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Transformation of Global Agri-Food Systems:
Trends, Driving Forces, and Implications for Developing Countries

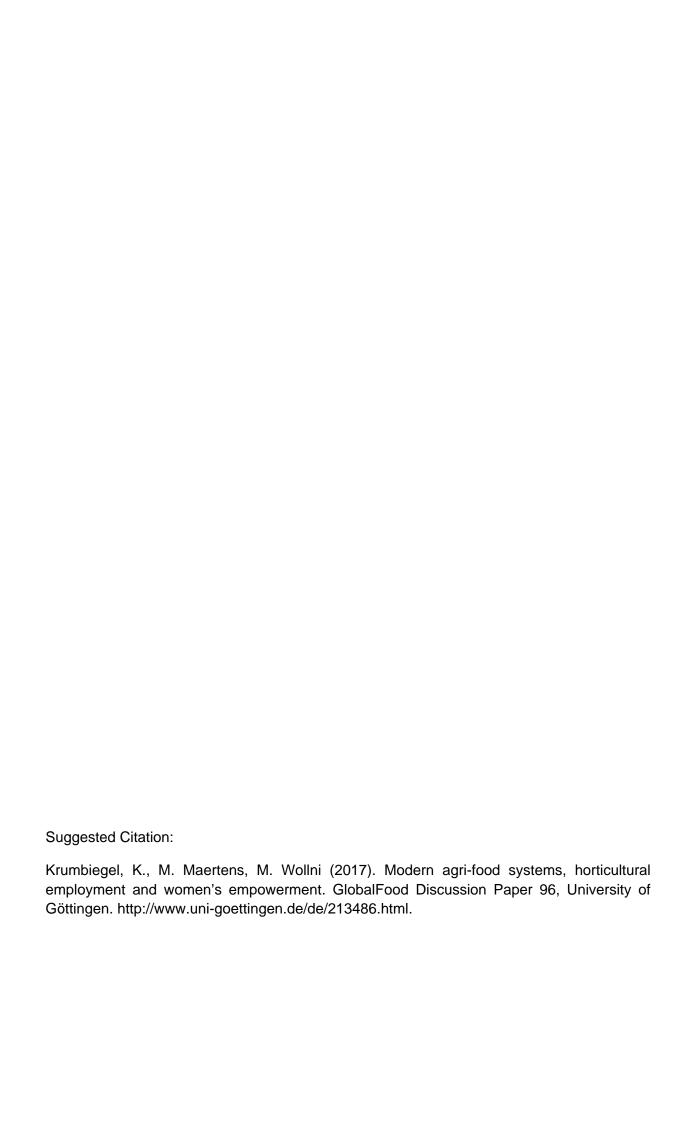**Georg-August-University of Göttingen**

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Modern agri-food systems, horticultural employment and women's empowerment

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Abstract:

The transformation of global agri-food systems has led to the increased establishment of export-oriented horticultural plantations in developing countries. These labor intense production sites are associated with feminized employment patterns for the delicate handling of fruits and vegetables and therefore provide employment opportunities for women in rural areas. However, the social implications of these developments for women workers' roles in their households remain hardly understood. We address this research gap by assessing a wide range of indicators reflecting women's empowerment. We use primary survey data of 422 married households in Ghana, living in areas of large-scale pineapple plantations. We apply entropy balancing, a new re-weighting technique, and combine this with regression analysis. We find that female horticultural wage workers contribute a major share to the household's income, are more mobile, have better control over assets and reduced responsibilities in household chores. Women workers also report having more input into household decision-making.

1. Introduction

In recent years, globalization of agri-food systems has led to an increased integration of developing countries into modern supply chains. Particularly the production of high-value horticultural crops has been fostered by the participation in international trade and foreign-direct investments. Modern agri-food systems are characterized by (1) high quality, safety and processing standards (2) vertical coordination along the globally spanning supply chain and (3) a trend towards consolidation of production units to exercise better control over imposed standards (Maertens and Swinnen, 2012). This has led to the establishment of labor intensive production sites, specifically large-scale horticultural and floricultural plantations that have created employment opportunities particularly in rural areas. These developments are associated with feminized employment patterns as companies often prefer women workers over men due to their perceived dexterity and "nimble fingers" to handle delicate produce (Barrientos et al., 2003). At the same time, companies may perceive women to be more docile with lower reservation wages and accepting of adverse working conditions. For example, the share of women in the Zambian fresh vegetable sector and in the flower industry in Kenya is 65% and 75%, respectively (Maertens and Swinnen, 2012). With the ability for women to contribute a stable and potentially permanent income to their household's income, the question remains whether this also leads to women's increased empowerment and higher bargaining power in the household. At the same time, work in export-oriented plantation agriculture is often linked to job insecurity, poor working conditions and insufficient wages. Its potential for generating social benefits has been questioned (Dolan, 2004).

So far, there are only a few studies that address the question of female empowerment through horticultural employment. They focus on either the gendered nature of modern supply chains in general (Barrientos et al., 2003; Dolan and Sutherland, 2002; Maertens and Swinnen, 2012) or discrimination and exploitation at the workplace (Barrientos et al., 2005; Dolan, 2004). Some exceptions exist. Said-Allsopp and Tallontire (2015) assess the Kenyan tea and cut-flower industries and provide evidence on female worker's greater self-reliance, financial independence and improved resistance of men's domination. Maertens and Swinnen (2012) indicate that 94% of women workers in export-oriented horticultural companies in Senegal report that their decision-making power in the household has increased, 67% that they enjoy more respect within their community, and 78% that they benefit from meeting and exchanging with other women in the companies. Using the same dataset, Maertens and Verhofstadt (2013) find a positive relationship between female bargaining power and child schooling, particularly for girls. Newman (2002) finds a significant impact of the cut flower industry in Ecuador on men's participation in housework due to women's increased participation in the labor force. However, not all studies find female horticultural employment to be favorable for women's empowerment. Friedemann-Sanchez (2006) evaluates employment effects for

female and male Columbian floricultural workers regarding their ownership of assets and property. She points out that even though wages are rather equal, female workers cannot use their wages to accumulate assets or buy property in the way that male workers can due to women's financial responsibilities towards their households. In Ethiopia, Hjort and Villanger (2011) document a significant increase in physical violence (13%) and emotional abuse (34%) of female flower workers by their husbands, and explain this as men's reaction on changing gender roles. Heath (2014) confirms the connection between female employment and domestic violence in Bangladesh, particularly for women who married young and have low education levels.

We contribute to the literature in two ways: (1) by using a quantitative survey-based method we add to the scarce existing empirical evidence on female empowerment in modern agri-food systems and (2) by applying a wide variety of indicators we provide a multidimensional analysis of women's empowerment. We base our analysis of women's empowerment on the conceptual framework developed by Kabeer (1999). In Kabeer's model (1999), a distinction is made between three different domains of empowerment: resources (pre-conditions), agency (processes), and achievements (outcomes). In our study we measure women's empowerment through both resources and self-reported agency, and use a variety of indicators to represent these two domains of empowerment. We thus focus on the pre-conditions and processes that empower women to achieve their desired outcomes, rather than on the actual outcomes that depend not only on empowerment per se, but also reflect personal preferences and interests.

2. Conceptual framework

Theoretical underpinnings of women's bargaining power and female empowerment are related to the functioning of a household. The literature differentiates between two main household modeling approaches. Unitary household models (Becker, 1981; Becker, 1974) presume that households have a single utility function, where labor is allocated according to the comparative advantage of household members, income is pooled and preferences for consumption shared and based on rational preferences. In this setting, the choice of the wife to take up work depends on the income of the husband. The higher his earnings, the less likely it is that the wife will involve in income generation herself and vice versa. In terms of labor efficiency, male and female labor can perfectly substitute each other. However, these unitary household models have been highly contested and alternative models depart from the unity assumption within a household (Browning and Chiappori, 1998, Haddad et al., 1997). Asymmetric power, social norms and gender relations are factors that influence expenditure choices and gender-specific division of labor. Bargaining models are based on the recognition that household members may have different preferences and interests, which they bargain for in order to achieve them, either in a cooperative or non-cooperative manner

(Quisumbing, 2003). Such household models assume that income and assets are also used for influencing household decisions and therefore affect bargaining power (Doss, 2005). Household members choose to supply labor based on their individual labor and budget constraints and personal objectives.

Our focus and approach on women's empowerment implicitly assumes a non-unitary household bargaining model in which women's labour allocation to off-farm employment is hypothesized to influence their bargaining power within the household. To assess women's empowerment, we follow Kabeer's (1999) definition of empowerment as expansion of people's ability to make strategic life choices. She relates the ability to exercise choice to three connected dimensions: resources (pre-conditions), agency (process) and achievements (outcomes). Resources include economic (e.g. income or assets), human (e.g. education) but also social resources such as a supportive network. Kabeer (1999) identifies agency as the capacity to define personal goals based on motivation and purpose. This reflects the ability to transform these choices into preferred outcomes (Narayan, 2005) through the use of influence, voice and skills (Kabeer, 2008). Finally, achievements are the result of using resources and agency to translate preferences into outcomes. In our paper we focus on the first two dimensions, resources (pre-conditions) and agency (process), because these represent the "initial conditions" (Kabeer, 2008) for increased women's empowerment.

