"AGRICULTURE SUSTAINABILITY: HOW IT IS IMPACTED BY GENDER INEQUALITY AND THE USE OF BIOTECHNOLOGY?"

by

Madalyn Daughrity
mdaughrity@niu.edu
(559) 972-0061

In Completion of the Graduation Writing Requirement
Northern Illinois University / College of Law

900 Gender, Sexuality and the Law
Fall Term 2022
Instructor: ELVIA R. ARRIOLA
December 22, 2022.

Table of Contents

I. Introduction

In the 21st century, the issue of climate change is challenging governments throughout the world to address issues of sustainability, in particular concerning agricultural practices. Farming is a historic practice that has sustained humanity through various styles and methods sometimes unique to the circumstances of a particular part of the world, its people, and its needs. The farmers of the world have been both male and female. This paper will be centered around the topic of agricultural practices in developing countries, and how US Agricultural Policy and their use of gendered agricultural aid tactics neglect the information possessed by indigenous women farmers, and how that impacts sustainability. This paper will utilize gender and how current agricultural aid policy favors male interests, as part of the critique of current policy objectives and interests. This paper will argue that women's cultural knowledge of the preservation of crops, drought-tolerant practices, etc., may provide the answer to sustainable agriculture issues across the globe. This paper supports the view that an agricultural aid policy that doesn't take into account gendered inequalities cannot fully address the oncoming global crises of sustainability. To flush out this theory, this paper will look specifically at a few different case studies of how women farmers in developing countries hold this knowledge, how that impacts sustainability, and how biotechnology is harming not only traditional farming practices but the women farmers' livelihoods as well. Part II of this paper will analyze U.S. Agricultural Aid Policy, the International Panel on Climate Change's Report on Sustainability, and how that is related to gender. Part III will look into the history of biotechnology and agriculture policy. Part IV discusses case studies of gendered US agricultural aid. Part V analyzes the use and implications of biotechnology in developing nations. Part VI will address policy

recommendations that are aimed at equalizing aid opportunities and achieving sustainable agriculture and food systems.

II. U.S. Agricultural Aid Policy, the IPCC'S Report on Sustainability and Why Gender Matters

The Intergovernmental Panel on Climate Change (IPCC) released its Working Group 1 Report, the first installment of its Sixth Assessment report, on August 9, 2021.[1] This report illuminated the current critical state of the global climate crisis and delivered concerning news that the tipping points[2], are predicted to arrive a decade sooner than predicted by the IPCC three years ago.[3] However, the IPCC's 2021 Report emphasizes that there is hope for our planet if we take immediate and drastic action towards sustainability, especially in agricultural practices. In the journal, "Frontiers in Sustainable Food Systems", authors Kate Farhall and Lauren Rickards emphasize that to achieve sustainable food systems and improve our climate change outcomes, the planet must utilize sustainable agriculture practices. [4] Farhall and Rickards argue that in agriculture-based development efforts, for sustainability to be attained, increased attention must be given to gendered power relations, as gender inequality has been a major barrier to developing sustainable, successful agricultural systems within these nations.[5]

Farhall & Rickards critique of the current agricultural aid systems deployed in developing nations illuminates a concerning pattern of history in foreign agricultural aid donations. For

---

[1] IPCC, *IPCC Press Release* (August 9, 2021), Ipcc.ch/site/assets/uploads/2021/08/IPCC_WGI-AR6-Press-Release_en.pdf

[2] Events which, once they occur, will create feedback loops that worsen damaging climate change conditions that are already occurring. PCC, Intergovernmental Panel on Climate Change (2021).

[3] *Id.*

[4] Farhall, et. al., *The "Gender Agenda" in Agriculture for Development and Its (Lack of) Alignment With Feminist Scholarship*, Frontiers in Sustainable Food Systems (February 10,2021), https://www.frontiersin.org/articles/10.3389/fsufs.2021.573424/full

[5] Farhall, et al., *The "Gender Agenda"*, (2021).

decades, nations like the United States have worked to implement agricultural aid programs to developing countries in the creation of successful, and sustainable food systems for their populations. To complete this tall task, the United States has looked to large agricultural conglomerates such as Monsanto, to donate genetically modified crops as solutions for famines, food shortages, and drought. However, their progress in developing successful, stand-alone food systems in these countries through these methods has been largely unsuccessful due to various factors. With this in mind, this paper will analyze how United States Agricultural Aid has been unsuccessful in creating successful, and sustainable food systems in developing countries due to two factors; (1) failure to address gender inequality in agricultural aid; and (2) the impacts of biotechnology on sustainability.

To illustrate how United States Agriculture Aid policy has been unsuccessful in creating successful and sustainable food systems, this paper will utilize quantitative methodology in the form of case study research. The different case studies included will analyze the different issues brought by the implementation of US agriculture aid in developing nations. To better understand this pressing issue, we will first look back to the history of the United States policy regarding agricultural aid, and where it currently stands today.

III. History of Biotechnology and Agriculture Policy

A. Introduction to Biotechnology

The World Bank estimates that 86% of impoversished people in developing nations rely on agriculture as their primary source of income.[6] To address many of the agtricultural issues that

[6] Adenle, et. al., *Analysis of Open Source Biotechnology in Emerging Countries: An Emerging Framework for Sustainable Agriculture*, Technology in Society, Volume 34, (August 2012), https://www.sciencedirect.com/science/article/abs/pii/S0160791X12000450

challenge these farmers and lead to unstable food systems in developing countries, scholars have looked to agriculture biotechnology as an answer.[7] Agriculture biotechnology refers to the genetic engineering (GE) of plants and animals for agricultural benefit.[8] Commonly, the term refers the use of recombinant DNA techniques (CRISPR CAS-9) that produces desired traits in crops, such as pesiticide and herbicide tolerance. [9]

The United States is a leading producer and innovator of GE crops. [10]As such, the US is highly interested in the global acceptance and regulation of the adoption of this technology by other nations. [11] While the US has deemed genetically modified crops safe for consumption since the early 1990s, other countries have not shared the same sentiment and have expressed valid concerns about the environmental and health implications that the introduction of this technology may create.[12] In response, the US has had prfound influence in spreading messaging about the positoive attributes of agriculture biotechnology, especially in regions with unstable food systems. [13]Accordingly, the use and adoption of GE crops has made its way into provisions of trade agreements made between the United States and other large agricultural importers and exporters.[14] While, the use of biotechnology in agriculture has presented positive effects on agricultural production, it has also presented challendes for farmers and policymakers alike.

---

[7] Congressional Research Service, *Agriculture Biotechnology: Overview, Regulation, and Selected Policy Issues*, Congressional Research Report, (March 9, 2021), https://crsreports.congress.gov/product/pdf/R/R46737
[8] *Id.*
[9] *Id*.
[10] *Id*.
[11] *Id*.
[12] *Id*.
[13] *Id*.
[14] *Id*.

