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Economic Benefits of Empowering Women in Agriculture: Assumptions and Evidence

Systematic reviews and meta-analyses generally focus on intervention impacts or outcomes. Less common, however, are reviews of the assumptions and theory underlying the pathways between intervention and outcome. We consider the hypothetical case for interventions to empower female farmers, either by prioritizing women for new investments or re-allocating existing resources. Empowerment is defined as increased women's decision-making authority related to agricultural resources, management and production, and income. We hypothesise two avenues through which productivity or health benefits might arise: (i) eliminating female-male differences in, e.g., input access; or (ii) leveraging gendered risk, time, and social preferences leading women to differentially allocate resources. A review of evidence highlights the extent of support for the baseline, behaviour change, and economic benefit assumptions behind these hypothesised avenues. Findings suggest returns to investing in female farmers could be significant in various contexts but estimates of economic returns to empowering women in agriculture remain limited.

Introduction and Framework

A growing body of evidence postulates that empowering women may lead to economic benefits for women themselves and for their households and communities (World Bank, 2011; Duflo, 2012; Kabeer and Natali, 2013; Gates, 2014; Klasen, 2018). The 2016 Africa Human Development Report estimates that gender inequality costs sub-Saharan Africa approximately \$95 billion per year, and a 2015 McKinsey Global Institute study suggests that \$12-\$28 trillion could be added to the global economy if women achieved parity with men in economic outcomes. Less work, however, focuses specifically on the potential impacts of women's empowerment in agricultural settings.

Through a comprehensive literature review this paper considers how prioritizing women's empowerment in agriculture might lead to economic benefits. Drawing on Kabeer (1999; 2017), we consider women's empowerment as the ability to make or

express strategic and meaningful choices and decisions related to one's own life. While we recognise that there are benefits of improving women's empowerment in and of itself, and that there are important non-economic domains of empowerment, we focus narrowly on women's economic empowerment, noting that positive economic outcomes are generally associated with social empowerment (e.g., supportive community norms) and psychological empowerment (e.g., efficacy or self-perception) (Conger and Kanungo, 1988; Brody et al., 2015). We further restrict the scope of economic empowerment to only include measures that directly relate to gender and agricultural outcomes.

With this intentionally narrow focus, we consider three measures from the Women's Empowerment in Agriculture Index (WEAI): women's decision-making power related to 1) productive resources, 2) agricultural management, and 3) agricultural income. For each measure, we summarise theoretical causal pathways through which changes in women's empowerment in agriculture, owing to gender-based differences in constraints or in decision-making, are hypothesised to affect direct outcomes from agriculture and longer-term economic benefits.

Were resources unlimited, contending that investing in female farmers has economic benefits is a low risk proposition. Instead, assuming a binding budget constraint, we theoretically consider the case for spending the marginal dollar on empowering female farmers as a means of increasing household productivity, either prioritizing women for new investments or re-allocating existing resources. While some studies test for different economic returns by gender for a given agricultural intervention, there is little work evaluating economic returns of interventions targeting women's empowerment in agriculture. By specifying theoretical pathways for such returns, we can search for evidence on the underlying assumptions and required

behavior change. Under these conditions, the literature suggests at least two distinct avenues via which net economic benefits from investing in women's empowerment in agriculture might arise. The first is by equalizing access to productive resources (including access to and control over land, labour, and other inputs) between women and men, and the second by leveraging differences between women and men that might lead to improved household outcomes.

For the first avenue, equalizing access to productive resources assumes that given the same access to and control over agricultural inputs and technologies, on average female and male farmers would be equally productive. Under the common assumption that initial input applications have a higher return than subsequent applications (diminishing marginal returns), and that women start from lower levels, then marginal productivity gains from increasing women's use of inputs would be higher than investing in more of the same inputs for men (Saito et al., 1994; Udry et al., 1995; Quisumbing, 1996; Croppenstedt et al., 2013; UN Women, 2015). Within this avenue we consider two theorised pathways to economic benefits. Pathway 1.1 focuses on empowering women through increasing their access to and control over agricultural inputs, thereby increasing overall agricultural productivity by reducing gender productivity gaps. Pathway 1.2 focuses on women's control over their own labour, hypothesizing that removing constraints to women's mobility and participation in off-farm labour markets could increase overall household labour productivity.

