Helicropping – early adopters’ experiences

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Abstract
Aerial establishment of pasture and crops in hill country in New Zealand has received mixed publicity. Popularly referred to as ‘spray and pray’ this detracts from the success some practitioners have achieved with ‘helicropping’, a highly structured process that has the potential to markedly change hill country farming. Four farmers with an average of 4.5 years (range 2 to 7 years) of helicropping in New Zealand hill country were interviewed using a semi-structured snowball technique. Cross-case analysis was used to analyse themes of learning experience of helicropping, crop establishment, utilisation and economics, and the management of potential risk of soil loss from hill country cropping and harvest. Generally, all aspects ranked highly in terms of success. However, there was a strong message that this was attributable to strictly following a prescribed process that reduced risks both to a profitable return and to soil conservation.

Keywords: hill country, soil conservation, pasture renovation, no tillage

Introduction
Applying seed aerially to hill country inaccessible to tractors (for cultivation) is not a new concept. With the advent of aerial topdressing in the late 1940s as capable and reliable post World War II aeroplanes became available, farmers mixed grass seed with fertiliser with variable results in terms of pasture establishment. To enable the seeds to reach the soil surface a ‘hoof and tooth’ practise was used to reduce pasture cover and trample in the seed. Research confirms this practise was effective in enhancing seedling establishment (Lambert et al. 1985; Macfarlane et al. 1986; Gillespie et al 2006), and with salt application increasing the palatability and hence pasture cover reduction in some situations (Gillespie et al. 2006).

The same issues were being grappled with and the same solutions utilised in 2013 (Douglas et al. 2013). However, the vulnerability of hill country soils to erosion and the downstream effects in terms of nutrients, suspended solids and loss of surface water quality are now better understood. With pressure for increased productivity, farmers are turning to the hill country as a cheaper development option. Hill country under 1000 m altitude with slopes greater than 20 degrees comprises around 40% of productive land in New Zealand. Increased productivity from genetically improved pasture species and successful crop establishment may increase the hill country contribution to New Zealand’s Gross Domestic Product (Lane & Willoughby 2016).

This paper documents the experiences of four hill country farmers who have explored the boundaries and economic practicalities of helicropping to gain better production, while mindful of their custodial environmental role.

Methods
Three broad themes were explored in semi-structured interviews with each of the four farmers (Galetta 2013). The themes, couched within the context of helicropping included: farm systems (how helicropping fitted into the wider scheme of individual farm practices), economics (the profitability of helicropping) and environment (the impact of helicropping on soil quality). The object of the interviews was to pursue a theme with each interviewee until no new information was forthcoming. The information was interpreted from interview transcripts by themes and summaries of themes made by cross-case analysis. The information forming the basis of this qualitative study is presented as verbatim quotes from the interviews as italicised statements.

The four properties were in the central North Island. Three of the interviewees owned more than one property.

Farmer A
Operation: Overwintering young stock.
Farm: 1000 ha at an altitude of 550 to 600 m, annual rainfall averaging 1300 mm (winter dominant).
Overwintering 1400 calves, 1400 heifers and a few bulls.
Helicropping experience: 7 years.

Farmer B
Operation: Breeding, finishing and dairy support.
Farm: 430 ha (300 ha effective, balance in native bush) at an altitude of 140 to 570 m, annual rainfall averaging 1800-2200 mm (winter dominant). Overwintering 1400 calves, 1400 heifers and a few bulls.
Helicropping experience: 4 years.
Famer C
Operation: Beef and lamb finishing.
Farm: 520 ha at an altitude of 100 to 500 m, annual rainfall averaging 1200-1550 mm (winter dominant). Overwintering 7500 stock units.
Heliocropping experience: 2 years.

Farmer D
Operation: Lamb breeding and finishing.
Farm: 890 ha at an altitude of 200 to 457 m, annual rainfall averaging 1100 mm (winter dominant). Overwintering 4000 lambs, 3200 ewes, 180 cows, 145 (rising 2-year old) heifers, 145 (rising 2-year old) steers, 290 weaners, 50 (rising 3-year old) steers.
Heliocropping experience: 5 years.

Results and Discussion
Respondents felt that much of the information required for successful heliocropping was available for crop establishment. However, there was little in the way of formal support around decision making and much of their early efforts were by “Trial and error”, “it’s a technique that needs to be developed…we needed to find some solutions and kept working on it until we found the solutions”, “we started off from 10 ha and just tried different ways of achieving a good result”.