The challenges produced by the implementation and use of GE crops includes; labeling regulations, global trade concerns and environmental impacts. [15]

B. How US Foreign Policy is Shaped by Agricuture Aid

The United States is one of the largest foreign aid donors, globally, and is one of the foremost donors of food and agricultural aid. This is largely because the US has been identified as a surplus agricultural producer, and the US has used this surplus to leverage foreign policy objectives around the globe.[16] One of the first instances of agricultural aid being used as a diplomacy effort occurred following the First World War, when Congress authorized the funding of a large-scale U.S. Government food relief program that sent both food and agricultural supplies to Europe and Poland.[17] This US action also included provisions that benefited U.S. producers by giving preference to American grown crops for export to these countries as part of this program.[18] By the mid- 1940's U.S. agricultural contributions were incorporated into crises reponses by entities like the United Nations.[19] However, after WWII, global recovery and the beginnings of Cold War tensions led the United States to seek new avenues for agricultural aid.[20] Thanks to continued agricultural innovation of technology and science, and the increased output these advances created, the US was able to leverage its food

[15] Congressional Research Service, *Agriculture Biotechnology: Overview, Regulation, and Selected Policy Issues*, Congressional Research Report, (March 9, 2021), https://crsreports.congress.gov/product/pdf/R/R46737
[16] U.S. Department of State, A Short History of U.S. International Food Assistance (2009), https://2009-2017.state.gov/p/eur/ci/it/milanexpo2015/c67068.htm.
[17] *Id.*
[18] *Id.*
[19] *Id.*
[20] *Id.*

market superiority to reinforce the efforts to contain the spread of Communism throughout the globe.[21]

C. Food for Peace Program

On July 10, 1954, President Eisenhower signed the Agricultural Trade Development and Assistance Act of 1954 (P.L. 480). [22] This Act became known as the Food for Peace, a program who's primary objective was to assist the United States in solving the issue of huge U.S. agricultural surpluses that arose from Federal government commodity price subsidies and increases. [23]

Food for Peace authorized three different categories for agricultural aid; Title I provided the sales of agriculture surplus stocks to nations in need.[24] While Title II and Title III allowed for contributions to Non-governmental organizations, United Nations organizations and government-to-government donations, but only in the case of dire emergency or need.[25] The Food for Peace Program was initially intended as a short-term solution to the US agricultural surplus issue. It ended up being a permanent fixture of United States Foreign Policy.

Though many praise the United States for its humanitarian efforts via the use of food aid, many also consider Food for Peace as one of the most harmful aid programs to developing countries.[26] Food for Peace's objective is to alleviate hunger, and while many agree that it

---

[21] U.S. Department of State, A Short History of U.S. International Food Assistance (2009), https://2009-2017.state.gov/p/eur/ci/it/milanexpo2015/c67068.htm.
[22] *Id.*
[23] The Heritage Foundation, "How American Food Aid Keeps the Third World Hungry" (1988), https://www.heritage.org/trade/report/how-american-food-aid-keeps-the-third-world-hungry
[24] U.S. Department of State, A Short History of U.S. International Food Assistance (2009), https://2009-2017.state.gov/p/eur/ci/it/milanexpo2015/c67068.htm.
[25] *Id.*
[26] The Heritage Foundation, "How American Food Aid Keeps the Third World Hungry" (1988), https://www.heritage.org/trade/report/how-american-food-aid-keeps-the-third-world-hungry

accomplishes that goal in the short term, many critics of the program voice their concern about how the program typically lowers the price that developing country farmers can get for their crop.[27] This economic phenomena is attributed to the influx of US crops grown by subsidized American farmers depressing the local food production of the developing country and making it more difficult for local farmers to sustain themselves.[28] Many argue that the program is actually only beneficial aid to U.S.fFarmers, as they are allowed to be paid fair market price for their surplus crops, at the expense of the U.S. taxpayers and the developing countries' market in which the aid ends up.[29]

D. Private Sector Influence

Bayer, BASF, Dow Agroscience, DuPont Pioneer, Monsanto and Syngenta are all major US agricultural conglomerates who have skin in the US agricultural aid policy game.[30] These companies not only produce and sell genetically modified (GM) seeds and herbicides, but they also lobby and advise governments on GM regulations and work with both the US and developing nation farmers on cropping with their products.[31] Over the decades, these large conglomerates and their role in the development use of GM crops have faced a plethora of public criticism, however, that has not hindered them from expanding their presence both in the US and abroad.[32] These multinational corporations aim to address critical issues in food markets of developing nations by enlisting the help of specifically designed GM seeds that can

---

[27] The Heritage Foundation, "How American Food Aid Keeps the Third World Hungry" (1988), https://www.heritage.org/trade/report/how-american-food-aid-keeps-the-third-world-hungry
[28] *Id.*
[29] *Id.*
[30] Devex, The GMO Debate: "How Do Corporations Perceive Their Role in the GMO Debate?" (2018), https://www.devex.com/news/how-do-corporations-perceive-their-role-in-the-gmo-debate-92507
[31] *Id.*
[32] *Id.*

mitigate a variety of issues including weed control, pest infestation and drought tolerance.[33] Additionally, Bayer, Monsanto and Syngenta consider GM crops to be one of the many tools needed to reduce agricultural waste and improve yield.[34]

Although these multinational corporations may be an important element in the conversation of establishing sustainable and effective food systems, many criticize their involvement in aid programs due to the high profits yielded from the use of their seeds, and their power plays to increase their control over global agriculture. [35] It is common to see critics of these agricultural conglomerates draw comparisons to Big Tobacco, as both industries are believed to have deceived the public on the probable health and economic risks of the products that they are selling, to keep generating large profits.[36] When interviewed by Devex News, Bayer spokesperson Holger Elfes stated, "It is true that we generate profits with the sales of our seeds, but farmers would not buy them if the seed did not offer higher earning opportunities for them, too".[37] There is significant political movement that urges Congress to enact regulations that will force these corporations to participate in public-private parternerships to incentivize collaboration between public and private institutions as a solution to the greed involved with the development and commercialization of GM crops.[38] Due to this movement, companies like Bayer have partnered with organizations like the International Rice Research

---

[33] Devex, The GMO Debate: "How Do Corporations Perceive Their Role in the GMO Debate"? (2018), https://www.devex.com/news/how-do-corporations-perceive-their-role-in-the-gmo-debate-92507
[34] *Id.*
[35] *Id.*
[36] NBC News, "Big Tobacco Finally Tells the Truth In Court Ordered Campaign" (2017), https://www.nbcnews.com/health/health-news/big-tobacco-finally-tells-truth-court-ordered-ad-campaign-n823136
[37] Devex, The GMO Debate: "How Do Corporations Perceive Their Role in the GMO Debate"? (2018), https://www.devex.com/news/how-do-corporations-perceive-their-role-in-the-gmo-debate-92507.
[38] Devex, The GMO Debate: How Do Corporations Perceive Their Role in the GMO Debate? (2018), https://www.devex.com/news/how-do-corporations-perceive-their-role-in-the-gmo-debate-92507.