We identify four potential pathways of empowerment in the context of horticultural wage labor, potentially influencing both the resources and agency dimension. First, women are able to generate a higher income in comparison to other income-generating activities in rural areas, like agricultural production or small-scale businesses. Therefore they are able to generate substantial financial resources and provide a significant contribution to the household income. This may enable the acquiring of and control over household assets, such as motor vehicles or agricultural assets. Second, workers receive regular trainings during their employment. These trainings range from first aid to management skills and learning about product hygiene and handling. The acquired knowledge may be applied in agricultural production of the household and therefore contribute to more female input into agricultural decision-making. Third, many workers are engaged in labor unions on the plantations. As labor unions ensure that worker's opinions are taken into account in the company, this requires workers to establish and sometimes voice their viewpoints. The involvement in worker representation may also lead to more engagement outside the company. Fourth, women that are employed outside their home may be exposed to a greater variety of perspectives and way of thinking in comparison to women that mostly stay at home or in the community. As workers are usually allocated into task teams, they engage and communicate with a number of different people

during the day. The exposure to different ideas and the ability to use their voices may well enhance the agency of female workers, namely the ability to identify preferred outcomes. This may contribute to women's increased input into household decision-making. The change of mindset and greater confidence can further encourage mobility as women aim to overcome the confinements of their communities.

We consider a large variety of individual indicators to measure the two dimensions of women's empowerment. As part of the resources dimension, we assess overall household income, the female spouse's contribution to the household income, the share of assets she owns and is able to sell, her mobility, and her reproductive workload. The ability to obtain an individual income is considered an indicator of empowerment, as it allows women to invest in their preferences, such as personal items or their children's well-being. This implies that she herself can decide over the use of her income. In Ghana, households do not commonly pool incomes and therefore it is likely that female spouses can use their incomes for their preferred choices (Chen and Collins, 2014). The ownership of assets and the ability to sell assets are considered to be stronger indicators for empowerment than income, as assets are perceived as being more durable and stable. As control over assets can only be assessed in relative terms against that of other household members (Doss, 2005), these indicators are quantified as the share of assets owned and sold. The mobility of women in the public domain is an indicator of social change, as traditionally women are often constrained in their ability to visit certain places unaccompanied (Mahmud and Tasneem, 2014). We consider this as a resource for empowerment, because women's ability to travel enables them to be economically active or invest in their social networks. Finally, time is an important resource as women in addition to productive tasks and income generation are usually responsible for reproductive tasks such as household chores and childcare activities. Thus, when time-consuming employment activities are taken up, overall workload of women usually increases, which is often considered „the cost of empowerment". However, we argue that the time spent on reproductive tasks is a better indicator than overall workload to reflect women's empowerment within the household. Finally, for the agency domain we analyze the self-reported input into various areas of household decision-making, ranging from minor household expenditures to agricultural production decisions.

3. Data

We select the Ghanaian pineapple sector as case study for a modern supply chain because it is one of the country's most important horticultural export crops. In 2011, Ghana's export volume of fresh and processed pineapple was worth 51 Million USD and therefore represents the 6th most important export crop in terms of value (Gatune et al., 2013). About 15 large-scale plantations produce pineapples for the export market, eight of which make up for 93% of Ghana's pineapple

exports. The sector has been established for a relatively long time period of 15-20 years. This provides a good setting to assess research questions that reflect a slowly changing cultural and social process such as female empowerment. The central area for pineapple production in Ghana is located in rural areas, but with access to the airport and shipping port on the coast. Plantations are set up on the periphery of settlements in relatively populated areas where they can source labor easily. Most workers are therefore locals from the surrounding villages of the companies and did not specifically migrate to this area for work opportunities.

We collected original household data in 2015. In a first sampling stage, we purposefully selected eight pineapple plantations that are comparable to each other by choosing those similar in size and scale of capacity. All companies belong to the largest and most productive ones in the sector and can therefore be considered as drivers of the sector. In our context, this is relevant because those agricultural companies that are able to sustain their business over a substantial period of time also have the largest implications for social change and rural development. In a second sampling stage, we received lists of villages, from which the eight selected companies source their workers. We obtained lists of workers within each village, from which we randomly sampled worker households to be interviewed. To generate a control group, we randomly selected non-working households in the same villages. Additionally, we included three villages where no households are employed on pineapple plantations.

Our sample consists of 532 households. To allow a more accurate assessment of intra-household bargaining processes, we only incorporate those households that have two decision-makers and exclude all single households for our empirical analysis. We refer to the main decision-makers as male and female spouse in order to utilize a neutral terminology. Due to the exclusion of single-headed households our sample size is reduced to 422 observations. We differentiate between two groups of female spouses: (1) those who are predominantly employed on a horticultural plantation and (2) those who are self-employed in either agricultural production or in small-scale businesses. Indeed, female wage workers can additionally be self-employed in agricultural or non-agricultural activities besides their wage work. In terms of terminology, we refer to the first group as women employees and the second group as self-employed women. Of our 422 observations, 153 female spouses are women employees on Ghanaian pineapple plantations and 269 are self-employed. A structured questionnaire was used for the survey, which incorporated questions on household characteristics, family health and education levels, land ownership and agricultural production as well as employment conditions, provision of services, labor union involvement in the companies. A gender-specific section was only administered to the female spouses in the household within a secluded and private setting.

4. Methods

4.1. Women's empowerment measures

To relate the potential pathways of women's empowerment to the context of our study, it is important to understand working conditions and company characteristics of the sampled pineapple plantations in Ghana. Table 1 provides us with information on workplace characteristics, the types of jobs women do and the services that are provided by the company. The women in our sample work on average 7.83 hours a day. The majority of women (70%) works at least 7 hours per day and has a permanent work contract (73%). This means that their employment on pineapple plantations represents their dominant work activity for income generation. They receive trainings ranging from product and personal hygiene to first aid. They are also trained in their particular work task, contributing to their human resources. About 40% of those interviewed report to have participated in at least one training in the past 12 months. Unionization of workers is common in Ghana. Also, the majority of pineapple plantations in our study has a company labor union, in which 38% of female workers are members. When it comes to the particular jobs, most women are engaged in washing and packaging of pineapples or field maintenance including soil preparation and weeding. Other work categories are more male-dominated, such as chemical application. More men also work in technical and administrative jobs.

Table 1 Workplace characteristics of female horticultural wage workers in the sample

	Variable	Mean Value
Workplace characteristics	Work hours per day	7.83 (1.72)
	Permanent contract	0.73
	Participated in a training in the past 12 months	0.37
	Number of trainings received	1.34
	Labor union present at the company	0.63
	Female worker labor union membership	0.38
	Planting and Harvesting	0.19
	Export and Packaging	0.26
	Field preparation and maintenance	0.24
Type of job of female workers	Sucker management	0.20
	Chemical application	0.06
	Technical management including agronomy	0.02
	General management including administration and supervision	0.02

Standard deviations in parenthesis.

We measure women's empowerment through a number of indicators of the resources and agency domain of empowerment, which are based on the conceptual discussion in section 2. We assess (1) the total annual household income (in log) and (2) the female spouse's share of the household income to identify the contribution of female wages to generating financial resources for the household. We identify (3) the share of asset categories owned solely by the female spouse or

jointly by both male and female spouse. For this purpose, we consider a range of asset categories that are suitable in the Ghanaian context (motor vehicles, TV set, radio, fans, freezer, gas stove, kente cloth, bank account, small animals, and poultry). In addition to information on asset ownership, we also have information on who can decide to sell them. Based on this information, we calculate (4) the share of asset categories that female spouses are able to sell, either independently or together with the male spouse. To proxy for women's mobility (5) we include a dummy variable that equals one if the woman travels by herself to the capital city Accra. In addition, we measure the total distance (in km) the female spouse travels by herself to the market, health center, Accra, or her relatives. Finally, female spouse's reproductive workload (6) contains the sum of indoor chores (domestic chores such as food preparation, cleaning, washing clothes), outdoor chores (domestic chores such as fetching water, collecting firewood), and care activities (care activities for children, the elderly, the sick).

To represent the agency domain, we apply a scaling approach to identify the input to and influence on decision-making of the female spouse regarding (1) major household expenditures (large appliances for the house or building investments), (2) minor household expenditures (food for daily consumption or other household needs), (3) crops that are primarily grown for household food consumption, (4) crops that are grown primarily for sale in the market, (5) non-farm economic activities (such as small businesses, self-employment activities etc.), (6) wage and salary employment and (7) children's education and health. The scale ranges from 1="No input" to 4= "Input into all decisions in the respective category". Table 2 provides an overview of the variables measuring the resources and agency domain of women's empowerment.

