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 multiple forms of power imbalances (not only gender) inherent in research. In this Perspective we demonstrate its utility in agriculture settings and present evidence that explicit attention to power and values 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 fields, particularly relating to data generation and use3–6. 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, reflecting both fields’ inclusion of the human experience in their scope (ADD CITATION). However, in the technical fields falling under the umbrella of agricultural science, carving out space for reflexivity remains a formidable task. The recently developed Data Feminism framework13, which targets technical scientists, is particularly well-suited to support agricultural researchers in interrogating their research context. The framework is rooted in empirical studies of power (the reader is directed to D’Ignazio and Klein 2020 for specific discussion of these studies) and while the term Data Feminism may invoke an assumption of gender focus, Data Feminism 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 three select Data Feminism themes (power, reciprocity, and framing) in the research process, with accompanying reflections, activities and outcomes (Table 1). We chose these three themes due to their broad implications and ability to be addressed in the typical agricultural research context.

### Table 1. Summary of paper structure

|  |  |  |  |
| --- | --- | --- | --- |
| **Theme** | **Research phase(s) for application** | **Data Feminism-derived reflection** | **Reflection-motivated activities** |
| Power | Hypothesis generation and study design | Research for the public good should seek to equalize power | Serving the margins, leveraging science, expanding the concept of scientific measurements |
| Reciprocity | Conducting and implementing research | Farmer-researcher relations should be reciprocal | Multi-dimensional compensation, metrics for success |
| Framing | Analysis and dissemination | All research is values-informed | Acknowledging and identifying values, 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 academic experiences in the industrialized 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.

# 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 agricultural 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, here we present an adaptation of the matrix applied to a woman farmer in the US (Table 2).

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### Table 2. Domains through which power may be experienced as a woman farmer (adapted from Collins 1990)

|  |  |  |
| --- | --- | --- |
| **Domain** | **Description** | **Example power disparity** |
| **Structural domain** | Laws and policies that distribute power |  |
| **Disciplinary domain** | Entities that implement and enforce (or fail to implement and enforce) laws and policies distributing power |  |
| **Hegemonic domain** | Entities that circulate ideas related to who has power |  |
| **Interpersonal domain** | Individual experiences, expression, and awareness of who has power |  |
| 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 | | |

A matrix presenting other examples of power inequalities experienced by a wider range of groups in modern US agricultural systems is provided in Supplemental Information.

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 agricultural production, exclusion can occur due to individual characteristics as well as farm-level features (e.g., production system, degree of farm mechanization). This systemic and/or cultural exclusion often translates to omission from agricultural research activities24,25. One method for addressing this power disparity is to conduct research with institutionally excluded groups. Beyond the direct benefits, this also leverages a researcher’s power to help culturally label the needs, experiences, and knowledge of the marginalized as equally valuable26. It can also inspire solutions that benefit everyone. For example, in 1987 a group of farmers formed Practical Farmers of Iowa27 (hereafter referred to as Practical Farmers) as a peer-to-peer learning community28, partially in response to feeling neglected by the Land Grant’s extension systems29. By listening to these farmers, a researcher was inspired to study a low-input system that became an influential crop diversification experiment30. Researcher participation in the Women Food and Agricultural Network31 similarly inspired scientifically fruitful activities with women land owners32,33. More recently, Latino farmers in the Midwest have little institutional support, and Practical Farmers launched a Latino Engagement program (Supplemental Information). These are select examples, and in US agriculture excluded groups may include women, minority, tenant, queer or refugee farmers; or organic, low-input, small, or low-mechanization farms.

## 2.2 Leveraging science

By leveraging their scientific training, agricultural scientists have great potential to contribute to documentation of power imbalances (Table 2), and therefore support their mitigation. For example, a series of studies documented significantly longer-term soil degradation and crop yield losses than assumed by the laws dictating required remediation periods accompanying underground pipeline installation 34–36. This scientific effort thus documented a structural power imbalance. However, science can also be used to create a power imbalance. For example, US Land Grant universities have traditionally wielded unique power in generating nutrient application recommendations using top-down, siloed experiments (that often lack statistical power37) using data that is not made publicly available and without extensive input from the public, farmers, or even other. Driven largely by water quality concerns, the public has begun to demand more transparency with regards to agricultural nutrient management, prompting farmer-led groups and universities to reimagine how nutrient recommendations are created. New programs are democratizing and contextualizing recommendations using open-source methodologies and modern computing power capabilities, while also supporting horizontal knowledge exchange. Iowa State University recently launched an ambitious program wherein farmers volunteer to perform nitrogen rate trials in their own production contexts38, increasing the relevance of the data driving the recommendations. The data will be collectively pooled and used to drive transparently calculated, more nuanced recommendations and development of a publicly available and mechanistic predictive model. Similarly, Practical Farmers launched a regional program paying farmers to test nitrogen rates of their choice using replicated trials and sharing their results with the public. These efforts leverage new scientific and computing capabilities to redistribute power more equally amongst farmers, scientists, and the public, but also represent a positive shift in awareness regarding detrimental power inequities in previous applications of science.

