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The effect of membership in producer organizations on women's empowerment: Evidence from Kenya

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ABSTRACT

In developing countries, producer organizations (POs) are important for achieving women empowerment mainly through promoting women's access to the organization's resources and services. However, by improving access to markets and technologies, household membership in POs often results in commercialization of smallholder farming, leading to women disempowerment as men take over control of the farm. We use data from dairy smallholders in Kenya to explore the impact of membership in bargaining and processing POs on women empowerment. Applying the Women Empowerment Livestock Index, we capture six domains of empowerment: production; nutrition; resources; income; opportunities; and workload. We find that when a household joins any PO, regardless of whether the man or the woman in the household is the registered member, women achieve a higher control over production decisions, buying and selling of land and cows, use of loans and receiving dairy income. Distinguishing by gender of membership, there is stronger women empowerment when the woman in the household is a member. We also find that woman membership in bargaining POs results in greater empowerment, in terms of ownership of cows, than woman membership in processing POs. The paper suggests that women empowerment is affected by the functional characteristics of POs.

1. Introduction

The first world conference on women, in Mexico City in 1975, formed the beginning of a journey towards the advancement of women. A series of other women conferences followed, with the 1995 World Beijing Conference on Women marking a significant turning point for the global agenda for gender equality where 189 countries committed to equal rights and opportunities for all women and girls. However, more than 25 years later, gender inequalities persist around the world, particularly in rural areas of developing countries (Duflo, 2012; Jayachandran, 2015). In Sub-Saharan Africa, women have unequal access to economic opportunities (UN-Women, 2020) and have less control over key production resources such as land and livestock (Quisumbing et al., 2015; Ragsdale et al., 2018).

Empowerment of women can improve food security, reduce rural poverty and improve nutrition and health as suggested by the CGIAR (CGIAR-IEA, 2017), the United Nations (UN, 2016) and The World Bank (World-Bank, 2012). According to FAO (2011), if women have equal access to production resources and services as men, they can increase

production on their farms by 20–30%. Furthermore, women's participation in agricultural development benefits families and generations. Impact evaluations of a homestead food production project in Bangladesh and Nepal show that women's control over production decisions and income increases their decision-making power regarding child health and nutrition (HKI, 2010).

As women empowerment is increasingly seen as a pillar for sustainable economic development and social well-being, alternative models for development that support women's participation in agriculture are needed. Producer organizations (POs) are promoted as an important entry point for rural development (ILO, 2014). Guided by values of self-help, equality, and equity, as well as economic growth through cooperation, the business model of POs can facilitate women empowerment (Burchi & Vicari, 2014; Manchón & Macleod, 2010). However, by improving access to markets and technologies, household membership in POs often results in commercialization of smallholder farming, leading to women disempowerment because men take over control of the farm (Achandi et al., 2018; Johnson et al., 2016; Quisumbing et al., 2015). Household membership in POs is further

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associated with participation in formal activities like training and meetings, which increase women's workload because of their responsibilities to care for farm and family (Lyon et al., 2016; Ragasa et al., 2013). These mixed findings of household membership in POs suggest the need to further assess patterns of women empowerment arising due to differences in POs, for instance, in terms of the organizational functions and services, and the type of membership.

The type of membership varies in two ways; i) household membership, i.e. either a man or a woman in the household is a member, and ii) woman membership, i.e. the woman herself is a member. Membership of a household in a PO, and particularly when a man in the household is a member, does not always imply that women benefit. While household membership enables households to access resources, literature suggests that households do not allocate intra-household resources in a fair or optimal manner, but that allocation follows preferences of the person in power (Wouterse, 2016). In Ethiopia, women in households participating in apple cooperatives have low bargaining power because of men's control over the apple business (Alemu et al., 2018). To minimize this bias in intra-household resource allocation, POs encourage women to register as members to increase their access to and ownership of productive resources leading to empowerment. In Sub-Saharan Africa, women who are members of dairy POs gain an opportunity to participate in modern dairy markets, a domain that has largely been dominated by men (Quisumbing et al., 2015). The stronger economic position also enhances women's bargaining power in the household. While most studies focus on what the impact of women membership in POs is on women empowerment, this study aims to shed light on how different membership types affect women empowerment.