For the second avenue, leveraging differences between women and men assumes that for a given set of household resources, women's and men's choices differ – i.e., on average, female and male choices surrounding crop management, input use, childcare and other investments differ, possibly due to differences in risk, time, and social preferences. Under the common assumption that women and men, on average,

differentially prioritise resource expenditures, increasing a women’s share of household decision-making authority would be expected to change household economic outcomes (Duflo, 2003; Doss, 2013; Pandey et al., 2016). Within this avenue we consider three pathways that posit increasing women’s management and production decision-making power will lead to beneficial individual and household outcomes, given assumed female-male differences in decision-making under similar circumstances. Pathway 2.1 connects differences in women’s and men’s decisions of what crops to grow with household nutrition outcomes. Pathway 2.2 hypothesises that differences in plot management between women and men, specifically if women are more likely to intercrop, will thereby influence farm soil quality, pest management, and long-term household agricultural productivity. Finally, Pathway 2.3 draws a connection between differences in how women and men spend income from agriculture and impacts on household nutrition and education outcomes. We note that any measured benefits from leveraging female-male differences in the resource choices they make may dissipate as women gain more access and control, if the differences are not due to being a woman per se, but rather stem from being disempowered – since this would change the circumstances in which evidence of these differences in decision-making have been observed.

Figure 1 summarizes the theoretical framework and the component parts for which we search for evidence. The height of the purple bars corresponds to the count of supportive studies, indicating a much larger body of literature provides evidence of economic benefits from eliminating female-male differences compared to leveraging them, and the large beige arrows indicate that for Avenue 2 there is a large body of general evidence, but little evidence that is gender disaggregated.

[FIGURE 1]

Methods and Findings

To investigate these two hypothesised avenues and five associated pathways, we reviewed the peer-reviewed on women's empowerment in agriculture as of late 2019. Articles were identified by reviewing at least the first 40 results of targeted search strings for each pathway in Google Scholar and Scopus. The principal search terms used for these searches are available in a spreadsheet of supplementary material. At the first stage of screening, we narrowed our search of peer-reviewed journal articles to those indexed by Scopus and/or Web of Science; full texts of these articles were further reviewed for relevance. We considered both quantitative and qualitative studies meeting the selection criteria, including reviews, ensuring studies were counted only once. Because the possibility of publication bias towards novel or significant findings exists with the peer-reviewed literature (Franco et al., 2014), we also reviewed published but not peer-reviewed (grey) literature. We used the same pathway-specific principal search terms in Google Scholar and Google and reviewed the first 10 results for each search string. We do not assume differences in the reliability of findings, but because of a different sampling and review process, we include these studies but analyse them separately. Our final sample contains 243 peer-reviewed and 124 grey literature papers.

The five hypothesised pathways rest on the assumptions that (i) the baseline conditions for women and men differ; (ii) there are changes in technology adoption and use or other behaviour arising from women's empowerment that address or leverage those baseline differences; and (iii) those changes are associated with economic benefits. Few studies present evidence relating to an entire pathway from empowering women to an economic return, so our review considers evidence for each assumption in a given pathway individually. For each of these three assumptions embedded in each

pathway, we classify all studies as supportive, mixed, or non-supportive according to whether or not they affirm those linkages.

We further classify each study by its geographical scale (local, regional, national, multi-country) and method (qualitative, descriptive, non-experimental, quasi-experimental, experimental, review, field experiment). “Qualitative” evidence indicates that the study uses qualitative methods (e.g., interviews and focus groups), and no statistical analysis. “Descriptive” evidence indicates that the study uses descriptive statistics to suggest a correlation between two variables but does not formally test this association. “Non-experimental” evidence indicates that the study uses regression-based analysis or other tests for associations between variables but does not test for causality. “Quasi-experimental” evidence includes studies that use a variety of techniques to compare the effects of an intervention across treatment and comparison groups without random assignment, most commonly by using instrumental variables regression, matching techniques, or panel data with fixed effects, in an attempt to evaluate causality of relationships. “Field experiment” studies use techniques from soil science to establish experimental plots to test an agricultural technology, often controlling for soil, plot, and environmental characteristics. “Experimental” studies use randomly assigned treatment and control groups enabling identification of causal average treatment effects. Finally, “Review” evidence indicates studies that synthesise literature qualitatively (e.g., an extensive literature review) or quantitatively (e.g., a systematic review or meta-analysis).