With an average experience of 5 years (range 2 to 7 years) experience with heliocropping all interviewees indicated they had a method that worked for them on their property, provided profitable returns along with soil protection from erosion. By inference there may have been an average of 1500 ha being helicroped in the region around helicopter costs including travel time to site, number of visits to the site and size of area treated. These costs were similar to those incurred with more traditional ground-based equipment used for cultivation (Lane & Willoughby 2016). There were financial advantages in being close to the helicopter base and ensuring that as many operations as possible, including herbicide spraying, seed, fertiliser and insurance application (slug bait and insecticide), were completed in the one day. Additional helicopter costs could be incurred should intervention be required for pest or weed management. It was essential to ensure that the size and capacity of helicopter required from small “You get a much better job with a small brush” to “the big machines carry a lot more”. Obviously different sized machines have differing costs and this along with the cost of running the chopper per hour are all factors that need to be considered before the decision is best for the job. Helicopters may be constrained by wind, rain and low cloud, but as “You’re not putting a wheel on the paddock” sowing can be undertaken with high soil moistures. An interesting side-line around these comments about reducing vehicular traffic on the farm related to health and safety issues. “Good to get the tractors off my place. It’s an accident waiting to happen”. “I worry every time the contractor (tractor) is working the place that he’ll tip the thing”. The idea that helicopters may be safer is questionable.

Utilising suitable spray technology, in particular Accu-Flo™ boom nozzles substantially reduces spray drift and permitted accurate spray placement to within 2 m - “He (helicopter pilot) is spraying willows in our conservation area, now amongst our oak trees…can spray a willow tree and leave my oak tree which is 2 m away without any damage”. The precision of the spraying was further emphasised “He applies half rates in a half overlap pattern to improve coverage on uneven terrain”. Improved sprayer technology means “He (the farmer) can spray the area, the weeds are quite accurately without mixing with other products”.

An appreciation of the role improved technology in helicopters and application hardware was a feature of all interviews (e.g. some helicopters pilots use two different hopper sizes; a small one with greater measurement accuracy for seed and slug-bait, and a larger one for fertiliser) has improved the reliability of establishing helicrops in hill country; combined with the accuracy of GPS flying for both speed and location has resulted in precise pesticide, seed and fertiliser application.

It was seen as a good time to engage the helicopter operator in discussions and planning for the upcoming spring programme (being a down-time for helicopter operators) and to ensure both parties understood the extent and complexities of the programme. “It has been a game changer”, “I worry every time the contractor (tractor) is working the place that he’ll tip the thing”. The idea that helicopters may be safer is questionable.

Response to observations of and risk management for soil loss were varied from “I never do a paddock with steep faces” and “I don’t touch the light soils” to “I plan to re-grass the whole farm using helicroping”. “A common theme. With an average experience of 5 years (range 2 to 7 years) managing soils was that “At the first indication there might be heavy rain I take the stock off” and “I never leave the stock on if it’s raining”.

Only one of the farmers introduced direct interventions such as bands or buffer strips to manage soil and nutrient loss across all four properties there was a strong response that soil loss was to be guarded against. “We are very conscious of its (soil loss) potential to happen”. Along with the awareness were statements that conveyed a desire to ensure soil loss did not happen. “Start at the top of the catchment weeding the paddocks first, to avoid all our conservation strips”. These observations agree with the work of Tozer et al (2016) who measured higher soil moisture retention under buffer strips a few metres wide could be left to allow paddock subdivision with an electric wire. A strip following the established contour line along the paddock bottom of the paddock“.

Economic viability of successful heliocropping was seen as a “Game changer”, “and changing the face of hill country farming”.

The key ingredient was the availability of winter feed in the form of kale or swedes, allowing growth of young stock (lambs, rising 1 year old or rising 2-year old heifers or steers) preparing them to “Better utilise the spring flush”, “It means we don’t have to throw the run off”. Implying that the cost of maintaining stock over winter on hill country farms was incurred off-farm. “We can beat the rush to market” was a common theme. Growing rather than maintaining stock over the spring flush” and “leave 1800 to 2000 kg DM/ha when grass is ready”. These statements illustrate a desire to ensure soil loss was to be guarded against. “We are very conscious of its (soil loss) potential to happen”. Along with the awareness were statements that conveyed a desire to ensure soil loss did not happen. “Start at the top of the catchment weeding the paddocks first, to avoid all our conservation strips”. These observations agree with the work of Tozer et al (2016) who measured higher soil moisture retention under buffer strips a few metres wide could be left to allow paddock subdivision with an electric wire. A strip following the established contour line along the paddock bottom of the paddock“.

The popular practice was establishing swedes (Brassica napus) in the first year “Swedes in the first year and in the spring we followed pretty much the same procedure with kale”. Kale (Brassica oleracea) was used in year two, with the pasture species or chichory (Cichorium intybus) sown in year three. “Into new grass so the moment that the animals walk out of the crop at the end of July, early August, we get the chopper straight back and aerial spray grass seed”.

Varying the plantings was seen necessary to avoid build-up of disease such as club root (Plasmodiaphora brassicae), and was the practice of each farmer.
with stock on the crop, there is an added component to soil loss risk depending on grazing management and stock type.