In addition to the type of membership, a growing number of scholars are becoming interested in how the type of PO enables rural women to overcome gender-specific challenges in decision-making and resource ownership (Dohmworth & Hanisch, 2017, 2019). The distinction is made between a mixed-gender PO and a single-sex PO with the basic argument that single-sex POs allow women to fully control membership benefits. However, in India, membership in women-only POs did not enhance women's control over income or their intra-household decision-making power (Dohmworth & Hanisch, 2017). Few studies take into account the type of PO in assessing women empowerment outcomes, yet POs differ in many aspects including value chain functions and organizational characteristics (Bijman et al., 2016; Kormelinck et al., 2019). We have not found any study that distinguishes the empowerment effect of POs based on their functions along the value chain and their organizational characteristics.

Focusing on value chain function and using qualitative data, we categorize POs in the Kenyan dairy value chain into four types: bargaining, cooling, hub, and processing (Mwambi, 2020). These POs are similar in that men and women in a community where a PO operates can join any organization (but a farmer can only belong to one dairy PO) and only one member of the household is registered. However, differences exist in organizational characteristics. A bargaining PO adopts a self-help group legal form, has limited its operations to collection and bulking, membership size is small, volume intake and investments are low, no food safety controls are carried out unless through a third party, and services such as training, credit, veterinary, and inputs are lacking. Members in a bargaining PO benefit from collective bargaining. A processing PO adopts a cooperative legal form and is vertically integrated into processing, leading to the production and marketing of different final dairy products. Membership size is large and volume intake is high, and so is the investment in physical and human assets. Tight food safety control measures are employed and additional services are provided. Members incur costs of membership fees, share contribution and investing in meeting food safety requirements of the POs, but they in turn benefit from collective bargaining and access to services. In between bargaining and processing are cooling and hub PO types that show intermediate levels of vertical integration, membership size, volume intake, food safety control, and service provision.

This study focuses on bargaining and processing POs. These two types of POs have existed in Kenya for decades (Mutinda et al., 2015; Owango et al., 1998; Wanyama, 2009), but no study has compared their impact on women empowerment. Theoretically, we expect household and woman membership in a processing PO to have a higher impact on women empowerment than membership in a bargaining PO because of the additional services and value-added functions of the former.

Our study seeks to contribute to the discourse on women empowerment and membership in POs by addressing four research questions. The first two questions look at the effect of household membership on women empowerment by comparing member-households with non-member households while the last two questions look at the effect of woman membership on women empowerment by comparing women members with men members. Thus, we ask: 1) What is the effect of household membership in POs versus household non-membership on women empowerment? 2) Does the household membership effect vary between bargaining and processing POs? 3) What is the effect of woman membership in POs versus man membership on women empowerment? 4) Does the woman membership effect vary between bargaining and processing POs?

We use the dairy value chain in Kenya as our case study and restrict our sample to married households. In East Africa, POs are promoted by development practitioners and governments, and their contribution to women empowerment in the livestock sector is a major topic of discussion in gender and development studies (Basu et al., 2019; Galiè et al., 2019; Njuki et al., 2014; Tavenner et al., 2018; Tavenner & Crane, 2018). Many studies, however, focus on the dairy hubs initiated by the East Africa Dairy Development (EADD) project, which has an integrated gender framework to improve women's participation. Not much research has paid attention to the bargaining and processing POs. Understanding the role of POs in women empowerment is critical in designing agricultural policies and development programs that increase gender equality.

The next section presents a background of women empowerment in the Kenyan dairy value chain. It also presents the conceptual framework of women empowerment and membership. In Section 3, the methods and data are outlined, before presenting the results and discussion in Sections 4 and 5, respectively. We conclude, in Section 6, with policy implications and the limitations of the study.

