Symposium 4: Nutrition and Sustainable Food Production

Strategies for environmentally sustainable agriculture in Australia

JR Donnelly
Profitable Sustainable Agriculture, CSIRO Plant Industry, Canberra, ACT 2601

Agriculture provides essential food and fibre, but perturbs natural landscapes. The cost is a changed natural world, so it is reasonable that agriculture should be as efficient as possible, occupy minimum space and leave sufficient land for other purposes (water catchments, conservation of biodiversity, recreation). These objectives can be entirely compatible with profitable and sustainable farming, if farm management is focussed on the major drivers of profit, balanced nutrient use and minimizing leakage of water beyond plant roots.

Farming is big business feeding Australia's population and earning about $20B each year in export income. This has been achieved by outstanding innovation often with science as a catalyst, making farming possible on impoverished soils under low and often erratic rainfall patterns. Trends in wheat yields since 1860 illustrate the point. Initially, yields declined due to soil nutrient exhaustion, then recovered slowly with the introduction of superphosphate and subterranean clover in rotations to supply crops with nitrogen, and from the use of new cultivars. Later, semi-dwarf varieties, selective grass herbicides, control of root diseases by including canola as a breakcrop and N fertilizer technology further boosted yields which in SE NSW now exceed 3t/ha (cp. 1t/ha 1860). The control of quality, the composition and content of protein and minerals in grain (Zn) is now better understood and can be manipulated. Overcoming subsoil constraints that restrict a plants capacity to capture water and nutrients is next step in the progression to sustainable profits.

Meat and wool production have also benefited from innovation. Despite low wool prices in the 1990s some farmers achieved consistent profits compared with losses on similar farms with conventional management. The successful farmers used a consultant who focussed on a few key profit drivers identified by research, such as stocking rate (animals/ha) which controls production per ha. Interactions with other management variables, particularly time of lambing or calving were very important. The most difficult issue for the consultant to resolve was the estimation of production risk which is due to variability in seasonal and year-to-year weather patterns and which interacts strongly with stocking rate. Simulations using computer models are now proving to be a highly effective way of assessing this farm-specific production risk.

While farming businesses must be profitable to be financially sustainable, emerging threats such as soil acidification and dryland salinity are causing serious land degradation. Finding affordable, effective solutions is a major issue for sustainable development. Soil acidification is the most serious and widespread threat, less obvious than salinity, with annual costs exceeding $900M. Areas at greatest risk are the more productive, better-watered regions where soil acidification occurs slowly in nature but is accelerated by farming. The best solution is to apply lime and use acid-tolerant plants, but this is expensive. Liming is generally essential to grow canola and the pay-back is immediate, with increased yield and benefit to subsequent cereal crops. By contrast, pay-back in grazing enterprises might take several years, so less frequent liming with the use of tolerant deep-rooted perennial plants to slow the rate of acidification is preferred. It is the toxic levels of Mn and Al in acid soils that damage plants and recently genes conferring Mn and Al tolerance have been isolated with potential for plant breeding. A novel Al-tolerant phalaris cultivar has been developed increasing the value of this most productive grass for land conservation where its deep roots can soak up excess moisture and nutrients. Soil acidification may also contribute to salinity directly by leaching of soil cations and indirectly through reduced plant growth lowering water use and thus causing water tables to rise.

An environmentally sustainable agriculture for Australia must be based on balanced nutrient cycles and efficient water use to avoid environmental degradation. Farm management must be focussed on key profit drivers with knowledge of the production risks involved. If production is efficient then land can be released for other purposes without sacrificing farm profits.