Institute, in a partnership to improve developing country access to direct seeded rice.[39] Many of these corporations have also partnered with the Bill and Melinda Gates Foundation, a nonprofit foundation founded by billionare Bill Gates, that states its goal is to improve global health, and to aid in the cure to global hunger and extreme poverty.[40] While this may seem like an admirable partnership, many have critiqued the Bill and Melinda Gates Foundation's continued push to expanded high-cost and chemical dependent agriculture in developing nations, like Africa.[41] This can be seen through the Foundations flagship agricultural program titled the "Green Revolution". Critics state that this program works to deepen the humanitarian crisis of failed food systems in developing nations by creating issues such as; increased environmental degradation, reduced biodiversity, increased pesticide use and increased dependency on developed nations.[42]

IV. Case Studies on Gender in Aid

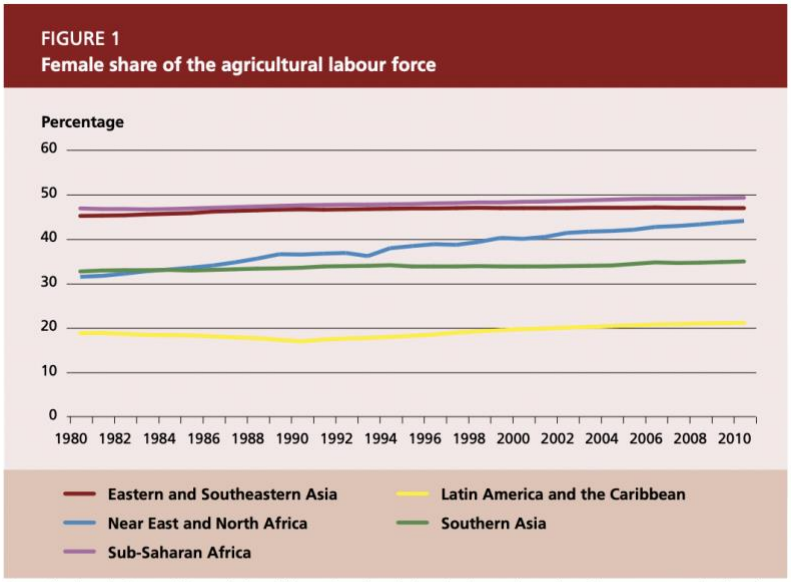
A. Issue Framing

The agriculture sector in many developing nations underperforms for a variety of reasons, one of these being that women in these nations lack the proper resources and opportunities to increase agriculture output.[43] In 2010 the Food and Agriculture Organization (FAO) of the United Nations published a report entitled, "Women in Agriculture Closing the

---

[39] Devex, The GMO Debate: How Do Corporations Perceive Their Role in the GMO Debate? (2018), https://www.devex.com/news/how-do-corporations-perceive-their-role-in-the-gmo-debate-92507.
[40] Bill & Melinda Gates Foundation. Website. https://www.gatesfoundation.org/
[41] Stacy Malkan, U.S. Right to Know, Critiques of Gates Foundation Agricultural Interventions in Africa (2022), https://usrtk.org/bill-gates/critiques-of-gates-foundation/
[42] *Id.*
[43] Food and Agriculture Organization of the United Nations, "The State of Food and Agriculture: Women in Agriculture: Closing the gender gap for development' (2011), https://www.fao.org/publications/sofa/2010-11/sofa-presentation/en/

Gender Gap for Development" that addressed gender inequality in agriculture across the globe. The FAO conducted this important research to investigate the underperformance of developing nations in the agriculture sector, and found that this issue is largely attributed to the inequalities that women farmers face in these nations.[44] The report details the inequalities that women farmers in developing countries face, and the low agricultural output, food security concerns, and stalled economic progress that these countries suffer from. [45] The report also found that while women make up 43% of the agricultural labor force in these developing countries, women receive lower wages for the same work, have a greater overall workload than men and are much less likely to purchase and use chemical inputs for their crops such as fertilizers and pesticides.[46] Additionally, it was found that while female farmers produce less output than their male counterparts, this difference is not related



Note: The female share of the agricultural labour force is calculated as the total number of women economically active in agriculture divided by the total population economically active in agriculture. Regional averages are weighted by population.
Source: FAO, 2010b. See Annex table A4.

[44] Food and Agriculture Organization of the United Nations, "The State of Food and Agriculture: Women in Agriculture: Closing the gender gap for development' (2011), https://www.fao.org/publications/sofa/2010-11/sofa-presentation/en/
[45] *Id.*
[46] Food and Agriculture Organization of the United Nations, "The State of Food and Agriculture: Women in Agriculture: Closing the gender gap for development"(2011), https://www.fao.org/publications/sofa/2010-11/sofa-presentation/en/

to the efficiency of their farming, but rather the differences in funding opportunities and chemical input use.[47] To address this large scale issue of gender inequality amongst women farmers in developing nations, one must first intimately understand this issue. To do so, this paper will utilize the case study research of Mexico, Sub-Saharan Africa, and Ethiopia to illuminate what gender inequality in agriculture looks like in different developing nations, and the impact that it has on developing sustainable food systems. These case studies will each highlight an aspect of gendered agriculture that must be changed or improved for the world to achieve sustainable agricultural food systems, and meet our climate goals before it is too late.

B. Mexico – Gendered Traditions

Mexico is home to a population of 126,014,024 inhabitants, of which 51.5% are women.[48] Women in Mexico have an economic participation rate of 45%, while 77% of men perform economic activities, thereby demonstrating an inequality of economic participation of 32%.[49] This inequality can be evidenced in Mexico's agricultural sector by the Mezcal industry.

One of Mexico's most traditional products, Mezcal, is also a staple of Mexico's agricultural sector, having an exportation value of $148 million per year.[50] Mezcal is a distilled alcohol beverage made of agave, and the production occurs mainly in the Oaxaca region.[51] This

---

[47] Food and Agriculture Organization of the United Nations, "The State of Food and Agriculture: Women in Agriculture: Closing the gender gap for development"(2011), https://www.fao.org/publications/sofa/2010-11/sofa-presentation/en/

[48] David Israel Contreras-Medina, et al., "Innovation of Women Farms: A Technological Proposal for Mazcalilleras' Sustainability in Mexico, Based on Knowledge Management." *Advancing Gender Equality in Rural Areas of Developing Countries*. October 22, 2021.