2. Background

2.1. Women empowerment in Kenya

Kenya has adopted both international and national policies for addressing gender equality and women empowerment. At the international level, Kenya is a signatory to the Beijing Platform for Action, the Convention on the Elimination of all forms of Discrimination Against Women (CEDAW) and the Millennium Development Goals (MDGs), which emphasize gender equality and women empowerment. At the national level, the Kenyan government has taken concrete steps to promote gender mainstreaming in the agricultural development process. In 2000, the government developed the National Policy on Gender and Development which provides a framework to reduce gender inequalities in different sectors (GoK, 2019a). In 2005, the Ministry of Gender, Children and Social Development was established. The Ministry's overall objective is to ensure empowerment of women through mainstreaming the needs of women, men, boys and girls for them to participate and benefit in all sectors of development. To further strengthen gender equality plans, the government introduced the Agricultural Sector Gender Policy in 2013, aiming at systematically and structurally addressing gender inequalities and their causes in the agricultural sector (GoK, 2013).

These efforts have yielded some tangible results, such as socio-economic development programs like the Women Enterprise Fund that has made progress in promoting financial inclusion and women

empowerment. As of 2019, KES. 15.629 billion (USD 145.83 million) had been disbursed as credit to 1,632,825 beneficiaries countrywide, with a repayment rate standing at 96%, and more than one million women had received trainings (GoK, 2019b). At the decentral levels of government, several gender-related programs have been adopted including the County-Specific Gender Data Sheets facilitated by UN-Women, and aimed at keeping track of the county's progress in gender mainstreaming. Such programs increase women's access to resources, and their participation in decision-making at the community levels.

Despite the positive progress, a review by the Gender Directorate (MDP 2015) on the implementation of the Beijing Platform Plan for Action notes that tangible benefits for the majority of women in Kenya are yet to be realized, especially in rural areas, and that absolute poverty is higher among women than men in both urban and rural areas (GoK, 2015). Our study makes a contribution to understanding gender issues in the agricultural sector of Kenya, and particularly in the dairy value chain.

2.2. The dairy value chain in Kenya in relation to women empowerment

The dairy value chain in Kenya has considerably transformed since the 1990's because of increased demand for milk and milk products. The increasing demand is a result of market liberalization, population growth, increasing urbanization, and changing dietary patterns, with consumers demanding safe and nutritious milk and dairy products. Increased demand for milk has led to new employment and income-generating business opportunities along the dairy value chain. Further, it has led to a shift from traditional open grazing to modern dairy production that is highly intensified involving practices such as adopting pure breed cows, complementary feed-production strategies, and better disease control. Intensification, however, requires appropriate access to services such as finances, technical knowledge, and veterinary services (van der Lee et al., 2020).

Modern dairy production presents different challenges and opportunities for men and women, since they do not have the same access to resources. It also implies a potential shift in gender roles at the household and the market levels. At the household level, traditionally, in most communities, dairy farming is regarded as a women's enterprise to meet food requirements and as a source of income (Galiè et al., 2021; Katothya, 2017). Women carry out daily activities such as milking, watering and feeding, while men tend to have a larger role in activities such as animal health management (Gallina, 2016). At the market level, men and women sell milk through the formal and informal value chains (see Appendix 1).

The informal chain sells non-processed dairy products and includes both licensed and unlicensed businesses (Alonso et al., 2018). This chain handles about 70% of the marketed milk (KDB, 2017) and has minimal compliance with milk safety measures due to lack of knowledge and testing technology (Flintrac & USAID-KAVES, 2014). In the informal chain, farmers receive payment mostly in cash but have low bargaining power and low access to production and marketing-related services. However, farmers benefit from reduced transaction costs as traders collect milk from the farm and transport it to buyers in nearby towns and cities.

Smallholders can organize themselves in POs to sell milk through the formal chain. The formal chain is defined as the chain of dairy enterprises that are fully or partially effectively regulated through inspection and licensing. The formal chain represents 30% of the milk reaching the market. Strict food safety monitoring and control is practiced (Alonso et al., 2018). This chain is dominated by dairy POs (Kiambi et al., 2018).

Dairy PO models range from bargaining to processing and can follow different value chains (Mwambi, 2020). Small POs, which are mostly bargaining POs, sell more than 90% of their milk as raw to large POs (mostly processing POs), and sometimes to retailers, traders and private consumers. Large POs process 80% of their milk to produce pasteurized, UHT milk, yoghurt, fermented, cheese, butter, ghee, cream and long-life

flavored milk (Kiambi et al., 2018). These are sold mainly through distributors to retailers or directly to consumers. The remaining 20% is sold raw but chilled, mainly to institutions such as schools.

