UBC Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Biodiversity and Protein Consumption – Making the Link

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Biodiversity

Protein Consumption

Making the link

THE UNIVERSITY OF BRITISH COLUMBIA

SEEDS Sustainability Program

UBC Botanical Garden

Introduction

We completed this project as a component of our course, GEOG 446A - Agriculture and the Environment - with Dr. Loch Brown, professor of geography at the University of British Columbia. It was conceptualized by Dr. Tara Moreau of the UBC Botanical Gardens and carried out in conjunction with the UBC SEEDS Sustainability Program, with the intention to be used as an outreach tool for visitors of the botanical garden, with an overarching goal to contribute to sustainability initiatives on campus.

The topic we took on was protein consumption and its effect on global biodiversity. We thought this would be an important topic as the world's population is growing rapidly and in order to maintain food security - while at the same time not totally decimating biodiversity - we must find practical and sustainable solutions.

In what follows we have researched, analyzed and unpacked how protein cultivation affects biodiversity, as well as other taxes it puts on valuable natural resources such as water. Our submission is intended to demonstrate the depth research we have conducted on this topic, as well as being an accessible outreach tool for use at the UBC Botanical Garden. Our intention is to make these ideas easily communicated to people of all ages and cultures, and with our "take-aways" enable folks to easily incorporate these ideas and tools into their lives, affecting the micro-geographies that lead to global change.

In this report we have included:

1. An **'Outreach Toolkit'** that is designed to be a guide for the Botanical Garden when they are doing outreach work with visitors. We wanted to make a lasting impression on folks, so we have included a demonstration of how to sprout lentils and encourage those facilitating the outreach to have a before and after sample of sprouted lentils and to walk visitors through the process. We have also included physical take aways; 3.5" x 2" (or business card size) hand-outs that contain a step-by-step guide of how to sprout at home and a recipe card that include sprouted food. With the hand out we suggest that a plastic screen (very inexpensive) be included so folks can start sprouting at home right away (all they need is a jar!). We believe that experiential learning leaves the most lasting impression, and if visitors are given a memorable experience - as well as the tools - they are more likely to change their behaviour.

2. An **infograph** that clearly, and in an accessible way, outlines and compares biodiversity and protein consumption. It begins by laying out what is threatening biodiversity, then moves on to how we get our protein; comparing plant and meat protein. It also compares the amount of water, land use (area), and fossil fuels used to produce plant versus animal protein. We arrive on the conclusion that there is less of an impact on biodiversity

with plant based protein cultivation and encourage folks to make a difference by consuming more plant based proteins.

3. Two **case studies** assessing the effects of livestock and pulse production on biodiversity. Intended to be a part of the educational outreach package.

4. An **annotated bibliography** which demonstrates our breadth of research with an explanation of how and why these sources were significant. It is also a springboard for further research and can be used as reference in the outreach work.

This document was prepared by Kasper Sundbaek, Pedram Alvari, Ziyang Jin, Christopher Monaghan, and Erin Grace.

If you have any questions feel free to contact us.

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Outreach Toolkit

1 Learning Objectives

- to include and engage folks of all ages and backgrounds in experiential learning about the benefits of plant based protein consumption.
- to communicate the global need for preservation of biodiversity and the implications of its loss.
- to provide folks with easy and accessible ways to include plant based protein, particularly pulses, into their diet.

2 Facilitator Guide

When researching and putting together our project, we decided that the best way to try to affect change is at the micro-level. If we can give folks access to knowledge and tangible tools to help influence small changes in their life, the global impacts can be substantial. This is why we focused on educating about small dietary changes. We found that a lot of people didn't know how easy it was to sprout pulses and it is a fun and engaging way to inform and educate. Therefore, we believe that experiential learning is the best way to educate folks and the following is an outreach tool/demonstration on how to sprout together with a banner. The spouting and the infograph banner is meant to be put together as a stand.

