

Responses to Hunter Grazing Trial

ACARP ref# 53259

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Comments¹ on 2016 report² on grazing trials on Upper Hunter mine rehabilitation sites.

²ACARP ref# 53259

¹By Professor Mark Sutherland and 

Review of 2016 grazing trial on Upper Hunter rehabilitated coal mine land

ACARP Ref# 53259

The scientific design of this trial is deeply flawed and the data collected fails to include several critical measurements that are essential for demonstrating that the beef produced on these pastures is safe for human consumption.

1. No details are provided as to how this land has been “rehabilitated”, or what materials sourced externally from the site have been included in the resulting soil profile, or how much coal mine material or derivatives are present in the pasture root zone.
2. Active rehabilitation of the Mt Arthur site took place between 1995 and 2000, while rehabilitation of the HVO site took place “during the 1980’s” (the only information provided). Hence this report is a snapshot of these sites 15 and perhaps 30 years after rehabilitation respectively. A longitudinal study of production over this time interval would have been much more relevant. Such a study might indicate how soon after rehabilitation it is safe to resume commercial beef production. The length of time that has elapsed since these sites were rehabilitated also raises the question of whether the methods used are in any way similar to the rehabilitation methods currently in use today.

There is no information regarding the grazing history of each of the different trial sites since active rehabilitation was completed. The grazing history of each site will have a critical effect on soil fertility and pasture composition. While it is likely that the analogue sites have been grazed throughout this period, there is no evidence that this is also the case for the rehabilitated sites.

3. The unmined analogue sites are not true controls and cannot be used as benchmarks to assess the effects of rehabilitation.
 - a. The rehabilitated sites have been sown with highly productive commercial pasture species and treated with fertilizer during the period of rehabilitation, although details of which fertilizers and how much of each is not provided. The analogue sites were all plots of unimproved native pasture which appear to have received no fertilizer inputs.
It is hardly surprising that the rehabilitated sites produced higher quantities (biomass) and a higher quality (metabolisable energy) of feed (but see point 6 below) and therefore gave apparently higher weight gains in the cattle.
 - b. In one case (HVO) the analogue site is 5km from the rehabilitated site. The likelihood that these “paired” sites differ in microclimate, soil characteristics and water availability is very high and renders comparisons of their productivity meaningless.

4. Soil testing of sites has been limited to measurements of pH, salinity, phosphorus, sulphur, potassium, and soil carbon. No results are reported for heavy metals or other by products of coal mining such as PCBs (polychlorinated biphenyls) which are a class of highly persistent organic residues found in coal mining wastes. The detection of heavy metal or PCB contamination in Australian beef would put our export trade at risk and the individual producer on whose property this occurred would be held responsible.

It is a dangerous oversight to not test the soil and water on rehabilitated sites thoroughly for heavy metals and PCBs which persist in the environment for decades and are stated as known potential residue contaminants of grazing animals in areas exposed to coal mine wastes on former coal mine leases and also to materials such as coal washery wastes (chitters) that can be brought onto properties. See Meat and Livestock Australia factsheet: "On farm risk assessment for persistent chemicals and physical contaminants".

<https://www.mla.com.au/globalassets/mla-corporate/meat-safety-and-traceability/documents/on-farm-practices/property-risk-assessments/lpa-factsheet-propertyriskassessment.pdf>

No results for carcass testing for these contaminants are reported and blood levels are only reported for lead and selenium. Furthermore, blood is not the appropriate tissue sample to accurately test for persistent chemicals that may contaminate carcasses, impact on food safety and the entire Australian meat export trade.

5. Dam water quality is not consistent across each trial group. It is concerning that dam water in rehab areas is corrosive and has higher pH. This implies questions need to be asked about minerals leaching into the water table and runoff into dams.
6. The design of the trial is weak with regard to the number of animals (5 or 10) (especially after several cattle "escaped" from some plots), the replication of plots (n=2 or 3) and the number of sites (n=2) investigated. Furthermore all results are reported as crude averages with no indication of the extent of standard errors for these means and therefore the background variability between replicates. In fact there has been no statistical analysis of these results conducted at all, an absolute requirement for demonstrating significant differences between plots, and an omission which renders this report unpublishable in peer review journals. It is likely that a number of the apparent differences between sites reflect no more than the background variation (error) present in the trial.
7. It is significant that this report does not have the courage to include a discussion of the results or any summary of the conclusions which can be drawn. On this it is quite silent

– it concludes nothing. The majority of its pages are filled with data tables and graphs that are poorly unexplained and in some cases just padding (see the long lists of pasture species).

Conclusions

The following conclusion can be drawn from this study:

Cattle fed on previously fertilized improved pasture *probably* gain more weight than cattle grazed on unfertilized unimproved native pasture.

