Genetically Modified Crops and Gender Relations in Low- and Middle-Income Countries: A Critical Review

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Abstract: Genetically Modified (GM) crops have been lauded as a tool to redress stagnating yields and food insecurity amongst poor farmers since their release in the early 1990s. The potential for GM crops to alleviate poverty for farmers in Low- and Middle-Income Countries (LMICs) will likely hinge on their ability to enhance women's overall wellbeing, yet there is little research that evaluates if (and how) the technology has such transformative potential. This article reviews the existing scholarship on this topic by grouping it into three strands: 1) the impacts of GM crops on labor processes; 2) gender and patterns of adoption; and 3) the consequences of GM crops for intrahousehold gender relations. Each area is characterized by contradictory findings, reflecting the diversity and complexity of gender relations in different contexts. Our review suggests that further research should build on mixed-methods approaches that involve long-term interactions with households in order to generate robust and gender-disaggregated data that yields nuanced, context-specific analysis.

Keywords: Genetically Modified crops; gender; LMICs

Can Genetically Modified (GM) crops help to empower women farmers in Low- and Middle-Income Countries (LMICs)? Despite an extensive and growing literature on the developmental impacts of GM crops (Flachs 2019; Leguizamon 2020; Qaim 2016; Schnurr 2019), this question has received relatively little attention. GM crops have been lauded as a tool to redress stagnating yields and food insecurity amongst poor farmers since their initial release in the early 1990s. These first-generation GM crops conferred traits of insect resistance and herbicide tolerance to key commodity crops such as cotton, maize and soy (see Table 1). Second-generation crops emerged later to address the needs of farmers in LMICs (see Table 2). These GM varieties were the result of Public-Private Partnerships designed to avoid restrictive Intellectual Property rights and target staple crops that had largely been ignored by private investment and innovation, with a focus on traits that matter to poor farmers, including disease resistance and biofortification (Dowd-Uribe 2017; Schnurr 2015).

Table 1. First Generation Genetically Modified Crops

CROP	**TRAIT***	**STATUS****	**COUNTRY**
COTTON	*Insect Resistant; Herbicide Tolerant; Stacked*	Approved	Argentina; Brazil; Burkina Faso; Columbia; Costa Rica; eSwatini; Ethiopia; India; Kenya; Malaysia; Mexico; Myanmar; Nigeria; Pakistan; Paraguay; Philippines; South Africa, Sudan; Vietnam
		Field Trials	India (new varieties); Kenya
MAIZE	*Insect Resistant; Stacked* *Drought Tolerant*	Approved	Brazil; Chile; Columbia; Costa Rica; Cuba; Egypt; Honduras; Indonesia; Malaysia; Mexico; Nigeria; Pakistan; Panama; Paraguay; Philippines; South Africa; Thailand; Uruguay; Vietnam; Zambia
		Field Trials	Kenya; Mozambique; Nigeria; Tanzania
SOYBEAN	*Herbicide Tolerant; Stacked*	Approved	Argentina; Bolivia; Brazil; Chile; Columbia; Costa Rica; India; Indonesia; Malaysia; Mexico; Nigeria; Paraguay; Philippines; South Africa; Thailand; Uruguay
CANOLA	*Herbicide Tolerant*	Approved	Chile; Malaysia; Mexico; Philippines; South Africa
SUGARCANE	*Insect Resistant; Stress Tolerant*	Approved	Brazil; Chile; Indonesia
ALFALFA	*Herbicide Tolerant*	Approved	Argentina; Mexico; Philippines
WHEAT	*Herbicide Tolerant; Drought Tolerant*	Approved	Argentina; Columbia

*Stacked varieties refer to combined traits of insect resistance and herbicide tolerance
** Data on approved status compiled from the following sources: ISAAA GM Approval Database (Updated January 14, 2020).

