Data Feminism as a guide for agricultural research

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# Abstract

Agricultural research reflects complex institutional and interpersonal relationships that have historically been, and continue to be, subject to power imbalances. Recently, the Data Feminism framework was developed to aid scientists in understanding and addressing power imbalances inherent in research. In this Perspective we demonstrate its utility in agriculture settings and present evidence that explicit attention to power concomitantly fosters research creativity and leads to positive societal outcomes.

# Introduction

Agriculture involves the cultivation of land to produce food, an arrangement primed for power disparities. Indeed, over thousands of years and across civilizations, agriculture has enabled, leveraged, fomented, and reflected power hierarchies1,2. It follows that the interpersonal and institutional relationships upon which agricultural research is built mirrors those artifacts, with profound ethical and social consequences. This is not unique to agricultural research; global recognition of the need to intentionally examine how power interacts with science has spurred the creation of new academic fields3–6. While social scientists have long recognized these interactions7, technical scientists are increasingly being asked to consider the context of their work. There have been calls for and attempts to codify reflexivity in the fields of food studies and agroecology8–12, but it remains a formidable task in the field of agriculture writ large. The recently developed Data Feminism framework13, which targets technical scientists, is particularly well-suited to support agricultural researchers in this pursuit. The framework is rooted in empirical studies of power and emphasizes intersectionality, or the need to study multiple dimensions of power14. Because it is action-oriented and domain-agnostic, D’Ignazio and Klein’s (2020) work has been highly cited in numerous disciplinary contexts. To our knowledge, it has had limited interpretation in the context of agriculture, though a recent study evaluated the National Agricultural Statistics Service (NASS) agency of the United States Department of Agriculture (USDA) on their data reporting practices through the lens of Data Feminism15.

We posit that explicit application of the Data Feminism framework would positively contribute to research creativity, stakeholder participation, and agricultural sustainability overall. To support this thesis, we discuss the application of Data Feminism themes (power, reciprocity, and framing) in the research process, with accompanying example activities and demonstrably positive outcomes (Table 1).

### Table 1. Summary of paper structure

|  |  |  |
| --- | --- | --- |
| **Data Feminism-derived theme** | **Research phase(s)** | **Agricultural research activities** |
| Research for the public good should seek to equalize power | Hypothesis generation and study design | Serving the margins, technical audits, incorporating other ways of knowing |
| Farmer-researcher relations should be reciprocal | Conducting and implementing research | Compensation, metrics for success |
| All research is values-informed | Analysis and dissemination | Acknowledging co-existence of multiple truths, supporting diverse framings |

The goal of this paper is to interpret select themes from the Data Feminism framework in an agricultural setting and serve as an encouraging resource for more intentional work in this area. Our perspectives are strongly framed by our collective experiences in the agricultural systems of the United States (US), and specifically of those in the maize-producing areas of the Midwest. However, while the specifics of a given system vary, we believe the topics are universal. This is not meant to be a comprehensive review of power issues in agriculture, nor a thorough documentation of efforts to address those issues. Rather, our hope is that this perspective supports technically trained agricultural scientists in connecting their work to its broader societal implications and in sculpting that work to contribute to a more equitable society.

# Research for the public good should seek to equalize power

When one can obtain one’s will even in the face of resistance from others, they wield power16. Central to Data Feminism is the fact that power is unevenly distributed and experienced in this world and redistribution requires intentional examination and intervention.This foundation is particularly relevant in agriculture; overarching features such as labor exploitation (both historic and modern17), Native land dispossession18,19, and selective land ownership rights20–22 render power inequities deeply embedded in agricultural systems. Research seeking to support public good requires an understanding of how that research passively endorses or challenges power artifacts. However, because power is a complex topic with dedicated scholars, this pursuit may feel daunting to the average scientist. To aid non-experts in contextualizing their work, Data Feminism applies Collins’ (1990) matrix of domination23 to elucidate where and how power inequities may manifest, and therefore clarify how they may be challenged. To demonstrate its application, we present an adaptation of the matrix with select examples from modern US agricultural systems (Table 2).