Farmers belonging to both bargaining and processing POs are encouraged to intensify their production through the use of zero grazing practices, concentrated feeds, and pure cattle breeds, to produce higher quality and quantities of milk (Tavener & Crane, 2018). POs, in turn, facilitate farmer's access to markets, inputs and training services, with bargaining POs offering fewer services than processing POs. All POs continue being traditional in ownership and control rights; they are member-owned and member-controlled enterprises. POs have open membership and are democratic, that is, voting is on a one-member-one-vote basis. To join these organizations, farmers have to pay a membership fee which is higher in processing POs than in bargaining POs. Share and capital contributions are other common charges incurred by farmers joining processing POs.

In terms of male and female participation, evidence suggests that women are underrepresented in membership in Kenyan dairy POs because of a lack of time and access to resources (Katothya, 2017). However, POs are increasingly becoming aware and responsive to gender-related constraints in membership that arise from commercialization of dairy. For instance, traditionally the head in married households is usually the man and he is the person officially registered as the member; benefits derived from membership are channeled to him (Basu et al., 2019). But this is changing. Dairy hubs in Kenya incorporate a gender responsive approach (Tavener et al., 2018). Hubs encourage women to actively supply milk to the organization, assume leadership roles, and access financial services. In bargaining and processing POs, our informal interviews with the PO staff and board members indicate that strategies such as equality in joining and participating in voting as well as the one-third rule (30% of PO leaders should be women), are applied to promote women's membership and participation in decision-making. Despite these efforts, a recent study by Mwambi et al. (2020) shows that although the percentage of men and women belonging to bargaining and processing dairy POs in Kenya is not significantly different, women are excluded from participation in decision-making, particularly in processing POs. Kiptot and Franzel (2019) conducted a study to examine factors that make volunteer farmer-training programs in dairy POs successful. Three years after the end of the project support, the POs had about 78% male volunteer farmer trainers and only 23% female, showing low participation of women.

At the household level, traditionally, in Kenya, women play a predominant role in milking, watering, cleaning out the pens, and feeding the animals while men have a larger role in activities related to animal health. Women exercise greater control over milk and milk marketing in the informal chain but this trend is changing due to the increasing commercialization (Gallina, 2016). Selling to the formal value chain is linked to increased milk production and commercialization, and men are likely to take control over product marketing when yields are higher (Wilkes et al., 2020).

2.3. Women empowerment and membership in producer organizations

In analyzing the impact of farmer membership in POs, economists usually focus on income gains (Ma & Abdulai, 2016; Mutonyi, 2019; Verhofstadt & Maertens, 2014). However, the focus on income excludes the issue of empowerment (Alkire, 2002). The term empowerment is subject to various conceptualizations and interpretations (Alsop et al., 2006; Kabeer, 1999; Narayan, 2005), that focus, for example, on empowerment as an individual process of self-awareness and development (Eyben & Napier-Moore, 2009); as a relational change in power dynamics (Drydyk, 2013); as a change in power structures (Kilby, 2006); as access to different elements of development (health, education, earning opportunities, and political participation) (Kabeer, 2020); or as economic progress (McOmber et al., 2021). We define empowerment as 'the process by which an individual acquires the capacity for self-

determination' (Galiè et al., 2018; Kabeer, 1999). Resources, agency, and achievements are key elements of empowerment. Resources refer to the control over economic, human and social resources (Kabeer, 1999), while agency is the ability to act on behalf of oneself (Kabeer, 2005; Sen, 1999). Both resources and agency constitute peoples' capabilities, that is, their potential for living the lives they want (Kabeer, 1999). The term achievements refers to the extent to which the potential is realized (Kabeer, 2005).

