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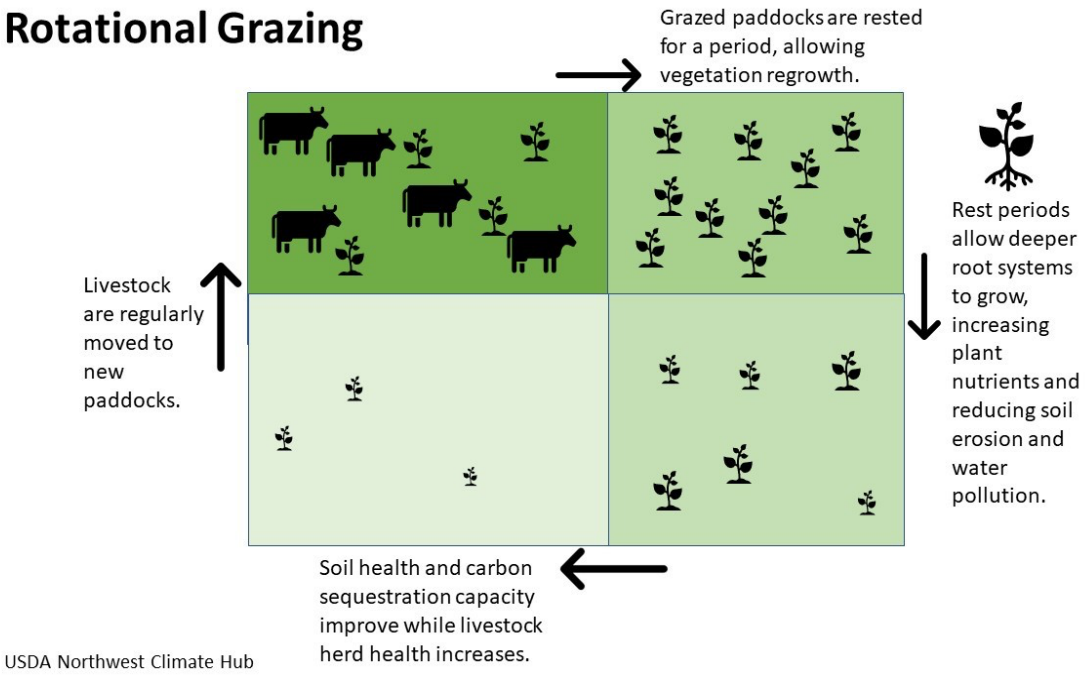
An Annotated Bibliography for Rotational Grazing: Why Animals Are Essential to Agroecology?



Summary:

According to Apricot Lane Farms, Biomimicry is the imitation of natural ecosystems, and its three main principles are: animals, compost, and cover crop. Regenerative rotational grazing is the agroecological strategy of routinely moving livestock to a new place to graze in order to improve soil, plant, and animal health. From a historical context, rotational grazing of livestock is the biomimicry of the natural migrations of grazing bison and other wild ruminants in areas like the Great Plains before America's prairies and grasslands became less wild. As a

herd, bison would graze from one area, trample the grass, and leave behind excrement before moving to a new area of forage to eat. Biomimicry of this historical practice helps prevent overgrazing, enhance regrowth, and build humus through the trampling of the grass. After the Bison would travel through, migrating birds followed, such as Black-billed Magpies and Brown-headed Cowbirds, hitching a ride on the backs of bison to eat the insects in the dung of bison. This is beneficial because it helps breakdown and scatter the fertilizer for quicker absorption into the soil. Thus, regenerative farms often mimic this natural relationship with cows and chickens. There is a huge stigma around farm animals as massive Methane and Carbon Dioxide emitters, but when these animals aren't farmed industrially for meat, they can decrease atmospheric carbon. I am fascinated by the different essential traits farm animals have to regenerative farming along with biodiverse wildlife. Grazing farm animals provide so many ecological and agricultural benefits. For this annotated bibliography, I will provide sources that explain such benefits.

Annotated Bibliography:

Díaz de Otálora, X., Epelde, L., Arranz, J., Garbisu, C., Ruiz, R., & Mandaluniz, N. (2021). Regenerative rotational grazing management of dairy sheep increases springtime grass production and topsoil carbon storage. *Ecological Indicators*, *125*, 107484. https://doi.org/10.1016/j.ecolind.2021.107484

This peer reviewed study, "Regenerative Rotational Grazing Management of Dairy Sheep Increases Springtime Grass Production and Topsoil Carbon Storage," tested the

difference between regenerative sheep grazing and conventional sheep grazing in terms of grass production and topsoil carbon storage. The study found that regenerative rotational grazing achieved 30% higher springtime grass production and 3.6% higher topsoil carbon storage than conventional rotational grazing.