For peer-reviewed and grey literature, Figure 2 shows that the majority of studies were non-experimental, though quasi-experimental studies were more common in the peer-reviewed literature, particularly for Pathway 1.1 (equalizing inputs). Studies reporting findings from sub-Saharan Africa made up over half the entire evidence base

(denominated by all low- and middle-income countries (LMICs) and some high-income countries appearing in global studies), particularly for Pathway 1.1. Pathway 2.1 (leveraging differences in crop choices) has a relatively large number of studies in South Asia compared to other LMICs. Evidence on the components of each pathway – baseline differences, behaviour change, and economic benefit – were largely spread across geographies.

[FIGURE 2 HERE]

Overall, relatively more supportive than non-supportive studies were found, though with differences across Avenues 1 (equalizing resources) and 2 (leveraging differences across genders; noting the issues in measuring differences in underlying gender preferences) and associated pathways. We also look for evidence of publication bias, and find an almost equal proportion of supportive to non-supportive and mixed evidence across peer-reviewed and grey literature (Figure 3), with the exception of Pathway 1.2 (increasing women’s control over their labour) and Pathway 2.2 (leveraging gendered differences in farm management / intercropping), the latter of which has fewer than 20 studies for any pathway component.

[FIGURE 3 HERE]

A summary of findings for the peer-reviewed literature follows for each pathway. We provide counts for supportive, mixed, and non-supportive articles for each pathway, but the emphasis in our pathway-specific text is on supportive studies and non-supportive studies that are experimental or highly-cited quasi-experimental studies. Overall, evidence from the grey literature appears largely consistent with the peer-reviewed literature, suggesting that any potential publication bias towards positive results has a limited impact on our conclusions. We also note that within all quantitative studies, it is common for significant but small point estimates to be emphasized more

than insignificant but large estimates, without considering sample size or other factors potentially driving these results. Because we are reporting the findings as reported by the authors, we follow this convention. Further, for space considerations, text cites are generally only provided in cases of two or fewer relevant papers, and we refer the reader to a spreadsheet of supplementary material containing all 367 papers coded by pathway and component as well as geography, methodology, gender disaggregation, and whether or not the study was peer-reviewed.

Avenue 1: Eliminating Female-Male Differences in Resource Access

Pathway 1.1: Increased Women's Use of Productive Resources

The first pathway in Avenue 1 assumes that an increase in women's relative decision-making power related to agricultural and productive resources (including both access to and control over agricultural inputs and technologies) would lead to a reallocation of household resources and an increase in their use by women, increasing household agricultural productivity. The specific baseline, behaviour change, and economic benefit assumptions for Pathway 1.1 are that:

- (1) Women have lower access to and control over agricultural inputs than men, contributing to lower agricultural productivity for women;
- (2) Given greater access to and control over inputs, women's input use would increase; and
- (3) The marginal yield returns to increasing input use by women (as a result of equalizing access and control relative to men) are higher than for men, *ceteris paribus*, such that directing new resources to women and/or reallocating resources within the household would increase household productivity.

[FIGURE 4 HERE]

We find ample peer-reviewed evidence (53 studies) indicating that women in LMICs often have less access to inputs such as labour, farm equipment, seeds, draft animal power, fertiliser, land, extension services, and credit, in comparison with men, at either the plot, individual, or household level. Of these 53 studies, 25 discuss lower productivity for female-managed or -owned plots, female farmers, or female-headed households compared to their male counterparts. Six of these studies show that this productivity difference between female and male farmers diminishes significantly once access to inputs is controlled for and conclude that differences in use of inputs drive a portion of the gender productivity gap. Three studies find that unequal access to complementary inputs at the baseline is associated with lower adoption of improved maize technology by women, and might explain the absence of effects from increased women's land ownership on household welfare.