Table 2. Second Generation Genetically Modified Crops

CROP	**TRAIT***	**STATUS****	**COUNTRY**
ALFALFA	*Herbicide Tolerant*	Approved	Argentina; Mexico; Philippines

BANANA	*Biofortified; Disease Resistance; Virus Resistance*	Field Trials	Uganda; Malawi
CASSAVA	*Disease Resistance*	Field Trials	Kenya
	Virus Resistance + Biofortified (VIRCA Plus)	Field Trials	Nigeria; Uganda; Kenya
COWPEA	*Insect Resistance*	Approved	Nigeria
		Field Trials	Burkina Faso, Ghana, Malawi, Nigeria
EGGPLANT	*Insect Resistance*	Approved	Bangladesh
		Field Trials	India
POTATO	*Disease Resistance (3RVictoria)*	Approved	Argentina; Indonesia; Malaysia; Mexico; Philippines
		Field Trials	Bangladesh; Uganda
PAPAYA	*Disease Resistance*	Field Trials	Malaysia
RICE	*Herbicide Tolerant*	Approved	Columbia; Honduras; Mexico; Philippines; South Africa
	Nitrogen Use Efficient, Water Use Efficient, Salt Tolerant (Newest Rice)	Field Trials	Ghana; Nigeria
	Biofortified (Golden Rice)	Field Trials	Bangladesh (Greenhouse); Philippines
SORGHUM	*Biofortified*	Field Trials	Nigeria; South Africa (Greenhouse)
TOMATO	*Virus Resistance*	Field Trials	Indonesia

*Stacked varieties refer to combined traits of insect resistance and herbicide tolerance

** Data on field trial status compiled from the following sources: Maize (Essen 2018; ISAAA 2015; ISAAA 2016); Cotton (ISAAA 2020; Subramani 2021); Potato (Ahmad 2020; Daba 2020); Eggplant (Mohan 2020); Rice (Isaac 2019; NBA 2012; Rees and Harvey 2021; Stokstad 2019); Sorghum (Bafana 2008; Essen 2018); Cowpea (Addae et al. 2020; Essen 2018, Gakpo 2018; ISAAA 2016); Banana (Afedraru 2019; ISAAA 2016; Nimusiima et al. 2015); Cassava (ISAAA 2017, ISAAA 2020, Ongu 2019); Wheat (Calderini et al. 2020; Demaree-Saddler 2020; Robin 2020); Papaya (Hoe-Han Goh 2015); Tomato (Rahayu 2017)

Until recently, few accounts have considered the relationship between either first- or second-generation GM crops and gender amongst poor farmers in LMICs. In its wide-ranging assessment of GM technology released in 2016, the United States' National Academy of Sciences, Engineering, and Medicine concluded that "the analysis of the gender implications of GM crops remains inadequate" (NAS 2016, 11). A State of Affairs report released by the International Food Policy Research Institute (IFPRI) laments this "gender gap", emphasizing that "information about impacts on women, gender-specific attitudes, and gender perspectives in biotechnology decision-making is largely nonexistent" (Chambers et al. 2014, xv). This gap is concerning because women are crucial to food production and farming activities in LMICs, yet they are frequently marginalized in agricultural decision-making and control over resources. An established body of literature suggests that when women gain more control over agricultural production, there is increased productivity and wider welfare gains for the household (Meinzen-Dick et al. 2019; Quisumbing 2003; Udry et al. 1995). Hence, there is a strong need to systematically assess the implications of GM crop varieties on gender, especially among poor farmers (Addison and Schnurr 2016; Gouse et al. 2016).

This gap in knowledge is surprising given that the broader scholarship on gender and new agricultural technologies extends back many decades. Esther Boserup's (1970) seminal book *Women's Role in Economic Development* explored the foundational role that gender plays in shaping agricultural development, arguing that intensification efforts have tended to sideline women by excluding them from the productive economy. Boserup showed how women's marginalization stemmed from their limited access to resources (relative to men) and their reproductive roles, but was careful to note that such patterns of gender differentiation varied according to the agro-ecological, political, and cultural contexts of the farming system in question. Studies building upon Boserup's work in the 1980s identified different types of conflict that materialized between men and women when intensification efforts, such as the adoption of cash crops, were introduced at the household level (Carney and Watts 1991; Jones 1983; Maxwell and Fernando 1989). Later contributions demonstrated that men tended to adopt new agricultural technologies at higher rates than women, though researchers suggested this reflected unequal access to labor, income, and decision-making more than any innate aversion to new tools or techniques (Doss and Morris 2001; Doss 2002; Peterman et al. 2014; Quisumbing 1996; Udry 1996). Research also emerged showing that men's higher adoption rates were a result of gendered differences in household priorities and divisions of labor (Meinzen-Dick, Kovarik, and Quisumbing 2014; Quisumbing and Maluccio 2003). Overall, this literature emphasizes that the potential for new technologies to enhance rural development depends on whether women gain decision-making power over cropping methods, variety selection, labor allocation, and the use of household income (Doss 2013; Hillenbrand et al. 2014; Kilic, Palacios-López, and Goldstein 2015; Meinzen-Dick et al. 2011; Quisumbing 2003; Smith et al. 2003; Udry et al. 1995).