2.1 Demonstration of How to Sprout: Before and After

The demonstration of how to sprout is designed for a group of 15-20 people of all ages (could be more). What is limiting the group size is that everybody should be able to hear the presenter and see the jars with sprouts which will be next to the banner.

2.1.1 Supplies

Scissors, a few large mason jars and their lids, dried pulses (any kind), a jar of already sprouted pulse (prepare a couple days in advance).

2.2 Outreach Instructions

- Greet the group and tell them that you are going to be talking about pulses today, and ask them what they know about them. Ask them what they know about biodiversity and get them to define it. Have them to look at the infograph and use it as a reference to ask

the groups questions/facts about pulses and biodiversity. Talk about the state of the world which on the infograph is called: what is threatening biodiversity?

- Next, ask the group how much protein they think is in 100 grams of the following, comparing the animal (the red ones are animal) and plant based proteins:

Protein per 100 g
Soybeans 36.49 g
Velvel Beans 32.4 g
Red lentils 29 g
Chicken 27 g
Pork 27 g
Beef 26 g
Broad Beans 25 g
Lamb 25 g
Red Kidney Beans 23.6 g
Black Beans 21.6 g
Green Lentils 14 g

- Have a conversation about the benefits of plant based proteins opposed to animal based. Look at the section on the infograph called: how can we get protein? Talk about the impact on the infograph for meat versus plants. This comparison is taken from Reijnders and Soret (2003) and compares soybeans with meat. Soybeans is set to 1 and the impact from different kinds of meat are compared with this. For example, in the meat portion, the mason jar filled with water shows that meat production (depending on type of meat) uses 4.4-26 times more water than soybean production.
- Next, ask the group if they're familiar with sprouts. Then ask them if anyone has ever sprouted at home. Ask them if they know about the benefits of eating sprouts (digestive enzymes etc).
- Then tell them you are going to teach them how to sprout at home and give them the supplies to do so!
- Start the demonstration:

2.2.1 Demonstration on Sprouting

1. Take the already prepared jar of sprouts (image below).

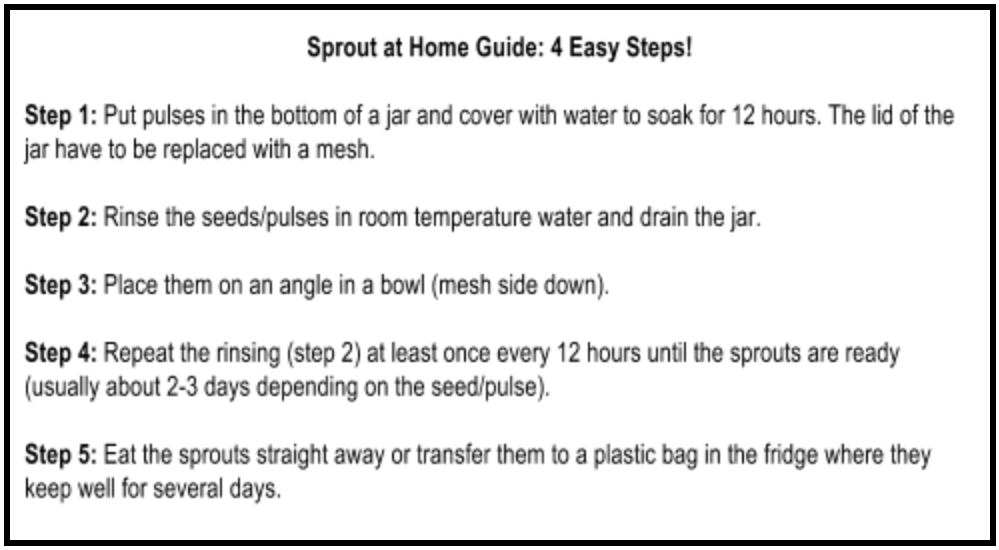
2. Give a demo of rinsing the sprouts and putting them in a bowl, tell them to do that twice a day and you will have sprouts in 2 days or less.