### Table 2. Domains through which power may be expressed and experienced (adapted from Collins 1990)

|  |  |  |
| --- | --- | --- |
| **Domain** | **Description** | **Select examples of uneven distribution or experience of power from modern US agriculture** |
| **Structural domain** | Laws and policies that distribute power | Racially tiered implementation and funding of US land-grant university system24–26; discriminatory design of US land heirship laws27,28; discretionary implementation of eminent domain laws29 |
| **Disciplinary domain** | Entities that implement and enforce (or fail to implement and enforce) laws and policies distributing power | USDA credit granting discrimination based on race and gender30; systematic exclusion of groups via USDA NASS census collection formats31,32; barriers to participation of American Indian lands in NRCS programs33 |
| **Hegemonic domain** | Entities that circulate ideas related to who has power | Gendered expectations for land ownership and management34; public extension and conservation programs focused on top-down, technical solutions35; focus on Western science in agricultural curriculums36 |
| **Interpersonal domain** | Individual experiences, expression, and awareness of who has power | In- and out-group mentalities in agricultural practitioners37, gendered experiences of fieldwork and farmer interactions38,39; gender biases in agricultural students40 |
| USDA - United States Department of Agriculture; NASS - National Agricultural Statistics Service, an agency responsible for collecting and reporting information related to agricultural production within the USDA; NRCS - Natural Resource Conservation Service, an agency that provides technical and financial assistance to land owners | | |

To help agricultural researchers envision how their work may integrate into a larger effort to rebalance power in one or more domains, we present three research activities with attendant examples of positive experiences.

## 2.1 Serving the margins

In agriculture, institutional exclusion can manifest through individual characteristics as well as farm-level features (e.g., production system, degree of farm mechanization). This systemic and cultural exclusion often translates to exclusion from agricultural research activities41,42. Conducting research that serves institutionally excluded groups lends legitimacy, helping to elevate their experiences and knowledge as equally valuable43. It can also inspire solutions that benefit everyone. For example, in 1987 a group of farmers formed Practical Farmers of Iowa44 (hereafter referred to as Practical Farmers) as a peer-to-peer learning community45, partially in response to feeling neglected by the Land Grant’s extension systems46. Years later, one of those farmers’ low-input systems inspired the design of an influential crop diversification experiment47. More recently, Latino farmers in the Midwest have little institutional support, and Practical Farmers launched a Latino Engagement program (Supplementary References). Researcher participation in the Women Food and Agricultural Network48 similarly inspired scientifically fruitful activities with women land owners49,50. By serving institutionally excluded groups, agricultural researchers leverage their privilege to help build legitimacy within the margins, and by listening, they can in turn gain rich scientific insights.

## 2.2 Technical audits

By leveraging their scientific training, agricultural scientists have great potential to contribute to documentation of power imbalances, and therefore support their mitigation (Table 2). For example, a series of studies documented significant soil degradation and crop yield losses following the required remediation accompanying underground pipeline installation 51–53. By quantifying long-term impacts on productive agricultural land (a globally limited resource), this research allows landowners to advocate for fair compensation and for the public to more accurately evaluate true costs of pipeline installations. Similarly, the environmental impacts of nitrogen use in agriculture have been extensively documented54, and stakeholders are demanding more accountability with regards to agricultural nutrient management55. University nutrient recommendations have traditionally been generated using top-down, poorly designed56, siloed experiments without extensive input from the public, farmers, or even other scientists. In response, farmer-led groups and universities have begun to reimagine this arrangement, starting programs to democratize and contextualize recommendations, while supporting horizontal knowledge exchange. Iowa State University recently launched an ambitious program wherein farmers volunteer (see *Reciprocity* section) to perform nitrogen rate trials in their own production contexts57. The data is collectively pooled and used to drive transparently calculated, more nuanced recommendations and development of a publicly available and mechanistic predictive model. Similarly, Practical Farmers (see *Serving the margins* section) , launched a regional program paying farmers (see *Reciprocity* section) to test nitrogen rates of their choice using replicated trials and sharing their results with the public. These efforts represent a positive redistribution of power in generating nutrient recommendations.

