

THE ENVIRONMENTAL IMPACT OF SHEEP CONFINEMENT FEEDING SYSTEMS

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SUMMARY

Confinement feeding systems are being used increasingly in dryland Australia for the finishing of lambs, and for maintenance of the flock in drought conditions. They have great potential as part of the farming system to address other major issues, such as herbicide resistance, soil compaction and improved management of pastures through deferred grazing. Whilst the benefits of confinement feeding systems are well documented, the environmental risks they pose and how can these risks be minimised through site selection, design and management are less well understood. Current legislation and guidelines consider sheep to be mini cows, but there are significant physiological and production differences between intensive cattle and sheep systems that may influence their relative potential to cause environmental harm. This paper examines the key differences between the 2 systems, particularly the pollution potential of cattle and sheep manure that is influenced by levels of moisture, nutrients and biochemical oxygen demand. It also questions how a grain-based diet may influence levels of pathogens in sheep manure, and the potential impact on food safety. There are large gaps in our knowledge of the environmental impact of sheep confinement feeding systems in Australia. Producers need guidelines on site selection, design and management of sheep confinement feeding systems to minimise environmental harm, but these must be based on sound research if sheep meat and wool are to retain their product integrity.

Keywords: sheep, confinement feeding systems, environment, pollution, manure, management

INTRODUCTION

Confinement feeding systems are defined as an enclosed area where all feed and water are brought to the animal. This includes any grain finishing system, from purpose built systems through to small paddocks with self-feeders (Bryant and Kirby 2003). In dryland Australia, confinement feeding systems have been primarily used to protect extensive areas of paddocks from soil erosion, and pastures from further damage in times of drought (NRE 2003), and to achieve a consistent supply of quality sheep meat to meet market specifications (Bell *et al.* 2003).

The role of confinement feeding in dryland farming systems in Australia is becoming more obvious. There is increasing demand, particularly from the United States, for heavier lamb and consistency in supply. Confinement feeding systems are the most cost effective way of finishing out-of-season lambs to meet specifications and, thereby, increase total export markets (D. Bradford, *pers. comm.*). The competition for land from cropping has increased in the last decade in traditional sheep producing areas (Meat and Livestock Australia 2003). Australian producers have increased their grains and other livestock enterprises at the expense of sheep and wool, with the number of broadacre farms with sheep falling by 20,000 in a decade to just over 40,000 farms in 2002/3 (Ashton 2003). Confinement feeding systems allow sheep production to continue in conjunction with arable cropping of cereals, legumes, canola and cotton. Broadacre farming problems such as soil compaction (Proffitt *et al.* 1993) and herbicide resistance (Roy 2003) can also be overcome by cutting pasture for silage and feeding it to sheep in the confined areas. With less area available for grazing, pastures need to yield more, and require higher inputs. To ensure good establishment and longevity of high input pastures, deferred grazing and fodder conservation are required (Devenish and Hyder 2001). Confinement feeding systems allow producers to retain stock whilst deferring grazing, and to maximise the value of improved pastures by feeding them as high quality conserved fodder such as hay or silage.

Globally, consumers are demanding product integrity, and the industry needs to be able to guarantee it at every stage of the supply chain (Crombie 2003), and this includes environmental sustainability and animal welfare. If confinement feeding systems are to be an ongoing part of wool and sheepmeat production, they need to meet or exceed consumer demands.

ENVIRONMENTAL HARM ASSOCIATED WITH CONFINEMENT FEEDING SYSTEMS

Confinement feeding systems allow sheep and cropping systems to coexist and create more profitable and sustainable farming systems (Milton 2003). However, their potential for land degradation, pollution and related effects such as erosion, nutrient run off, groundwater contamination, greenhouse emissions, odour, dust, noise and flies at the farm and catchment level have not been quantified. They are likely to pose an environmental hazard. Nutrient levels increase in the soil with potential for nutrient leaching and runoff. The soil surface is exposed and loosened and at risk of wind and water erosion. Manure builds up, and its decomposition can produce noxious gases, harmful to both the ozone layer and animals. Effluent can contaminate waterways with excess nutrients and pathogens. Higher dust levels in the air can pose a health risk to humans and animals. However, the level of environmental risk posed by sheep confinement feeding systems has not been measured. Nor has there been any research into how site and environmental factors such as slope, soil type, hydrology, rainfall, distance to waterways and remnant vegetation affect the potential for degradation. Without this information, it is hard to know how sheep confinement feeding systems can be best designed and managed to minimise damage to the natural resource base.