The potential for GM crops to alleviate poverty for farmers in LMICs will likely hinge on their ability to enhance women's overall wellbeing, yet there is little research that evaluates if (and how) the technology has such transformative potential. This review organizes the existing scholarship into three strands: 1) the impacts of GM crops on labor processes; 2) gender and patterns of adoption; and 3) the consequences of GM crops for intrahousehold gender relations. Each area is characterized by contradictory findings, reflecting the diversity and complexity of gender relations in different contexts. Our review suggests that further research should build on mixed-methods approaches that involve long-term interactions with households in order to generate robust and gender-disaggregated data that yields nuanced, context-specific analysis.

I. GM crops and labor dynamics

Much of the scholarship on gender and GM crops emphasizes the unique constraints that women in LMICs face in their production practices—due largely to differential access to land, labor, and capital. But tensions persist around whether GM technologies will reduce or exacerbate these inequities. This debate over whether GM crops will serve to help or to hinder women's productivity is particularly pronounced within the realm of labor. It has been long accepted that women provide more agricultural labor than men (Doss 2011), so the directionality of how a new GM variety will impact labor dynamics will play a crucial role in determining gendered outcomes. The following literature can be grouped around two sets of findings: The first group finds that GM crops decrease the workload for women farmers and laborers, while the second demonstrates how GM crops can increase labor demands.

The first group of studies suggest that GM crops create labor savings for female members of farming households. This trend is most pronounced in South Africa, where researchers employed small-group discussions alongside survey data captured over a ten-year period in the eastern province of KwaZulu-Natal (Gouse et al. 2016). Their findings revealed that GM herbicide-tolerant cotton saved women time weeding, while GM insect-resistant cotton lessened the need to fetch water for insecticide spraying. Women saved nearly twice as much time weeding as did men. The time saved was devoted to other household duties and to tending their own gardens, although the authors note that some of these labor savings were offset by the extra labor required for harvesting higher yields from the GM crops. On balance, though, these researchers concluded that women farmers "can potentially benefit more from the introduction of GM technologies than their male counterparts due to their specific roles in the smallholder production system in KwaZulu-Natal, South Africa" (Gouse et al. 2016, 37).

A second study from Colombia (Zambrano et al. 2011; Zambrano et al. 2012) corroborates these claims around labor savings. Researchers there used a combination of methods including surveys, participant observation, interviews, focus groups, textual analysis, and participatory mapping to show that the reduced pesticide sprayings associated with GM insect-resistant cotton allowed women to save funds that were previously used to hire men who undertook spraying. As in South Africa, women farmers were also particularly enthusiastic about GM herbicide-tolerant cotton because it reduced the burden of weeding, a task that fell primarily to them (and their children).

Importantly, Zambrano et al.'s results exposed gender differentiation as a dynamic *amongst* groups of women—as opposed to *between* women and men. Women who were employed as agricultural laborers, in this case weeders on other farms, expressed concern that the labor-saving properties of GM cotton would undermine this valuable source of income. A third study from the Philippines also demonstrates differences between women, which in this case showing that some women were able to translate labor saved from pesticide applications into other off-farm employment opportunities including office employment, as well as other buying and selling activities (Yorobe and Smale 2012).

The second group of studies offer oppositional findings: that GM varieties create more, not less, labor, and that women could benefit from being hired as additional agricultural workers. Combining economic modelling and survey data, Subramanian and Qaim (2009, 2010) found that the higher yields associated with GM insect-resistant cotton increased the demand for hired labor required for sowing, weeding, and harvesting. With respect to income, women hired as agricultural workers benefited from this extra work, with returns for hired female agricultural workers projected to rise by 55% (Subramanian and Qaim 2010, 304). Similar results were reported from a survey of four areas of Punjab province in Pakistan, where the introduction of GM insect-resistant cotton precipitated a doubling in demand for hired labor (Kouser, Abedullah, and Qaim 2017). Nearly 80% of these income gains were captured by women.