This has been clearly understood in global agriculture for many centuries. Unfortunately the study provides no answers for the central question concerning the productivity of rehabilitated mining sites.

We also conclude the following:

- 1) The study is poorly designed and lacking in statistical rigour.
- 2) The analogue plots are totally unsuitable as control benchmarks for grazing productivity. Like must be compared to like.
- 3) There is no detailed information provided concerning how these mine sites were rehabilitated and what bulk and fertilizer components were incorporated into them.
- 4) Soil and water testing is grossly inadequate and does not provide any assurances regarding the absence of unacceptable heavy metal and PCB contaminants. Carcass test results for these contaminants would be an absolute requirement before any beef products from rehabilitated mining lands are sold on domestic or export markets.

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of

‘A STUDY OF SUSTAINABILITY AND PROFITABILITY OF GRAZING ON MINE REHABILITATED LAND IN THE UPPER HUNTER NSW’

ACARP Ref No 53259, June 2016.

Author of the Study under review is not shown in the document, pages are not numbered and explanatory captions are not included with photographs, some graphs and tables.

There are no stated aims or objectives for this study. It appears that neither the authors nor the proponents knew exactly what they were trying to prove. This is reflected in the results.

It is stated in the SUMMARY that ‘ it is important to note that they (the results) reflect the age and quality of the rehabilitation work being monitored and do not reflect outcomes from other mine rehabilitation work.’

In the section labelled BACKGROUND five published papers are cited, but the references are not listed, therefore those citations should be disregarded. One of those citations quoted, however, states that the rehabilitation of mine sites to provide pasture, costs \$25,000 per hectare! Another quoted citation without a reference, states that there is increasing acceptance that reconstructed sites cannot be returned to pre-mining condition.

There is no listing of ‘Materials and Methods’ This means that it is very difficult to ascertain exactly what was done to the rehabilitated and control (analogue) areas prior to and during the study period. Also, it is not stated whether the cattle were treated for internal and external parasites during the study.

It is stated that the Mount Arthur “Edderton Farm” rehabilitation area was sown to a pasture mix 16-20 years previously and vermicast fertilizer was applied post sowing in 1997. No mention of further pasture seed or fertilizer application is made, yet it appears that lucerne plants, mentioned in the plant species list for both the Mount Arthur and the HVO rehabilitation sites, have persisted in quite appreciable numbers. The analogue areas have apparently had no application of pasture seed or fertilizer.

In the PASTURE MONITORING section sub-headed BOTANELS, there are a series of graphs presented showing green matter and dry matter production. These graphs have no explanatory captions associated with them, therefore it is not clear what the various lines mean.

The SOIL TEST RESULTS do not include several important plant/animal nutrients such as iron, selenium, boron and copper. Also the results do not include potentially toxic substances (apart from lead), such as mercury (which is synergistic with lead in its toxic effects and both are cumulative), chromium, arsenic and fluoride. In order to make the blood tests more meaningful they should have included at least an erythrocyte count and haemoglobin levels. These measurements would indicate the level of iron uptake from the pastures. Iron is essential for the production of blood and muscle tissue.

Australia’s export cattle industry, which earns the country billions of dollars annually, is reliant on our “clean-green” image. The National Pollutant Inventory indicates that annually, large amounts of

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highly toxic chemicals carried on dust, are released into the atmosphere around Muswellbrook and Singleton. These chemicals include compounds of lead, mercury, arsenic, chromium and fluorine. For the sake of the future of our export cattle industry, these substances should have been included in the blood testing regime.

Towards the end of the study report, there is a series of photographs of cattle in yards. These photographs have no captions. One photograph shows a number of fat, scouring cattle with poor skin colour and apparently little hair. Another photograph shows a beast in a crush with a very rough reddish coat. These photographs possibly indicate cattle with mineral deficiency or other health problems. What in fact do they mean?

Comments on the design of the study.

This study purports to be one in which the production of beef from rehabilitated mining land is compared with the production of beef from farming land. In reality it is a comparison of land which was sown with an improved pasture mix and treated with fertilizer at some time in the past, with untreated native pasture land. It is well known that improved pasture will provide a greater bulk of feed than unimproved native pasture and hence will fatten cattle more quickly. In other words, this study is not valid in its implication that rehabilitated mining land is superior for fattening cattle than normal farming land.

For a valid comparison, an area of rehabilitated mining land would need to be treated in exactly the same way as an equivalent area of non-mining land. That is, both areas are cultivated and sown with the same pasture mix and fertilizer application.

As presented in this study, the cost of \$250,000 to rehabilitate 10 hectares of mining land to the stage where it will safely fatten cattle for market, is completely prohibitive.

This study is at best, invalid and at worst, deliberately misleading.