Literature on participation in development programs and women empowerment can educate us on the possible effects of membership in POs. According to Basu et al. (2019), the effect of participation in development programs can be conceptualized using two kinds of strategies; presence and property. Presence refers to participatory activities that recognize and involve women in development through their work and knowledge at the household level, and provide women access to collective organizations and training. Property refers to policies addressing gender inequalities by linking women to material resources (e.g., land and livestock). The study on household participation in a dairy development program in Kenya and Uganda shows that women membership in cooperatives (presence) enabled them to achieve some control over part of the income from milk (property). Where women were provided cattle by the development program (property), this led to increased women's workload in the dairy farm (presence).

Using the sustainable livelihood framework, Quisumbing et al. (2015) argue that development programs distribute assets to beneficiaries directly affecting the individual's asset holdings. Differences in women's and men's asset ownership have implications for bargaining power within the household. The authors report that a dairy program intervention in Mozambique provided improved cattle breeds to households leading to increased ownership by men, because the cattle were registered under the household head, in most cases a man. Women's workload increased as more labor was required to manage and care for the highly productive breeds.

Fischer and Qaim (2012) adopt Fafchamp's model of intra-household resource allocation which states that productive household members allocate their total time to labor for own income-generating activities, labor provided to others, and leisure. A woman will contribute labor to the man's agricultural plot if she benefits more from intra-household cooperation compared to working off-farm. Fischer and Qaim (2012) show that membership in a PO increased commercialization of the banana farm, leading to more male control over banana production and revenues. Still, women in member households provided a higher share of labor than women in non-member households.

In India, Dohmwrith and Hanisch (2017) show that PO membership has a negative effect on women empowerment. Members of a women-only cooperative had less control over dairy income when compared with unorganized women dairy farmers or members of a mixed-gender dairy cooperative. This adverse effect could be explained by men increasing their control over dairy production when women-only dairy cooperatives are formed. In contrast, women in Uganda increased their control over agricultural production and marketing by joining women farmer cooperatives (Ferguson & Kepe, 2011). Women also increased their involvement in decision-making on marketing through membership in dairy farmer groups in Zambia (Kafle et al., 2018).

The effect of participation in development programs on women empowerment is mixed. Context and social norms in communities may explain these differences (Galiè et al., 2015; Quisumbing et al., 2015). We contribute to this discussion by examining how PO membership affects women empowerment and whether the effects depend on the type of PO or gender of the member.

2.3.1. The Women Empowerment Livestock Index

Although quantifying women empowerment is difficult, it is necessary for measuring impact. A comprehensive and standardized measure is the Women Empowerment in Agriculture Index (WEAI), which was jointly developed by the USAID, IFPRI, and the Oxford Poverty and

Human Development Initiative (Alkire et al., 2013). WEAI is a survey-based index reported at the country or regional level, based on individual-level data collected by means of interviews with man and woman within the same household. WEAI evaluates five domains of empowerment: (i) production; (ii) income; (iii) resources; (iv) leadership; and (v) time.

Building on the WEAI, The International Livestock Research Institute (ILRI) and Emory University, recognizing the importance of livestock to rural communities in East Africa, developed the Women Empowerment in Livestock Index (WELI), a measure to assess the empowerment of women in the livestock sector (Galiè et al., 2018). The dimensions of empowerment in the WELI include (1) decisions about agricultural production; (2) decisions related to nutrition; (3) access to and control over resources; (4) control over and use of income; (5) access to and control over opportunities; and (6) workload. Recently, WELI has been used in a qualitative study measuring women empowerment in livestock in Tanzania (Price et al., 2018), and in a mixed-methods study on the relationship between women empowerment, household food security and nutrition in Tanzania (Galiè et al., 2019). By using WELI, we contribute to understanding how POs affect women empowerment in livestock value chains.

3. Methods and data

3.1. Farm survey

The study seeks to assess the effect of membership in POs on women empowerment and how the effect varies between bargaining and processing PO, and between man and woman membership. To answer these questions, we conducted a household survey in Kenya between October and December 2018 to collect data on household decision-making and asset ownership. Purposive sampling was used to select Meru and Nyandarua counties, which are among the main milk sheds in the country (Rademaker et al., 2016). We purposively selected one sub-county in Meru and two sub-counties in Nyandarua, targeting those having a mixed pattern of PO and non-PO dairy value chains. At the sub-county level, we used stratified sampling with three strata; processing PO, bargaining PO, and non-member farmers.