Table 2 Description of variables measuring women's empowerment

Dependent variables	Variable type	Variable definition	Frequency (%)				Mean
HH Income	Continuous	Overall household yearly income in log, measured in GHS.					5869.69 (5759.72)
Female income share	Continuous	Share of the household income that the female spouse generates					29.33 (30.87)
Female asset ownership	Continuous	Share of asset categories (vehicles, TV set, radio, fans, freezer, gas stove, kente cloth, bank account, small animals, poultry) owned solely by the female spouse or jointly by both spouses					38.93 (40.14)
Female ability to sell assets	Continuous	Share of asset categories that female spouse can decide to sell					35.66 (36.37)
Farthest travel distance	Continuous	Distance that the female spouse travels by herself to the market, health center, Accra or her relatives, measured in km.					138.05 (91.30)
Accra capital city	Dummy	Female spouse travels to the capital city Accra alone					0.73 (0.44)
Female reproductive workload	Continuous	Female spouse's reproductive workload as the sum of indoor and outdoor chores and care activities for children or the elderly, measured in hours.					4.92 (2.61)
Female spouse's self-identified input into decision-making regarding:			1=No input	2=Input into some decisions	3=Input into most decisions	4=Input into all decisions	
…major HH expenditures	Categorical	The range of responses was from 1=No input to 4=Input into all decisions.	11.54	25.72	20.19	42.55	2.94 (1.07)
…minor HH expenditures	Categorical		3.81	22.62	19.29	54.29	3.24 (0.93)
…HH food crop production	Categorical		4.53	24.60	23.95	46.93	3.13 (0.94)
…HH cash crop production	Categorical		5.77	24.62	23.46	46.15	3.1 (0.97)
…HH non-farm activities	Categorical		7.12	23.44	26.41	43.03	3.05 (0.97)
…HH wage labor activities	Categorical		7.47	26.03	27.83	38.66	2.98 (0.97)
…kid's education & health	Categorical		1.72	16.75	26.11	55.42	0.82 (0.82)

Standard deviations in parenthesis.

4.2. Estimation strategy

To estimate the effect of female employment on horticultural plantations on female empowerment we estimate the following regression model:

(1) $$WE_i = \alpha_0 + \alpha_1 \text{FE}_i + \alpha_2 X_{hh} + \varepsilon_i$$

where (WE_i) is women's empowerment, FE_i is female wage employment, X_{hh} is a vector of other individual and household characteristics, the alphas α are parameters to be estimated and ε is a random error term. Women's empowerment (WE_i) is measured through various indicators as described in the previous section, and separate regressions are run for each indicator. For continuous outcome variables (household income, female income share, female asset ownership, female ability to sell assets, farthest travel distance, female reproductive workload), we use OLS estimation. For the binary outcome indicator (whether the female spouse travels alone to Accra) we apply Probit regressions. For categorical indicators on input into decision-making, which is measured via a rating with four levels, we estimate ordered Probit models. Two main explanatory variables FE_i are used, namely (1) a treatment dummy that takes a value of one if the female spouse is employed on a horticultural plantation and zero if otherwise and (2) a continuous variable of the years of female employment on horticultural plantations. We expect that a woman's empowerment increase with her length of employment. As this effect may level off at a certain point in time, we add an additional squared term of the years employed to address this. The control variables have been selected in accordance to previous literature on women's empowerment and include among others the education levels of the spouses, size and religion of the household, and the employment status of the male spouse.

Estimating the effect of female employment on horticultural plantations on female empowerment is not straightforward, because of potential problems of selection bias and reverse causality. In addition to empowerment being influenced by employment, the female spouse's choice in work activity may well be the outcome of her existing bargaining power (Basu, 2006). On the one hand, more empowered women may self-select into employment. It is possible that only those women with significant bargaining power can overcome household constraints and are sufficiently mobile to take up employment outside the household. On the other hand, less empowered women may self-select into employment with the ultimate aim to increase their bargaining power in the household. We aim to reduce this potential bias by including two proxy variables for initial empowerment of the female spouse in our vector of explanatory individual and household characteristics: the age gap between the spouses and the education gap between the spouses. To

further reduce potential bias we apply two approaches in addition to the unweighted regressions: (1) propensity score weighted regressions and (2) an entropy balancing method (Hainmueller, 2011).

For the first approach, we combine regression analysis with propensity score weighting. Using a vector of observed variables (*x*), we predict the probability of female employment using a Probit estimator in order to derive the propensity score:

(2) $$p(x) = \Pr\{T = 1|x\} = E\{T|x\}$$

The binary treatment variable is regressed on the same covariates that are also included as covariates in the outcome regression (equation (1)). In addition, we add agricultural land (in ha) as covariate expecting that women in households with low land endowments will be more likely to take up horticultural employment (see appendix table A.1). The region of common support is between 0.106 and 0.824, and the balancing properties are satisfied (see appendix figure A.1 and table A.2). Using the estimated propensity scores we reweight our data, and then estimate regression (1) as specified above.

For the second approach, we combine regression analysis with entropy balancing, a new technique that effectively balances the conditioning variables and improves the comparability between treatment and control groups. Entropy balancing reweights the control group observations on balancing requirements (same mean, variance, and skewness). Among the possible sets of weights that fulfill these requirements, entropy balancing chooses those that deviate as little as possible from uniform weights (Marcus, 2013; Hainmueller, 2011). The counterfactual mean is estimated as follows:

(3) $$E\big[Y(\widehat{O})|D = 1\big] = \frac{\Sigma_{\{i|D = 0\}}{}^{Y_i w_i}}{\Sigma_{\{i|D = 0\}}{}^{w_i}}$$

where every control group observation receives an entropy balancing weight w_i. These balancing weights are identified via a reweighting scheme that minimizes the entropy distance metric as described in Hainmueller (2011). In comparison to using propensity scores, which can lead to a decreased balance of some covariates, entropy balancing improves balance for all conditioning variables and is therefore more effective (Marcus, 2013). Again, we select the same conditioning variables for entropy balancing as for the control variables in the outcome regression, which are assumed to be unaffected by female employment. Conditioning variables before and after balancing are reported in appendix table A.3. We then use the entropy balanced data to estimate regression (1).

5. Results and discussion

5.1. Descriptive statistics

Table 3 provides an overview of household characteristics and a mean comparison between women employees and self-employed women. We see that overall there are only few differences between these two groups. They are comparable regarding household demographics in terms of age of the female and male spouses, their educational attainment, and the number of dependents. The literacy level of the male spouse is slightly lower for households with a woman employee. Similarities further exist regarding religious beliefs, with the only exception that households with women employees are more likely to be Pentecostal. Living conditions are also comparable across households, including access to improved sanitation (approx. 20%), clean drinking water (approx. 80%) and electricity (approx. 85%). Only about 10% of the households own a gas stove, which implies a high demand for firewood that women are responsible to collect. Distances to points of services (markets, health centers, schools) are comparable across the two groups to a certain degree. On average households with women employees live further away from health centers and closer to Accra than households with self-employed women. It is not surprising to see a large difference in terms of the ownership and usage of agricultural lands. Those households with women employees have significantly less land than the control group. This is in line with the hypothesis that particularly the landless and near landless self-select into horticultural wage employment.

Table 3 also provides an overview of the individual sources of income for the households, such as income from horticultural wage employment or self-employment (such as trading or business). Horticultural employment is the largest income source for households with a women employee. In some households (36%) both spouses are actually employed on the plantation. The most important income sources for households with self-employed women are also horticultural employment (of the male spouse), agricultural production and small-scale businesses.

Table 3 Descriptive statistics on individual and household characteristics

Variable	HH with woman employee (N = 153) Mean	HH with self-employed woman (N = 269) Mean
Male spouse is employed on horticultural plantation	0.36	0.43
Age of male spouse	40.16 (9.41)	40.12 (9.96)
Age of female spouse	35.50 (8.52)	34.52 (9.62)
Number of dependents	2.34 (1.58)	2.42 (1.64)
Male spouse has no schooling	0.15	0.11
Male spouse has primary schooling only	0.20	0.17
Male spouse has secondary schooling or higher	0.65	0.72
Literacy level of male spouse	0.61*	0.69
Female spouse has no schooling	0.30	0.27
Female spouse has primary schooling only	0.30	0.28
Female spouse has secondary schooling or higher	0.41	0.45
Literacy level of female spouse	0.39	0.41
Protestant	0.20	0.20
Pentecostal	0.66**	0.56
Catholic	0.07	0.07
Muslim	0.03	0.04
Access to improved sanitation	0.24	0.20
Access to clean drinking water	0.78	0.81
Electricity	0.86	0.84
Distance to market (km)	7.23 (6.90)	7.19 (6.77)
Distance to health center (km)	4.57*** (4.99)	3.11 (3.84)
Distance to primary school (km)	0.21 (0.65)	0.19 (0.57)
Distance to Accra capital city (km)	63.34*** (51.06)	79.66 (61.05)
Distance to pineapple plantation (km)	3.73 (3.52)	3.79 (3.64)
No. of HH asset categories	3.65 (2.18)	3.64 (2.11)
HH owns gas stove	0.10	0.11
Agricultural land (in acres)	1.12*** (1.35)	1.73 (1.79)
Total yearly income (GHS[1])	6559.73* (5902.34)	5477.21 (5650.52)
Total yearly income per adult equivalent [2] (GHS)	2329.03** (2518.33)	1858.30 (2249.01)
Horticultural wage labor income (GHS)	3082.52*** (1856.30)	1242.37 (1727.22)
Agricultural income (GHS)	1018.92 (4029.56)	1199.41 (3663.61)
Income from self-employment (GHS)	940.73*** (1958.51)	1809.59 (2950.83)
Other wage labor income (GHS)	885.18 (2771.61)	672.50 (2356.13)
Other income (e.g. gifts, remittances) (GHS)	79.77 (296.10)	125.25 (494.78)

Standard deviations in parenthesis, * (p<0.1), ** (p<0.05) and *** (p<0.01) for ttest of continuous variables and chi2 test for categorical variables