Nineteen studies report on the effects of empowering women by increasing their control over productive resources, generally through directly providing inputs to women or lowering the costs to women of obtaining such resources. Of these, 12 find that women's empowerment is associated with higher female use of inputs and technology. Elias et al. (2013) and Emmanuel et al. (2016) suggest that increasing women's access to and use of productive resources leads to economic benefits from increased agricultural productivity. Additionally, 32 studies report on economic benefits relating to increased women's productivity, but only 18 provide positive evidence of the hypothesised pathway. Davis et al. (2012) find that women's productivity was higher than men's following an intervention to increase input use, but Karamba and Winters (2015) and Wossen et al. (2017) find no difference in productivity gains between women and men. Agarwal (2018) concludes that higher female agricultural productivity

is contingent on a variety of factors such as technical training and support, credit availability, and commercial crop choice. Beaman et al. (2013) find that increased output due to increased female input use does not translate to increased profits, while Bhaumik (2016) finds that the share of income generated through high-value agriculture that improves household welfare is negatively associated with female land ownership. A study by Diiro et al. (2018) highlights the significant positive association between women's empowerment indicators and maize productivity in Kenya: the authors estimate that a one-unit increase in female production decision-making is associated with a 32% increase in maize productivity. Five studies find that agricultural resources are inefficiently allocated at the household level and argue that increasing women's control over agricultural resources will increase productivity, but do not demonstrate this empirically.

Evidence on the technical efficiency of female and male farmers is mixed: Moock (1976) and Akamin et al. (2017) find female farmers to be more technically efficient than male farmers; Kinkingninhoun-Médagbé et al. (2010) find no female-male difference; and Mar et al. (2018) and Flores and Reyes (2019) find lower technical efficiency among female farmers. Seymour (2017) finds that closing the empowerment gap between women and men in Bangladesh significantly improves technical efficiency for jointly managed plots, but also for plots not actively managed by women. Finally, while seven studies find that women have equal or greater productivity than men when controlling for input use, and Mishra et al. (2017) find a higher value of crop production for female-headed households despite less production area and higher fixed and variable costs, five other studies find evidence that a gender productivity gap remains even after controlling for the gender gap in input access.

As a body, these studies suggest that women's access to and control over agriculturally productive resources is unequal, and that reducing this difference could lead to high marginal economic benefits from increased productivity.

Pathway 1.2: Increased Women's Participation in Labour Markets

The second pathway hypothesises that increasing women's decision-making authority over their own labour time and mobility would increase women's participation in markets, including off-farm labour markets, which would contribute to increased household labour productivity. Following Haggblade et al. (2010), we consider non-farm labour market participation as employment in all activities other than primary agricultural production. Thus, non-farm labour includes a range of activities such as manufacturing, mining, services, agro-processing, and so on. While we recognise that not all women would choose to participate more in off-farm labour markets if given the choice, this pathway rests on the baseline, behaviour, and economic impact assumptions that:

- (1) Women's labour choices and mobility are more constrained than men's, restricting access to off-farm income opportunities;
- (2) With more labour choices and mobility, women would participate more in off-farm labour; and
- (3) There would be positive marginal returns to household labour productivity if women were more able to reallocate their labour, including expanding participation in off-farm labour markets.

[FIGURE 5 HERE]

We find support from 27 published studies for the assumption that women are less likely than men to participate in off-farm labour markets, though participation rates are

not attributed to women's decision-making authority related to their own time and labour. The evidence further indicates that where women do participate in off-farm employment, it is generally in self-employment and activities with lower returns. Constraints to migration, and lower access to distant off-farm work and markets are also associated with women participating less than men in off-farm labour. In a study in Mozambique, Porsani et al. (2018) report that men migrate and/or allocate labour mainly to fixed-wage employment, cattle rearing, and off-farm activities in case of worsening farming conditions, whereas women allocate labour to on-farm activities including farming fields in exchange for cash and low return trading. In contrast, Lanjouw (2001) and Ruben (2001) conclude that women in female-headed households are more likely to participate in off-farm work as compared to male-headed households, although this may be primarily in low-productivity occupations. Finally, Dietz et al. (2018) find even when women participate in off-farm economic activities and salaried employment at lower rates than men, female autonomy in decision-making over tasks and income generated from these activities may be higher than the returns from agricultural activities.