CURRENT LEGISLATION AND GUIDELINES

In terms of environmental requirements, there are a number of state government acts, by-laws and regulations that cover the legal responsibilities of managers of intensive animal production systems. In regional Western Australia, for example, these include the Environmental Protection Act 1986, Environmental Protection Amendment Act 2002, Water and Rivers Commission Act 1995, Soil and Land Conservation Act 1945, Town Planning and Development Act 1928, and Health Act 1911. The responsibility of the operator is to neither pollute nor cause any form of environmental harm without appropriate approvals (EPA 2002). Currently, sheep confinement feeding systems for less than 10,000 animals are subject to the same EPA restrictions as cattle feedlots. Many of the state departments of agriculture have developed guidelines for sheep confinement feeding systems, which include designs and management to minimise environmental harm. These recommendations are based, however, on data from other intensive industries, primarily cattle feedlotting, and general land conservation methodology. In effect, sheep are viewed as mini cows by legislators and agricultural advisers, despite some fundamental differences between intensive cattle and sheep production.

CATTLE FEEDLOTING VERSUS SHEEP CONFINEMENT FEEDING SYSTEMS

There are significant differences between traditional cattle feedlotting and sheep confinement feeding systems in terms of purpose, structure and duration, and in the pollution potential of manure and the manure:soil interface.

Purpose. The purpose of cattle feedlotting is solely for production and finishing. A beef feedlot is a confined yard area where cattle are completely hand or mechanically fed for the purpose of production (Agricultural Council of Australia and New Zealand 1992). Sheep confinement feeding may have a number of purposes including drought management, deferred grazing or mating, as well as finishing out-of-season lamb.

Structure. The major cattle feedlots are specialised and capital intensive industries run independently from the rest of the farming system. Eighty percent of cattle feedlot production is in the 78 Australian feedlots that have a capacity of more than 1,000 head (Australian Lot Feeders' Association 2002). Most of these operate all year round. Lot feeders commonly buy store cattle from producers or turn off cattle on contract for cattle owners. Sheep confinement feeding systems tend to be a value adding activity to bring unfinished lambs up to market specifications when paddock feed is short (Milton 2001) and operate for a few months of the year. Confinement feeding systems are usually run in conjunction with the rest of the farming system to make the most of commodity prices.

Duration. Cattle spend between 100 and 180 days in a feedlot (Runov 1977), depending on economic factors such as market prices and feed costs, and target market specifications. Lambs that have been well backgrounded usually spend 4 weeks in confinement feeding on high grain diets (Dowling 2000), though some lambs may need to be lotfed for 6-10 weeks (Bell *et al.* 2003). In maintenance situations, sheep will be kept in a confined feeding area until conditions have improved.

Manure. Manure management is a major environmental issue for intensive livestock production. For every kg of animal product consumed by humans, over 20 kg of wastes are generated in animal feedlots (Taiganides 1977). Manure is high in nutrients such as nitrogen, potassium and phosphate, as well as salts. The pollution potential of untreated manure from intensive livestock production can be up to 160 times greater than raw municipal sewage (Illinois EPA 1991). The pollution strength of the organic matter in manure or waste water is often expressed as the biochemical oxygen demand (BOD₅), which is the amount of oxygen required to stabilise decomposable organic material under aerobic conditions (Chastain 1995). Another useful measure is the BOD:COD ratio (biochemical oxygen demand: chemical oxygen demand) which measures the degradability of organic carbon (Taiganides 1977). The higher the BOD:COD ratio, the faster the material will degrade and cause nuisance conditions.