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[1] GHS = Ghanaian Cedi (Exchange rate: 1 GHS = 0.21 Euro cent on 15.June 2015 at the time of survey implementation)
[2] We apply the OECD adult equivalence scale that is weighted accordingly: value 1 for first household member, value 0.7 for each additional adult and value 0.5 for each child under the age of 18 years

Table 4 presents both indicators of resources and agency for empowerment. Regarding the resources domain, we observe that women employees generate an income, which is twice as high as that of self-employed women. While we report the mean here, the large standard deviation suggests that incomes may indeed vary substantially within the group of self-employed women. The high income of employed female spouses is also reflected in the high share contributed towards the household income, which is almost 50% in comparison to 16% among self-employed women. This substantial income contribution also translates into a higher overall household and per adult equivalent income. In terms of assets, women employees own more assets both in number and in household share than self-employed women. This is also true for the women's ability to sell assets. Regarding the mobility, the differences are less pronounced, but female horticultural workers are more likely to travel unaccompanied to Accra, the capital city of Ghana. Overall, they also travel longer distances to the market, health centers, Accra, and relatives. Women employees have a significantly lower reproductive workload than self-employed women. On average, female employees spend 1.08 less hours per day on indoor and outdoor chores as well as care activities. However, they also spend less time on personal activities, such as eating and personal hygiene, social activities with friends and neighbors and sleep. This is owed to their productive workload, including own farm production, horticultural employment, agricultural work off the own farm, and off-farm non-agricultural work. On average, women employees work 7.76 hours per day in comparison to self-employed women, who work 5.28 hours per day.

Ultimately, we are also interested in women's input into decision-making within the household as indicators of agency for women's empowerment. As can be seen in the bottom part of Table 4, female horticultural workers self-report to have more decision-making power in a number of categories, namely major household expenditures, household food and cash crop production as well as wage labor activities in the household. Female workers do not confirm increased decision-making regarding minor household expenditures, non-farm activities as well as their children's education and health.

Table 4 Descriptive statistics on women's empowerment indicators

	Variable	HH with woman employee (N = 153)					HH with self-employed woman (N = 269)				
		Frequency (%)				Mean	Frequency (%)				Mean
Indicators of resources for empowerment	Female yearly income in GHS					2420.47*** (1453.01)					1234.23 (3029.02)
	Female income share					48.45*** (27.14)					16.22 (40.58)
	Female asset ownership (number)					1.79** (1.53)					1.39 (1.91)
	Female asset ownership (share)					49.40*** (37.39)					32.97 (40.51)
	Female ability to sell assets (number)					1.67*** (1.69)					1.11 (1.50)
	Female ability to sell assets (share)					45.83*** (36.76)					29.86 (34.91)
	Female spouse travels alone to Accra					0.78*					0.70
	Farthest travel distance (km)					157.95*** (98.23)					126.73 (85.25)
Time spent by female spouse on…. (in hrs)	… reproductive activities					4.23***(2.16)					5.31 (2.76)
	… personal activities					2.00* (1.19)					2.22 (1.38)
	… own farm production					0.46*** (1.32)					1.89 (3.02)
	… pineapple plantation					7.15*** (3.03)					0
	… agricultural work off the own farm					0.03 (0.20)					0.07 (0.59)
	… off-farm non-agricultural work					0.12*** (0.86)					3.32 (4.04)
	… educational activities					0					0.03 (0.37)
	… indoor chores					2.61*** (1.28)					3.36 (2.03)
	… outdoor chores					0.81 (1.28)					0.99 (1.56)
	… care activities					0.81 (1.12)					0.96 (1.30)
	… shopping, use of services etc.					0.09 (0.45)					0.08 (0.43)
	… social activities					1.56*** (1.46)					2.42 (2.38)
	… sleeping					8.35* (1.30)					8.65 (1.69)
		1	2	3	4		1	2	3	4	
Indicators of agency for empowerment — Female spouse's input into decision-making regarding:	…major HH expenditures	6.58	27.63	19.08	46.71	3.06* (1.00)	14.39	24.62	20.83	40.15	2.87 (1.10)
	…minor HH expenditures	1.97	20.39	22.37	55.26	3.31 (0.86)	4.85	23.88	17.54	53.73	3.20 (0.97)
	…HH food crop production	4.95	12.87	25.74	56.44	3.34*** (0.89)	4.33	30.29	23.08	42.31	3.03 (0.95)
	…HH cash crop production	4.60	17.24	25.29	52.87	3.26* (0.91)	6.36	28.32	22.54	42.77	3.02 (0.99)
	…HH non-farm activities	5.93	19.49	30.51	44.07	3.13 (0.93)	7.76	25.57	24.20	42.47	3.01 (1.00)
	…HH wage labor activities	3.97	25.17	27.81	43.05	3.10* (0.91)	9.70	26.58	27.85	35.86	2.90 (1.00)
	…kid's education & health	2.03	14.86	27.03	56.08	3.37 (0.81)	1.55	17.83	25.58	55.04	3.34 (1.00)

Standard deviations in parenthesis, * (p<0.1), ** (p<0.05) and *** (p<0.01) for ttest of continuous variables, chi2 test for categorical variables and Wilcoxon-Mann-Whitney test for ordinal categorical variables.
Categories for input into decision-making: 1=No input, 2=Input into some decisions, 3=Input into most decisions, 4= Input into all decisions.

The main regression results (from unweighted regressions, propensity score weighting, and entropy balancing) on the indicators of resources and agency for women's empowerment are summarized in table 5 for the binary female employment variable, and in table 6 for the length of female employment. The three estimation approaches yield similar results in terms of direction, magnitude and significance of effects, which supports the robustness of our findings. We base our results discussion on the estimates of the entropy balancing approach as the most advanced method to reduce potential bias. The full regression results from entropy balancing regressions including all covariates are reported in appendix tables A.5 and A.7 (for indicators of resources for empowerment) and in appendix tables A.6 and A.8 (for indicators of agency for empowerment). The unweighted and propensity score weighted regression results are very similar and are not included in the appendix, but are available upon request.

Considering the indicators of resources for empowerment in table 5, regression results from the entropy balancing model reveal that female horticultural employment increases household income by 61%. Women employees contribute 30% more income to the household income than self-employed women. This shows the important role of paid employment for women's income contribution at the household level. Furthermore, women employed in the horticultural sector have better control over assets, such as motor vehicles, radios and TV sets. Women employees' share of household asset ownership increases by 19% and the share of household assets they can decide to sell increases by 13%. The mobility indicators suggest that women employees are 10% more likely to be able to travel independently, for example to the capital city of Ghana. Overall, employed women travel 30 km farther to the market, health centers or their relatives. They are also able to reduce their reproductive workload in the household, spending 1.26 hours less time on chores and care activities. Whether the female spouse achieves this by higher efficiency, lower performance, or the husband or a child taking over these tasks remains an open question that cannot be answered with our data set. The full regression results (appendix table A.5) show that besides female employment other factors influence women's empowerment as expected. This includes the male employment status, education of both spouses and overall connectivity of the household to the market and other amenities.

Regarding agency for empowerment, table 5 also presents results on women's input into decision-making within the household. We find female employment to have a positive effect on input into decision-making in the majority of categories. Women employees can better influence decisions regarding major expenditures, household food and cash crop production as well as wage labor

activities. Results for decisions on minor expenditures of the household are not as clear but rather vary across the models. Higher female decision-making power regarding agricultural production may be due to trainings that women receive on plantations. The ability to apply the training content to the personal farm setting may be highly valued by the male spouse. Furthermore, female workers may use some of their wage labor income to purchase farm inputs, such as fertilizer, leading to more decision-making power over household agricultural plots. Female employment does not increase input into decision-making regarding non-farm activities and kid's education and health. Regarding choices for their children, all women seem to have a say in that. Within our sample, 82% of all women confirm that they either have input into most or all decisions made on their children's health or education. We conclude that power in one area of decision-making does not necessarily translate into more power in another area. These decision areas may indeed be quite distinct from each other and be bargained over individually. This may depend of the importance the household attributes to the individual area. We also calculate the marginal effects for our outcome variables of input into decision-making (appendix table A.4). We find that our positive results are largely driven by female employment leading to a higher probability of input into all decisions in the respective category - rather than input into most, some or no decisions. The full regression results (appendix table A.6) indicate that cultural (religion, regional differentiation) and demographic (age gap) patterns play an important role for determining indicators of agency for empowerment as well.

Table 6 presents the results of the unweighted, entropy balanced, and propensity score weighted regressions with the length of employment in years and years squared as explanatory variables of interest. We can see that women's empowerment increases with the number of years a woman is employed in the horticultural sector. This applies to all indicators, both for the resources and agency domain. The longer the woman has been employed on a pineapple plantation, the higher the household income and the more the female worker contributes to this income. Also, her asset ownership increases with the length of employment. The reason behind this could be that women, who have been employed for longer, receive higher wages due to more experience, or take over more responsible jobs that are better paid. From the squared years of employment we see that the relationship between employment and empowerment has a concave shape. Based on the negative coefficients, it can be seen that the correlation with income and assets eventually levels off and starts decreasing after approximately eight to nine years of employment. This pattern holds for all variables except for women's reproductive workload. With longer employment periods, women are able to progressively reduce their reproductive workload, until reaching a turning point at 1.56 hours of workload reduction after eight to nine years of employment. Thus, women seem to be able to reduce their childcare and household chore responsibilities to some extent as a result of increased empowerment and autonomy. Yet, as discussed above, our results do not allow deriving conclusions

on who is taking over these responsibilities instead. Regarding agency for empowerment, we can also see that input into decision-making increases with years of employment up to a certain point, after which it starts to level off and slightly decrease again.