This is an example of pseudo-science (there is a lack of scientific rigour) and if left unchallenged, could cause harm to Australia's beef exports and damage the name of scientific research in the agricultural industries.

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January 2017

Comments on a grazing trial report on mine rehabilitated land in the Upper Hunter, June 2016

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My comments are based on a 38 year career (1975 – 2013) as a District Veterinarian/Senior District Veterinarian working in the Rural Lands Protection Board/Livestock Health & Pest Authority system. I have retained my veterinary registration post retirement.

My main area of expertise is the health and welfare of grazing farm livestock, particularly cattle. Pesticide residues, and chemical and plant toxicity in livestock was a particular area of my interest and expertise.

Comments on the Upper Hunter grazing trial

1. My first impression was the irresponsibility of the so-called design of the study in failing to consider that beef cattle are:
 - a) Destined for human consumption where heavy metal residues are a concern to consumers
 - b) Part of a major export industry valued at \$11.44 billion in 2014/15 (**see MLA report attached to this e-mail**). This industry is highly sensitive to the issue of residues in export meat. In 1987, the district where I was working at the time (Moss Vale Rural Lands Protection Board) was in the front line in relation to the detection of pesticide residues (DDT) in Australian beef in the US and Japan. Only major beef industry action in instituting an Australian property based beef testing and traceback system prevented the loss of a beef export industry worth billions of dollars.
 - c) It should be noted that Australia now has world class traceback capabilities to trace residue affected beef carcasses back to the property of origin. Australian beef industry organisations have made it very clear that if beef export markets are lost as a result of residues in the future, the responsible person/corporation would be charged for the full cost of the loss. If cattle from the mine grazing trial ended up in the beef export market and heavy metal residues were detected resulting in the loss of beef export markets, the coal companies responsible for these trials could expect a lawsuit for compensation for millions of dollars.
2. Australian coal contains trace elements which are of significant environmental concern. A report by the Australian Coal Industry Research Program (ACARP) "Trace Elements in Coal" (2006) is attached to this report. I presume the coal industry will not complain about the use of its own figures in assessing the impact of trace elements in coal on the Upper Hunter grazing trial. The ACARP report lists the following elements found in coal to be of major concern:
 - Arsenic
 - Boron (only of concern in relation to plant toxicity – not a beef residue issue)
 - Cadmium
 - Chromium
 - Fluorine
 - Mercury¹ (see UNEP report below)
 - Molybdenum
 - Lead

¹ http://www.unep.org/chemicalsandwaste/Portals/9/Mercury/Documents/coal/FINAL%20Chinese_Coal%20Report%20-%202011%20March%202011.pdf

- Selenium
3. The soil test reports show no evidence of **any** soil testing for these trace elements. In the absence of any information on where the components of the ‘rehabilitated soil’ originate from, and how much coal contamination is present, baseline soil testing for potentially toxic elements in coal listed above should have been an absolute minimum before the grazing trial was commenced.
 4. Cattle blood tests (report pages are not numbered – another example of poor practice) attempt to test for some trace elements of concern, but most elements from the above list have been omitted.
 - **Selenium** – assessed by analysis of the selenium-containing enzyme glutathione peroxidase (designated as GSHPX in the report) – selenium levels appear to be acceptable
 - **Lead** – blood leads are below detectable levels. However, blood lead tells only part of the story. Faecal lead assessments can also be done in the live animal which will provide a better picture of any lead intake.
 - Levels of the other levels of concern (especially mercury) are unknown because there has been no testing done. Some elements can be tested with blood analysis. Others are better tested through analysis of liver and kidney samples collected at slaughter – particularly bioaccumulating metals such as mercury² and cadmium.
 - I recall that a cattle grazing trial in the Hunter Valley some years ago used fat sampling to test for fluorine levels in grazing cattle.
 - I am not an expert on the current best sampling techniques for some of these untested elements, but that information would certainly be available through the Regional Veterinary Laboratory at Benalla, Victoria or the Elizabeth Macarthur Agricultural Institute at Camden NSW. It would seem that nobody bothered to ask.

The study of cattle grazing on mine rehabilitated land is fundamentally flawed, as discussed above. The trace elements listed as being of concern in coal come from the Australian coal industry’s own figures which have been around since 2006 and were easily found on the internet. Failing to test for mercury in particular in grazing beef cattle which are by definition part of the human food chain is in my professional opinion negligent. Mercury has been known for decades as having the capacity to bioaccumulate through the human and animal food chains. Soil and cattle testing for mercury should have been a fundamental requirement of the trial.

² There is growing international concern about mercury levels in thermal coal. The 2011 UNEP report listed at reference #1 shows significant mercury levels in Chinese coals (table 7, p 13) and more importantly for the purposes of this grazing trial, significant mercury levels have been found in Australian coals tested in China (Table 2, p 6)