



## **Review of the Gender and Social Impacts of Improved Seed Technology in Developing Countries: Policy Implications\***

**Preethi Krishnan**

Sociology Graduate Student  
Purdue University

**Andrew Raridon**

Sociology Graduate Student  
Purdue University

**Leigh Raymond**

Professor of Political Science  
Director of Center for the Environment  
Purdue University

**Mangala Subramaniam\*\***

Associate Professor of Sociology  
Purdue University

**PURDUE**  
UNIVERSITY

PURDUE POLICY RESEARCH INSTITUTE  
Gerald D. and Edna E. Mann Hall, Room 166  
203 S. Martin Jischke Drive  
West Lafayette, IN 47907  
Phone: (765) 494-1050  
Email: [ppri@purdue.edu](mailto:ppri@purdue.edu)  
[www.purdue.edu/discoverypark/ppri](http://www.purdue.edu/discoverypark/ppri)

\* Authors are listed in alphabetical order.

\*\* Corresponding author [msubrama@purdue.edu](mailto:msubrama@purdue.edu)

Experts have acknowledged the limits to growth that the processes of climate change, population expansion, and resource depletion will place on agricultural producers in the 21<sup>st</sup> century (FAO 2012). In response, scientists are employing biotechnology to create new improved seed varieties. However, developing improved seed technology (IST) involves complex and controversial issues that span across disciplines in the biological and social sciences (see Box 1). In this policy brief, we emphasize the need to better examine the gender and social impacts of advancements in seed technology. Based on a detailed review of the literature, we determine that despite recent advancements, women and small farmers still face distinct challenges, particularly in developing countries. For example, farmers need to access a variety of resources to use IST but access to those resources is restricted by gender and class. Formal regulatory and property rights agreements can further hamper women's agricultural potential. We suggest that policy makers (1) take into account existing gender and class inequalities in agricultural systems when crafting IST regulations, (2) work to understand how marginalized farmers may be lost in the gap between public and private IST distributions systems, (3) strive to increase transparency in how IST innovations are created and regulated, and (4) promote and support interdisciplinary research teams.

### ***What Is Improved Seed Technology (IST)?***

We define improved seed technology (IST) as any seed that has been genetically modified by humans to express certain traits. Historically, farmers genetically modified seeds by intentionally selecting the most desirable varieties to plant in the future, or by cross-pollinating different varieties to create stronger, more productive hybrids. Increasingly, genetic modification is carried out with the assistance of biotechnology to identify with more precision desirable plant genes. In some cases, "transgenic" genetic modification involves the insertion of foreign genetic material into a plant's genetic code, creating "genetically modified organisms."

IST stands to impact millions of farmers, the majority of whom are smallholder farmers in developing countries cultivating fewer than two hectares of land. Smallholders are central to global food security as they currently produce over 70 percent of the world's food (FAO 2013). Yet many underprivileged and/or smallholder farmers lack sufficient access to technical information, fertile land, postharvest support, and quality or affordable inputs such as fertilizer, pesticides, and

seeds (Bhutani 2013). These shortcomings in developing countries contribute to significant yield gaps, sometimes upwards of 40 percent (Lobell, Cassman, and Field 2009). Beginning in the mid-20<sup>th</sup> century, these inefficiencies inspired coordinated public research and development (R&D) efforts to improve farming systems in developing countries, exemplified by the creation of national and international agricultural research institutions (NARIs). During the Green Revolution, researchers developed and made available hundreds of high yielding varieties of IST for staple crops, particularly wheat and rice, available to farmers.

Since then there has been a slow shift towards private sector R&D on IST. Public research initiatives, on which developing countries had relied, are losing funding and scientific capital (Lipton 2007). Recent innovations in seed technology, or the so-called contemporary “genetic revolution,” have attracted much corporate attention, as shown by the expansion into biotechnology R&D by transnational agribusinesses such as Monsanto, Syngenta, DuPont, Novartis, and their regional affiliates. Companies are using market approaches to develop and distribute IST to farmers and some national governments are withdrawing public expenditures from IST R&D programs in favor of allowing the free market to provide these services (Speilman et al. 2014). This new wave of privately funded IST development, it is argued, has created IST useful to farmers in the developed world, such as herbicide resistant corn and soybeans—crops with higher profit margins (Elliott et al. 2005).

## Questions for IST Policies

Experts contend that closing the yield gaps in small farm holdings is imperative to increasing global food security and raising the general welfare of small farmers and the communities that depend upon them. IST is increasingly prescribed as the central means for achieving this end, and tremendous effort has gone into the production of new and novel varieties of IST. But what impact does IST have on small farmers and on women? Our review of literature and field observations raises four key issues related to the social and gender impacts of IST for policy makers.