3. Show them the end result, the sprouted jar.
4. Then tell them how to use the sprouts; delicious to add to salads, use instead of rice (just heat slightly), make burgers (on take-home recipe card) and many other creative possibilities. Also, let them know that you can literally sprout any grains or seeds! Brown rice, chick peas, alfalfa! Encourage them to experiment and have fun with sprouting!

2.3 Physical Take-Aways

- The take-aways will be for the visitors to the UBC Botanical Garden to take home with them. There will be two components both 3.5” x 2” (or business card size).

    1. A step by step guide of how to sprout at home (seen below). Included in this will be a plastic canvas/ screen (very inexpensive; video link with instructions https://www.youtube.com/watch?v=cY1hbwkpcjE) for folks to start experimenting with sprouting at home right away.
    2. Recipe card (also seen below).



Sprout at Home Guide: 4 Easy Steps!

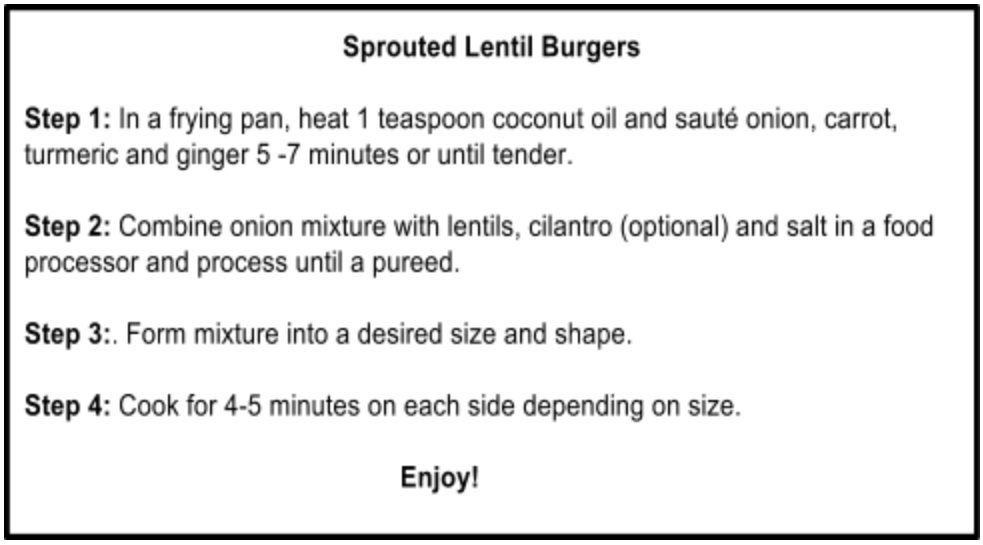
Step 1: Put pulses in the bottom of a jar and cover with water to soak for 12 hours. The lid of the jar have to be replaced with a mesh.

Step 2: Rinse the seeds/pulses in room temperature water and drain the jar.

Step 3: Place them on an angle in a bowl (mesh side down).

Step 4: Repeat the rinsing (step 2) at least once every 12 hours until the sprouts are ready (usually about 2-3 days depending on the seed/pulse).

Step 5: Eat the sprouts straight away or transfer them to a plastic bag in the fridge where they keep well for several days.



Sprouted Lentil Burgers

Step 1: In a frying pan, heat 1 teaspoon coconut oil and sauté onion, carrot, turmeric and ginger 5 -7 minutes or until tender.

Step 2: Combine onion mixture with lentils, cilantro (optional) and salt in a food processor and process until a pureed.

Step 3:. Form mixture into a desired size and shape.

Step 4: Cook for 4-5 minutes on each side depending on size.

Enjoy!