We find evidence from 13 studies indicating that increasing women's control over their own labour and mobility is associated with higher off-farm market participation. Specifically, multiple studies for women's education, Swaminathan et al. (2010) and Owusu et al. (2011) for access to credit, and Beyene (2008) for income transfers, suggest that increases in women's capital and subsequent intra-household bargaining and decision-making authority are linked to an increased probability of female off-farm employment. These findings are highly context dependent: in a study in Pakistan, Fafchamps and Quisumbing (1999) find education is associated with decreased female employment in farm and non-farm activities, however better educated

women that do work are more likely to work in non-farm activities. Zhang et al. (2018) report that women comprised 35% of wage-earning migrants in China by 2015, which the authors theorise may be related to competitive labour markets being associated with a decline in discriminatory practices, and hence increased employment opportunities for women. Further, four of these studies point to marital characteristics associated with encouraging or hindering female off-farm employment, and find that childbearing age and childcare responsibilities also play an important role in determining women's labour force participation. For example, in a study in sub-Saharan Africa, De Jong et al. (2017) find husbands' off-farm employment, as well as the education level of both spouses, is associated with a higher likelihood of wives engaging in off-farm employment. The authors also find both relatively early and late childbearing ages to be negatively associated with female propensity to engage in off-farm work. In Ghana, Abdulai and Delgado (1999) find women's participation in non-farm work is negatively associated with their husbands' returns from off-farm work. In rural China, Qiao et al. (2015) show that both having school-aged children and elderly family to care for were negatively correlated with the income earned by female migrants and female members of the family. Despite similar off-farm employment levels between women and men, women remained the main care providers for both children and the elderly.

While a larger body of evidence reports on the circumstances in which higher returns are possible from off-farm compared to farm labour, we identified 11 studies reporting on productivity effects of off-farm labour market participation for women in particular. Gartaula et al. (2017) in Nepal find women's well-being, agency, and empowerment to be higher in nuclear households with access to remuneration from distant off-farm jobs. The authors conclude that improving women's mobility and increasing access to distant off-farm employment opportunities may increase labour

productivity for women. However, five studies suggest that while incomes are higher for non-farm employment compared to farm employment in low- and middle-income countries, women earn lower wages than men, potentially due to their concentration in less productive employment or due to differences in education compared to men.

Overall, the available evidence suggests that off-farm labour activities can increase labour productivity and economic benefits. To the extent that women would choose to participate more in off-farm labour given the authority to do so, we would therefore expect their labour productivity to rise, conditional on the availability of opportunities. It is more difficult, however, to understand how overall household labour productivity would change without knowing whether a woman's off-farm labour hours were in addition to, or instead of, previous farm, domestic, or leisure hours, and how household labour is re-allocated (e.g., to a spouse, other household adults, children, or market labour) in response to her off-farm work.

Avenue 2: Leveraging Female-Male Differences

Pathway 2.1: Improved Household Nutrition

The first pathway in Avenue 2 hypothesises that increasing women's relative decision-making authority related to agricultural management and production will affect decisions of what crops to plant, increasing household dietary diversity and improving nutritional outcomes, thereby leading to reduced health costs and increased labour productivity. This pathway rests on the baseline, outcome, and economic impact assumptions that:

- (1) Women have less control over agricultural management and production decisions than men, favouring men's crop planting choices which on average are less diverse and nutritious;

- (2) Planting a greater diversity of crops and more nutritious crops improves nutrition; and
- (3) The marginal returns to household nutrition for households for crop planting decisions made by women (e.g., more nutrient-dense vegetables and legumes) would be higher than for crop planting decisions made by men, *ceteris paribus*.