## 2.3 Incorporating other ways of knowing

Multiple ways of knowing originates in Indigenous epistemologies but has migrated into common vernacular. It recognizes the diverse means through which individuals and groups understand the world around them, including empirical observation and logical reasoning, but also personal experience and cultural traditions extending from place-based knowledges, for example. In dismissing knowledge originating outside of traditional scientific methods, scientists limit the potential contribution such knowledge can have in enriching scientific understanding58. It follows that by utilizing non-traditional measurements, agricultural scientists can honor multiple ways of knowing while still working within a scientific framework. An apposite example is USDA NASS reporting of a ‘workable field day’, defined as day where weather and field conditions allow producers to work in fields a major portion of the day59. It has a scientific underpinning60 but represents a deeply personal interaction between the farmer and the land that has evaded modelling attempts61. Workable-day survey data is commonly used in extension, but to our knowledge has had limited use within research. In an example of challenging hegemonic power around knowledge generation, Practical Farmers recently launched a study wherein farmers will quantify their experiences with cover cropping through the metric of workable field days (S1). This effort values farmers’ ways of knowing in a scientific framework, and will uniquely enrich our understanding of how cover crops impact soil-water dynamics.

# Farmer-researcher relations should be reciprocal

The *way* research is done presents myriad opportunities to distribute power more equitably. For over a century, experimental plots managed by researchers have been the workhorse of agricultural research. As agricultural research evolves, opportunities abound for blending research plots with farm fields to perform more statistically powerful and relevant public research in collaboration with farmers62–64. However, these arrangements require careful consideration to support equitable and fair power relations.There are several guides for farmers when conducting on-farm research65,66, but there are fewer resources suggesting best practices for the scientists, researchers, and organizations they collaborate with. A recent publication provides excellent guidance on working with communities and organizations in general9, however we feel the farmer-researcher collaboration merits explicit attention for agricultural scientists.

## 3.1 Compensation

The context for farmer involvement in research can vary widely67,68, but to our knowledge there are few studies on mechanisms for farmer compensation and how those mechanisms influence collaboration dynamics69. This omission is problematic; research participants should always be compensated, and the form this compensation takes is particularly germane to the topic of power. It is common for farmers to be compensated by *the experience and knowledge gained from the activities*, *access to research findings*, *better productivity*, or a similarly non-tangible exchange. In its most egregious forms, this arrangement is elitist, extractive, and disrespectful. We acknowledge individual researchers may be constrained in their access to unrestricted grant money to pay collaborators, but without an offer of fair compensation, collaborators may reasonably intuit a devaluation. Moreover, failing to provide compensation further exacerbates historical biases, favoring well-resourced farmers in access to on-farm research activities. Funders clearly have a role to play; researchers have highlighted barriers to budgeting for non-university research participants70, and while some funding agencies explicitly allow for farmer-participant compensation (e.g. USDA-SARE), to our knowledge none require farmer participants to be compensated.

Fair remuneration is in everyone’s best interests; equitable partnerships are more likely to be sustained in the long-term71. For example, Practical Farmers has a robust farmer cooperator program that is still in operation after more than 30 years, a fact they attribute in part to their policy of monetarily compensating farmers for their participation in on-farm research (S3). For comparison, the Iowa Nitrogen Initiative (see *Technical audits*) was not allocated money for farmer-participant compensation, and they have capacity for more participants than they can secure. While research on farmer compensation and project outcomes is scarce, blending of monetary compensation with other forms that support learning, sharing, development, and growth are likely to be most effective63,69, and could be used to specifically support institutionally-excluded groups’ needs (e.g., childcare, language interpretation). The authors provide examples of blended compensation packages that coincided with high participant satisfaction in supplemental files as a resource (Supplementary References).

## 3.2 Metrics for success

In addition to compensation, both researchers and farmers should aim for relationships defined beyond simple transactions. Many researchers strive to build rich relationships with their farmer collaborators, but often lack metrics to help them articulate and measure that success (Figure 1). Building on recommendations from various sources9,13,72, we present the following four broad metrics as guides for building equitable projects:

1. Were power and resources shared?
2. Was trust was built?
3. Did learning occur in both directions?
4. Were both entities transformed as a result of the collaboration?

Incorporating these metrics *a priori* can help guide activity planning, and help ensure anticipated outcomes are aligned within a relationship of reciprocity.