A consistent response across all themes was the necessity to “Make sure you do it properly to make sure you get a good crop”, “you can cut corners”. It was clear from the interviews that the detail of successfully establishing crops devolved to the farm level based on the quality of decisions such as fertiliser requirements in relation to soil nutrient levels and crop requirements, and potential for weed and pest impacts. The choice of crop was determined by the type and/ or class of animal for which it was targeted, with the area determined by both availability and crop volume to sustain or grow animals. Differences in the pattern of seasonal rainfall dictated when to establish a heli-crop, and were based on soil moisture rather than a calendar event. Delaying a decision until soil temperatures were suitable was clearly outweighed by considerations of soil moisture and ensuring the crop was established well before the soils dried out.

The preceding dialogs record the experiences of the four interviewees at a time when all have come through the initial learning experiences for helicropping. Attention needs to be paid to their experiences and what might be done in the future if other hill country farmers are to take up the practice of helicropping with confidence.

Conclusions
All four respondents reported profitable returns from their experiences with heli-cropping. Combined with their experiences of reliable crop establishment this has convinced these early adopters that the practice was a good fit within their farming practices and did not conflict with their obligations as environmental custodians looking to preserve hill country soils. Their experiences of reliable crop establishment this are recorded in this paper.

REFERENCES
Galetta, A. 2013. Mastering the semi-structured interview and beyond: from research design to analysis and publication. New York University Press.

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Abstract
The use of legumes to increase animal performance is well known, but why are sheep and beef farmers not using a legume forage system in New Zealand hill country, and what information do they need before introducing a legume forage system? A co-innovation process was started to explore the challenges sheep and beef farmers face introducing a legume forage system into hill country and their information needs. The first step in this process, reported here, was to run eight workshops throughout New Zealand which 105 farmers and agribusiness representatives attended. Results showed that getting the right information from trusted sources was the highest priority for farmers looking to introduce a legume forage system. Information provided by the science community and industry needs to be region specific as the range of knowledge around legume species differs across regions. Some of the information required by farmers is already well documented, but may not be in the hands of the right people.

Keywords: challenges, forage, farm system, information requirements, knowledge, legumes, sheep and beef farmers

Introduction
Evidence is emerging that pasture production in New Zealand hill country has declined in the past 10 to 15 years (Mackay & Costall 2016), especially on some slopes and aspects. So while maintaining advances in productivity and profitability by utilising more of the feed grown (Fennessey et al. 2016), this option is rapidly running out. New technologies are required to maintain productivity and profitability into the future. Hill country development and sustainability are hampered by limitations of soil nitrogen and water. Legumes, by fixing atmospheric N, increase water use efficiency, and supply high quality feed to ewes and lambs and cows and calves, providing stock for red meat supply at premium times. Previous science developing forage legumes has often failed as farming practices have not changed to capture the benefits of feed quality, improved water use efficiency and feed quantity, that are proven to increase animal production (Stevens et al. 2012).

The use of legumes to increase animal performance is well known (Lambert & Litherland 2000), however, sheep and beef farmers are not adopting legume forage systems in New Zealand hill country. What information do they need before introducing such a system? This research reported aimed to understand the perceived challenges farmers face when introducing a legume forage system and what information requirements they needed to adopt such a system. This paper reports on the first step towards providing researchers with information that farmers need to know to be able to make a change to their farm system. Such information will help researchers incorporate these needs into research programmes.

Methods
For complex issues, such as changing a farm system, a co-innovation approach can assist with change (Turner et al. 2014). This approach involves a number of people and organisations working together in the design and implementation of research. A co-innovation process was used to explore the challenges and information requirements when introducing a legume forage system into hill country. A benefit of ‘co-innovation’ is better understanding of the problems as a result of involving more people and organisations, which in turn provides greater confidence that the solutions will be successful (Rijswijk et al. 2015). People and organisations, through a process of interaction and social learning, become aware of the values and needs of participants in the co-innovation system. Ideally, this enhances each person’s moral and knowledge perspectives and increases their respect and opportunity for developing a solution that attempts to satisfy the needs of all (Hounkonou et al. 2012; Klerkx et al. 2012; Klerkx & Nettle 2013). The hypothesis was, if people and organisations from all parts of the system are involved in specifying the problem and co-developing a solution, then that solution is more likely to be fit-for-purpose and be adopted by the end-users (who helped develop it) than would otherwise be the case.

Workshops
Eight farmer workshops were held throughout New Zealand, and the results are reported on here. Farmers were asked to identify and explore the perceived challenges, forage, farm system, and information requirements when introducing a legume forage system into hill country. A benefit of ‘co-innovation’ is better understanding of the problems as a result of involving more people and organisations, which in turn provides greater confidence that the solutions will be successful (Rijswijk et al. 2015). People and organisations, through a process of interaction and social learning, become aware of the values and needs of participants in the co-innovation system. Ideally, this enhances each person’s moral and knowledge perspectives and increases their respect and opportunity for developing a solution that attempts to satisfy the needs of all (Hounkonou et al. 2012; Klerkx et al. 2012; Klerkx & Nettle 2013). The hypothesis was, if people and organisations from all parts of the system are involved in specifying the problem and co-developing a solution, then that solution is more likely to be fit-for-purpose and be adopted by the end-users (who helped develop it) than would otherwise be the case.

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