Two processing POs out of the seven and one bargaining PO out of seven in the Imenti-South sub-county in Meru were chosen. One processing PO operating in the Kinangop and Ol-Kalou sub-counties in Nyandarua was selected as it was the only one available; it has members in both sub-counties. We selected one bargaining PO out of the seven present in Ol-Kalou sub-county in Nyandarua. We purposively selected the POs based on accessibility, receptiveness of the PO staff and representativeness. The processing and bargaining POs selected are representative as they have similar characteristics to other POs in terms of size, resource capacity, functions, and services. We used reports from the Kenya Dairy Board and Agriterria (Kagathi, 2014), a study by Wageningen UR and the FAO (Ton et al., 2016), as well as scientific articles (O'Brien & Cook, 2016) to verify the representativeness of selected POs.

The biggest challenge in a cross-sectional survey is to get a random sample of households. The PO membership registers were not up-to-date, therefore, a list of milk collection routes was used to sample the households/respondents for the survey. Enumerators, seven in number, followed a different route every morning. The first enumerator started to identify households at the start of the collection route. The other six enumerators proceeded on the same route with each enumerator starting to identify households at least two kilometers from where the previous enumerator was left. We used the following technique to identify households belonging to the targeted PO. When the first household was identified, enumerators were required to skip four households doing dairy farming to pick the next household. This process was repeated until the targeted number of respondents had been reached. For the selection of non-members, enumerators converged in the village center and followed a particular route belonging to the trader. A similar

identification procedure as that for PO members was used. A total of 474 married households was reached. The number of sampled households by membership status is presented in [Table 1](#).

In all the sampled households, we collected data using face-to-face interviews with individual farmers. Only married households were selected. For member households, we interviewed the man or the woman being the PO member, while for non-member households we interviewed the man or woman responsible for the dairy farm. While we acknowledge that interviewing both men and women in a household could lead to a better understanding of intra-household gender dynamics, we believe that our approach provides useful data. The data collected provide information on the production, assets, income, and workload of the households, and how these are distributed within and across households.

3.2. Definition and measurement of outcome variables

For the outcome measures we used the WELI tool ([Galiè et al., 2018](#)). The first outcome variable is the “Decisions about agricultural production” (in the past year). We asked “Who made most decisions on (i) buying inputs, (ii) breeds of cows, and (iii) land use” (0 = man, 1 = woman, 2 = jointly). On the nutrition dimension, we asked: “Who made most decisions on the amount of milk to be used for home consumption?” (0 = man, 1 = woman, 2 = jointly) and “Who was mostly responsible for managing cow health, milking, cleaning the milking area, cleaning the milking vessels, milk storage, and milk transportation?” From the literature, we know that dairy farm activities are undertaken by different people ([Gallina, 2016](#)), so our response categories for the last question included; 0 = man, 1 = woman, 2 = boy child, 3 = girl child, 4 = man employee, 5 = woman employee.

The dimension “Access to and control over resources” covered land, livestock and financial resources. We asked, “Who makes most decisions on (i) buying and selling of cows and (ii) buying and selling of land”. Questions like “Who owned most of the cows” and “Who owned most of the land” were asked to measure asset ownership (in the past year). Regarding access to credit, the first question aimed at prompting whether the household had access to credit; “Did any member of the household take any loan or borrowed cash from a formal institution in the past 12 months for the purpose of dairy farming?” (1 = yes, 0 = no). Follow-up questions were asked to determine how decisions were made on the loan. These included “If yes, who decided on the amount of money to be borrowed?” and “Who decided on how to use the money?” The response categories were (0 = man, 1 = woman, 2 = jointly between man and woman, 3 = male child, or 4 = female child).

Two questions were asked on control and use of income; (i) “Who received most of the income from the sale of milk in the past year?” and (ii) “Who made most decisions on how the income from sale of milk was to be spent?” (0 = man, 1 = woman, 2 = jointly). We captured access to and control over opportunities in the following ways; (i) “Who mostly accessed agricultural extension services in the past year?” and (ii) “Who made most decisions on where to sell milk in the past year?” (0 = man, 1 = woman, 2 = jointly).