Before reading this study, I already knew that rotational grazing had higher topsoil carbon storage, but I did not know much about the grass production. I learned that enhanced grass production could explain why there is increased soil organic carbon observed under Regenerative Rotational Grazing management. Additionally, I learned that since rotational grazing allows paddocks to have longer resting periods between grazing, grass can recover, regenerate, and productivity can increase. I also learned that this augmented springtime pasture production observed for Regenerative Rotational Grazing might help maintain grass productivity under the projected climate change impacts.

Environmental and Energy Study Institute (EESI). (2022). *The climate and economic benefits of rotational livestock grazing*. EESI. https://www.eesi.org/articles/view/the-climate-andeconomic-benefits-of-rotational-livestock-grazing

This article, “The Climate and Economic Benefits of Rotational Livestock Grazing” from the Environmental and Energy Study Institute explains that regenerative rotational grazing can help mitigate climate change. Almost 30% of US methane emissions are from enteric fermentation, the digestive fermentation process of ruminant animals.

Rotational grazing can help reduce these emissions by providing increased forage quality that is easier for livestock to digest, therefore resulting in lower emissions. The article also explains that manure accounts for 12% of agricultural GHG emissions. But manure deposited in pastures produces fewer Methane emissions and fertilizes the soil. Lastly in terms of climate change, the article explains why rotational grazing increases and maintains topsoil carbon soil. Furthermore, the article explains how rotational grazing can increase climate resilience by retaining moisture, protecting against water and wind erosion, and protecting waterways from nutrient and sediment runoff. Finally, the article includes why rotational grazing can provide long-term economic benefits as well.

From this article, I learned so much more about how regenerative rotational grazing can help mitigate climate change. I did not know that with conventional grazing systems' manure is stored in liquid form in lagoons, tanks, or pits which produces more methane in addition to enteric fermentation. Thus, when rotational livestock systems help reduce these emissions by more evenly distributing the manure over the land instead of concentrating in one area. Plus, it also adds fertilizer to the soil. I also learned that the reason rotational grazing systems help soil store carbon better is because overgrazing from continuous grazing causes soil to be exposed, which causes it to release carbon. Rotational grazing on the other hand allows the soil and the plants to recover in between grazing, which keeps the carbon in the soil.

Rotational grazing and regenerative agriculture at Clagett Farm. Chesapeake Bay Foundation. (2021). https://www.cbf.org/news-media/multimedia/video/rotational-grazing-andregenerative-agriculture-at-clagett-farm-how-to-make-farms-bay-friendly.html

This video, "Rotational Grazing and Regenerative Agriculture at Clagett Farm" by the Chesapeake Bay Foundation, provides a case study of Regenerative Rotational Grazing in action. Michael Heller, Clagett Farm Manager, explained that before they conducted rotational grazing, there was severe soil erosion with no topsoil. He says that the solution to this issue was rotational grazing because it allows vegetation to grow back in between grazing. The video goes on to explain how manure can increase soil health and microbial activity. Furthermore, the video explains that pairing rotational grazing with cover crops can increase these benefits. Cover crops can also increase soil health by increasing organic matter and fixing nitrogen into the soil.

From this video, I learned why rotational grazing increases soil moisture and decreases erosion. If you let the plants grow, the roots can reach deep into the ground, to hold moisture better and prevent erosion. These roots can also sequester carbon and reduce runoff. Additionally, I did know the benefits of cover crops, but it is good to know that if we combine the two practices, the benefits will increase even more. It is interesting to learn that cover crops and rotational grazing hold very similar benefits, thus utilizing both will increase those specific benefits.

Rowntree, J. E., Stanley, P. L., Maciel, I. C., Thorbecke, M., Rosenzweig, S. T., Hancock, D.

W., Guzman, A., & Raven, M. R. (2020). Ecosystem impacts and productive capacity of a multi-species pastured livestock system. *Frontiers in Sustainable Food Systems*, *4*. https://doi.org/10.3389/fsufs.2020.544984

This peer-reviewed study, "Ecosystem Impacts and Productive Capacity of a MultiSpecies Pastured Livestock System," studied the benefits of having more than one species within the rotational grazing system. The study conducted a whole-farm life cycle assessment (LCA) of a Multi-Species Pasture Rotation System (MSPR) in the southeastern US. It compared the production outputs, greenhouse gas emissions, land footprints, and soil health outcomes of the Multi-Species Pasture Rotation System to a conventional, commodity (COM) production system of each species. The study found that the incorporation of soil C sequestration into the LCA reduced net GHG emissions of the MSPR by 80%, resulting in a carbon footprint that was 66% lower than COM.