It is important to note, as Subramanian and Qaim (2010) do, that the benefits associated with increased labor earnings will depend largely on local labor markets; such dynamics will play out differently across different contexts. In Uganda, Addison and Schnurr (2016) draw on survey data and focus groups with over 150 farmers to assess how local level labor dynamics shape outcomes for women farmers. Their study of farmer attitudes towards a GM version of disease-resistant cooking banana reveals that the increased yields and associated heightened demands for harvesting could be met with hired labor in the larger plantations that dominate the country's southwestern region, echoing the trends revealed by the studies from India and Pakistan mentioned above. But in the central and eastern regions of the country, where farms tend to be smaller and subsistence-oriented, women are more likely to be saddled with these additional chores as unpaid laborers. These "growing burdens" could serve to exacerbate intra-household conflict, or divert women's labor away from other activities, such as the cultivation of crops for household consumption (Addison and Schnurr 2016, 967). This research serves as a reminder that the causal relationships underpinning the potential labor benefits that can accrue to women farmers—decreases in pests, weeds, or disease spur increased yields, which boost demand for female labor and, in turn, raise women's earnings—depends upon the specific context into which a particular GM variety is introduced.

II. Gender and adoption patterns

A second strand of scholarship examines the relationship between gender and adoption patterns in LMICs. Two lines of inquiry feature most prominently here. The first includes quantitative studies that seek to delineate the importance of gender as a predictor variable of adoption, while the second utilizes qualitative methods to examine how gender impacts value-based preferences and adoption choice of GM varieties. Two quantitative studies suggest gender does not play a significant role in the decision over whether or not to adopt GM crops. Results from the Philippines indicate that gender was less significant a variable in determining adoption rates relative to farm size, experience with new varieties, and seed price (Falck-Zapeda and Zambrano 2013). Another study in Uganda tested eleven independent variables as predictors of farmer uptake of GM cooking banana. Region, farm size, membership in a farming association, experience with improved varieties, and previous visits from extension officers were all statistically linked with positive responses to GM varieties. Gender was not (Schnurr and Addison 2017).

While there is little quantitative research showing whether women are more or less enthusiastic in either their attitudes towards, or adoption of, GM varieties, some quantitative researchers worry that women remain disproportionately excluded from the benefits associated with GM crops due to factors that are correlated with gender (Doss 2001). One prominent concern revolves around asymmetrical access to information. A number of studies have hypothesized that women are slower to adopt GM varieties because they are not privilege to the same information conveying the technology's benefits as their male counterparts. Most of this research suggests that women have fewer opportunities to interact with seed suppliers, and fewer opportunities to participate in knowledge-sharing forums such as farmers' associations or credits groups, due to heavy workload burdens at the household level (Gouse et al. 2012; Zambrano et al. 2011). This was underlined in the case of GM insect resistant cotton in South Africa. The authors concluded that the major factor accounting for lower adoption levels among women was a dearth of information: "the lack of information about new varieties and their specific benefits feature more prominently among women farmers than men" (Gouse et al. 2016, 36).

Another factor constraining some farmers' adoption of GM crop varieties concerns a lack of access to key inputs. In Burkina Faso, Falck-Zepeda and Zambrano (2013) found that women farmers had difficulty adopting GM cotton because they were excluded from land ownership. Village-level groups made up of landowners were the exclusive conduit through which GM varieties were made available in the vertically controlled cotton sector. Such concerns over lack of access to key inputs persist amongst second-generation GM technologies, which are characterized by Public-Private Partnerships that promise permissive Intellectual Property agreements and a focus on traits and crops that matter to poor farmers. For example, preliminary work on the much-heralded Water Efficient Maize for Africa (WEMA) project, designed to bring drought-tolerant maize to smallholder farmers in five countries across east and southern Africa, suggests that women farmers will have difficulty meeting the accompanying growing requirements, including higher rates of fertilizer use and easy access to credit (Demers-Morris 2015). The concern here is that "women farmers will be disproportionately excluded from potential benefits offered by WEMA seeds because of their relatively disadvantageous access to the additional inputs required to ensure its success" (Schnurr 2019, 168).