[FIGURE 6 HERE]

We find 19 peer-reviewed articles suggesting that women plant and consume more diverse and nutritious crops than men. Seven of these articles indicate that women plant and consume a greater variety of crops than men at the individual level and as both heads of households and plot managers. Ten studies support the assumption that women grow and consume more vegetable, leafy green, and legume crops on average than men. Three studies report that households with female heads also grow more diverse crops than male-headed households. Further, two studies highlight women's role in agrobiodiversity through seed collection and preservation (Hosken, 2017; Suma and Grossmann, 2017). Finally, one study indicates a female land use preference for agroforestry (Villamor et al., 2017), a source of household food consumption.

Seven studies support a link between women growing more diverse and/or nutritious crops and increased household dietary diversity and/or nutrition. Jones et al. (2014) suggest that the association between crop diversity and nutrition is stronger for female-headed households than male-headed households, and four studies report that women leverage crop diversity for improved household nutrition, including via business income (Snapp and Fisher, 2015). Powell et al. (2017) find female-headed households to have greater dietary diversity, despite legal and social limitations on land ownership and crop choice. Pandey et al. (2016) find that women's empowerment interventions

aimed at agricultural diversification to nutrient-rich crops are associated with better household nutritional outcomes. Ochieng et al. (2017) and Murendo et al. (2018) also find an association between the cultivation of fruits and vegetables and improved female and child dietary diversity. Sibhatu and Qaim's (2018) recent systematic review of 45 studies in 26 countries finds that a majority of studies report generally (though not uniformly) positive associations between production diversity and dietary diversity and/or nutrition, with a meta-analysis finding a positive but small mean effect size, with a larger mean effect size for sub-Saharan Africa. Other studies link measures of women's empowerment to dietary diversity directly, considering for example female earning status and income, mother's education, and overall household commercialization of farm production.

Improved nutrition has further been generally associated with corollary economic benefits, including lower health costs and higher short-run and lifetime labour productivity. We did not, however, identify any studies reporting on the longer-term economic benefits of women's specific decisions to plant more diverse and nutritious crops.

To the extent that vegetable and legume crops or home-garden crops contribute to household nutrition outcomes, and that women choose to plant more of these crops than men, the evidence suggests that increasing women's decision-making authority related to agricultural management and production might lead to economic benefits. It is not clear, however, that the difference between women's and men's crop planting decisions would hold if women were given more authority over household plots, as female/male differences in crops planted may be due to specialization in crop cultivation at the household level, with traditionally "women's crops" allocated to female-managed plots.

Pathway 2.2: Improved Cropland Soil Quality

The next pathway hypothesises that increasing women’s decision-making authority over farm management can result in improved on-farm soil management practices including higher rates of intercropping, leading to improved soil quality, and ultimately higher land productivity. This pathway rests on the baseline, outcome, and economic impact assumptions that:

- (1) Women have less control over agricultural management and production decisions than men, favouring men’s management choices which involve less intercropping;
- (2) Intercropping improves soil quality; and
- (3) The marginal returns to household land productivity from women’s greater tendency to intercrop would be higher than management decisions made by men, *ceteris paribus*.

[FIGURE 7 HERE]

Eight studies suggest that women choose to intercrop more frequently than men, as plot managers, joint plot managers (Ndiritu et al., 2014), and as heads of household (Khan et al., 2008; Thebe, 2018). However, Bezner-Kerr et al. (2007) and Muriithi et al. (2018) suggest this pattern does not necessarily hold across different contexts, and that there may be no gender difference in the propensity to intercrop. No studies in the sampled literature report whether intercropping differences hold following interventions to give women more authority over household plots and inputs.

The literature strongly supports the claim that intercropping is associated with higher soil quality and with lower soil erosion for a variety of intercropping systems,

though this is not gender specific. Similarly, the positive association between soil quality and agricultural productivity is also relatively well-established in the field of soil sciences, so for contexts in which women systematically intercrop more than men, increasing women's control over agricultural management decisions might produce economic benefits.