2.4 Informational Take- Aways

- Clarify myths around protein → You can easily get enough protein from plants!
- Making the connection between consumer choices and global issues/ impacts; link to biodiversity as seen in the infograph.
- Change eating habits. If folks who are meat eaters could switch one meal a week to pulses, the global impacts would be exponential.

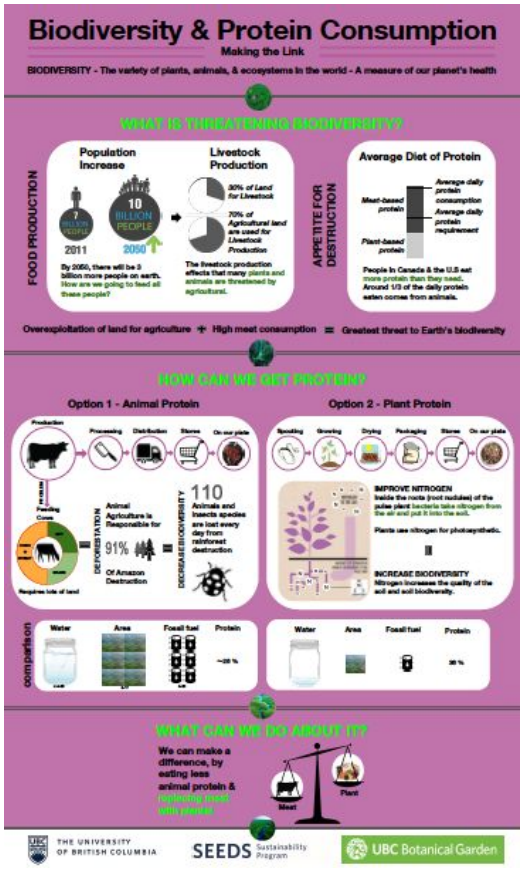
Infograph

The Infograph poster is designed to be printed on a roll-up banner, measuring 120cm x 200cm. This kind of banner can be pursued through online printing services, such as AirExpress (website below), for approximately $153 (shipping included).

Banner name:
120X200cm Teardrop Roll Up Banner Stand for Exhibition, Big Trade Show Roll Up Banner Display with PVC Banner Printing Price.

Banner source:
https://www.aliexpress.com/store/product/120X200cm-Teardrop-Roll-Up-Banner-for-Exhibition-120cmX200cm-Trade-Show-Roll-Up-Banner-Display-with-PVC/1724025_32623208395.html

Picture of the infograph:



Link to the infograph so it can be edited:
https://docs.google.com/presentation/d/1ASbJP7PKpiupmFoTcM9y2J3ZG58gws_q1XyQkj_ElYQ/edit?usp=sharing

Case study

1 Meat and Biodiversity

The case study to be examined surrounding meat and biodiversity is that of Polyface farm. Located in Virginia, Polyface is a family owned, pasture-based, organic, local-market farm that produces beef, pork, poultry, and rabbits.

This image showcases the pasture-based livestock production techniques at Polyface farm.

The main distinction to be discussed between Polyface and conventional meat production is that the former is a polyculture while the latter is a monoculture. This separation directly relates to the level of biodiversity found in each system. The polyculture at Polyface farm works to increase biodiversity by utilizing natural growing practices and avoiding harmful chemicals. The livestock being produced graze on native pastures which in turn uses low amounts of fossil fuels, requires no man-made chemical inputs, conserves nutrients and water, and supports a wide range of biodiversity (Machovina et al., 2015).

On the other hand, monocultures limit biodiversity by replacing the natural vegetation and local habitats with an alternative that relies on a limited number of crop species and animal breeds (Food and Agriculture of the United Nations, 2009). This industrial approach to producing food on a massive scale leads to ecological destruction with degradation of soil, deforestation, and pesticide resistance (Machovina et al., 2015). Although the argument can be made that monocultures protect non-agricultural biodiversity by reducing pressure to expand crop and pasture areas, polycultures are more productive when considering the total output rather that single crop yield (Machovina et al., 2015; Food and Agriculture Organization of the United Nations, 2009). The level of biodiversity encouraged at Polyface reduces output losses due to weeds, insects, and diseases, and makes a more efficient use of the available resources

of water, light, and nutrients (Machovina et al., 2015). Overall, polyculture meat production, as seen at Polyface farm, is a move to reconnect to land and nature for which biodiversity is viewed to be an integral part, and monocultures, in opposition, continue to play a detrimental role.