A second line of inquiry utilizes qualitative methods to examine how gender impacts value-based preferences and adoption choice of GM varieties. Many studies emphasize the different factors and processes that men and women utilize in deciding whether to plant GM crops (Zambrano et al. 2011). The most valuable contributions here have identified the different criteria that women employ in their decision-making relative to men, with a particular emphasis on value-based preferences, i.e. crop characteristics such as quality, taste, texture, or colour that are independent of yield. In South Africa, women's decision-making around whether to adopt GM maize foregrounded the issue of taste. For these farmers, "quality perceptions were more important than the yield factors", which led these women to prioritize their traditional Open Pollinated Varieties relative to GM counterparts, which exclusively comprised hybrid seed (Gouse et al. 2016, 36). Other studies showcase how GM breeding programs tend to prioritize increased yields over all other criteria, suggesting that this preoccupation with yield resonates more with men than women (Dowd-Uribe 2017; Schnurr and Addison 2017). A study measuring farmer perspectives on soon-to-be-released GM versions of cooking banana in Uganda asked farmers to rank their preferences for value-based preferences such as taste, colour and texture relative to other yield-based traits such as bunch size, faster growth rates, and pest and disease resistance. Qualitative results suggest women were especially concerned with taste and colour, expressing concern that GM varieties would lose the soft and aromatic qualities which they prized highly (Schnurr et al. 2020). These findings synch with results showing that women tend to prize value-based characteristics more than men, especially in crops destined for home consumption (Edmeades et al. 2007; Lunduka, Fisher, and Snapp 2012; Namonje-Kapembwa and Chapoto 2017).

III. Gender, power, and decision-making

A third and final strand of scholarship shines a light on the impacts of GM crops for gendered power relations in LMICs, particularly in terms of agricultural decision-making. A number of studies following the adoption of GM insect resistant cotton in India suggest that GM varieties serve to undermine women's decision-making. One study of GM cotton adoption in the states of Rajasthan and Maharashtra revealed how the widespread adoption of insect-resistant varieties disadvantaged women at the farm-level: women expressed frustration at having to buy hybrid seeds every year and lamented the restrictions on saving seed, which they felt disadvantaged their role as seed managers (Kelkar et al. 2019). Women further expressed frustration at being shut out of the decision on whether to adopt GM insect-resistant cotton by men who were confident that their own knowledge of the crop's high-earning potential outweighed any reluctance or resistance offered by women, leading the authors to conclude that the pattern of GM cotton production remains "overwhelmingly masculinist and Monsanto-centric" (Kelkar et al. 2019, 5). Similar studies echo this concern regarding the tendency for GM crops to marginalize women by eroding their traditional knowledge of seed management and devaluing their role as seed savers (Carro-Ripalda and Astier 2014; Falnikar and Dutta 2019; Leguizamon 2019; Pole and Reda 2007; Tandon 2010).

But other authors report strikingly different results. Examining the case of GM maize in South Africa, Gouse et al. (2016) convened gender-specific focus groups in which women were adamant that they made their own decisions regarding the planting of GM maize and its associated production regime. Very few participants reported consulting their husbands or other male household members (Gouse et al. 2016). The report by the US National Academies of Sciences makes early reference to women's decision-making power increasing in households that adopt GM crops (NAS 2016), though the references provided later in the report speak more to collaborative patterns of decision-making rather than discrete improvements in decision-making power (e.g. Yorobe and Smale, 2012 and Zambrano et al. 2013 cited in NAS 2016, 292-293).

While these debates regarding downstream impacts on farmer decision-making require more evidence in order to be conclusive, there is even less research regarding the impacts of upstream decision-making. The decision-making process that guides the experimental pipeline for GM crops remains dominated by male stakeholders (Ezezika et al. 2012). When processes and protocols at the design stage are opened up to include end users, these tend to amplify male voices. Doss (2015) emphasizes the importance of not just assessing gender disparities in the adoption and productivity of new agricultural technologies, but also analysing how this information can be translated into specific programs and policies. These insights underscore the importance of integrating gender as a key consideration throughout the full project life cycle: from priority setting to conceptualization to experimentation to assessment. Modifying the technology development process is crucial to ensuring inclusivity and positive outcomes for poor women farmers, while also achieving key nutritional and poverty alleviation goals (Bezner-Kerr 2012; Rasaga 2012).

IV. Conclusion

This review has surveyed the existing literature on the relationship between gender and GM crops in LMICs, organized around three discrete strands of scholarship related to labor relations, adoption patterns, and farmer decision-making. Our review suggests that each one of these three strands comprises complex and partial findings around whether GM varieties are labor-saving or labor-swelling, the degree to which and how gender shapes adoption patterns and on-farm outcomes, and the impacts that GM crops have on intra-household power relations. More importantly, we note that the complexity surrounding these findings may have less to do with the technology itself, as much it has to do with existing gendered and socio-economic inequities.