[49] *Id.*

[50] *Id.*

[51] *Id.*

product is produced by Mezcaleros masters called "Mezcalilleros".[52] Mexcalilleros are the small scale producers who possess the intricate traditional knowledge to transform the agave plant into Mezcal.[53] The process of harvesting agave piñas and processing them into Mezcal has, over time, developed a set of economic and regulatory barriers that resulted in the reduction of profits for those in the industry.[54] As such, many left the mezcal industry, which pushed the women remaining in the community to take over the care of cultivation and processing of Mezcal today.[55] Women are involved with nearly every step in the productal of mezcal, and often work as the mayordomos (foremen) of the processing facility, without the actual title or pay of that position.[56] Dr. Delgado, spokesperson for Union de Mujeres Mezcaleras de Michoacan, states, "Women are always part of the process of making mezcal, they are always present, whenever I witness a distillation, I like to ask the wives because they know every step of the way but they often shy away and hide behind their husbands … because that is a part of their culture".[57] Due to the deeply rooted machismo culture of Mexico, women are often prevented from taking the lead, or if they do, they must seek the approval of men to do so.[58] As such, women in the mezcal industry are often highly concentrated in activities that require fewer physical skills, even if they posses more industry knowledge than their male counter

---

[52] David Israel Contreras-Medina, et al., "Innovation of Women Farms: A Technological Proposal for Mazcalilleras' Sustainability in Mexico, Based on Knowledge Management." *Advancing Gender Equality in Rural Areas of Developing Countries*. October 22, 2021.
[53] *Id.*
[54] *Id.*
[55] *Id.*
[56] Joahna Hernandez, Mezcalistas, "The Intersection of Feminism, Mezcal, and Economic Decelopment" (2020), https://www.mezcalistas.com/the-intersection-of-feminism-mezcal-and-economic-development/.
[57] Joahna Hernandez, Mezcalistas, "The Intersection of Feminism, Mezcal, and Economic Decelopment" (2020), https://www.mezcalistas.com/the-intersection-of-feminism-mezcal-and-economic-development/.
[58] *Id.*

parts.[59] The work of female mezcal farmers and producers largely goes unnoticed often because of their roles as wives and mothers, as well as agriculturalists.[60] The New York Times found that women's unpaid labor globally is worth $10.9 trillion and in Mexico, women spend at least 6 hours a day taking care of relatives, or performing domestic work.[61]

There is an urgency in rural communities of Mexico to boost their local economies by perpetuating a more gender inclusive system of production and recognizing the value of all labor performed, regardless of gender. In a country that has long honored patriarchal policies, the answer may be simple: pay women for the work they do, and it will help regulate the economic acivity of the agricultural sector.

C. Sub-Saharan Africa – Gendered Biotechnology Access & Aid

A large critique of agricultural aid programs is the failure to encapsulate gendered perspectives in the creation of successful and sustainable food systems in developing countries. In Sub-Saharan Africa (SSA), agricultural systems currently favor male-centric perspectives on crop production and management, even though 60-80% of the agricultural labor in this region is carried out by women. [62] This is primarily due to multinational corporations who have partnered with men when conducting agricultural aid programs to promote the use of biotechnology and advanced technologies within the agricultural sector within SSA.[63] The

---

[59]Joahna Hernandez, Mezcalistas, "The Intersection of Feminism, Mezcal, and Economic Decelopment" (2020), https://www.mezcalistas.com/the-intersection-of-feminism-mezcal-and-economic-development/.
[60] *Id.*
[61] Wezerek, Gus and Ghodsee, Kristen R, The New York Times, "Women's Unpaid Labor is Worth $10,9000,000,000,000" (2020), https://www.nytimes.com/interactive/2020/03/04/opinion/women-unpaid-labor.html
[62] Obidimma C. Ezezika, et al., "She Came, She Saw, She Sowed: Re-negotiating Gender-Responsive Priorities for Effective Development of Agricultural Biotechnology in Sub-Saharan Africa". *Journal of Agricultural and Environmental Ethics*. (2013).
[63] *Id.*

National Research Institute in Uganda states that even though in SSA it is the women who culturally till the land, when the aid corporations have meetings about these programs for new technologies, it is the male farmers who are invited, and who show up.[64]

Lack of access to a variety of agricultural resources is also a large setback for SSA women farmers. Research has found that women farmers in SSA are much more likely to be affected by lack of access to affordable seed, land tenure, labor support and proper equipment.[65] However, the major barrier SSA women farmers face is affordability. Often, improved biotechnology, like improved seed varieties and chemical inputs, are unaffordable to small scale women farmers in SSA, because of the premiums placed on these products by the multinational corporations who market them as aid relief in these regions.[66] Women in SSA also have little ability to acquire the credit or capital needed to qualify to purchase from these programs due to partricharcal lending practices in the region.[67] In 2001, a study of adoption of improved maize was found to be unequal for women and men farmers in SSA, soley due to disparities between accessibility to necessary inputs for the utilization of this crop.[68] The same study found that for these adoption rates to become equal, aid organizations targeting SSA must establish policy measures to ensure equitable access to these necessary inputs, regardless of gender.[69]

---

[64] Obidimma C. Ezezika, et al., "She Came, She Saw, She Sowed: Re-negotiating Gender-Responsive Priorities for Effective Development of Agricultural Biotechnology in Sub-Saharan Africa". *Journal of Agricultural and Environmental Ethics*. (2013).
[65] *Id.*
[66] *Id.*
[67] *Id.*
[68] *Id.*
[69] *Id.*

D. Ethiopia

While encourgaging women farmers continued participateion in cropping is imerative to the development of sustainable agriculture systems, empowering women farmers to participate in agriculture research is just as impactful. By including women's traditional and indigenous knowledge of sustainable agriculture practices into agriculture research, the potential for sustainable agricultural systems to be founded and perpetuated is incredible.[70] In Ethiopua, women contribute about 43% to the agricultural labor force, yet most of the agricultural aid information disseminated is to male farmers.[71] While Ethiopia is highly agrarian and has a long history of traditional crop diversification, they are struggling to maintain a sustainable food system to feed their rapidly growing population, like most other developing countries.[72] This is believed to be caused by a variety of factors, one of which being the underrepresentation of women in Ethiopia's research and governance systems.[73] This is critical, especially in Ethipia, because women there manage the "calorie generating plots" for the household, which is the key to their food security.[74] Because the women are the key to food security of each household in the country, they are also the key to food security for the nation as a whole. This role that Ethiopian women play in the household also makes them extremely important to include in agricultural research positions due to their intimate knowledge of region specific issues, practices and techniques.[75] Studies have shown that through implementation of inclusive

---

[70] Annet A. Mulema, et al., "Women farmers' participation in the agricultural research process: implications for agricultural sustainability in Ethiopia." *International Journal of Agricultural Sustainability, Volume 17*. 2019.
[71] *Id.*
[72] *Id.*
[73] *Id.*
[74] *Id.*
[75] *Id.*

programs that incentivize women empowerment in agricultural research in Ethiopia not only will have a profound impact on the nations agricultural output, but also the development of sustainable food systems. Research has also shown that besides empowerment, education, access to land and information are also key determining factors to women's research involvement.[76] As the quest for determining sustainable food systems occurs, it is imperative that women are encouraged to participate in all facets of agriculture, including research.