Pathway 2.3: Improved Nutrition and Educational Attainment

The final pathway hypothesises that increasing women's control over agricultural income could change the allocation of household expenditures to improve household nutritional and educational outcomes. This pathway rests on the baseline, outcome, and economic impact assumptions that:

- (1) Women have less control over agricultural income than men, favouring men's spending choices, which on average involve less expenditure on food and education;
- (2) More spending on food and education (particularly for children) improves nutritional and educational outcomes; and
- (3) The marginal returns to household nutritional and educational outcomes for spending decisions made by women would be greater than for spending decisions made by men, *ceteris paribus*.

[FIGURE 8 HERE]

We find nine studies conducted in LMICs suggesting that women or female-headed households spend a greater proportion of household income than men on a variety of household goods, in particular food and education. Four studies find that increasing

women's income, assets, or their share of household income or assets is associated with increased household food or education expenditure. However, other studies find mixed results or no significant association between women's control of income and household food or education expenditure, for urban households (Doss, 2006) and in certain countries including Bangladesh, Brazil, and South Africa (Thomas, 1997; Quisumbing and Maluccio, 2003). Kennedy and Peters (1992) find no significant difference between male- and female-headed households when controlling for household income, and Kenayathulla (2016) in Ethiopia finds a greater probability of having positive budget shares for education among male-headed households.

Eleven studies connect household spending on food and education with improved nutrition and education outcomes for children. Four of these studies report a positive association between higher household food and education expenditure by women and educational and nutritional outcomes for children. Duflo (2003) finds a particular association between income for maternal grandmothers and girls' nutrition. We find further evidence through six of these studies that greater female control over household resources, in particular income, is associated with improved household nutrition and children's education outcomes, though these studies do not specify that this is accomplished through increased household spending on food and education.

Multiple studies find either significantly higher labour productivity or lower health costs from improved nutrition and additional years of schooling in a variety of contexts. The estimated private returns to investment are generally large, and without even factoring in social benefits can be over 20% for primary school (Psacharopoulos & Patrinos (2004).

While we did not find any evidence specifically testing the longer-term benefits of women's control over household income or spending generally, this body of work

suggests benefits of increasing women's control over agricultural income in contexts where women are more likely than men to spend income on household food and education.

Conclusions

Published estimates of economic returns to empowering women in agriculture are still relatively rare, are mostly based on non-experimental evidence, likely biased towards positive outcomes, and are often limited in terms of data quality. Empirical evidence, where it exists, generally emphasizes significance over magnitude. Ultimately, due to the heterogeneity of study types, interventions, and indicators, it is difficult to provide summary empirical evidence across all links within the five causal pathways examined here. Direct evidence for some of these pathways – from women's empowerment to economic benefits – is limited, though we find supporting evidence when separately considering a) the associations between female/male differences and direct outcomes and b) the associations between those direct outcomes and long-term benefits without considering a gender element.

In most cases, studies do not calculate the economic benefits of women's empowerment specifically, but rather provide a range of estimates from particular outcomes. This is particularly true for Pathways 2.1, 2.2, and 2.3, which consider the benefits of leveraging differences in decisions between men and women to improve household nutrition, soil quality, and children's nutrition and educational achievement, respectively. Estimates of benefits drawn from the existing literature suggest that returns to investments in women's empowerment in agriculture through the five pathways could be significant in contexts where the assumed female-male differences hold, though it is not clear how these differences might be affected if women were

given greater control over agricultural productive resources, management, and income. Previous macro-level studies have calculated potential gross gains of \$100 million in Malawi, \$105 million in Tanzania, and \$67 million in Uganda per year (UN Women, 2015) from closing the agricultural productivity gap between men and women (Pathway 1.1). Other calculations suggest a 0.72 percent reduction in the incidence of undernourishment, with an additional 80,000 people being sufficiently nourished every year in Tanzania (UN Women, 2015).