From the study, I learned that multi-species rotational grazing isn't as much of a fullproof solution than it may seem. The study found that while a MSPR can produce livestock protein while regenerating the land, a lot more land is required compared to COM grazing. So, it introduces the question: Do the pros of MSPR outweigh the cons? It could be possible that the less land required to grow produce on a regenerative farm would counteract the land needed for multi-species grazing.

Spratt, E., Jordan, J., Winsten, J., Huff, P., van Schaik, C., Jewett, J. G., Filbert, M., Luhman, J., Meier, E., & Paine, L. (2021). Accelerating regenerative grazing to tackle farm, environmental, and societal challenges in the Upper Midwest. *Journal of Soil and Water Conservation*, *76*(1). https://doi.org/10.2489/jswc.2021.1209a

This peer-reviewed article, "Accelerating Regenerative Grazing to Tackle Farm, Environmental, and Societal Challenges in the Upper Midwest" from the *Journal of Soil and Water Conversion,* unpacks regenerative rotational grazing as a solution to environmental issues. It explains that regenerative rotational grazing can improve soil health and functioning because they maintain dense plants that can prevent erosion, improve soil fertility, and reduce nutrient runoff. It also claims that regenerative rotational grazing can increase animal health. Furthermore, it explains that regenerative grazing can increase financial resilience. Moreover, it illustrates that regenerative grazing can reduce methane emissions as mentioned above.

From this article, I learned that regenerative rotational grazing could decrease costs for farmers because it reduces the need for purchased grain and forage. It also reduces repair and maintenance costs for machinery, equipment, and labor, since livestock are harvesting more of their own feed and distributing their own manure. I also learned that regenerative rotational grazing improves the health and welfare because they have room to roam and get to constantly graze new areas. This results in lower stress and lower incidence of disease.

Teague, R., & Kreuter, U. (2020). Managing grazing to restore soil health, ecosystem function, and ecosystem services. *Frontiers in Sustainable Food Systems*, *4*. https://doi.org/10.3389/fsufs.2020.534187

This peer-reviewed article, "Managing Grazing to Restore Soil Health, Ecosystem Function, and Ecosystem Services" first addresses the stigma around ruminants and climate change due to their methane emissions in the industrial agriculture sector. The article explains that this is a misconception because when applied in the right conditions, they can help the environment. The article addresses this claim by explaining that with rotational grazing, ruminants can produce higher permanent soil cover that will reduce soil erosion and increase carbon storage. It also discloses that regenerative rotationally grazed livestock can increase soil organic carbon, improve soil ecological function, and reduce production costs by eliminating tillage, fertilizers, and biocides.

Before researching rotational grazing, I also felt like ruminants only produced negative impacts to the environment. I believed that the only way livestock could live happily and sustainably was at farm animal sanctuaries. While I still think animal sanctuaries are great for animals previously in industrial agriculture, I learned that regenerative rotational grazing allows the animals to be happy, healthy, and ecologically friendly.

YouTube. (2023, September 5). *Rotational grazing: Chicken Soil Engineers in gardens & pastures*. YouTube. https://www.youtube.com/watch?v=bC6DEi5eNeQ

This video, “Rotational Grazing: Chicken Soil Engineers in Gardens and Pastures,” provides a case study for chicken rotational grazing. The video explains the specific benefits of chickens in a rotational grazing system. It illustrates that the chicken poop adds to the fertility of the soil, their natural scratching and pecking behavior helps to aerate the compact earth and incorporates carbon and organic matter into the soil. The farm periodically rotates the chicken coop through different areas of woodland and pastures. This practice of rotational grazing gives chickens access to fresh, new pasture, and prevents overgrazing of any one area.

From this video, I learned that chickens have a lot of different benefits that ruminants don’t provide. The chickens control pests and weeds, which solves a lot of agricultural problems. I also learned that chickens aerate the soil when the scratch and peck the ground. I also learned that by adding chickens to rotationally graze beds that have been recently harvested, it helps prepare them for the next season. Instead of mechanical tilling, chickens can naturally till the soil, fertilize the soil, weed the soil, and remove pests before planting.