V. Use of Biotechnology

The United States has implemented GE Crops as solutions for famines, food shortages, and drought in a variety of developing countries, for decades.[77] While the introduction of this technology was meant for positive effect on unstable food systems, the application of GE crops in developing countries often falls short of success. History of biotechnology investments and aid package donations into foreign developing nations has shown that simply inserting a technology as a one-size-fits-all solution to intricate resource issues has devastating impacts on that nations farmers, economy and its environment. Agriculture biotechnology's lack of success in perpetuating stable and sustainable food systems in developing nations can be contributed to three factors : market concentration, corporate exertion of control over farmers, and its detrimental effects on the environment.

[76] Annet A. Mulema, et al., "Women farmers' participation in the agricultural research process: implications for agricultural sustainability in Ethiopia." *International Journal of Agricultural Sustainability, Volume 17*. 2019.
[77] Congressional Research Service, *Agriculture Biotechnology: Overview, Regulation, and Selected Policy Issues*, Congressional Research Report, (March 9, 2021), https://crsreports.congress.gov/product/pdf/R/R46737

A. Market Concentration

Economists opine that when four or less companies control at least 40% of a market, it is no longer able to be idenitified as competitive. [78] Four multinational agriculture companies account for 54% of the global seed market, and only six companies account for 76.1% of global agrochemical sales.[79] This data illustrates the perpetuating trend of vertical integration, otherwise known as market concentration, in the agriculture industry.[80] As this trend progresses, the increased industry consolidation will result in a few multinational agriculture corporations having profound positions of power in the global agriculture industry, both politically and economically.[81] This concentration impacts farmers in developing nations dramatically because when the seed market becomes smaller, the prices that the farmers will pay for their seed rises exponentially due to reduced market

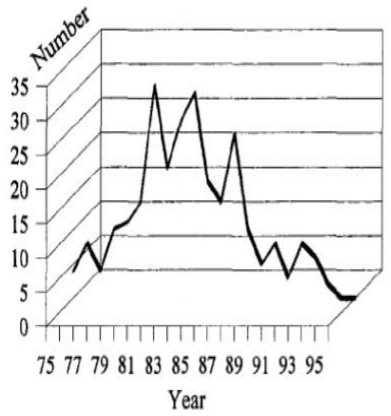


Figure 1. Number of new agro-biotechnology firms

Table 1. Numbers of Inter-Firm Activities in the Agro-biotechnology Industry

	Period			Total
Activity	1981–85	1986–90	1991–96	1981–96
Mergers and Acquisitions	19	115	274	408
Equity Investment	24	41	47	112
R&D Agreements	84	244	147	475
Joint Ventures	24	77	81	182
Licensing Agreements	6	78	122	206
Distribution Agreements	9	66	109	184
Production Agreements	1	3	21	25
Total	167	624	801	1,592

[78] Ken Roseboro, *GE Seed Monopoly*, The Organic and Non-GMO Report, (September 2013), https://www.pccmarkets.com/sound-consumer/2013-09/ge_seed_monopoly/

[79] Fugile, et. al., *Research Investments and Market Structure in the Food Processing, Agricultural Output and Biofuel Industries Worldwide*, United States Department of Agriculture Economic Research Report Number 130, (December 2011), https://www.ers.usda.gov/webdocs/publications/44951/11777_err130_1_.pdf?v=5127.7

[80] Ken Roseboro, *GE Seed Monopoly*, The Organic and Non-GMO Report, (September 2013), https://www.pccmarkets.com/sound-consumer/2013-09/ge_seed_monopoly/

[81] Kalaitzandonakes, Nicholas, *Vertical and Horizontal Coordination in the Agro-Biotechnology Industry: Evidence and Implications*, Journal of Agricultural and Applied Economics, (February 1997), https://www.researchgate.net/publication/5138996_Vertical_and_Horizontal_Coordination_in_the_Agro-Biotechnology_Industry_Evidence_and_Implications

competition.[82] Accordingly powerful global agricultural conglomerates are able to continuously raise the price of their products, much to the detriment of the impoverished farmers that rely on this seed for their livelihood.[83] This cycle is devastating to developing nation farmers who cannot afford to continuously pay more for their seed, and receive less profit overall for their crop. As such, market concentration is rapidly exacerbating developing nation's farmers' debts, and their contributing to the instability of their food systems overall. Additionally, due to the perpetuation of the vertical integration of the agriculture industry, the GE crops that developing farmers are seeking for traits such as drought and pesticide tolerance, are bypassing the small impoverished farmers in developing nations that need them most to create a stable food system, and are instead going to the wealthier farmers that can afford to keep paying heightened commodity prices for these seeds.[84]

Table 2. World's Largest Seed Companies

Company	Seed Sales (Millions)
Monsanto (United States)	$6,700[a]
Dupont/Pioneer (United States)	$6,400
Syngenta (Switzerland)	$3,850
Group Limagrain (France)	$3,400
Land O'Lakes (United States)	$756
KWS AG (Germany)	$615
Bayer Crop Science (Germany)	$430

Source: ETC Group, Communique #99: Patenting the "Climate Genes" ... and Capturing the Climate Agenda." May/June 2008.

a. Includes sales from Seminis, acquired by Monsanto in 2005, and Delta and Pine Land, acquired in 2007.

However, market concentration has effected more than just the seed markets for developing nation farmers looking to utilize biotechnology in search for food security, it also effects the chemical inputs they use on their crops. While most genetically engineered crops are made to

[82] Ken Roseboro, *GE Seed Monopoly*, The Organic and Non-GMO Report, (September 2013), https://www.pccmarkets.com/sound-consumer/2013-09/ge_seed_monopoly/
[83] Ken Roseboro, *GE Seed Monopoly*, The Organic and Non-GMO Report, (September 2013), https://www.pccmarkets.com/sound-consumer/2013-09/ge_seed_monopoly/
[84] Cowan, Tadlock, *Agricultural Biotechnology: Background and Recent Issues*, Congressional Research Resport, Congressional Research Service, (September 2, 2010), https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1026&context=crsdocs

withstand glyphosate, the main ingrediaent in most herbicides, studies have shown that many weed species have also genetically evolved alongside the use of GE crops, and are now becoming resistant to herbicides.[85] To combat this resistance, farmers across the globe are being instructed by the companies that sold them the seeds to apply a mix of agrochemical inputs on their fields, that glyphosate based products alone used to be able to terminate.[86] This is highly detrimental to farmers as they are not only paying the increased prices leveraged by market concentration of seed companies, but are also purchasing the additional chemical inputs necessary to ensure a successful crop. It is also important to note that most of the seed companies utilized are also herbicide manufactures and benefit directly from both the sell of their seed and the perpetuation of glyphosate tolerant weeds as it incentivizes more sales of chemical inputs across the globe.