## 2.3 Expanding the concept of scientific measurements

While traditional Western science methodologies can have a role in addressing power inequities, expanding the definition of science is also an important component of redistributing power. The concept of ‘multiple ways of knowing’ originates in Indigenous epistemologies but has recently migrated into common vernacular. The concept 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 observations, scientists limit the potential contribution such knowledge can have in enriching scientific understanding39. 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 day40. It has a scientific underpinning41 but represents a deeply personal interaction between the farmer and the land that has evaded modelling attempts42. 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 (Table 2), Practical Farmers recently launched a study wherein farmers will quantify their experiences with cover cropping through the metric of workable field days (Supplemental Information). 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.

# Reciprocity

In addition to what research is done, the *way* research is done presents myriad opportunities to distribute power more equitably in 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 farmers43–45. However, these arrangements require careful consideration to support equitable and fair power relations.As these types of arrangements are becoming more common, the concept of reciprocity in farmer-researcher collaborations warrants explicit examination. There are several guides for farmers when conducting on-farm research46,47, 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 in relation to power and chose to focus on that relationship for this Perspective.

## 3.1 Multi-dimensional compensation

The context for farmer involvement in research can vary widely48,49, and while there are numerous publications examining the form of those relationships to our knowledge there are few studies on mechanisms for farmer compensation, and even fewer on how those mechanisms influence collaboration dynamics50. 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 participants51, 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, as equitable partnerships are more likely to be sustained in the long-term52. 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 (Supplemental Information). For comparison, the Iowa Nitrogen Initiative (see *Leveraging Science*) 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 effective44,50, 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 (Supplemental Information). Explicit attention to compensation is therefore an accessible way for agricultural researchers to support more equitable power relations in agriculture.

## 3.2 Metrics for success

Both researchers and farmers should often aim for relationships beyond simple transactions. The form of compensation package can play a role in this goal, but there are additional opportunities for building rich relationships. While many researchers strive to build deeper relationships with their farmer collaborators, they may lack metrics to help them articulate and measure their success in those efforts (Figure 1). Building on recommendations from various sources9,13,53, we present the following four broad metrics to help guide the construction of 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*

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 (Supplemental Information). As these questions have become guides for program design, participants have been highly satisfied (Supplemental Information) and membership is growing. Other researchers and entities likely utilize some form of these metrics, but more explicit and ubiquitous use would likely benefit project designs and evaluations, while concomitantly promoting equitable partnerships.

# Framing

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 oppression54,55. Today, many disciplines embrace interpretation, plurality of methods, critical reflexivity, and fallibilism as inherent in the pursuit of knowledge56,57. 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. In agricultural research, reflexivity on implicit values and their consequences for research framing is not common, and may even be seen as xxx. To help cement framing as an inherent component of all agricultural research endeavors, here we discuss two xx that may help does however require the researcher to break from reflect and their own values

## 4.1 Acknowledging and identifying values

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*58 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. This experience likely informed his approach to problems : 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 Prize59. Vogt also began his life in a rural area, but moved to the city and witnessed the urban development of the natural areas he associated with his childhood. 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-capacity60 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 valid, but values-informed truths can co-exist.

## 4.2 The importance of diverse framings

Borlaug and Vogt represent two American males of European descent, and their differing worldviews demonstrate 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 Revolution61. 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 that xxx.

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It follows that the broader the set of framings available, the greater the possibility for more equitable solutions62. Increased diversity of agricultural research scientists is a necessary corollary to that effort63.

The importance of values for science64

In more general terms, often times curiosity-driven explorations of seemingly contradicting truths in science are extremely productive, and often expose differences in values that may not have previously been well articulated65–70. This articulation can greatly aid in understanding XXXX something from the reviewer’s comments xxxxx. Scientists who acknowledge and navigate the existence of multiple truths are better equipped to provide solutions that do not preferentially disadvantage vulnerable groups71.

It follows that the broader the set of framings available, the greater the possibility for more equitable solutions62.

# Conclusions

Agricultural scientists who examine, challenge, and redistribute power can uniquely contribute to xxx, and may concomitantly enjoy positive impacts on research creativity and stakeholder participation. Moreover, agricultural scientists who build self-awareness of their own values and how those inform their perceived problems and solutions will likely be better able to recognize, incorporate (need better word), and solicit diverse framings, which promotes better outcomes for agricultural sustainability overall. For agricultural researchers, engaging with Data Feminism need not be overwhelming nor demand world changing activities; it simply asks that one reflect on power disparities and values embedded in their research. We hope this Perspective demonstrates both the worthiness and feasibility of such pursuits.

# 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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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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