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Agroforestry for sustainable goat farming: shade, shelter, fodder, and environmental benefits of trees.

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Abstract

The establishment of trees on farms provides shade and shelter for grazing livestock. Many trees and shrubs are also important feed sources, especially during periods of pasture scarcity. In addition, agroforestry provides many environmental benefits to farm ecosystems. All these factors suggest a vital role for trees in sustainable farming systems, especially in the context of climate change. This research focusses on the benefits of agroforestry to goat farming in Australia, a particularly important and growing industry given the increasing global demand for goat meat and Australia's lead role in world exports. There is significant potential for goats in silvopastoral systems, given their hardiness, adaptability, and tendency to browse on plant material that is not usually consumed by other stock. This project includes two major experiments: one investigates the effect of shelter provision on the growth and performance of newborn nursing kids (0-3 months old); and the second investigates the effects of shade provision, supplementation with fodder from acacias and willows, and potential interactions between these two factors on the productivity and performance of weaned kids (3-6 months old). Productivity parameters, such as live weight changes, control of internal parasites, and feed intake, will be used in the analysis. This study will lead to a better understanding of the roles that trees and shrubs play in sustainable goat farming, and will also result in well-tested recommendations to the goat industry, to optimally establish and design goat farms by incorporating trees and shrubs in the landscape.

Keywords: agroforestry; goats; shade and shelter

Introduction

Trees potentially have a positive role on farmlands through their impacts on both animal and plant productivity. Their direct benefits on livestock are through the provision of shade and shelter, which is probably the most common motivation for planting them (Wilson *et al.*, 1995). They also positively affect crops and pastures, by significantly contributing to the improvement of water use efficiency, yield gains, and plant health and productivity (Cleugh *et al.*, 1998). Together, these qualities add to the important environmental and conservation values of trees on farmlands.

Provision of shade and shelter for livestock

Heat stress may have detrimental impacts on animals, and may lead to decreased feed intake, lower productivity, and a range of serious health and welfare issues. Trees are the most effective shade producers when compared to artificial shading (Armstrong, 1994).They can significantly improve the effective temperature of animals by blocking direct solar radiation, and creating evaporative cooling (Blackshaw and Blackshaw, 1994). Provision of enough tree cover on farms for shade purposes seems to be the simplest management modification to reduce radiant heat gain, however this is often neglected, and stock are commonly seen crowded under single or sparse trees in paddocks (Gregory, 1995).

When hyperthermia occurs in goats, for example, their evaporative heat loss mechanisms are inadequate, leading to suppression of feed intake and the increase of maintenance energy requirements. The lower voluntary feed intake is beneficial under high ambient temperatures in terms of reducing heat production, but it will also lead to a lower nutrient supply for production purposes (Lu, 1988).

In cold weather, trees play an important role in sheltering stock from wind, rain, dew or frost. Shelter is very important in terms of preventing the inevitable shift of energy from productivity to maintenance requirements in animals subject to cold stress (McArthur, 1991), which may also alter grazing behaviour and thereby reduce intake (Bird *et al*., 1992).

In the Southern Tablelands of New South Wales, for example, the risk of death due to exposure was as much as 50% greater for merino twins compared to singles (Donelly, 1984). Recently-shorn adult sheep, particularly those in poor physical condition, are also particularly at risk when exposed to wet windy weather, especially during the first 24 hours following shearing, and even for seven days or more after that (Bird *et al*., 1992).

Provision of fodder

Fodder trees and shrubs constitute a nutritionally important feed for ruminant animals. Generally, when other forages are abundant, trees and shrubs are much less consumed by animals, however, during periods of drought, they constitute a valuable source of browse fodder (McLeod, 1973), and they might even constitute the only source of protein and energy if drought is severe (Ben Salem *et al.*, 2010). This suggests a very important role for fodder trees and shrubs on farms as an economical alternative to other forms of supplementation (Borens and Poppi, 1990).

The environmental value of trees on farmlands

Trees are able to recycle nutrients from deep layers of the soil and return them to the productive topsoil through falling litter, due to their extensively developed root system (Szott and Kass, 1993). Promoting agroforestry also presents a major opportunity to tackle the problem of land use and carbon dioxide-induced global warming; Trees also play a substantial role in protecting the soil against wind and water erosion, in the control of salinity at paddock level (Cleugh, 2003), and in presenting a high conservation value on farmlands, through providing refuge for many animal species, notably birds.

Potentials for goats in silvopastoral systems

According to Meat and Livestock Australia (McGregor *et al*., 2007), Australia is leading the world in goat meat export, and this coincides with the continuously increasing global demand on this meat. This presents a real opportunity for diversification and implementation of a mixed-species farming business in both rangelands and high-rainfall areas (Miller, 1999)
Goats are characterized by their ability to use trees and shrubs as sources of feed, especially in periods of pasture scarcity. They also differ from other livestock in their unique grazing behaviour, and by being selective and highly adaptable (Lu, 1988).
The most important characteristic of goats is their ability to tolerate relatively higher amounts of the secondary compounds, found in trees and shrubs, than sheep and cattle. While trees and shrubs may be nutritious, their palatability and digestibility are affected by the presence of these secondary compounds, such as tannins (Topps, 1992). The consumption of high amounts of tannins may lead to lower carcass yield and quality, and to toxication of several internal organs (Assefa et al., 2008).
This capability of a higher intake of condensed tannins (CT) suggests that goats can potentially make use of their anthelmintic effects. Many reports suggest that CT have a positive effect on reducing the worm burden in herbivores. Min et al., (2005) for example reported that CT-containing foliage not only reduced worm eggs production and inhibited larval development, but also obviated the need for anthelmintic treatment.

About this study

This project will explore the suitability of goats in agroforestry systems in the Southern Tablelands of NSW, Australia. The characteristics of these animals and their ability to use fodder from trees and shrubs suggest a good potential to integrate them in silvopastoral systems where they would not necessarily compete for feed resources with sheep and cattle, which are grazers, if provided with enough browse material. On the other hand, goats are susceptible to extreme climatic conditions, although to a different extent than other stock due to their hardiness and high adaptability. The project hopes to provide empirical evidence of the effects of shade and shelter from trees on liveweight of growing goats. Some native trees, commonly found in the area of study, will be used to supplement the growing weaners, to test the effect on growth rates and on the presence of internal parasites. The study will therefore provide a better understanding of the role of trees in the productivity and environmental sustainability of goat farming.

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