B. Corporate Control

As market concentration deepens, so does the intricate power dynamic between the corporations that sell GE crops, and the developing nations farmers who receive the crops. As the global agriculture sector becomes monopolized, the corporations that remain become politically powerful and have the ability to exert this power over policymakers, and the farmers who rely on their products.[87] These corporations exert power over developing nations farmers via the use of structural power. Structural power is the means of being hyper-attentice to the political implications of mutual-dependencies. Here, the mutual dependency relationship exists

---

[85] Nandula, et. al., *Glyphosate-Resistant Weeds: Current Status and Future Outlook*, Outlooks on Pest Management, (August 2005), https://www.ars.usda.gov/ARSUserFiles/64022000/publications/reddy/nandula-grw12.pdf
[86] *Id.*
[87] Fairfield, Tasha, *Structural Power in Comparative Political Economy*, London School of Economics and Political Science (August 19, 2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2646855

between both the developing nation farmers and the multinational corporation, because the farmers depend on the corporations for funding and agricultural aid facilitation, while the corporations depend on the farmers continues reliance on their seeds and chemical inputs to generate mass profts. International policy scholars have closely studied this dynamic and have determined that there are two main ways in which the multinational corporations manifest their extreme power over developing nation farmers.

Primarily, one of the main factors that gives corporations control over developing nation's farmers is the development of various intellectual property rights protections. Intellectual property rights are intended to restrain competition, aadversely effect trade, and impede the transfer and dissemination of technology.[88] As such, the development of stringent intellectrual property rights can have a detrimental effect on competition in a market. Without government intervention, or regulatory action to prevent or counteract these anticompetitive protections, market concentration is intensified by these strengthening of intellectual property rights.[89] The contestion of intellectual property protections in relations to the use of agriculture biotechnology stems from critiques of the Trade-related Aspects of Intellectual Property Rights (TRIPS) agreement that was enacted by the World Trade Organization in 1995.[90] Intellectual property protections are often viewed as divisive regarding the interests of developed and developing countries, and this is illuminated frequently within the TRIPS agreement.[91] Many

---

[88] Cowan, Tadlock, *Agricultural Biotechnology: Background and Recent Issues*, Congressional Research Resport, Congressional Research Service, (September 2, 2010), https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1026&context=crsdocs
[89] *Id.*
[90] Dickson, David, *Loosening the Grip of Patents on Research*, Commission on Intellectual Property Rights, (October 14, 2002), http://www.iprcommission.org/graphic/Views_articles/SciDev_Net.htm
[91] *Id.*

viewed the agreement as an acceptance of the "unbnalance" of the agreement or its tendency to favor transnational corporations over that of developing countries, and their populations.[92] This critique cstems from the language in the agreement that pressures developing nations to accept higher standards of intellectual property right protections than is deemed necessary by the World Trade Organziation.[93] International trade scholars have deemed this move nefarious because the push for this adoption of higher standards comes before it has been analyzed to see if it would be detrimental to developing nation's efforts towards poverty alleviation and creation of stable food systems. [94] This push for higher standards is particularly crippling for developing nations because it stifles any local innovation that may naturally occur, especially in developing countries that do not have access to large technological funding capacities.[95] In a time were sustainable agriculture practices are imperative to the survival of the earth, it is inconceivable that the indeginous agrarian practices that have lasted centerius would be stifled out my monopolistic and corporate greed. By siliencing the indeginous populations of these countries, multinational corporations are able to further push their agenca of GE crop implementation, thereby entrapping small land holders and agrarian population into the debt cycle that is GE crops in developing nations.

While private organizations have heavily invested in agriculture biotechnology research due to its ability to increase profits, public funding and research is possible and may help to incentivize local innovation across the globe. It is important to consider that in addition to

---

[92] Dickson, David, *Loosening the Grip of Patents on Research*, Commission on Intellectual Property Rights, (October 14, 2002), http://www.iprcommission.org/graphic/Views_articles/SciDev_Net.htm
[93] *Id.*
[94] *Id.*
[95] *Id.*

public and private incentives, public policy, such as; intellectual property rights, regulatory policy, and educational policy strongly affect how heavily research and development is funded by either the private or public sector.[96] The strengthening of intellectual property rights, for example increases a private entity's desire to heavily invest in research and development of innovation.[97] Recently, the uprise in private US biotechnology research has stemmed from the ability to be able to receive patent protection for genetic alterations to living organisms such as plant varieties.[98] In *Diamond v. Chakrabarty*, the Supreme Court of the United States held that patent protection for genetically engineered microorganisms should be granted as long as it meets the requirements for obtaining a utility patent.[99] This holding, along with other protections put in place by the US Patent and Trademark Office, was the significant push towards private research in biotechnology that created the conglomerates that stand today.

C. Detrimental Effects on the Environment

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity is an international agreement, adopted in 2000, and took effect in 2003, that relates to the safe handling, transportation and use of genetically engineered organisms, including crops.[100] The protocal permits a country to require formal prior notification from countries exporting biotech seeds and living modified organisms intended for introduction into the environment.[101] The

---

[96] Caswell, et. al., *Agircultural Biotechnology: An Economic Perspective*, Economic Research Service Report, United States Department of Agriculture, (September 1998), https://www.ers.usda.gov/webdocs/publications/40591/33088_aer687_002.pdf
[97] *Id.*
[98] *Id.*
[99] *Diamond v. Chakrabarty*, 447 U.S. 303 (1980).
[100] Congressional Research Service, *Agriculture Biotechnology: Overview, Regulation, and Related Policy* Issues, Congressional Research Report, (March 9, 2021), https://crsreports.congress.gov/product/pdf/R/R46737/3
[101] *Id.*

protocol also establishes processes for more detailed identification of living modified organism commodities in international trade.[102] However, as it stands today, the United States is not a party to the Convention, and therefore is not a party to the protocol, even though over 170 other countries are. An explaination as to why one the largest and most productive agricultural country in the world is not a part of this protocol is found in the US' prioritization of industrialized agricultural practices. Industrial agriculture places consistency and productivity over biodivertsity, however this increased productivity comes at an immense cost in the form of monocropping.[103] Large fields of monocultures of a single crop make farming very simplistic for farmers and are highly productive in their yields, but these monocultures requires high yields of agrochemical inputs that reduce the ability of wild species of crops both on and off of the farm.[104] This reduction in plant diversity can have effects on the animals and ecosystems that depend on these plants to perpetuate their existence.[105] An example of this is found in the US with the increased use of glyphosate. The increased use of this chemical has significantly reduced wild plant diversity on and around American farmland which has significantly impacted the populations of monarch butterflies, that rely on these plants.[106] Biodiversity in domesticated crops is vital because it ensures a large gene pool exists within the crop variety for traits such as disease resistance.[107] By allowing monocultures to become prevelant through

---

[102] Congressional Research Service, *Agriculture Biotechnology: Overview, Regulation, and Related Policy* Issues, Congressional Research Report, (March 9, 2021), https://crsreports.congress.gov/product/pdf/R/R46737/3
[103] Tauranac, Maggie, *Biodiversity and Agriculture*, FoodPrint, (February 17, 2021),https://foodprint.org/issues/biodiversity-and-agriculture
[104] *Id.*
[105] *Id.*
[106] *Id.*
[107] *Id.*

the use of GE crops, it is allowing food supplies to become vulnerable to threats such as disease, climate change, and even agroterrorism.[108]

