The story of Tara Hills high-country research

B.E. ALLAN¹, H.M. CHAPMAN² and J.M. KEOGHAN³

¹Wattie Bush, 565 Blair Rd, RD22, Geraldine 7992, New Zealand

²University of Canterbury, PB4800, Christchurch, New Zealand

³PO Box 35 Rolleston 7643, New Zealand

br.wattiebush@gmail.com

Abstract

The 3340 ha Tara Hills high-country station near Omarama was a Government owned research facility between 1948 and 2005. Here we present the story of the rise and fall of Tara Hills; turned from a depleted wasteland into the vibrant research centre of the 1980s, it was eventually sold to commercial interests in the early 2000s. By the early 1980s, Tara Hills had 14 permanent staff and was internationally recognised as a model for dryland farm development, experimentation and demonstration. However, subsequent changes in emphasis for New Zealand farming resulted in a decline in dryland research and to the inevitable sale of this high-country station. We summarise the broad range of research and its outcomes associated with Tara Hills, spanning soils, pasture species, their establishment and production, irrigation, grazing management, animal breeds, animal production and genetics, and farm systems. The changing face of New Zealand's agricultural research and extension is an integral part of this story.

Keywords: tussock grassland, overgrazing, rabbits, oversown, soil conservation, subdivision fencing, stocking rate, merino, Ministry of Agriculture, MAFTech, AgResearch

Introduction

The story of Tara Hills as a Government owned high-country research station is unique and intriguing. It illustrates how the ever changing Government approach to Research and Development in New Zealand impacted agricultural science.

Tara Hills lies in the heart of the drier mountain lands of the South Island of New Zealand, and the story starts at the mid-point of the 20th Century when this land was typically severely depleted following 100 years of extensive overgrazing, burning and an ever worsening rabbit infestation. Tara Hills was originally the hogget or 'wintering block' for the historic Omarama Station. Dick Wardell, the late owner of Omarama Station, recalled when the Taylor family sold the lease of Tara Hills to the Government. The property had only one fence separating hill and flat and was "one of the bigger and harder days mustering in the district with eight or nine men needed".

The first 10 years: the soil conservation era

Rabbit control, irrigation and vegetation regeneration

The 3340 ha station was purchased by the Soil Conservation and Rivers Control Council (SCRCC) in 1948. Justification for purchase was that the property was a typical case of serious depletion and considered, therefore, with the lack of scientific knowledge at that time, to have the potential for severe soil erosion. At the time of purchase, the station carried only 1700 poorly performing sheep, clipped only 2.8 kg of wool/head, and averaged only a 60% lambing. The first hardy staff, such as Graham Dunbar, were quite rightly directed to focus on rabbit proof fencing the flat, controlling rabbits with the help of dogs, netting, poison and gas, and planting (and replanting!) thousands of shelter trees.

On the denuded lower hill-country, numerous permanent run-off plots were established to quantify the extent of water run-off and soil loss. Records were gathered for 10 years and during that time, no doubt to the surprise of the enthusiastic soil conservators, no run-off or soil loss was recorded.

The concept of accelerated soil erosion as a result of vegetation depletion was not the only misconception. A lack of soil moisture was thought to be the major limiting factor to production. The potential benefit of irrigation on the flat was thus recognised and early attempts, led by George Calder, gave mixed results until the need for improved soil fertility and clover inoculation were realised. Green feed crops, especially ryecorn and oats proved successful. This flat development, together with better rabbit control overall, led to a reduced grazing pressure on the hill which inevitably helped with natural grass regeneration.

Twenty-five ha of dryland flat was put aside for agronomic experimentation. Hundreds of grass species, both native and exotic, were meticulously evaluated. It is interesting that Jim Douglas commented in his review of this work (Douglas 1974) that, despite this extensive testing, "the dominant introduced species throughout the tussock grassland region are the self-spreading naturalised grasses browntop, Yorkshire fog, sweet vernal and *Poa pratensis*, and the two

main agricultural species of New Zealand, cockfoot and perennial ryegrass". In the early 1960s the Forest Research Institute (FRI) established an arboretum of various conifers near the administration buildings, sheltering the expanding staff housing area from the harsh elements. At the same time FRI also established a two ha dryland tree provenance trial on the flats for *Pinus contorta*, *P. ponderosa* and *P. jeffreyi*.

