

Impact Objectives

- Quantitatively evaluate the negative and positive effects of forest grazing
- Provide data that will support the development of guidelines on forest grazing

Farming cows in forests

Dr Yuri Yamazaki discusses her work that aims to understand and develop best environmental practices for rearing cattle and other livestock



How did you come to be involved in this field of research?

The theme of my doctoral thesis was to clarify the effects of land use, such as upland farming and dairy farming, on river water quality, especially nitrogen concentration. In Japan, mountains and forests spread in the upper part of the basin whilst the middle and lower parts are used as agricultural land and urban areas. In rivers with a significantly lower ion concentration in the upstream forest basin, the nitrogen concentration in the river water often increased slowly, even though agricultural land increased in the middle and lower basins. In other words, river water quality deteriorates as agricultural land use increases in the basin and, at the same time, river water quality in forest areas also affects downstream water quality.

On the other hand, in the case of livestock, the relationship is quite linear. The higher the breeding density is, the higher the nitrogen concentration in the river water is and therefore the greater the effect on river water quality. It seemed to me that we were keeping the river water quality worse not only for the environment but also for livestock themselves. At the time I was conducting this work, I was introduced to a farmer who was grazing in the forest and saw the beauty of the environment and the relaxed life of cattle. I felt that grazing in the forest was the livestock system we needed to continue in a sustainable way.

You are investigating grazing on ecosystems. What are some of the questions you are hoping to address through this work?

We want to quantitatively evaluate the negative and positive effects of forest grazing. For example, current river water quality is good, but how many cattle can we increase to maintain this environment? How does grazing cattle change the semi-natural grasslands in the mountains? How does grassland in the mountains affect wildlife? There is still much to be clarified about forest grazing, but we would like to show results that serve as guidelines in order to spread forest grazing.

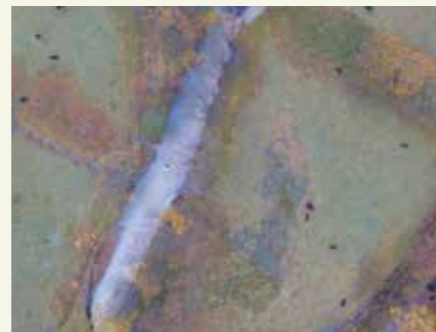
What methods and tools are you using for your investigations, and how do you test and validate your findings?

We conduct image analysis using sensor cameras to investigate the behaviour of grazing cattle and wildlife in forest pastures. We are also working on image classification by machine learning (such as discriminating between cows and deer). In addition, we use aerial photography with drones to observe the use of pastures (vegetation type, overgrowth, etc.). In water quality analysis, ionic components such as nitrogen, phosphorus, calcium and magnesium in river water are analysed. To further clarify the effects of grazing cattle, a new analysis of stable isotope ratios will be introduced. In Japan, it is difficult to compare and verify the results because there are only a few cases of forest grazing.

At this stage, water quality is monitored and compared for general stables and grazing.

Are there any challenges you have had to deal with in this research?

Since we are dealing with grazing cattle and nature, there were some observation problems. For example, sensor cameras were installed between pastures and forests. When cows and deer got used to the camera, they could touch the camera which moved it or even broke it! This is one of the difficulties of investigating animals. Since this problem is inevitable, we have responded by changing the position of the camera or increasing the number of surveys and performing detailed maintenance. We also find it difficult to publish and expand on good results. In the past, we often reported bad results, such as the cause of water quality deterioration. In this survey, we got some questions like 'why are you investigating if the river water quality is good?'. In my opinion, both good and bad results from different agriculturally practices should be further clarified if we are to better understand best practices. ●



Drone view of forest grazing in autumn

Reducing environmental impact of livestock

Researchers at Tokyo University of Agriculture are investigating the possibility of grazing cattle in forested and mountainous areas as a way to minimise the impact that livestock has on the surrounding environment

There is a myriad of issues that form our global crisis of climate change and the destruction of the environment. If we are to develop sustainable practices that can help reverse the destructive trends, we need revolutions across a range of industries. The agricultural industry is huge, globally essential activity that will always be with us. It is intimately tied to the environment and has multiple direct impacts on it.

Naturally, the world will always require food, whether that be from livestock or crops. Therefore, we need to continue improving our agricultural practices if we are to sustain the global population. Livestock pose a particular set of questions regarding how to best maintain them. They take up significant space, consume a lot of vegetation and produce a lot of waste. Whilst avoiding and reducing meat consumption is a growing social movement, this will never eliminate meat consumption and only further emphasises how we should rear livestock in a sustainable and non-destructive manner.