Table 5 Overview of the regression results estimating the effect of female employment (binary variable) on empowerment indicators

Outcome variable	Unweighted regression#	Propensity score weighting#	Entropy balancing#
HH Income	0.583***	0.624***	0.610***
	(0.164)	(0.141)	(0.193)
Female income share	32.18***	28.87***	29.57***
	(3.885)	(3.011)	(3.077)
Female asset ownership	17.23***	17.54***	19.06***
	(4.390)	(4.338)	(4.484)
Female ability to sell assets	13.29***	10.09**	13.23***
	(3.832)	(4.204)	(4.142)
Farthest travel distance	35.88***	33.53***	30.13***
	(9.544)	(10.481)	(10.62)
Accra capital city	0.119***	0.113**	0.097**
	(0.045)	(0.048)	(0.048)
Female reproductive workload	-1.183***	-1.314***	-1.263***
	(0.261)	(0.284)	(0.281)
Female input into decision-making…			
…major HH expenditures	0.305**	0.339***	0.293**
	(0.122)	(0.129)	(0.131)
…minor HH expenditures	0.251**	0.261*	0.203
	(0.126)	(0.135)	(0.138)
…HH food crop production	0.613***	0.678***	0.670***
	(0.154)	(0.161)	(0.165)
…HH cash crop production	0.469***	0.474***	0.524***
	(0.163)	(0.165)	(0.165)
…HH non-farm activities	0.184	0.231	0.294**
	(0.135)	(0.142)	(0.144)
…HH wage labor activities	0.336***	0.366***	0.382***
	(0.124)	(0.132)	(0.138)
…kid's education and health	0.156	0.132	0.202
	(0.129)	(0.136)	(0.139)

Standard errors in parenthesis. Significant effects are indicated with * (p<0.1), ** (p<0.05) and *** (p<0.01)
Depending on the type of dependent variable, we use OLS, Probit or Ordered Probit regressions

Table 6 Overview of the regression results estimating the effect of female employment (length of employment) on empowerment indicators

Outcome variable	Unweighted regression[#]		Propensity score weighting[#]		Entropy balancing[#]	
	Years	Years squared	Years	Years squared	Years	Years squared
HH Income	0.157**	-0.009	0.161***	-0.010***	0.138***	-0.008**
	(0.066)	(0.006)	(0.047)	(0.004)	(0.048)	(0.004)
Female income share	9.424***	-0.529***	9.035***	-0.487***	8.902***	-0.487***
	(1.563)	(0.140)	(1.405)	(0.137)	(1.259)	(0.115)
Female asset ownership	5.170***	-0.354**	4.313**	-0.264	5.165***	-0.355**
	(1.765)	(0.157)	(1.804)	(0.167)	(1.629)	(0.140)
Female ability to sell assets	2.883*	-0.136	1.628	-0.052	1.746	-0.067
	(1.539)	(0.137)	(1.675)	(0.134)	(1.691)	(0.137)
Farthest travel distance	9.258**	-0.558	7.170*	-0.464	7.712*	-0.504
	(3.815)	(0.343)	(4.307)	(0.382)	(4.066)	(0.365)
Accra capital city	0.035*	-0.001	0.029	-0.001	0.030	-0.001
	(0.019)	(0.002)	(0.019)	(0.002)	(0.018)	(0.002)
Female reproductive workload	-0.367***	0.020**	-0.377***	0.022***	-0.354***	0.020***
	(0.104)	(0.009)	(0.095)	(0.008)	(0.089)	(0.007)
Female input into decision-making regarding….						
…major HH expenditures	0.132***	-0.009**	0.147***	-0.010***	0.112**	-0.008**
	(0.047)	(0.004)	(0.046)	(0.004)	(0.047)	(0.004)
…minor HH expenditures	0.098**	-0.008*	0.113**	-0.009**	0.071	-0.006
	(0.049)	(0.004)	(0.051)	(0.004)	(0.051)	(0.005)
…HH food crop production	0.216***	-0.015***	0.245***	-0.017***	0.212***	-0.014***
	(0.058)	(0.005)	(0.054)	(0.004)	(0.056)	(0.004)
…HH cash crop production	0.161***	-0.012**	0.156***	-0.011***	0.151***	-0.010***
	(0.060)	(0.005)	(0.057)	(0.004)	(0.057)	(0.004)
…HH non-farm activities	0.075	-0.006	0.092*	-0.006	0.068	-0.005
	(0.052)	(0.004)	(0.049)	(0.004)	(0.052)	(0.004)
…HH wage labor activities	0.120**	-0.008**	0.133***	-0.010**	0.112**	-0.008*
	(0.048)	(0.004)	(0.051)	(0.004)	(0.052)	(0.005)
…kid's education and health	0.068	-0.006	0.089	-0.008	0.070	-0.006
	(0.049)	(0.004)	(0.047)	(0.004)	(0.049)	(0.004)

Standard errors in parenthesis. Significant effects are indicated with * ($p<0.1$), ** ($p<0.05$) and *** ($p<0.01$) # Depending on the type of dependent variable, we use OLS, Probit or Ordered Probit regressions

6. Discussion

Our findings show that female agricultural employment in modern agri-food systems can contribute to women's empowerment in the domains of resources and agency and that this empowerment increases with the length of employment. Positive effects are found for economic resources (household income, female share of household income, asset ownership and ability to sell assets) and human resources (mobility and time). Particularly the generation of a substantial and stable income has implications for women's role in the household. Female workers' contribution to the overall household income is 30% higher than in households where the woman is either involved in agricultural production or self-employed. Such opportunities for income generation are particularly relevant in rural areas, where women have few choices of being employed. The Ghana

Living Standard Survey 6 confirms that the female participation rate in the formal economy is very low: 11.7% in comparison to 29.5% of men are engaged in wage employment (Ghana Statistical Service, 2015). In rural areas, only 4.5% of women (vs. 12.9% of men) are employed in private companies, public and non-profit organizations (Ghana Statistical Service, 2015). Instead, women are often engaged in unpaid family labor and in small-scale businesses (FAO, 2012), which do not necessarily contribute to empowerment. Malapit and Quisumbing (2015) point out that while women in northern Ghana are engaged in household agricultural production, they hardly control assets or decide over agricultural activities. Inefficient and unproductive economics activities, like small businesses or trading, often do not generate an income either large or stable enough to bring about change in household's gender relations. For example, Anderson and Eswaran (2009) find that only employment outside of the husband's farm and not employment in general leads to women's greater autonomy.

Moreover, our findings confirm that increased empowerment in the resources domain also leads to empowerment in the agency domain. Female horticultural workers report higher levels of input into decision-making for the majority of the selected areas. In Ghana, traditionally male spouses are in charge of household decision-making as they are the ones generating the major income for the household. Dako-Gyeke and Owusu (2013) report the view of a small-scale farmer in Ghana: " . . . *as a man, I work and bring in all the money, I am in charge of the household decision making . . .women just play a minor role. For instance, if there is an issue you can choose to inform the woman or not, but the man is the one who plays an active role by taking care of the woman, family and even the woman's extended family"*. Against the background of the traditional role setting of Ghanaian households, our results are promising for female empowerment.

Based on our findings for the two dimensions of resources and agency, we can confirm that both dimensions are linked to each other. Not only does agricultural employment increase women's access to resources of income, time, and mobility, but also women's feeling of higher bargaining power and voice in the household. This supports Kabeer's (1999) conceptualization of women's empowerment within the framework of the non-unitary household model (see section 2). The household bargaining model stipulates that individual preferences lead to bargaining over resource allocation and expenditure patterns. The empowerment of women is therefore reflected in the access to economic and human resources. In our case of female horticultural employees, these resources are related but not restricted to higher incomes generated by women. Women employees receive company trainings, which may be useful for the household's agricultural production. Women may further be exposed to different ways of thinking related to gender perceptions. Labor unions

enable women to learn about rights and representation, which can be utilized in different spheres of living outside of company grounds.

Our findings are also in line with those of other studies that assess the ramifications of modern supply chains that rely on gendered structures for agricultural production and processing. For example, studies in the Kenyan cut-flower and tea as well as the Senegalese tomato industry find that female workers perceive their decision-making power to be greater (Maertens and Swinnen, 2012; Said-Allsopp and Tallontire, 2015). We confirm that these perceptions of greater autonomy are also reflected in improved access to resources. Our findings on time resources connected to reproductive workload support those of Newman (2002) who provides evidence that due to female employment on flower farms, their male spouses take over more household responsibilities in Ecuador. Whether female workers are always able to utilize their resources according to their choices may depend on different regional settings and expectations towards women. Friedemann-Sanchez (2006), for instance, concludes that female flower workers in Colombia have greater constraints in buying assets or property in comparison to male flower workers even though their wages are basically equal.

7. Conclusion

We conclude that large-scale, export-oriented horticultural plantations can contribute to women's empowerment through employment creation. We differentiate between two different domains of empowerment: resources and agency (Kabeer, 1999). By doing so, we link the analysis to a conceptual framework of women's empowerment that assumes a non-unitary household bargaining model. Our findings show positive effects of horticultural employment on resources indicators including household income, female contribution to the household income, asset ownership, ability to sell assets and female mobility. Further, the time spent on chores and care activities is significantly reduced for female workers. Better access to economic and human resources also translates into an increased input into household decision-making. We find that women employees have more say regarding major expenditures, household food and cash crop production as well as wage labor activities.