Manure quantities and composition are influenced by many factors including age, breed, diets and weight (US EPA 2002). Currently, there is little documentation on the composition of sheep manure under dryland Australian conditions. However, the differences between feedlot cattle and sheep manure characteristics are documented in other areas of the world. On a weight basis, sheep produce two thirds as much manure as cattle. It is drier, has half the concentration of nitrogen, a similar concentration of phosphate and almost twice as much potassium (Pennsylvania State University 2003). Sheep manure also has half the biochemical demand for oxygen of cattle and a BOD:COD ratio of 7.8% compared with 17.4% for cattle (Taiganides 1977). Whilst these figures suggest that sheep manure is less polluting than cattle manure, there is a wide range of documented values that illustrates the need for a range of 'norms' for sheep manure in dryland Australian conditions.

Sheep manure is difficult to dilute or mix with water, as solids tend to float. Consequently, with the exception of manure from early-weaned lambs on a liquid diet, sheep manure is best handled in solid form (Pennsylvania State University 2003). The comparative dryness of sheep manure is a potential benefit. With good manure management, moisture levels could be kept below 33% where there is no oviposition from any flies or any fly development (Taiganides 1977).

Pathogens. Unlike the cattle industry, acid resistant *Escherichia coli* has not been identified as a major food safety issue in sheep, but the change from relatively alkaline diets of pasture and stubble to a more acidic, grain based diet in a confined feeding system could change this. All animal manure has high levels of faecal coliforms and bacteria. Whilst most pose little risk to human or animal health, an acid resistant strain of *Escherichia coli* (*E. coli* O157:H7) is common in grain-fed cattle, and can cause food-borne illness in humans (Russell 2000). A grain-based diet results in a lower pH in the gut, causing higher shedding of the acid resistant *E. coli* in the manure. We do not know whether there will be a similar food safety issue posed by sheep fed on a grain-based diet.

Pad and manure management. In cattle feedlots, it is desirable to maintain a pad, a compacted layer below the surface of the feedlot that prevent infiltration of nutrients and effluent into the groundwater. Manure is scraped from the top of the pad periodically, and effluent is usually collected in ponds. The moisture in the manure from high stocking rates prevents dust becoming a problem. Good manure collection, storage and disposal (whether spreading as fertiliser or composting) prevents anaerobic decomposition of manure and subsequent build up of odours and emissions of greenhouse gases. In sheep confinement feeding systems, it is not possible to maintain an impermeable manure pack due to the relatively short residence times of sheep in confinement. The environmental impacts of the absence of a pad, and the build up (and break down) of sheep manure during the period of confinement feeding have not been studied. Straw is commonly used as a 'deep litter' system in sheep confinement feeding systems to reduce dust and disease, and provide warmth for the animals through the breakdown of straw. To date, there has been no research into how the use of straw affects the environmental impacts of a confinement feeding system.

CONCLUSIONS

There are a number of gaps in the knowledge that exists about the environmental impact of sheep confinement feeding systems. The research questions that urgently need to be answered are;

- What are the normal ranges of nutrient composition and pollution potential of manure from sheep confinement feeding systems under dryland Australian conditions, and how are they affected by age, breed, weight and diets?

- How does a grain-based diet affect the levels of acid-resistant *E. coli* in the gut, and what is the potential impact for product safety?
- What influences the development of a pad in sheep confinement feeding systems, and how does the pad impact on groundwater contamination, runoff and greenhouse emissions? In the absence of a pad, what are the environmental impacts of using straw or other materials?
- What moisture levels are needed to prevent dust, flies and odour becoming a problem and how can these levels be maintained?

It is important that these questions are answered fully, and guidelines are developed to assist producers in the site selection, design and management of sheep confinement feeding systems. Wool and sheepmeat need to be produced in an environmentally sustainable way. Consumers demand product integrity that includes environmentally sustainable production systems and animal welfare at all points of the supply chain. Failure to meet this consumer demand could lead to loss of our international markets. Without data on the polluting effects of confinement feeding systems for sheep, and guidelines for producers on how best to set up and manage confinement feeding systems, the sheep industry is unable to guarantee the integrity of sheep products, and meet international and domestic consumer requirements for environmentally sustainable production.

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