### 1) Existing Inequalities Impacting Women in Agricultural Systems

Agricultural systems in developing countries are gendered. Although most of the literature makes no

specific reference to gender as relations of power, our review points to three important aspects of disparities between men and women that need attention. First, across the developing world, many women lack access to key agricultural resources, most critically land. Informal rules of land ownership and inheritance, and occasionally formal rules barring women from owning property, restrict women’s access to the very soil necessary for farming. Land ownership is also crucial to accessing other key agricultural inputs such as fertilizer, pesticides, machinery and infrastructure, and seeds, all of which can be expensive and require access to outside lines of credit. Without land for collateral, women are at a disadvantage. Second, men are overrepresented in informal and formal agricultural institutions, such as extension services, seed dealers, and government agencies. While in extreme cases women are barred from participating in these institutions, more frequently they are informally discouraged from approaching and interacting with men-dominated institutions based on cultural norms dictating women’s appropriate contact with men. The result is women’s lack of access to pertinent agricultural information about best practices, as well as a lesser voice in crafting farming regulations and laws. Third and finally, women and men are involved in different tasks in agricultural labor. Although tasks vary across crops and regions, overall women tend to participate in the more laborious hands-on tasks, such as weeding, harvesting, transplanting, and mixing agricultural chemicals whereas men tend to operate machinery, negotiate sales and purchase inputs, and plant and apply chemicals. Women are also responsible for much of the household and domestic labor in farming household even if they play an integral role on the farm. The result is a double labor burden for women—a labor burden that is informally accepted as natural and acceptable in many regions of the developing world. Although there are efforts being undertaken to address these inequalities, overall women still face many challenges regarding access to inputs, capital, and land.

#### ***Policy Implication 1: IST May Create and Exacerbate Gender Inequality***

IST is highly dependent on synthetic and technologically-intensive inputs in order to maximize its desirable traits. For instance, high-yielding varieties may require precise applications of specific synthetic fertilizer mixes, while herbicide-

resistant IST may only be tolerant to a single, proprietary brand of herbicide. Furthermore, the advanced scientific innovation and research that went into developing the IST in the first place is expensive, requiring the coordination of public and private research laboratories, the purchase of multiple patents protecting specific gene mapping and insertion procedures, and the procurement of the germplasm in the first place, which can take years to develop. The result is IST that is sometimes upwards of 300 percent more expensive than the comparable alternative, not accounting for the specialized inputs that must be purchased and applied in specific ways. Because women already lack access to agricultural inputs, land, credit, and information, it is very likely that the further proliferation of IST will create new and exacerbate existing gendered inequalities in the agricultural systems of developing countries. Furthermore, if IST is developed with the intention of increasing yields, this may add to women's labor demands and inadvertently lower their quality of life. Conversely, if IST is developed to reduce weeding or transplanting requirements, women engaged in farm labor may lose valuable income. In sum, the gender implications for IST are complex and vary by crop and region, and so IST policy must account for the gendered impacts in specific contexts in order to avoid new negative burdens on women.

## 2) Public versus Private and For-Profit IST Distribution Mechanisms

As noted above, the increasing privatization of production and global sales of IST has led to greater control by privately owned multinational agribusinesses and their regional affiliates over the distribution mechanisms of IST. We find that the distribution of IST and IST-related information differs between public and market-based, for-profit systems in significant ways.

Typically, public research institutions, such as those that characterized the Green Revolution, rely on state agricultural extensions and their field agents to contact and develop relationships with farmers to ensure their access to appropriate seed technologies, inputs, and the necessary information to use them effectively. This system is characterized by an exchange of information between farmers and extension agents, and farmers are often very involved in contributing to the extension systems that serve them by reporting the performance of different varieties in their fields. In contrast, private entities utilize a market-based approach and rely on

seed dealers and retailers affiliated with private corporations rather than public extension services. Their motivation to engage with farmers is based in a desire to increase their profit margins.

Furthermore, the vast majority of both extension agents and seed dealers are men, and dominant agricultural institutions are designed to better serve men. Yet there is little consideration of how IST might exacerbate, alleviate, or shift existing gender inequalities in agriculture-related tasks, particularly in developing countries. We contend this is in part because studies of IST do not explicitly consider gender as involving relations of power as occurring in micro-level interactions, such as in interactions with extension agents and other support service providers, as well as institutionally, such as in the ways in which government extension is structured. This fundamental difference in conceptualizations of gender is a crucial factor in understanding how many studies overlook or inadequately account for gender differences in the impacts of IST (Subramaniam et al., no date).

Additionally, examinations of IST's impacts do not sufficiently consider how private, profit-oriented distribution chains may not equally serve all farmers or their specific needs, nor whether farmers' knowledge is sufficiently valued in private systems and/or extension-based systems. Because price dictates the distribution dynamics of private supply chains, it is likely that remote farmers, poor or underprivileged farmers, and women farmers will not have equal access to IST, and that larger, richer, and more centralized and connected farmers will be advantaged by private IST distribution schemes. This raises larger questions about which farmers do and should have access to IST, how agricultural production in developing countries fits with a turn towards neoliberal distribution schemes, and whether or under what conditions IST is scale neutral. Accordingly, there is a need to reconsider which farmers stand to benefit from participation in a more privatized distribution system, which ones are left out, and how private and public distribution systems can be rendered complementary towards effectively improving farmers', including women farmers', access to IST.