With this study we add to the scarce empirical literature on gender effects of modern agri-food systems. We corroborate earlier derived conclusions on higher perceived self-reliance and autonomy by assessing additional agency indicators of empowerment. We contribute by expanding the analysis to more resources-based indicators. However, we recognize the shortcomings of our study. As we use a cross-sectional data set for our analysis, we cannot fully rule out selection bias. We aim to reduce such bias through econometric techniques, particularly the innovative entropy

balancing approach that improves the balance of covariate distribution. However, panel data evidence would help to fully disentangle causal relationships of employment and empowerment.

Ultimately, the results of our study emphasize that employment effects are important to consider when analysing the implications of modernization of agriculture and increased high-value exports. Employment opportunities for income generation and empowerment should be reflected in the context of pro-poor development strategies.

Appendix

Table A.1 Propensity score for female employment

Variable	Propensity score
Male spouse is employed	-0.322** (0.141)
Age gap	-0.011 (0.010)
Female spouse age	0.010 (0.008)
Dependency ratio	0.0001 (0.001)
Education gap between spouses	-0.003 (0.021)
Female spouse is literate	0.068 (0.181)
Male spouse is literate	-0.298 (0.180)
Pentecostal	0.375** (0.170)
Catholic	0.441 (0.303)
Muslim	-0.121 (0.395)
Traditionalist	-0.415 (0.311)
Distance to market	-0.031** (0.012)
Distance to health center	0.050** (0.021)
Distance to Accra	0.001 (0.005)
Total agricultural land	-0.168*** (0.043)
Greater Accra	0.302 (0.205)
Eastern Region	0.293 (0.258)
Volta Region	-0.218 (0.696)
Constant	-0.364 (0.435)

Standard errors in parenthesis.
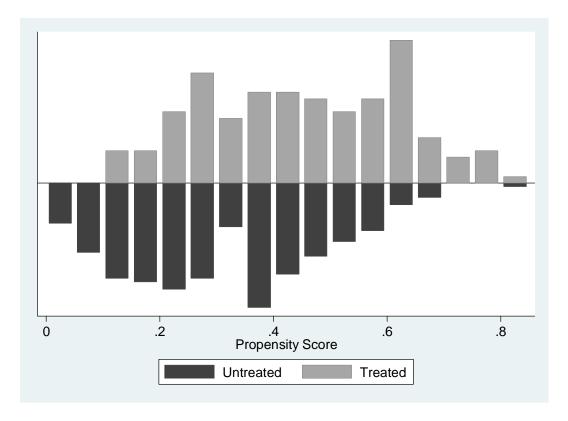Significant effects are indicated with * ($p<0.1$), ** ($p<0.05$) and *** ($p<0.01$)

Figure A. 1 Propensity score overlap treatment and control group

Table A.2 Overview of Propensity Score Balancing Properties

	Treatment and Control	N	Propensity Score Mean
Block 1	HH with women employee	10	0.155 (0.030)
	HH with self-employed woman	53	0.155 (0.026)
Block 2	HH with women employee	52	0.302 (0.057)
	HH with self-employed woman	101	0.300 (0.063)
Block 3	HH with women employee	51	0.487 (0.059)
	HH with self-employed woman	74	0.496 (0.059)
Block 4	HH with women employee	38	0.662 (0.060)
	HH with self-employed woman	10	0.644 (0.029)
Block 5	HH with women employee	1	0.824
	HH with self-employed woman	1	0.814

Standard deviations in parenthesis, * (p<0.1), ** (p<0.05) and *** (p<0.01) for ttest of continuous variable

Table A.3 Overview of conditioning variables before and after entropy balancing

Before weighting	Treat			Control			After weighting		
	Mean	Variance	Skewness	Mean	Variance	Skewness	Mean	Variance	Skewness
Male spouse is employed	0.3553	0.2306	0.6048	0.4349	0.2467	0.2625	0.356	0.2301	0.6016
Age gap	4.678	22.94	0.7495	5.602	35.72	1.277	4.675	22.92	0.7518
Female spouse age	35.51	73.09	.4808	34.52	92.58	.6218	35.49	73.04	0.4879
Dependency ratio	101.3	4723	0.8049	10.5.4	5597	0.7831	101-3	4721	0.8076
Education gap between spouses	2.013	17.73	0.5262	2.297	14.58	0.2602	2.012	17.73	0.5271
Female spouse is literate	0.3882	0.2391	0.459	0.4126	0.2433	0.3549	0.3888	0.2385	0.4564
Male spouse is literate	0.6118	0.2391	-0.459	0.6914	0.2141	-0.829	0.6112	0.2385	-0.4561
Catholic	0.07237	0.06758	3.301	0.06691	0.06267	3.466	0.07248	0.06748	3.298
Pentecostal	0.6645	0.2244	-0.6967	0.5576	0.2476	-0.232	0.6637	0.224	-0.6929
Muslim	0.02632	0.02579	5.918	0.04089	0.03937	4.637	0.02636	0.02576	5.913
Traditionalist	0.03947	0.03817	4.73	0.1041	0.0936	2.593	0.03954	0.03812	4.726
Distance to market	7.229	47.86	1.183	7.195	45.83	1.236	7.225	47.83	1.185
Distance to health center	4.53	24.82	0.8783	3.108	14.71	1.305	4.527	24.81	0.8801
Distance to Accra	63.5	2621	1.695	79.66	3727	0.896	63.46	2620	1.698
Eastern Region	0.1053	0.09481	2.572	0.08922	0.08156	2.882	0.1056	0.09479	2.567
Central Region	0.2039	0.1634	1.469	0.2416	0.1839	1.207	0.2046	0.1634	1.464
Volta Region	0.1711	0.1427	1.747	0.3086	0.2141	0.829	0.1716	0.1427	1.742

Table A.4 Overview of the marginal effects estimating the effect of female employment (binary variable) on input into decision-making

Outcome variable	Unweighted regression[#]	Propensity score weighting[#]	Entropy balancing[#]
Female input into decision-making…			
…input into **all major HH expenditures**	0.112** (0.044)	0.120*** (0.045)	0.105** (0.046)
…input into most major HH expenditures	-0.004 (0.003)	-0.003 (0.004)	-0.004 (0.004)
…input into some major HH expenditures	-0.052** (0.021)	-0.057*** (0.021)	-0.049** (0.021)
…input into no major HH expenditures	-0.056** (0.023)	-0.060** (0.024)	-0.052** (0.024)
…input into **all minor HH expenditures**	0.094** (0.047)	0.096* (0.049)	0.074 (0.050)
…input into most minor HH expenditures	-0.016* (0.008)	-0.016* (0.008)	-0.012 (0.008)
…input into some minor HH expenditures	-0.058** (0.029)	-0.056* (0.029)	-0.046 (0.030)
…input into no minor HH expenditures	-0.019* (0.010)	-0.023* (0.013)	-0.016 (0.012)
…input into **all decisions on HH food crop production**	0.222*** (0.052)	0.232*** (0.051)	0.230*** (0.051)
…input into most decisions on HH food crop production	-0.030*** (0.011)	-0.031*** (0.011)	-0.031** (0.012)
…input into some decisions on HH food crop production	-0.141*** (0.035)	-0.143*** (0.036)	-0.141*** (0.035)
…input into no decisions on HH food crop production	-0.051*** (0.017)	-0.058*** (0.017)	-0.058*** (0.020)
…input into **all decisions on HH cash crop production**	0.172*** (0.058)	0.167*** (0.056)	0.178*** (0.053)
…input into most decisions on HH cash crop production	-0.019** (0.010)	-0.015* (0.009)	-0.017* (0.010)
…input into some decisions on HH cash crop production	-0.104*** (0.036)	-0.109*** (0.039)	-0.111*** (0.035)
…input into no decisions on HH cash crop production	-0.048** (0.019)	-0.042** (0.017)	-0.050*** (0.019)
…input into **all decisions on HH non-farm activities**	0.069 (0.050)	0.083 (0.051)	0.104** (0.050)
…input into most decisions on HH non-farm activities	-0.007 (0.006)	-0.007 (0.006)	-0.006 (0.006)
…input into some decisions on HH non-farm activities	-0.038 (0.028)	-0.049 (0.030)	-0.060** (0.029)
…input into no decisions on HH non-farm activities	-0.024 (0.018)	-0.027 (0.017)	-0.039* (0.020)
…input into **all decisions on HH wage labor activities**	0.121*** (0.044)	0.126*** (0.045)	0.131*** (0.045)
…input into most decisions on HH wage labor activities	-0.006 (0.005)	-0.001 (0.006)	-0.001 (0.006)
…input into some decisions on HH wage labor activities	-0.070*** (0.026)	-0.073*** (0.026)	-0.078*** (0.026)
…input into no decisions on HH wage labor activities	-0.045** (0.018)	-0.052** (0.020)	-0.053** (0.022)
…input into **all decisions on kid's education and health**	0.058 (0.048)	0.048 (0.050)	0.073 (0.050)
…input into most decisions on kid's education and health	-0.019 (0.016)	-0.015 (0.015)	-0.021 (0.015)
…input into some decisions on kid's education and health	-0.033 (0.027)	-0.027 (0.028)	-0.041 (0.028)
…input into no decisions on kid's education and health	-0.006 (0.006)	-0.006 (0.007)	-0.011 (0.008)