Additionally, because the utilization of GE crops requires increased use of agrochemical outputs, the use of these crops detrimentally pollute the environment around them. Research suggests that massive use of inorganic fertilizers, a form of agrochemical input used inconjunction with GE crops, is associated with the accumulation of contaminates in agricultural soils.[109] According to a US Geological Survey, pesticides were detected 97% of the time in samples from stream water in agricultural areas.[110] These contaminants significantly impair the quality of both surface and groundwater, as they do not remain stationary to the crop in which they are applied.[111] Runoff and infiltration transport these contaminants into local groundwater, streams, and rivers.[112] The infiltration of these contaminants into these water sources has a detrimental impact on the water sources ecosystems. The primary problem associated with increased chemical input in streams is nuisance levels of aquatic vegetation, such as algae.[113] This is because an increased concentration of nitrogen, an ingredient heavily found in most pesticides and herbicides, results in an increase in benthic algae production.[114]

---

[108] Tauranac, Maggie, *Biodiversity and Agriculture*, FoodPrint, (February 17, 2021), https://foodprint.org/issues/biodiversity-and-agriculture
[109] Zhang, et. al., *The Impacct of Agricutlural Chemcial Inputs on Environment: Global evidence from Informetrics Analysis and Visualization*, International Journal of Low-Carbon Technologies, Volume 13, Issue 4, Oxford Academic, (August 22, 2018), https://academic.oup.com/ijlct/article/13/4/338/5077788
[110] Gilliom, Robert J., *Pesticides in U.S. Streams and Groundwater*, Environmental Science and Techonology, American Chemical Society (May 15, 2007), https://pubs.acs.org/doi/pdf/10.1021/es072531u
[111] Water Resources, *Agriculutral Contaminants*, United States Geological Surveys, (March 1, 2019), https://www.usgs.gov/mission-areas/water-resources/science/agricultural-contaminants
[112] *Id.*
[113] *Id.*
[114]Munn, et. al., *The Quality of Our Nation's Waters: Understanding the Influence of Nutrients on Stream Ecosystems in Agricultural Landscapes*, U.S. Department of the Interior, U.S. Geological Survey, (2018), https://pubs.usgs.gov/circ/1437/cir1437.pdf

This overproduction leads to the alteration of invertebrate communities and biological conditions in the surrounding water ecosystems, thereby negatively impacting the environment, and the overall water health of the area.[115]

V. Policy Recommendations

As the world continues to turn, each day we are closer to the devastating timeline that the IPCC has set out in front of us for major climate change related disasters. However, if the globe can meet its sustainability goals, one of which is being able to create and foster sustainable and stable food systems, we may be able to mitigate some of the severe damage predicted to befall our planet within the coming years. In order to this, however, there are a plethora of adjustments we must make in how agriculture aid is given, how agriculture biotechnology is used and how these programs balance inequalities between genders.

A. Increasing Women's access to Agricultural Aid Programs

The FAO predicts that if women farmers had equal access to productive resources, they would be able to increase agricultural outputs by 20-30%, which is enough to provide food for 100-150 million people.[116] Increasing women's productive capability can be achieved through the promotion of female empowerment in the agriculture sector, policy objectives that equally distribute resources amongst male and female farmers, and re-framing the way that agriculture aid is distributed. This will not be an easy feat, however, because often increasing women's access to things like agricultural programs will require battling traditional policital oppression

---

[115] Munn, et. al., *The Quality of Our Nation's Waters: Understanding the Influence of Nutrients on Stream Ecosystems in Agricultural Landscapes*, U.S. Department of the Interior, U.S. Geological Survey, (2018), https://pubs.usgs.gov/circ/1437/cir1437.pdf

[116] United Nations Women, "Five Ways to Build Gender Equaltiy and Sustainability" (2022), https://www.unwomen.org/en/news-stories/feature-story/2022/02/five-ways-to-build-gender-equality-and-sustainability?gclid=EAIaIQobChMI9Jik4KnP-wIV1DizAB3y3ABHEAAYAyAAEgLMDvD_BwE

systems that women have faced for years. This includes obstacles such as, women not being able to enter contracts on their own, and not being able to obtain credit or capital. So while the agriculture sector can push for these large changes, it is also necessary for women to receive more social freedoms in these countries in order for the empowerment programs to really be impactful on the women in these communitys, as well as the climate.

B. Integrating Holistic and Proactive Gender Perspectives into Research

As highlighted in the Ethiopian case study, women's gender perspectives must be included in agriculture research for it to be fruitful in assisting to develop a successful and sustainable food system. The results from the African RISING project in the Ethiopian case study proved that for women to actively participate in all stages of the agricultural research process, there is a need for more holistic approaches that can unleash women's potential by increasing their participation in farmer-research groups, access to information and knowledge, building self-esteem, developing their ability to innovate, experiment and make strategic de csisions.[117] However, for this to successfully occur, men need to be engaged in the process of destroying gender norms and traditions that have shaped the oppression of women in agricultural roles for centeries.[118]

C. Focus on Agrobiodiversity Protections and Research

The utilization of genetically engineered crops contributorily perpetuates the use of monocultures in farming. In order to keep gene varieties abundant and thriving so that crops may have a large gene pool for traits like disease resistance, we must allow wild species and

---

[117] Annet A. Mulema, et al., "Women farmers' participation in the agricultural research process: implications for agricultural sustainability in Ethiopia." *International Journal of Agricultural Sustainability, Volume 17*. 2019.
[118] *Id.*

varieties of plants to grow on and around farmland to ensure their existence. Additionally, by preserving the wild relatives of these crops, we are preserving the ability of future generations to nourish themselves off of the same plants that we have used for centuries.

While preserving biodiversity of crops may seem like a daunting task, it can be accomplished utilizing infrastructure such as seed and gene banks across the globe to ensure continued accessibility to genetic varieties of important staple crops. Additionally, consumers can assist in preserving biodiversity by choosing lower-impact organic foods at the store whenever possible. This is helping by supporting organic farmers who have chosen not to spray chemical inputs on their crops, and thereby have preserved the biodiversity on and around their farms.

D. **Encourage Public Sector Research on Biotechnology**

As previously stated, the implementation of agriculture biotechnology into has created both great advantages, as well as great controversy over its use. A large portion of the controversy regarding the use of this technology surrounds the ownership of this property, its intellectual rights protections, and how those detrimentally affect small farmers that utilize these products due to the strength of the agriculture conglomerates in the marketplace. However, there are ways to anticipate and combat this concentration of power in the marketplace, and that is by incentivizing innovation. Incentivization of innovation can be accomplished at a variety of levels, but particular attention should be focused on increasing public sector research on agriculture biotechnologies through public universities and non-governmental organizations. As we move forward closer to the IPCC's projected impact dates, State and Federal legislatures should push for funding to be allocated to programs that publically explore the ways in which

biotechnology can help the globe create stable and sustainable food systems, so that our populations can thrive for generations to come.

