Feedpad and silage stack

The previous version of this note was published in August 2002.