Typically, livestock such as cattle are raised on large areas of meadows and grasslands. The more cattle you are looking to raise, the greater the amount of land needed. Where they feed has a profound impact on the environment around them. They can alter the vegetation growing and their waste can affect the water system. When it rains, their waste seeps into the soil and then into streams

and rivers. Rivers are basins for large areas of grassland and, most likely, multiple cattle farms. This means a huge multiplication of waste run off from livestock rearing. Dr Yuri Yamazaki of the Faculty of Regional Environment Science, Tokyo University of Agriculture is investigating alternative methods of cattle rearing. This work has developed directly from her doctoral studies which were aimed at evaluating the impact of dairy farming and upland farming on river water quality. This work led her to exploring the forest grazing of cattle as a potential alternate way of maintaining livestock. She is now working hard to evaluate this proposition. 'We hope that those who aim for environmentally conscientious agriculture will be able to pay attention to this new path for the livestock industry,' Yamazaki explains.

A STROLL IN THE WOODS

Forest grazing is the practice of allowing the cattle to roam forested areas instead of exclusively in fields and meadows. The flora of forest ecosystems is often more robust than in other areas due to the presence of a diverse range of plants and animals as well as the presence of trees themselves. Trees contribute enormously to maintaining a stable soil system and generally reducing the impact of contaminants on the local environment. To understand the exact impact of forest versus non-forest grazing, Yamazaki needs to gather biological and chemical read-outs for the local ecosystems.

'We aim to clarify the positive and negative environmental effects of rearing cattle in semi-wild conditions through forest grazing,' Yamazaki clarifies. 'This will allow for the development of appropriate breeding methods and guidelines for the practice. More broadly, our work is a survey that can propose new themes from the perspective of ecosystem services.'

Yamazaki is utilising a range of methods to evaluate and quantify the impact of forest grazing on the ecosystem. The river basin represents the end point for some of the most impactful chemical changes to the environment. It was therefore logical that Yamazaki should continue to build on her expertise in this area and use several measures for water quality as one of the readouts for environmental impact. The main variables in water quality as impacted by agriculture are the level of certain key ions. These are primarily constituted by nitrogen and phosphorous, although magnesium and calcium levels are also important. Both nitrogen and phosphorous is found in fertilizers and animal waste. In rivers, however, it is the balance between phosphorous and nitrogen levels as well as the total levels that are the key indicators of healthy river ecosystem. Shifting the delicate balance either way can cause single species of phytoplankton to dominate in the river. ►



This, in turn, throws the rest of the ecosystem out of balance and can profoundly change the flora and fauna of the river.

LOOKING AT THE WHOLE SYSTEM

Measuring water quality is not the only metric of a healthy ecosystem. Yamazaki and her team needed to evaluate the impact of the animals living within the semi-wild forest ecosystem. This involves the physical examination and monitoring of the

is a great sign of the lower impact of forest grazing versus grassland grazing,' she comments. 'At the same time, the pastures used by the cattle in and around the forested areas are also showing a lower impact from forest grazing. The grass make-up is varied with more wild grasses and even fungi making up part of the vegetation.' Finally, Japan is a country that experience many impactful natural disasters. Recently, typhoons have been the biggest problem.

‘We hope that those who aim for environmentally conscientious agriculture will be able to pay attention to this new path for the livestock industry’

environment itself. To this, Yamazaki has set up two methods – using drones and installing cameras in the woodland. The drones fly over the grazing areas and take images of the surroundings. This is then evaluated by the team who look for changes in the characteristics of the forest flora such as vegetation type and overgrowth. At the same time, cameras at ground level film fauna, primarily the cattle and wild deer that inhabit the forest. This footage is aimed at finding out more about their behaviour in this different context – where are they moving, what are they eating and what is their impact on other fauna. Together, this data will elucidate the direct impact the cattle are having on the environment and ecosystem. This impact can be compared to the impact they have on meadow and grassland that can be severely adversely affected the presence of grazing cattle and often needs to be rested.

The project is ongoing; however, Yamazaki and her team are already reporting interesting results from their work. The investigation is showing that the water quality of rivers near forest-grazing lands is largely identical to forested land without any grazing. 'This

Typhoons can cause havoc with agricultural land by causing massive run off soil due to high rainfall. This is obviously a huge issue for those raising livestock. However, the forest-grazed lands showed almost no effects from recent typhoons with the forest able to better resist soil run-off due to the anchoring effects of the trees.

A LEAFY FUTURE

Yamazaki's work has the potential to revolutionise the way we farm livestock. The indications are that forest-grazing could well provide a well-balanced ecosystem for the environment surrounding livestock farming. It is possible that, with the right balance between the reduction in meat consumption and moving cattle towards forest-grazing, the dairy and meat industries can become cornerstones of sustainable agriculture. 'This suggests that grazing in uninhabited areas, such as mountains and forests, would indirectly manage land and help prevent major ecological disasters, as the grazing cows will not dominate the grassland,' Yamazaki summarises. ●

Project Insights

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BIO

Yuri Yamazaki is an Assistant Professor at the Faculty of Regional Environment Science, Tokyo University of Agriculture. Her research focused on nitrogen pollution of agricultural area, and how to reduce the environmental load by improvement of agricultural management. More recently, she has been focusing on the livestock industry and conducting research on forest grazing.

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