Table A.5 Regression results for measures of women's empowerment (resources) after entropy balancing with dummy for female employment

Variable	HH Income	Female income share	Female asset ownership	Female ability to sell assets	Farthest travel distance	Accra capital city	Female reproductive workload
	OLS	OLS	OLS	OLS	OLS	Probit	OLS
Woman employee	0.610***	29.57***	19.06***	13.23***	30.13***	0.317**	-1.263***
	(0.193)	(3.077)	(4.484)	(4.142)	(10.62)	(0.159)	(0.281)
Male spouse is employed	0.373**	-9.158***	-0.880	-18.24***	6.221	0.362**	0.778**
	(0.167)	(2.900)	(4.962)	(4.250)	(11.59)	(0.180)	(0.320)
Age gap	0.028	0.100	0.0004	-0.856*	-0.358	-0.007	0.060*
	(0.017)	(0.353)	(0.472)	(0.464)	(1.051)	(0.016)	(0.034)
Female spouse age	0.014	0.0368	-0.108	-0.006	0.648	-0.009	-0.033*
	(0.009)	(0.193)	(0.244)	(0.230)	(0.605)	(0.009)	(0.017)
Dependency ratio	-0.001	0.0102	0.087***	0.064**	0.068	-0.001	0.0004
	(0.001)	(0.0233)	(0.031)	(0.030)	(0.079)	(0.001)	(0.002)
Education gap between spouses	0.021	-0.0654	-0.108	-0.205	-1.774	-0.039*	-0.035
	(0.028)	(0.466)	(0.698)	(0.592)	(1.662)	(0.023)	(0.040)
Female spouse is literate	0.193	-2.572	0.480	-3.491	-1.466	-0.022	-0.693**
	(0.309)	(4.529)	(5.407)	(5.277)	(15.41)	(0.226)	(0.301)
Male spouse is literate	0.234	0.174	5.578	7.065	9.614	0.323	0.419
	(0.178)	(4.105)	(5.927)	(5.489)	(15.25)	(0.217)	(0.356)
Pentecostal	-0.021	12.30	-3.121	6.407	14.74	-0.146	-1.061**
	(0.350)	(8.481)	(9.428)	(8.301)	(25.67)	(0.358)	(0.531)
Catholic	0.387*	-5.790	-5.817	0.903	4.890	0.141	-0.589
	(0.234)	(4.076)	(5.789)	(5.206)	(15.62)	(0.200)	(0.382)
Muslim	0.482	-8.606	-3.583	-14.71*	-3.471	0.396	-1.991***
	(0.298)	(6.551)	(13.54)	(8.492)	(20.09)	(0.425)	(0.675)
Traditionalist	0.024	-7.461	3.154	15.89	-6.515	0.132	-0.122
	(0.529)	(7.208)	(11.33)	(10.06)	(30.41)	(0.390)	(1.014)
Distance to market	-0.053**	-0.296	0.336	-0.208	1.977**	0.009	-0.027
	(0.023)	(0.280)	(0.446)	(0.437)	(0.917)	(0.016)	(0.027)
Distance to health center	0.002	0.434	-0.025	-0.930*	-0.619	0.006	-0.033
	(0.028)	(0.609)	(0.629)	(0.563)	(1.627)	(0.024)	(0.037)
Distance to Accra	-0.001	-0.0422	-0.112	0.026	0.240	0.004	-0.0078
	(0.008)	(0.117)	(0.167)	(0.167)	(0.405)	(0.006)	(0.010)
Eastern Region	0.053	8.342	21.13***	-5.644	-30.09*	-0.053	-1.789***
	(0.266)	(6.314)	(8.115)	(6.930)	(18.18)	(0.292)	(0.390)
Central Region	-0.249	7.477	-2.489	-16.18***	-8.633	0.055	-1.545***
	(0.204)	(5.473)	(7.271)	(5.817)	(15.46)	(0.235)	(0.394)
Volta Region	-0.329	10.29	15.56	-15.96	-13.12	-0.255	-0.348
	(1.014)	(16.97)	(22.01)	(22.37)	(54.05)	(0.789)	(1.194)
Constant	7.269***	22.57**	26.80	43.33***	73.04*	0.317	8.050***
	(0.589)	(11.42)	(16.41)	(14.78)	(39.64)	(0.605)	(0.910)
Observations	421	421	390	390	421	421	421
R-squared	0.146	0.284	0.123	0.164	0.075		0.207

Standard errors in parenthesis. Significant effects are indicated with * (p<0.1), ** (p<0.05) and *** (p<0.01)

Table A.6 Regression results for measures of women's empowerment (agency) after entropy balancing with dummy for female employment

Variable	Female input into decision-making regarding…						
	…major expenditures	…minor expenditures	…food crop production	…cash crop production	… non farm activities	… wage labor activities	…kid's education and health
	Ordered Probit						
Woman employee	0.293**	0.203	0.670***	0.524***	0.294**	0.382***	0.267
	(0.131)	(0.138)	(0.165)	(0.165)	(0.144)	(0.138)	(0.177)
Male spouse is employed	0.166	0.112	0.022	0.052	0.196	-0.132	0.293
	(0.139)	(0.147)	(0.172)	(0.183)	(0.156)	(0.156)	(0.186)
Age gap	0.017	0.037**	0.049***	0.049***	0.015	0.009	0.053***
	(0.014)	(0.015)	(0.014)	(0.016)	(0.015)	(0.013)	(0.020)
Female spouse age	-0.001	-0.001	-0.007	-0.007	-0.014	-0.006	-0.002
	(0.008)	(0.008)	(0.009)	(0.010)	(0.009)	(0.009)	(0.011)
Dependency ratio	-0.0004	-0.0004	0.001	-0.001	-0.001	-0.001	0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education gap between spouses	-0.016	-0.024	0.015	-0.030	-0.037*	-0.015	-0.003
	(0.020)	(0.021)	(0.026)	(0.030)	(0.021)	(0.021)	(0.0275)
Female spouse is literate	-0.052	-0.283	-0.122	-0.334	-0.288	-0.101	0.063
	(0.184)	(0.211)	(0.243)	(0.266)	(0.212)	(0.196)	(0.247)
Male spouse is literate	-0.218	-0.016	-0.121	0.066	0.139	-0.036	-0.271
	(0.182)	(0.202)	(0.208)	(0.228)	(0.184)	(0.181)	(0.236)
Pentecostal	1.007***	0.759**	0.814**	1.168***	0.886***	0.358	2.108***
	(0.305)	(0.328)	(0.388)	(0.379)	(0.321)	(0.337)	(0.452)
Catholic	0.023	-0.077	-0.242	-0.031	-0.305	-0.252	0.294
	(0.166)	(0.177)	(0.213)	(0.211)	(0.189)	(0.170)	(0.219)
Muslim	-0.343	-0.076	-0.556*	-0.277	-0.007	0.045	0.699
	(0.270)	(0.338)	(0.300)	(0.332)	(0.407)	(0.316)	(0.495)
Traditionalist	0.665*	0.551*	0.301	0.481	0.331	0.926***	-0.100
	(0.344)	(0.281)	(0.344)	(0.340)	(0.344)	(0.309)	(0.424)
Distance to market	0.005	0.005	0.020	0.021	0.002	0.003	0.031
	(0.011)	(0.013)	(0.014)	(0.016)	(0.014)	(0.013)	(0.019)
Distance to health center	-0.038*	-0.021	-0.019	-0.037*	-0.006	-0.019	-0.016
	(0.020)	(0.020)	(0.022)	(0.021)	(0.023)	(0.021)	(0.025)
Distance to Accra	-0.003	0.001	-0.006	-0.008	0.004	0.003	0.001
	(0.005)	(0.005)	(0.006)	(0.007)	(0.006)	(0.005)	(0.007)
Eastern Region	-0.055	0.096	0.051	0.0001	0.022	0.087	0.231
	(0.220)	(0.226)	(0.302)	(0.321)	(0.260)	(0.240)	(0.312)
Central Region	0.436**	0.555***	0.589***	0.474**	0.363*	0.577***	0.629**
	(0.213)	(0.210)	(0.217)	(0.235)	(0.215)	(0.210)	(0.256)
Volta Region	0.292	0.191	1.347	1.571*	-0.230	0.075	0.286
	(0.693)	(0.682)	(0.849)	(0.927)	(0.839)	(0.714)	(0.905)
Constant	-1.342***	-1.663***	-1.705***	-1.923***	-1.806***	-1.583***	0.074
	(0.486)	(0.544)	(0.525)	(0.627)	(0.590)	(0.473)	(0.728)
	-0.394	-0.444	-0.425	-0.639	-0.730	-0.470	
	(0.474)	(0.515)	(0.537)	(0.627)	(0.580)	(0.468)	
	0.162	0.119	0.334	0.068	0.008	0.298	
	(0.475)	(0.517)	(0.533)	(0.631)	(0.578)	(0.467)	
Observations	415	419	308	259	336	387	405

Standard errors in parenthesis. Significant effects are indicated with * (p<0.1), ** (p<0.05) and *** (p<0.01)