A collage of images of a farm

Description automatically generated

***Figure 1.*** *(a) A simple, transactional, and in-equitable exchange of resources wherein the metric of project success is measured by the increase in knowledge by the collaborating farmers (b) A richer relationship built on exchanges and associated metrics that promote fair and sustainable relationships; an example survey for assessing these metrics is available in supplemental information (S4).*

The success of this type of model can again be demonstrated by the longevity of the Practical Farmers on-farm research program, which has been in place since 1987. Practical Farmers has continually refined their post-program participation surveys, and the current form quantifies outcomes in the four metrics (Supplementary References). As these questions have become guides for program design, participants have been highly satisfied (Supplementary References) and membership is growing. Other researchers and entities likely utilize some form of these metrics, but more explicit and ubiquitous use would benefit project designs and evaluations.

# All research is values-informed

The feasibility (or even desirability) of objectivity in science has long been debated, and recent discussions highlight its conceptual abuse in colonialism, eugenics, and other forms of oppression73,74. Today, many disciplines embrace interpretation, plurality of methods, critical reflexivity, and fallibilism as inherent in the pursuit of knowledge, while still valuing the foundations of empirical evidence and systematic investigation75,76. Rather than pursuing objectivism (and insinuating it is possible), Data Feminism acknowledges that all research is framed by the background, values, and experiences of the researcher. Moreover, in a Data Feminism framework, this is desirable.

## 4.1 Acknowledging co-existence of multiple truths

A book written to illustrate how underlying value systems shape individuals’ approaches to complex global challenges unwittingly uses agricultural research as its backdrop: *The Wizard and the Prophet*77 explores the worldviews of Norman Borlaug and William Vogt, two white, Western men coming from divergent backgrounds, as they work on agricultural topics during the 20th century. Borlaug, raised on a Midwestern US farm, experienced a rural transformation born from the introduction of tractors. Borlaug researched ways to leverage technology to increase food production, an effort that contributed to a larger collection of innovations referred to as the Green Revolution and for which Borlaug won a Nobel Peace Prize78. Vogt began his life in a rural area surrounded by unbuilt environments, but moved to the city and witnessed the urban development of his place of birth. Vogt’s research emphasized the need to live within ecological limits rather than increase food production, and he formally developed the concept of ecological carrying-capacity79 as well as a model for environmental activism that is still used today. Borlaug and Vogt were both scientists, but their divergent approaches and conclusions were shaped by their personal values and experiences. The differing motivations do not invalidate their truths, but rather demonstrate how multiple truths can co-exist. Scientists who acknowledge and navigate the existence of multiple truths are better equipped to provide solutions that do not preferentially disadvantage vulnerable groups80, and curiosity-driven explorations of contradicting opinions is necessary for progress in complex topics81–83.

## 4.2 Supporting diverse framings

In the context of policy making, the acknowledgement of multiple truths is understood as an inherent complexity in addressing multi-faceted issues; therefore the broader the set of known realities, the greater the possibility for more equitable solutions84. Although the worldviews of Borlaug and Vogt are divergent, they represent two American males of European descent, demonstrating how even classical delineations such as race and gender portend little regarding value systems. Today, an increasing availability of diversely framed reflections concerning the Green Revolution has led to significantly more nuanced understandings of the motivations behind and impacts of the Green Revolution85. As calls for a second Green Revolution proliferate, the ability of society to leverage diverse voices is a prerequisite for crafting fair and equitable agricultural trajectories; increased diversity of agricultural research scientists is a necessary corollary86.

# Conclusions

In this paper we demonstrate how agricultural scientists can uniquely contribute to examining, challenging, and redistributing power, and how intentional application of Data Feminism principles positively impacts research creativity, stakeholder participation, and agricultural sustainability overall. For agricultural researchers, engaging with Data Feminism need not be overwhelming nor demand world changing activities; it simply asks that one incorporate attention to power relations in their research.

# Supplemental Information

A list of website references for cited Practical Farmers of Iowa activities and outputs; two examples of blended farmer compensation packages used by a non-profit and university team, respectively; post-participant survey used for farmer collaborators in the Practical Farmers of Iowa on-farm research program

# Author contributions statement

VN conceived of and wrote the first draft of the manuscript, AC and SG were major contributors in writing the manuscript, all authors contributed to editing and approved the final manuscript.

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# Competing Interests

All authors declare no financial or non-financial competing interests

# Data Availability

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

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