2 Pulses and Biodiversity

The cultivation of pulses has the potential to play an integral role in supporting biodiversity. This case study will focus on one method that showcases such an instance: milpa agriculture, a crop growing system used in Mexico.

This image depicts the milpa system and the intercropping of maize, squash, and legumes in Oaxaca, Mexico.

The traditional system is based on Mayan indigenous practices that produces, by means of intercropping, maize, squash, and legumes. The genetic diversity between varieties of crops in this system is immense, with reported *"16 distinct species of crops that belong to 9 different families and with 67 varieties planted nowadays"* (López-Forment, 1998). By increasing the diversity of crops within the system, it thereby increases the efficiency of resources used, generates higher crop yields, and lowers the risk of crop failure. The specific role pulses play in the system is primarily to fix nitrogen in the soil, and in turn increase soil fertility (Food and Agriculture Organization of the United Nations, 2016). This increased soil fertility enables biodiversity to flourish by providing a natural nutrient base, higher rates of soil carbon, and minimized soil erosion; all without the need for artificial fertilizers and other potentially harmful inputs (López-Forment, 1998; Food and Agriculture Organization of the United Nations, 2016). These three aspects enable other species to thrive, and the combination of living organisms helps to curb pests and diseases that may target the system (Food and Agriculture Organization of the United Nations, 2016). Therefore, pulses create the environment for which all components of the system are better equipped to adapt to fluctuating factors by having a

healthy foundation for growth. Within milpa agriculture, this case study has shown that pulses play an integral role for a biodiverse agro-environment.

A Final Thought…

As previously outlined, the intention of this project was to educate and inform visitors of the UBC Botanical Gardens around protein consumption and biodiversity. It is our hope that the combined educational resources provided through the outreach toolkit, the infograph, and the case studies, will reach people and influence small, but significant changes.

We would like to thank Dr. Loch Brown, Dr. Tara Moreau, the UBC Botanical Gardens, and the SEEDS Sustainability Initiative for giving us the opportunity to engage in this project and hopefully contribute to a more sustainable future. We would also like to thank the facilitators who will be carrying out this work and are excited to see it come to fruition.

In what follows is our annotated bibliography which displays our research and methodologies.

Annotated bibliography

Boucher, D. (2014). *Cows Are the Real Hogs: The IPCC and the Demand Side of Agriculture*. Union of Concerned Scientists. Retrieved from: http://blog.ucsusa.org/doug-boucher/cows-are-the-real-hogs-the-ipcc-and-the-demand-side-of-agriculture-486?

This article unpacks the IPCC report on climate mitigation and specifically discusses the effects the cattle industry has on it, suggesting alternatives that have less of an environmental impact. One of the arguments in the article is to cut greenhouse gas emission from the AFOLU sector by Bio25% and Boucher includes a poster that shows the distribution of agricultural land for different on food sources and the biomass produced to show that cows take up 86% of agricultural land, but only make up 8% of the biomass we consume as food. Boucher is suggesting policies that promote diets that shift away from beef and towards lower-emissions foods such as pork, poultry, eggs and of course plants. This article helped us validate our decision to try to change folks diets, but we could not find space on the infograph for it.

Cowspiracy. (2014). Retrieved from: http://www.cowspiracy.com/facts/

Cowspiracy's website includes a rich array of statistics around cattle production and consumption which were particularly useful for our project. The website was a great source of facts and one can follow the provided link (above) to learn more. In our inforgraph we included that '91% of deforestation in the amazon is caused by animal agriculture' and that '110 animals and insects species are lost every day from rainforest destruction'.

