Manaaki Whenua
Landcare Research

LINKONLINE

Short webinars for environmental policy-makers and practitioners

Soil Quality, Water Quality and Land Use Pressure

The following questions were asked during our live webinar with John Drewry and Stephen McNeill but due to time restrictions, we were unable to answer these in the session.

The **Catchment trends link land use to soil and water quality** StoryMap is available to view online: https://storymaps.arcgis.com/stories/30d6312e64c94c0b9567f439a0cac45b.

Suggest having a look at Phil Journeaux paper on land values and environmental constraints. There are lots of drivers for land value, I am not sure you've tested all of them?
Thanks for the helpful comment. We will take a look. Yes, there are many drivers, but we only looked at selected potential environmental ones that may have an association with these pressures.

Did you model water quality when exotic forestry is harvested c.f. unharvested catchments?
We did not specifically use harvested and unharvested - they were lumped together. It's likely though that much of that land use was unharvested, given that is typically the longer period of land use.

Land valuation is based on past sales and will have large variation in Olsen P values, so not surprised the association is weak. Location is more important in land values. Did you consider dairy only as the Olsen P value may be more positively associated?
Good points. We also modelled value using land use interactions with soil quality. This is where dairy showed some significant or marginally significant effect.

Has this work been peer-reviewed and published, and if so could you please provide the link?
We plan to submit both papers to 'Science of the Total Environment' very shortly. They will be open access and available when the publishing process is completed.

Might have missed it... what is the time period for the data used in this study?
Various periods listed on the slides including slide 6, but not all. For example, we looked at soil quality over the period listed (1995-2020), but ended up using soil data from around 2015 to 2020 to coincide with similar period of stock units.

Where relationships exist between soil quality and land value, do you think land has high value because soil quality is good, or is soil quality good because the land owners are taking care of it because the land has high value? In other words, which is the dependent variable - soil quality or land value?

Difficult to say, as some land uses or soils may have natural associations with soil indicators. For water quality, land use is important, and one of the conclusions was "The state and trend of water quality was strongly related to land use, catchment and climatic characteristics". From a statistical point of view, the question is not relevant - both are associated to some degree with the various responses and to one another.

Many other studies over many years have developed models that attempt to relate land use, slope, rainfall, etc to water quality. How do your results compare to what has been reported by these previous studies?

That question should be sent to Rich McDowell directly, who could answer in more detail. However, we gave a brief answer in the seminar that may have helped, from our understanding. From a statistical point of view, using similar design to previous work and then adding new explanatory variables tests whether previously-attributed effects were confounded by the absence of the new variable - in other words, it's helpful to model in steps.

You've concluded that land use pressure is not correlated to water quality. That has been reported by some previous studies but is counter to the current narrative that land use is the driver of poor water quality. What's your explanation of why you don't see a relationship between land use and water quality?

For water quality, land use is important, and one of the conclusions was "The state and trend of water quality was strongly related to land use, catchment and climatic characteristics.". Perhaps the point could have been made more strongly. However, land use was not strongly associated with land value, as we stated "Soil carbon concentration, Olsen P, and bulk density have a highly significant effect in predicting land value, but the other variables do not". It is also important to note that the study is not causal, so it is quite possible that the way one (causally-unrelated, but associated) covariate is defined better captures the association with a response than another (causally-related) covariate; this is common in environmental modelling.

How can we use this with landowners for farm environment management? Is there any mitigation findings that we can practically implement?

Good questions. We did not specifically look at this. I suspect it's probably too early to recommend specific mitigations from this project.

Have you used land capability (e.g., LUC) and areas of highly productive land and elite soils to predict land value? and hence declining WQ and soil quality where you have intensification

No, LUC was not used as a dataset. It could be in the future though.

bulk density is positively related to land value. Does this mean it's good to compact the soil? Can you please explain a bit more on how you assess the land value please?

No, generally it is not good to compact soil. The land value was obtained from the district valuation roll (DVR) data for all of New Zealand, which was purchased from a provider. The data needed a lot of cleaning as was mentioned.

So you found a link to predict land value from some soil quality indicators, but don't you ideally want to go the other way around?: predicting soil quality from land value.
That would be interesting too, as you suggest. We suspect more soil data would be needed to develop the relationship further. It is important to remember that these are catchment-wide estimates of value, so the importance of estimating catchment land value might be overstated.

Wouldn't there be factors other than soil quality that contribute to land value, such as climate, slope and proximity to city centres?
Good points. We did not specifically look at proximity. But we did look at 'catchment characteristics' like catchment slope, elevation, rainfall etc. But at the scale and the way we evaluated it, we concluded: "Soil carbon concentration, Olsen P, and bulk density have a highly significant effect in predicting land value, but the other variables do not. ". So in that sentence, 'other variables' refers to the catchment and climate characteristics including rainfall.

Interesting that soil quality does not link with water quality. I would have thought that poor quality soils would be more susceptible to erosion, and therefore contribute to sedimentation and high turbidity in water bodies. And that poor soils would require greater use of fertilizers and be less likely to retain them, leading to more runoff?
I tend to agree with your comments. However, in this case and set of analyses, soil quality did not appear to be useful. However, as mentioned, the soil quality data set was relatively small (sparse in some catchments) compared with the other data. The soil quality environmental monitoring data set is used for regional and SOE national reporting, so has some limitations, and tends to be sampled more typically on intensive land uses, as that's how it was originally set up. But there are other data which could be used in future to develop any relationships further.

On the land value map, why did not use value per area unit?
My understanding is the value is associated with property titles. Our spatial expert, looked at various ways of using the data - what we did seemed to be useful in this case.

The land value that you use is "assessed" value that is modelled and generally is not well suited for predicting/explaining environmental conditions. Did you try to use observed land values (from sales data)?
No we did not use any sales data. We used the district valuation roll (DVR) data for all of New Zealand and we were primarily interested in agricultural land.

What about the proximity to main urban areas affecting land use value?
We used the district valuation roll (DVR) data for all of New Zealand and we were primarily interested in agricultural land only. We did not specifically look at proximity. But you raise an interesting idea, which could be used in the future. It is important to remember that these are catchment-wide covariates, and proximity is difficult to encode in this manner. The model you have posed is inherently spatial, which would require covariates of more spatial richness than we had available to us.

I understand the results relating to predicting land value, but it's one of the take home messages about water quality that seems to defy logic, and I wondered if you can explain that to me? That is, the take home message that water quality was only weakly related to land use pressures (understanding that to mean ag intensification)…. I would have expected water quality to be strongly related to ag intensification?

I suspect, there might be some confusion with the two components of the study - I had tried to separate them. For water quality, land use is important, and one of the conclusions in the slide was "The state and trend of water quality was strongly related to land use, catchment and climatic characteristics.". Perhaps the point could have been made more strongly. However, land use was not strongly associated with land value, as we stated in that component "Soil carbon concentration, Olsen P, and bulk density have a highly significant effect in predicting land value, but the other variables do not. ". Those 'other variables' included land use.