A broad base of evidence reports on benefits from improved nutrition through improved labour productivity and reduced health costs. A 2014 report by the African Union Commission and others finds that treatment of undernutrition is a recurring expense for health systems in low-income countries, costing between 1-11% of countries' total public health budgets (African Union Commission et al., 2014). These increased health costs can also translate into reduced economic growth, with a World Bank (2006) estimate suggesting economic loss to malnutrition could amount to 2-3% of gross domestic product, and individual productivity losses due to malnutrition globally are estimated at more than 10% of lifetime earnings. Hoddinott et al. (2008) report that Guatemalan young adults who had been enrolled in a village-based nutrition intervention benefitted from a 46% increase in average wages. To the extent that women's decisions to plant more diverse and nutritious crops (Pathway 2.1) and to allocate more household income to food (Pathway 2.3) improve nutrition, empowering women in agriculture could have significant benefits.

Overall this review provides support for portions of all five theorised causal pathways between women's economic empowerment in agriculture and economic returns, though the evidence is often mixed. The evidence base, in general, is strongest for the first assumption of Avenue 1 (Pathways 1.1 and 1.2 on access to inputs and off-

farm labor, respectively), that female-male differences in resource access exist, and with few exceptions, supports the second assumption of behaviour change: that women would avail themselves of access to more productive resources or opportunities. The evidence for the starting assumption of Avenue 2 that posits that differences in preferences (rather than constraints) offer opportunities for realizing economic benefits through investments targeting women, is more mixed – fundamentally because of basic measurement challenges, including the difficulty of disentangling behaviour change stemming from preferences rather than constraints. This includes Pathways 2.1, 2.2 and 2.3 on decisions to grow diverse and nutritious crops, intercrop more often, and spend agricultural income on children, respectively.

The grey literature review supports the conclusions drawn from the peer-reviewed literature, with a few exceptions and limitations. The grey literature evidence base is similarly strongest for Avenue 1 on women’s decision-making authority related to agricultural productive resources – although it is more supportive of Pathway 1.1 (equalizing inputs) than for Pathway 1.2 (increasing women’s control over labor), largely due to several studies conducted in Ghana where gender norms promote men as having superior farming capabilities, leading women to participate more in off-farm employment (Kramer and Lambrecht, 2016). The evidence from the grey literature, however, similarly suggests that women’s off-farm employment typically involves activities with lower returns, and evidence remains strong for the assumption of behavior change for this pathway. For Avenue 2 on women’s decision-making authority related to agricultural management, production, and income, the literatures align except for Pathway 2.2 on intercropping where the grey literature yields very limited evidence for the behavior change and economic benefits components. Furthermore, consistent with Bezner-Kerr et al. (2007) and Muriithi et al. (2018), the grey literature does not

support the baseline assumption that women intercrop more often than men, all else equal. Overall, our review of the grey literature suggests that any potential publication bias has a limited impact on our conclusions, though future work may consider a full risk of bias assessment.

We suggest that it is possible and useful to make a theoretical case for spending the marginal dollar on empowering female farmers as a means of increasing household productivity, either prioritizing women for new investments or re-allocating existing resources – based on common theory around diminishing marginal returns (and women’s lower initial access relative to men), or gendered risk, time, and social preferences that would differentially prioritise resource expenditures. In part due to the limited cost (and revenue) data on interventions along the five pathways studied here, there are few calculations of potential returns per dollar of investment that directly test this proposition. But we nonetheless advance a framework with the component assumptions of female-male differences and behavior change that can start to build an evidence base. A common thread in the mixed or dissenting literature is that it can be misleading to generalise from female-male “averages” given that returns to empowerment are often context specific. In this vein, we have also noted some inconsistencies in published methods and findings, and several key data gaps, that may provide further insights into which pathways have the greatest potential to provide evidence on the association between women’s empowerment and economic benefits.

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Figure 1. Theoretical Framework

Figure 2a. Study Methodology Peer-Reviewed Literature

Figure 2b: Study Methodology Grey Literature

Figure 3. Proportion of Supportive Studies

Figure 4. Evidence Base Supporting Pathway 1.1

Figure 5. Evidence Base Supporting Pathway 1.2

Figure 6. Evidence Base Supporting Pathway 2.1

Figure 7. Evidence Base Supporting Pathway 2.2

Figure 8. Evidence Base Supporting Pathway 2.3