Farming First (Ed.). World Biodiversity. Retrieved from https://farmingfirst.org/

Farming First website supports 180 organizations representing the world's farmers, scientists, engineers and industry as well as agricultural development organizations to promote programs and activities to further sustainable agricultural development worldwide. This coalition of multi-stakeholder organization suggests that governments, businesses, scientists and civil society groups must pay attention to food security and sustainable development of ecosystems. The website compares the world biodiversity in 2000 and the predicted world biodiversity in 2030, and the result indicates that 10% of present biodiversity will be lost due to expanding infrastructure and agriculture. This data helped us to identify the importance of maintaining a sustainable long-term ecosystem by working towards sustainable agricultural methods, since agriculture is the main contributor to world biodiversity loss, and its carbon migration takes a great portion of total global emission.

Food and Agriculture Organization of the United Nation (Ed.). (2016). Pulses and Biodiversity. Retrieved from http://www.fao.org/pulses-2016/en/

This case study in Honduras speaks to the importance of changing cultivation practices and developing low-cost, resource-conserving systems for growing crops. It also shows a link between agricultural production and the rates of rural poverty and malnutrition. Through analyzing the benefits of pulses to biodiversity in a multiple cropping system, there are indicators of an increase in biodiversity. This is demonstrated by providing ecosystems with not only greater resistance and resilience against disturbance and stress, but also the improved ability to suppress disease and maintain soil health. This study helps our project to establish the connection between plant protein production and biodiversity by showing pulses have a multiple role in promoting living organisms and ecological complexity to re-establish the natural good functioning of ecosystems.

Food and Agriculture Organization of the United Nations. (2009). *The State of Food and Agriculture.* Rome: United Nations. Retrieved from: http://www.fao.org/docrep/012/i0680e/i0680e04.pdf

This 2009 edition of the FAO's flagship publication focuses on livestock and the environment. In order to ensure sustainable contributions to food security and poverty reduction the FAO argues for policy reform, as well as institutional and technical changes within the livestock sector to mitigate the impacts of livestock production on the environment. Given the likely continued growth in global demand for livestock products and the reliance of many people on livestock for their livelihoods, the FAO urges that with better natural resource management practices, the livestock sector can reduce its ecological footprint and contribute substantially to climate change mitigation.

López-Forment, I. (1998). *Changes in Diversity in the Process of Milpa Intensification.* Chicago: Latin American Studies Association.

This report examines traditional milpa systems in Yucatan, Mexico, intensive milpa system alternatives, and the biodiversity each possess. The traditional system consists of cultivating maize, legumes, and squash equally, while the intensive version focuses on producing the highest maize yields. Although both are high in biodiversity which provides flexibility to adapt to changing conditions, the intensive alternative is suggested to be more sustainable in practice. The report delves into the biodiversity of the system at great length, offering insights in the diversity of crops, its varieties, and other organisms that interact with the system. Overall, this enabled us to gain the necessary understanding of the mila system itself, and the ability to relate it to pulses and biodiversity.

Machovina, B., Feeley, K. J., & Ripple, W. J. (2015). Biodiversity conservation: The key is reducing meat consumption. *Science of the Total Environment*, 419-431.

This article forwards the idea that the consumption of livestock is one of the most negative forces affecting biological diversity. The cause of which stems from livestock production leading to climate change, soil loss, nutrient pollution, and the decrease of apex predators and wild herbivores. Three solutions are proposed to reduce the impacts of such consumption, while still meeting the nutritional needs of people. The most important for aiding this project was the last solution that explored reintegrating livestock production away from single product, intensive, fossil-fuel based systems and into diverse and coupled systems.