Advances in aerial technologies in the early 1950s, one of the few benefits of World War II, paved the way for experimentation in aerial oversowing of the hill-country. Initial attempts gave mixed results, and it was not until the inclusion of aerial fertiliser application along with the seed in 1952, that success was more assured. It is important to recognise that it is this dramatic improvement in vegetation cover on the hills, rather than irrigation and development on the flats, that was the major factor leading to the "turn-around of Tara" and the subsequent increases in stock numbers and performance.

The next 30 years: the Department of Agriculture/MAF era

Full steam ahead with development, research and demonstration

Around 1960, the administration of Tara Hills passed from the SCRCC to the Department of Agriculture and with that, the emphasis turned to management and development for increased productivity. The groundwork done during the earlier years meant overall stocking rates, that were initially reduced and kept static, were now able to be steadily increased (Figure 1). Stock performance also markedly improved. By 1964, Tara Hills was carrying over 3000 sheep that clipped over four kg /head and were averaging 90% lambing. In addition, 120 head of cattle had been introduced. The Omarama Stream was augmented with consented water from the Ahuriri River, paving the way for a greater and more dependable area of border-dyke irrigation, and the successful introduction of an automated pneumatic irrigation system. The resident staff numbers increased and on-site housing and improved services, meant families could now be accommodated.

With the change to the Department of Agriculture and then later (around the mid-60s) to the Ministry of Agriculture and Fisheries (MAF), Tara Hills came under the administration of the Invermay Research Centre, Mosgiel. A large and comprehensive range of research projects aimed at improving high-country pastoral farming production was now possible, with input from researchers from further afield making use of Tara Hills and in many cases, the surrounding district. The following is a summary of some of the more notable research undertaken at Tara Hills during this time.

Figure 1 Stock numbers at Tara Hills from 1948 to 1996 for both sheep and cattle, and the estimated buffer range for sustainable stock number.

Understanding soils and climate

A national climate recording station was started which was to show the average rainfall of 520 mm could be highly variable (380-770 mm). The moisture and nutrient requirements for the various soil types on both flat and hill were investigated. The outwash flats were low in water holding capacity and responded well to both phosphate (P) and sulphur (S) fertilisers. Lucerne struggled here because a shallow aluminium containing pan prevented deep root penetration. The foot-slope brown-grey earth soils were deeper and P-rich and, once understood, initiated trials with elemental S application and the development of high S content fertilisers. Lucerne thrived here.

An altitudinal range of climate stations showed the more highly leached and thus less fertile soils at higher altitudes were off-set from a pasture production viewpoint by reduced evapo-transpiration, giving greater soil moistures. The outcome of this was that the oversown and topdressed mid-altitude hill soils were most productive. With the added advantage of contrasting aspects that allowed seasonal spread in production and utilisation, this area became the valuable 'bread basket' for the property.

Pasture species - their establishment and production

Pasture establishment was difficult in this testing environment. Numerous dryland establishment trials for both cultivation and oversowing explored most suited species, seed preparation, sowing times and techniques, nutrient and insect control requirements. John Keogh (MafTech Invermay/AgResearch Lincoln) by-passed the establishment issues to identify the productive suitability of a huge range of conventional and alternative species options in various landscapes, environments and management conditions, by transplanting seedlings directly into the ground. Notable outcomes from this innovative work were the suitability of birdsfoot trefoil (*Lotus corniculatus*) to dry and difficult soils where conventional clovers would not persist, and the ability of Caucasian clover (*Trifolium ambiguum*) to persist and spread under a

range of grazing regimes. Collaborative trials with the Lincoln Agricultural Engineering Institute developed and refined direct-drilling techniques. The outcome was many demonstrations of successful pasture establishment in surrounding marginal dryland. Barbara Barratt (MafTech/AgResearch Invermay) worked on problems with Sitona weevil in lucerne, and searched for practical ways to reduce Grass Grub and Porina damage.

One of the main success stories of Tara Hills was the transformation irrigation can make on the light outwash soils. From brave beginnings using canvas dams, many researchers have studied water application rates, nutrient requirements, pasture composition, seasonal rates of pasture growth and the potential for autumn-saved pasture. The Forest Research Institute used the irrigated flats to successfully explore the design and suitability of over 100 tree species for shelter belts. Important outcomes were assurance of greater protection from potential soil loss during cultivation and the identification of the few species that were tolerant of frost in this challenging environment.