### ***Policy Recommendation 2: Attend to Gender and Class in Relation to IST Distribution Mechanisms***

Public distribution systems, such as those utilized by NARIs and other publically-funded institutions, operate from a different vantage point

than those connected to private distribution chains. Whereas marginal farmers were once the target of the majority of Green Revolution innovations, the contemporary Genetic Revolution in IST development tends to target wealthier farmers. In doing so, marginalized farmers without adequate access to capital and private distribution networks are potentially cut out of more of a competitive, pay to play system. One emerging alternative that merits more attention is the innovative creation of “farmer producer companies” (FPCs). FPCs are hybrid models of institutions that combine characteristics of private companies and cooperatives. In India, they have been made possible through an amendment of the Companies Act. These institutions typically employ a chief executive (a trained manager) with a board comprised of farmers. FPCs provide farmers inputs such as seeds.

Additionally, there have been attempts to form women-only FPCs. We suggest there is potential for FPCs to fill some of the gaps created by a shift towards private for-profit IST development and distribution, but that requires in-depth research and evaluation first.

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### 3) Uneven Expectations of Transparency

Another crucial issue complicating the measurement of IST’s impacts stems from the shift away from public research institutions towards market-based IST R&D strategies. A key difference between public and private IST R&D and distribution systems is the level of transparency expected in the trial and evaluation process. Public institutions are required to adhere to rigorous trials of ISTs and make such information public. These rigorous requirements deplete already-thin public budgets. Private companies are not held to the same requirements as public institutions or even follow established best practices for field trials of IST. While state-funded research institutions, such as publicly-funded universities and NARIs, operate

under an imperative that research be conducted and reported in a transparent manner, private IST research entities, such as private biotechnology laboratories and seed companies, operate under the imperative that information must be protected as governed by intellectual property regulations. Via international treaties to protect property rights for new seed varieties, private companies can invoke their right to IPR protection to justify the lack of transparency.

### **Policy Recommendation 3: Regulatory Mechanisms over Research and Access to Information**

The lack of transparency requirements for private IST developers creates an uneven playing field where resource-poor public systems are held to specific standards while private companies are granted leeway, and then private companies are heralded as more efficient and used as evidence of how the public system should be overtaken by private IST development and distribution. Policymakers should increase the public’s access to information about IST performance, and consider how IPRs may be used to withhold or obscure information about IST trial performance. Creating and enforcing regulatory mechanisms that will enable transparency in disseminating information about trials of ISTs should be a policy goal of national governments. Nations vary widely in their regulatory structures and processes depending on whether agriculture is a state or federal concern, and in the types of relationships countries and governments have with IST companies. International and national policies could require uniform, generalizable, and transparent studies on the impacts of IST as used by farmers in order to ascertain its effects, and to make those results widely known to farmers, regulators, and consumers.

### 4) Studying IST Impacts in the Social Sciences and Plant Sciences

Biological and social science researchers examining aspects of IST often do so from their own disciplinary lens. Studies examining the impacts of IST approach the topic from many diverse disciplines and methodological perspectives, resulting in studies that are difficult to compare and generalize from. Likewise, social critiques of IST are often fueled by an incomplete understanding of the science behind IST innovations and the significance and meaning of different biotechnological

advancements. Our review of the literature regarding the impacts of IST reveals that there is little effort to utilize a combined lens – social sciences and plant sciences - in examining IST. Studies of the impacts of IST typically adopt a narrow disciplinary approach, vary widely in methods used, and geographical areas covered.

**Policy Recommendation 4:  
Promote and Support Interdisciplinary  
Research Teams**

We suggest that IST research be conducted by interdisciplinary teams that adopt an integrated approach. Incorporating the expertise of biological and social scientists into examining the gender and social impacts can provide useful insights into aspects that need attention for wider use and adoption of a particular IST.

**Conclusion**

Any effort to use IST to improve food and nutrition security in the developing world must attend carefully to the already important inequalities and challenges in agricultural systems for women and small farmers. In this brief, we suggest some issues that policy makers should pay particular attention to in thinking about new formal rules governing farmer access to and use of IST. In making these suggestions, we acknowledge the difficulty of implementing and enforcing many existing IST rules in practice, as informal rules and customs frequently shape seed access and use more strongly than formal rules (c.f. Herring 2007). At the same time, we conclude that any serious attempt to use IST to address global food challenges must grapple with these gender and social implications, including attention to how formal rules then translate into actual practices affecting women and small farmers in the field.

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**Further Reading:**

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