For labor and workload, we first questioned the person that was most responsible for feed collection, purchasing feeds, feeding, watering, managing cow health, milking, cleaning the milking area, cleaning the

Table 1
Number of sampled households by membership status.

	Bargaining PO	Processing PO	All members	Non-members	Full sample
Total number of households	91	208	299	175	474
Man	60	126	186	81	267
Woman	31	82	113	94	207

vessels, milk storage and milk transportation in the past year. Our response categories included; 0 = man, 1 = woman, 2 = male child, 3 = female child, 4 = male employee, 5 = female employee, 6 = no such activity in the farm. Then we used a module of detailed time allocation to get an idea about man's and woman's time spent in different activities both on the farm and in the home. The farmer was required to provide information on a log of the activities carried out in the last complete 24 h. The time intervals were presented in 15 min, and one to two activities could be marked for each time slot. A summary of the women empowerment measures, indicators, and their description is presented in [Appendix 2](#).

3.3. The estimation strategy

We use an impact evaluation approach where membership in a PO is our treatment. This approach requires constructing a counterfactual, that is, the outcome for those being treated had they not been treated. Given the non-experimental nature of our data, our counterfactual is missing. We can only observe the difference in outcomes between members and non-members – the problem known as selection bias ([Heckman & Hotz, 1989](#)). Most non-experimental methods tackle this issue building on the assumption of “selection-on-observables”, that is, conditional on observable characteristics the difference between treated and non-treated is due to the treatment ([Heckman & Robb, 1985](#)). If this assumption holds, then treated observations can be matched with those non-treated that are sufficiently comparable according to specific criteria.

In our study, the units of analysis are individuals. $Y(1)$ and $Y(0)$ are the outcome of the members and non-members, respectively, and T is a binary variable being equal to 1 for a unit exposed to the treatment and 0 otherwise. Our measure of interest is the so-called Average Treatment Effect on the Treated (ATT), which can be expressed as follows;

$$\tau_{ATT}(X) = E[Y(1) - Y(0) | T = 1] = E[Y(1) | T = 1] - E[Y(0) | T = 1], \quad (1)$$

The ATT measures the difference between the expected empowerment for those individuals that are not members and the expected empowerment for those who are members. While the outcome for the members is available, the outcome for the members if they had not received the treatment cannot be observed but can be approximated. This identification is possible if the conditional independence assumption (CIA) holds, which implies that once we control for observable characteristics the decision of membership or non-membership can be considered random ([Dehejia & Wahba, 1999](#)). Propensity Score Matching (PSM) was introduced by [Rosenbaum and Rubin \(1983\)](#) for this purpose and became the most commonly used matching technique for non-experimental impact evaluation. Concerning the CIA, the distribution of covariates between treatment and control group needs to be balanced after matching on propensity scores ([Rosenbaum & Rubin, 1983](#)). This condition involves an intricate and often ineffective process of searching for the balancing solution ([Hainmueller, 2012](#); [Watson & Elliot, 2016](#)).

To overcome the shortcomings of PSM method in achieving satisfying balance, an entropy balancing method, as described by [Hainmueller \(2012\)](#), is used. Instead of checking for covariate balance after preprocessing, in entropy balancing the desired level of covariate balance is prespecified using a set of balance conditions. Entropy balancing then searches for the set of weights that satisfies the balance constraints. The balanced weights for treated and control units are subsequently employed for estimating the ATT using a probit model that includes women empowerment measures as outcome variables. The estimated coefficient is interpreted as the ATT because only the untreated group observations are weighted. Since we have binary outcomes, we use probit models with entropy weights. In selecting conditioning variables for obtaining entropy weights, all factors that affect membership and the outcome variable are included.