Hill pasture management

A comprehensive long-term animal grazing trial, initiated and run by Bruce Allan (MafTech Tara Hills/AgResearch Lincoln) on the mid-altitude hill-country at Tara Hills (the bread basket) started in the late 1970s to identify management practices for optimal and sustainable utilisation of the improved short tussock country. The 16 ha trial compared three stocking rates each at three management intensities (amount of subdivision fencing) and showed that 'down-country' management advantages to rotational grazing at higher stocking rates also applied to improved high-country. This trial became a focal point for other researchers and undergraduates to explore various issues such as: soil nutrient requirements, nutrient transfer, animal behaviour, soil carbon sequestration, plant species suitability, merino wool quality, native insect dynamics and empirical systems modelling.

Animal research

From the beginning, there was always a strong focus on animal performance and production at Tara Hills. The importance of good hogget nutrition for later life performance was demonstrated and practical benchmark target liveweights were set. A comparison of merino and corriedale sheep showed that the decision to change to merinos at purchase in 1948 was the right one. With the improved stock nutrition, ewes were shown to economically outperform wethers. Mating behavioural studies demonstrated that the ram:ewe ratio could be reduced to half the common practice in adult merinos, potentially reducing ram costs.

Crossing traditional high-country cattle breeds with the Friesian proved to give greater economic gain. A pre-lambing administration of selenium was shown to give a dramatic increase in lambing, lamb survival and growth. Tara Hills' irrigated flats were used to build up numbers of the highly fecund Booroola merino through an intensive breeding and artificial lamb rearing. Half-and quarter-cross Booroola:merinos were compared on the hill against traditional merinos, and while the crosses produced considerably higher lamb drops, the straight merino proved to be more productive and profitable. Deer farming was not researched at Tara Hills because comprehensive programmes already existed at Invermay Research Centre.

The final 15 years: the MAFTech and AgResearch era

The heady days of extension and a swing to user-pays research

The industry-funded or user-pay theme was growing politically under 'Rogernomics' and pressure was on the Advisory Services Division to become self-funding. Pressure was also on Tara Hills to better demonstrate what it preached. There was a general conception out there that the fertiliser budget at Tara Hills was unlimited and that the hills were under-utilised. It was in some response to this that Tara Hills hosted the 1984 High-Country Field Day. This huge undertaking saw 1300 visitors attend a wide range of multi-disciplinary displays within concurrent sessions, with presentations from researchers, advisors and farmers. Each visitor went home with a comprehensive 68 page information booklet.

Meantime, the management outcomes of the hill grazing trial were put into practice on the hill-country at Tara Hills. Using mostly electric fencing, the number of hill blocks was doubled to 30, with a particular focus on the mid-altitude-country, and a modest increase in stocking rate was recommended. Rotational grazing of ewes post-lambing allowed the build-up of essential feed banks, and the sunny face subdivisions allowed budgeting of autumn-saved pasture throughout the winter. Unfortunately, the science advice on ideal and sustainable stocking rates under this new management was overridden by central management, with overall stock numbers rocketing from 8000 to 11 000 (Figure 1), most probably in response to the perception that the Station was understocked. It is noteworthy that from this peak total, stock numbers returned to the 8000 level by the mid-1990s. Lessons learned!

In 1987, MAF morphed to MAFTech, with management of both research and advisory services joining forces. The research team at Tara Hills entered an era of revenue generation, and this greatly influenced activities. Many science staff became consultants and

farm extensionists, travelling to discussion groups and individual properties throughout the Mackenzie Country and Otago.

Tara Hills became a hub for international training, hosting visiting groups and dignitaries from Iran, China, Russia, Pakistan, Iraq, Peru, Chile, Uruguay, Argentina, Japan, Hungary and South Africa.

Working together in partnerships: key farmers, scientists and advisers/consultants

On-farm Investigative Development Trials and paddock-scale demonstrations started at numerous high-country locations with emphasis on highlighting the most appropriate pasture species across a range of managements and environments. John Keoghan secured Meat Research and Development Council (MRDC) funding to help develop and extend this work along with the partnerships approach, producing many practical publications and running field days - the most notable being that on Shepherds' Flat, Earnsclough Station in 1991. Besides the numerous scientific publications in conference proceedings and peer reviewed journals, both national and international, a number of popular press articles and books, based largely on research outcomes from Tara were produced. Of these, perhaps the most notable was the 'Guide to Tussock Grassland Farming' (Floate 1992) which highlighted advantages of identifying production landscapes within a property and then integrating their management into the farm operation.