Bibliography

Annet A. Mulema, et al., "Women farmers' participation in the agricultural research process: implications for agricultural sustainability in Ethiopia." *International Journal of Agricultural Sustainability, Volume 17*. 2019.

Adenle, et. al., *Analysis of Open Source Biotechnology in Emerging Countries: An Emerging Framework for Sustainable Agriculture*, Technology in Society, Volume 34, (August 2012), https://www.sciencedirect.com/science/article/abs/pii/S0160791X12000450

Bill & Melinda Gates Foundation. Website. https://www.gatesfoundation.org/

Caswell, et. al., *Agircultural Biotechnology: An Economic Perspective*, Economic Research Service Report, United States Department of Agriculture, (September 1998), https://www.ers.usda.gov/webdocs/publications/40591/33088_aer687_002.pdf

Congressional Research Service, *Agriculture Biotechnology: Overview, Regulation, and Selected Policy Issues*, Congressional Research Report, (March 9, 2021), https://crsreports.congress.gov/product/pdf/R/R46737

Cowan, Tadlock, *Agricultural Biotechnology: Background and Recent Issues*, Congressional Research Resport, Congressional Research Service, (September 2, 2010), https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1026&context=crsdocs

David Israel Contreras-Medina, et al., "Innovation of Women Farms: A Technological Proposal for Mazcalilleras' Sustainability in Mexico, Based on Knowledge Management." *Advancing Gender Equality in Rural Areas of Developing Countries*. October 22, 2021.

Devex, The GMO Debate: "How Do Corporations Perceive Their Role in the GMO Debate?" (2018), https://www.devex.com/news/how-do-corporations-perceive-their-role-in-the-gmo-debate-92507

Diamond v. Chakrabarty, 447 U.S. 303 (1980).

Dickson, David, *Loosening the Grip of Patents on Research*, Commission on Intellectual Property Rights, (October 14, 2002), http://www.iprcommission.org/graphic/Views_articles/SciDev_Net.htm

Fairfield, Tasha, *Structural Power in Comparative Political Economy*, London School of Economics and Political Science (August 19, 2015), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2646855

Farhall, et. al., *The "Gender Agenda" in Agriculture for Development and Its (Lack of) Alignment With Feminist Scholarship*, Frontiers in Sustainable Food Systems (February 10,2021), https://www.frontiersin.org/articles/10.3389/fsufs.2021.573424/full

Food and Agriculture Organization of the United Nations, "The State of Food and Agriculture: Women in Agriculture: Closing the gender gap for development' (2011), https://www.fao.org/publications/sofa/2010-11/sofa-presentation/en/

Fugile, et. al., *Research Investments and Market Structure in the Food Processing, Agricultural Output and Biofuel Industries Worldwide*, United States Department of Agriculture Economic Research Report Number 130, (December 2011), https://www.ers.usda.gov/webdocs/publications/44951/11777_err130_1_.pdf?v=5127.7

Gilliom, Robert J., *Pesticides in U.S. Streams and Groundwater*, Environmental Science and Techonology, American Chemical Society (May 15, 2007), https://pubs.acs.org/doi/pdf/10.1021/es072531u

The Heritage Foundation, "How American Food Aid Keeps the Third World Hungry" (1988), https://www.heritage.org/trade/report/how-american-food-aid-keeps-the-third-world-hungry

IPCC, *IPCC Press Release* (August 9, 2021), Ipcc.ch/site/assets/uploads/2021/08/IPCC_WGI-AR6-Press-Release_en.pdf

Joahna Hernandez, Mezcalistas, "The Intersection of Feminism, Mezcal, and Economic Decelopment" (2020), https://www.mezcalistas.com/the-intersection-of-feminism-mezcal-and-economic-development/.

Kalaitzandonakes, Nicholas, *Vertical and Horizontal Coordination in the Agro-Biotechnology Industry: Evidence and Implications*, Journal of Agricultural and Applied Economics, (February 1997),https://www.researchgate.net/publication/5138996_Vertical_and_Horizontal_Coordination_in_the_Agro-Biotechnology_Industry_Evidence_and_Implications

Ken Roseboro, *GE Seed Monopoly*, The Organic and Non-GMO Report, (September 2013), https://www.pccmarkets.com/sound-consumer/2013-09/ge_seed_monopoly/

Munn, et. al., *The Quality of Our Nation's Waters: Understanding the Influence of Nutrients on Stream Ecosystems in Agricultural Landscapes*, U.S. Department of the Interior, U.S. Geological Survey, (2018), https://pubs.usgs.gov/circ/1437/cir1437.pdf

Nandula, et. al., *Glyphosate-Resistant Weeds: Current Status and Future Outlook*, Outlooks on Pest Management, (August 2005), https://www.ars.usda.gov/ARSUserFiles/64022000/publications/reddy/nandula-grw12.pdf

NBC News, “Big Tobacco Finally Tells the Truth In Court Ordered Campaign” (2017), https://www.nbcnews.com/health/health-news/big-tobacco-finally-tells-truth-court-ordered-ad-campaign-n823136

Obidimma C. Ezezika, et al., “She Came, She Saw, She Sowed: Re-negotiating Gender-Responsive Priorities for Effective Development of Agricultural Biotechnology in Sub-Saharan Africa”. *Journal of Agricultural and Environmental Ethics*. (2013).

Stacy Malkan, U.S. Right to Know, Critiques of Gates Foundation Agricultural Interventions in Africa (2022), https://usrtk.org/bill-gates/critiques-of-gates-foundation/

Tauranac, Maggie, *Biodiversity and Agriculture*, FoodPrint, (February 17, 2021), https://foodprint.org/issues/biodiversity-and-agriculture

U.S. Department of State, A Short History of U.S. International Food Assistance (2009), https://2009-2017.state.gov/p/eur/ci/it/milanexpo2015/c67068.htm.

United Nations Women, “Five Ways to Build Gender Equaltiy and Sustainability” (2022), https://www.unwomen.org/en/news-stories/feature-story/2022/02/five-ways-to-build-gender-equality-and-sustainability?gclid=EAIaIQobChMI9Jik4KnP-wIV1DizAB3y3ABHEAAYAyAAEgLMDvD_BwE

Water Resources, *Agriculutral Contaminants*, United States Geological Surveys, (March 1, 2019), https://www.usgs.gov/mission-areas/water-resources/science/agricultural-contaminants

Wezerek, Gus and Ghodsee, Kristen R, The New York Times, “Women’s Unpaid Labor is Worth $10,9000,000,000,000” (2020), https://www.nytimes.com/interactive/2020/03/04/opinion/women-unpaid-labor.html

Zhang, et. al., *The Impacct of Agricutlural Chemcial Inputs on Environment: Global evidence from Informetrics Analysis and Visualization*, International Journal of Low-Carbon Technologies, Volume 13, Issue 4, Oxford Academic, (August 22, 2018), https://academic.oup.com/ijlct/article/13/4/338/5077788