More studies are needed to expose the complicated role gender plays in mediating the penetration of GM crops in poor, rural settings. But scholars also need to pay attention to the methods being employed to assess the uptake and impact of GM crops. Most of the existing knowledge surveyed in this review was generated via mixed methods projects that spent significant time engaging with farming communities impacted by GM varieties. A suite of newly released studies produced by the International Food Policy Research Institute (IFPRI) takes a different approach. These three IFPRI studies employ a particular economic surplus model known as DREAM (Dynamic Research Evaluation for Management), which is designed to estimate consumer and producer gains resulting from the introduction of a new agricultural technology. The first study by Dzanku et al. (2018) seeks to quantify the impacts of soon-to-be-available insect-resistant cowpea and nitrogen-use efficient rice in Ghana. The study's goal, to analyze potential gender differentiated welfare effects, is undermined by the absence of "sex disaggregated data related to technology adoption rates, yields, prices, insecticide use and overall cost of production" (Dzanku et al. 2018, 38). Instead of going into the field and obtaining these data themselves, researchers opt instead to devise estimates based on a longitudinal household survey that spanned from 1991-2013, alongside secondary sources. This approach allows the authors to craft specific estimates of differential production, consumption, and adoption rates for men and women. But the validity of these estimates remains suspect without gender-disaggregated data that speak directly to the study's central research questions.

A second IFPRI working paper examining new GM varieties of banana and cassava under experimentation in Uganda is similarly undercut by a lack of relevant data required for assessing potential gender disaggregated impacts, prompting the researchers to self-reflect on the "quite thin—even heroic—assumptions about differences in gender-based performance" that underpin their study (Kikulwe et al. 2020, 41). By their own admission, these researchers recognize that the assumptions embedded within their models might deviate significantly from reality: "an important gap and qualifier for the outcomes estimated and described here is that statistics and data availability and quality, especially on yields, is problematic" (Kikulwe et al. 2020, 46).

The third paper in the IFPRI series assesses potential benefits from new GM varieties of maize and cassava in Tanzania. These authors rely on national level statistics reported in the most recent census alongside more up-to-date national consumption data and conclude that men are better positioned than women to benefit from the introduction of these new GM varieties (Dzanku et al. 2018). The authors are careful to qualify their results as "quite speculative as they are derived from data captured in surveys that are not designed to examine gender differences" (Dzanku et al. 2018, 48). They conclude that a systematic analysis of the relationship between gender and GM crops "requires a much more purposive data-gathering exercise and a clear understanding of the political and socioeconomic nature of gender differentiation" (Dzanku et al. 2018, 48).

We hope that the three recent IFPRI studies represent a blip—and not a trend—in the empirical record. Economic modelling can offer important insights into how gender differentiation shapes outcomes with new agricultural technologies. But an exclusive reliance on quantitative analysis tends to simplify complex processes in order to understand how they function. The dependence on secondary data sets compounds misunderstanding here: incomplete data leads to incomplete results, which lead to problematic conclusions. Researchers need to create rigorous and robust farm household-level data that is gender disaggregated instead of relying on secondary data sets and analytical assumptions. The most crucial insights regarding the relationship between gender and GM crops have emerged from studies that offer context-specific, empirically rigorous accounts based on lengthy interactions with the particular farmers and households a specific GM variety is designed to benefit. More studies that employ a mixed methods approach while foregrounding the complexity of household relations, historically formed socio-cultural and economic dynamics, and regional variation in crop and land use are needed to better understand the complex relationship between gender and GM crops in LMICs.

Ending hunger, eradicating poverty, and achieving gender equality represent three of the seventeen UN Sustainable Development Goals[1]. The interrelated nature of these goals suggest that only deliberatively transformative and comprehensive policies and projects that tackle structural issues of inequity can lead to the desired goal of simultaneously empowering women while eradicating hunger and poverty. The promise of GM crops, to help alleviate food insecurity and enhance livelihood for poor farmers, should not come at the cost of gender

[1] SDGs #1, 2 and 5

equality in rural areas. After decades of research on women in agriculture, the evidence remains weak and sometimes contradictory with respect to the impact of GM crops on women farmers in LMICs. It remains incumbent upon policymakers and researchers to invest in research and programs that provide an accurate and holistic understanding of the impact of GM crops on women's equity and empowerment. Future research must prioritize the diversity and complexity of women's experiences in order to ensure that the introduction of any new technology improves women's standing within the household and society at large.

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