Table A.7 Regression results for measures of women's empowerment (resources) after entropy balancing with continuous variable for length of employment

Variable	HH Income	Female income share	Female asset ownership	Female ability to sell assets	Farthest travel distance	Accra capital city	Female reproductive workload
	OLS	OLS	OLS	OLS	OLS	Probit	OLS
Years of female employment	0.138***	8.902***	5.165***	1.746	7.712*	0.110*	-0.354***
	(0.048)	(1.259)	(1.629)	(1.691)	(4.066)	(0.060)	(0.089)
Years of female employment - squared	-0.008**	-0.487***	-0.355**	-0.067	-0.504	-0.005	0.020***
	(0.004)	(0.115)	(0.140)	(0.137)	(0.365)	(0.005)	(0.007)
Male spouse is employed	0.241**	-8.519***	-2.857	-19.98***	-9.993	0.332*	0.849***
	(0.119)	(3.291)	(4.595)	(4.260)	(10.85)	(0.170)	(0.274)
Age gap	0.010	0.146	-0.073	-0.675	0.852	0.005	0.039
	(0.013)	(0.360)	(0.448)	(0.438)	(0.977)	(0.015)	(0.028)
Female spouse age	0.013	-0.166	-0.046	-0.078	0.774	-0.012	-0.032**
	(0.009)	(0.320)	(0.246)	(0.227)	(0.573)	(0.009)	(0.016)
Dependency ratio	-0.001	0.015	0.070**	0.056*	-0.017	-0.002	-0.002
	(0.001)	(0.026)	(0.029)	(0.032)	(0.079)	(0.001)	(0.002)
Education gap between spouses	0.040*	0.884	0.112	-0.560	-1.555	-0.042*	-0.034
	(0.022)	(0.763)	(0.608)	(0.645)	(1.695)	(0.022)	(0.042)
Female spouse is literate	0.442**	3.481	0.405	-5.752	10.89	0.173	-0.641**
	(0.183)	(7.270)	(5.290)	(5.311)	(14.67)	(0.218)	(0.308)
Male spouse is literate	0.237	-4.721	3.645	5.531	12.82	0.251	0.593*
	(0.174)	(6.667)	(5.706)	(5.729)	(13.89)	(0.197)	(0.326)
Pentecostal	-0.697	-7.823	2.837	19.61**	-4.597	-0.287	-0.550
	(0.670)	(15.39)	(8.079)	(9.517)	(23.55)	(0.344)	(0.608)
Catholic	0.415**	-8.352**	-3.549	4.953	-7.548	0.084	-0.415
	(0.209)	(4.234)	(5.688)	(4.989)	(14.78)	(0.193)	(0.346)
Muslim	0.498*	-16.01**	-0.761	-7.733	2.038	0.630	-1.545**
	(0.258)	(8.140)	(13.41)	(9.960)	(23.97)	(0.479)	(0.677)
Traditionalist	0.118	-7.472	10.87	18.67*	-9.441	0.140	0.223
	(0.495)	(5.972)	(11.41)	(10.83)	(25.81)	(0.373)	(0.967)
Distance to market	-0.046***	-0.226	-0.260	-0.213	2.549**	0.011	-0.007
	(0.016)	(0.260)	(0.386)	(0.386)	(1.043)	(0.015)	(0.022)
Distance to health center	0.019	0.219	0.900	-0.053	-2.723*	-0.026	-0.059
	(0.021)	(0.435)	(0.625)	(0.641)	(1.560)	(0.025)	(0.036)
Distance to Accra	0.008	-0.014	-0.124	-0.025	0.752**	0.006	-0.004
	(0.005)	(0.132)	(0.148)	(0.154)	(0.367)	(0.006)	(0.008)
Eastern Region	0.135	14.12**	18.13**	3.483	-35.02*	-0.303	-1.879***
	(0.263)	(5.468)	(8.098)	(7.573)	(21.15)	(0.288)	(0.417)
Central Region	-0.017	12.48***	2.393	-11.69*	-12.43	-0.027	-1.746***
	(0.204)	(4.821)	(7.048)	(7.087)	(14.18)	(0.245)	(0.400)
Volta Region	-0.983	9.172	18.61	-4.265	-97.52**	-0.814	-1.083
	(0.655)	(15.74)	(19.64)	(20.57)	(47.07)	(0.722)	(1.087)
Constant	6.741***	29.11*	29.35*	45.57***	72.75*	0.590	7.779***
	(0.611)	(16.08)	(16.38)	(15.13)	(37.25)	(0.575)	(0.874)
Observations	420	420	389	389	420	420	420
R-squared	0.166	0.173	0.087	0.145	0.086		0.176

Standard errors in parenthesis. Significant effects are indicated with * (p<0.1), ** (p<0.05) and *** (p<0.01)

Table A.8 Regression results for measures of women's empowerment (agency) after entropy balancing with continuous variable for length of employment

Variable	Female input into decision-making regarding…						
	…major expenditures	…minor expenditures	…food crop production	…cash crop production	… non farm activities	… wage labor activities	…kid's education and health
	Ordered Probit						
Years of female employment	0.112**	0.071	0.212***	0.151***	0.068	0.112**	0.070
	(0.047)	(0.051)	(0.056)	(0.057)	(0.052)	(0.052)	(0.064)
Years of female employment - squared	-0.008**	-0.006	-0.014***	-0.010***	-0.005	-0.008*	-0.005
	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Male spouse is employed	0.094	0.029	-0.177	-0.135	0.237	-0.108	0.190
	(0.132)	(0.137)	(0.173)	(0.186)	(0.149)	(0.134)	(0.177)
Age gap	0.028**	0.042***	0.046***	0.041***	0.026*	0.017	0.048***
	(0.012)	(0.014)	(0.013)	(0.015)	(0.014)	(0.012)	(0.018)
Female spouse age	0.001	0.002	-0.012	-0.009	-0.010	-0.005	-0.010
	(0.007)	(0.008)	(0.009)	(0.010)	(0.009)	(0.008)	(0.011)
Dependency ratio	-0.001	-0.001	0.0002	-0.001	-0.002*	-0.001	-0.0004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education gap between spouses	-0.011	-0.017	0.048*	-0.009	-0.019	-0.002	0.007
	(0.020)	(0.020)	(0.025)	(0.028)	(0.020)	(0.020)	(0.028)
Female spouse is literate	-0.052	-0.169	0.112	-0.112	-0.111	0.030	0.176
	(0.164)	(0.183)	(0.214)	(0.236)	(0.182)	(0.170)	(0.225)
Male spouse is literate	-0.347**	-0.165	-0.154	0.049	0.107	-0.144	-0.229
	(0.169)	(0.176)	(0.200)	(0.220)	(0.171)	(0.165)	(0.222)
Pentecostal	0.820***	0.673**	0.868**	1.012***	0.995***	0.433	1.704***
	(0.304)	(0.309)	(0.377)	(0.343)	(0.326)	(0.343)	(0.444)
Catholic	-0.012	-0.090	-0.322	-0.074	-0.284	-0.281*	0.078
	(0.164)	(0.166)	(0.207)	(0.199)	(0.177)	(0.164)	(0.215)
Muslim	-0.125	0.266	-0.623*	-0.278	0.142	0.039	1.015**
	(0.284)	(0.318)	(0.330)	(0.353)	(0.354)	(0.299)	(0.451)
Traditionalist	0.940***	0.591**	0.464	0.504	0.489	0.848***	-0.091
	(0.292)	(0.280)	(0.340)	(0.353)	(0.363)	(0.313)	(0.430)
Distance to market	0.006	0.005	0.013	0.013	0.007	-0.00003	0.017
	(0.010)	(0.011)	(0.014)	(0.015)	(0.013)	(0.011)	(0.018)
Distance to health center	-0.033*	-0.020	-0.005	-0.029	0.002	-0.009	-0.027
	(0.019)	(0.021)	(0.022)	(0.023)	(0.021)	(0.019)	(0.027)
Distance to Accra	-0.001	0.0003	-0.0004	-0.0004	0.006	0.004	0.006
	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)
Eastern Region	-0.053	0.031	-0.028	-0.162	-0.104	-0.025	-0.100
	(0.233)	(0.224)	(0.298)	(0.334)	(0.262)	(0.214)	(0.323)
Central Region	0.516**	0.487**	0.703***	0.431*	0.290	0.578***	0.593**
	(0.217)	(0.218)	(0.236)	(0.251)	(0.218)	(0.206)	(0.263)
Volta Region	0.195	0.198	0.675	0.544	-0.533	-0.147	-0.433
	(0.618)	(0.645)	(0.727)	(0.799)	(0.659)	(0.613)	(0.853)
Constant	-1.364***	-1.738***	-1.725***	-1.794***	-1.677***	-1.587***	-0.435
	(0.468)	(0.503)	(0.552)	(0.622)	(0.552)	(0.470)	(0.665)
	-0.363	-0.557	-0.510	-0.613	-0.591	-0.459	
	(0.465)	(0.488)	(0.550)	(0.616)	(0.546)	(0.467)	
	0.160	0.016	0.235	0.058	0.220	0.377	
	(0.466)	(0.491)	(0.555)	(0.621)	(0.544)	(0.469)	
Observations	414	418	307	258	335	386	404

Standard errors in parenthesis. Significant effects are indicated with * (p<0.1), ** (p<0.05) and *** (p<0.01)

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