Penniman, L. (Photographer). (2015, August 10). *Corn, beans, and squash grow together in this milpa*. Retrived from: http://www.yesmagazine.org/planet/four-ways-mexico-indigenous-farmers-agriculture-of-the-future-20150810

Polyface, Inc (Photographer). (2011, July 25). *Salad Bar Beef*. Retrived from: http://www.polyfacefarms.com/2011/07/25/salad-bar-beef/

In addition to retrieving a picture from this website, it provided the necessary background information for the case study on meat and biodiversity.

Roser, M. (2016). Land use in Agriculture. *Published online at OurWorldInData.org.* Retrieved from: https://ourworldindata.org/land-use-in-agriculture/

This website provides several infographics to show the changes in land use over time, with special attention to the development of agricultural. It outlines the predicted changes moving forward with the FAO Land Use Database for countries and world regions since 1960. The results indicate that crop production in 2012 required much less land than what was needed in 1961 because the improved agricultural technologies raised yield, which in turn reduced the pressure on cropland. The website provides information about land use change in last 50 years, as well as projects it for the next 50. It also illustrates the current global agricultural land use and the changing global landscape of crop production in an infographics. It was useful for us in developing our idea and the impacts of land use change, especially with reference to crop production.

Reijnders, L., & Soret, S. (2003). Quantification of the environmental impact of different dietary protein choices. *The American Journal of Clinical Nutrition*, *78*(3 Suppl), 664S–668S. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12936964

This article argues that the expansion of agriculture has substantially increased the extinction rate of species, as food production and consumption are extremely wasteful and

necessitate large amounts of energy use, which result in an environmental burden. The article presents a life cycle impact assessment and quantitative comparisons of the environmental impact associated with animal and plant products. This comparison emphasizes the connection between dietary preference, agricultural production, and environmental degradation. This article also highlights the importance of long-term sustainability policies in agriculture, which we believe must be taken seriously. The article provides information about the environmentally relevant differences between meat protein and plant based proteins such as soybeans. This helped our project conduct the comparison between animal and plant protein, and conceptualize ideas about sustainable food systems that are inclusive of lower environmental, social, and economic costs.

Trust, K. 2012. Development of Inclusive Markets in Agriculture and Trade (DIMAT): The Nature and Markets of Bean Value Chains in Uganda.

This report gives a preview of the marketing and consumption of bean production and demonstrates the importance of beans both as a food security crop and a commodity that can enhance the economy of Uganda. This study included collecting sample data, analyzing a value chain, and, finally a SWOT analysis that was all based on primary and secondary sources. The report closes with recommendations that focus on possible ways forward for DIMAT to achieve their objective. It provides information about the main characteristics of the bean value chain and the constraints and opportunities within it. It was helpful for our project as we analyzed the commodity chain of plant protein.

Wirsenius, S., Azar, C., Berndes, G., Chalmers University of Technology, Chalmers tekniska högskola, Department of Energy and Environment, Physical Resource Theory, & Institutionen för energi och miljö, Fysisk resursteori. (2010). How much land is needed for global food production under scenarios of dietary changes and livestock productivity increases in 2030? *Agricultural Systems, 103*(9), 621-638. doi:10.1016 / j.agsy. 2010.07.005

This article indicates that the most important direct driver of terrestrial ecosystem change during the past 50 years has been land use change. Additionally, agricultural land expansion into forest, and other land with high biodiversity values, leads to substantial carbon dioxide emissions and biodiversity loss. The author's present model-based scenarios on projections of global food agriculture for 2030 by the FAO and the potential for sustainable growth. The study concludes that the global agricultural area will be substantially expanded, and the growth in animal food production will develop much faster than the FAO assumed. The result, they argue, will be increased deforestation pressure and loss of biodiversity as well as increased CO2 emissions. The results of this article highlight the importance of reducing the agriculture land by finding the alternative of animal food production, and the necessity of developing plant protein production.

Notes

We have included multiple images from Google searches and were under the impression that this will be used as an educational tool, and no citations are necessary.