An industry-driven Merino Group Breeding Scheme aimed at genetically produced super-fine wool was based at Tara Hills in 1990. Furthermore, an Ultrafine Group Breeding Scheme, which specifically aimed at producing four kg of quality 16 micron wool/ewe, was located at Tara Hills. Stock were selected from 11 commercial merino farmers and run in a closed flock on the irrigated flats, which was ideally set up to cater for the project needs, e.g. single sire mating. In 1989, 100 alpaca were imported from Chile to evaluate their fibre-producing potential under New Zealand conditions. The alpaca thrived, but unfortunately the anticipated market for their fibre did not develop sufficiently.

The heady days of MAFtech lasted (thankfully a lot would add!) for only 5 years. In 1992 the Government created Crown Research Institutes. Tara Hills became part of AgResearch, and was administered from Invermay. The advisory wing was split from the research wing and set up independently as Agriculture New Zealand. Also, the Grasslands Division of the Department of Industrial and Scientific Research was amalgamated into the new AgResearch, a sensible move that meant research such as that by David Scott at Mt John, was now more closely aligned with similar work from Tara Hills.

The tying-up of the flats for research purposes led almost by default to the hill-country (to become known as the 'hill farm') being evaluated as a separate commercial entity. The stock, farm resources, inputs, budgeting and accounts were kept separate from the 'flats' research programmes, and this gave the opportunity to undertake farm system analysis and to show the true viability of hill farming in this environment. The operation proved to be successful and sustainable, and with its product of high quality fine wool from well-feed merinos, highly profitable.

Other ventures arose because of the directive to make money. One hundred bee hives were purchased to investigate the potential for honey production and related bee products. A staggering outcome was that capital investment in the hives was paid back solely by the income from honey produced in the first year! The work showed that integrated grazing management of vipers bugloss (*Echium vulgare*) on low sunny faces gave an additional 30% income/ha over that gained from the fine wool grown. The evaluation of specialised crops that might suit the dry high-country environment was initiated at Tara Hills. Malcom Douglas (MAFtech Tara Hills/Crop & Food, Red Bank) investigated the potential for commercial production of essential oils, dried flowers, medicinal plants, herbs and ornamental natives. This work generated enough interest to set up an independent research facility at Red Bank, Alexandra, later to be administrated by the Crop Research Institute.

Conclusions

Did Tara Hills undertake the most appropriate research? This is a hypothetical question - appropriate from a political, science or a runholder viewpoint? It is interesting to note that results from a runholder survey conducted from Tara Hills by Gerald Scales (Scales *et al.* 1975) in the early 1970s revealed the Research Station to be already investigating five of the six topics they listed as of highest priority. The topic not researched was control of sweet briar, which Tara Hills certainly had its own share of on the lower hill slopes. It is worth noting, however, that the Department of Lands and Survey were already investigating briar control with goats at Merivale Station.

In the words of the late Dick Wardell, research at Tara Hills was "proactive and controversial". He expressed his hope that this approach would continue! In many cases the researchers were not the innovators of the work. Early runholders such as R.K. Ireland of Ribbonwood Station, who was sure down-country practices would also apply to the high-country, proposed innovative solutions. Tara Hills tested these, demonstrating what worked and what did not, thereby giving the high-country farmers greater confidence to apply the findings themselves.

The story of Tara Hills as a research station is one starting with adversity, misconceptions and a ‘seat of the pants’ approach to improvement. Despite this, the hardy early researchers did a tremendous job in turning the Station around in what became renowned as a “miracle of management”. This unique success story is well known and is more fully documented elsewhere (Floate 1992; O’Connor 1998). However, we are sure the early researchers did not for one minute dream that in 40 years the property would be carrying over five times the stock numbers, and be home to 14 permanent staff living mostly on the property, many with young families. With additional visiting researchers, students, overseas trainees and often visiting dignitaries, Tara Hills at this time was vibrant and social - a great place to live and raise a young family. This added considerably to the diversity of the surrounding community.

What is perhaps not so well appreciated is the added effect on the research programme imposed by the ever-changing political management. But despite all the frustration, this changing research climate also invited innovation and opportunity. Where else would alpacas, essential oils, royal jelly and maple syrup production have been investigated in the high-country?

Even with the best of information and knowledge at its fingertips, Tara Hills did not always get its farm management right. There were periods of mismanagement. The lesson here is that the necessary information for best practice is now documented and

available. Mistakes will continue to occur, but there should be no excuse for not proactively correcting them. One could argue that the research at Tara Hills ran its full course through the 55 years of its existence to a point where the Station was no longer needed as a research land resource. The fact that it is now a successful commercial property in the real world is testimony to this.

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