[Zhao and Percival \(2017\)](#) show that entropy balancing provides

superior covariate balance compared to traditional propensity score weighting methods, making it a preferred estimation model in recent studies in applied economics (Marcus, 2013; Meemken & Qaim, 2018; Neuenkirch & Neumeier, 2016). The key advantage of entropy balancing over traditional matching techniques is the ease with which the balancing property of covariates is achieved (Hainmueller, 2012). Balance constraints imposed directly by the researcher to estimate entropy weights ensure that the reweighted groups match exactly on the specified moments. Besides, matching methods assign binary weights to the observations in the control group – 1 if they match and 0 otherwise – and discards those observations with 0 weights. Instead, entropy balancing assigns positive weights to all the units in the control group, allowing to exploit the full sample. In entropy balancing, the estimated weights are maintained as close as possible to the base weights, which prevents loss of information for the subsequent analysis.

One shortcoming for all weighting and matching approaches is that they can only control for selection bias due to observable differences between the treatment and the control groups. In our case, it could be that the members differ from non-members in terms of unobserved factors, such as personal motivation, risk preferences, and entrepreneurial skills. Other approaches to deal with possible selection bias due to unobserved heterogeneity include Heckman selection models and endogenous switching regression. However, these methods require instrumental variables that are correlated with membership and uncorrelated with all outcome variables. Given the large number of outcome variables used in this study, we were unable to find instruments that meet those restrictions.

4. Results

4.1. Descriptive statistics of the sampled households

Table 2 presents the results comparing characteristics of member and non-member households. The selected variables are also the variables used for generating entropy weights. The variables are drawn from literature and include individual and farm characteristics such as age, gender, farm size, and education; they all may influence membership decisions or women empowerment (Miedema et al., 2018; Trommlerová et al., 2015). With an average farm size of less than 4 acres, sampled dairy farmers can be characterized as smallholders. Member household are more likely to have a male farmer, use hired labor, have higher production and be located in accessible areas than non-member households.

Distinguishing characteristics by PO type, member households of processing POs are likely to be more educated and to own pure breed cows compared to non-member households, but these variables are not significantly different between member-households of a bargaining PO and non-member households. Ownership of pure breeds is probably a result of access to breeding services.

The differences between member households and non-member households suggest that there is a selection bias. Failing to account for this bias could mean that we would overestimate or underestimate the effect of PO membership on women empowerment. To correct the bias, we reweigh the data using the variables presented in Table 2.

Table 2
Descriptive statistics of key variables used in entropy balancing.

Variable name	Description	Full sample N = 474	Non-members (1) N = 175	Bargaining PO (2) N = 91	Processing PO (3) N = 208	All members (4) N = 299	t-Test (2) – (1)	t-Test (3) – (1)	t-Test (4) – (1)
Age	Age of the farmer in years	48.39	46.73	49.56	49.27	49.36	1.67*	1.98**	2.20**
Male	If a farmer is male = 1, 0 = otherwise	0.56	0.46	0.66	0.61	0.62	3.09***	2.82***	3.41***
Education	Number of years of formal schooling	9.57	9.03	9.42	10.09	9.89	0.90	3.17***	2.68***
Hired labor	If a farmer has a casual or permanent worker on the dairy farm = 1, 0 = otherwise	0.43	0.32	0.49	0.49	0.49	2.81***	3.32***	3.62***
Logarithm of milk production	The log of the total amount of milk produced on the farm per year (in kg)	8.49	8.16	8.59	8.72	8.68	5.12***	7.48***	7.71***
Pure breed cows	If the farmer has pure breed cows = 1, 0 = otherwise	0.52	0.43	0.49	0.61	0.57	0.93	3.39***	2.91***
Farm size	The size of the farm of the farmer in acres	3.31	2.80	3.31	3.74	3.61	0.63	1.50	1.52
Ownership of transport	If the farmer has transport means = 1, 0 = otherwise	0.39	0.34	0.43	0.42	0.42	1.37	1.61	1.76*
Group membership	Whether the farmer belongs to another group apart from a dairy group = 1, 0 otherwise	0.64	0.65	0.58	0.65	0.63	-1.10	0.05	-0.42
Nyandarua County	If the farmer is located in Nyandarua county = 1, 0 = otherwise	0.48	0.49	0.48	0.48	0.48	-0.12	-0.30	-0.28
Distance to collection point	The distance to the nearest PO milk collection center in km	0.79	1.19	0.67	0.50	0.55	-1.66*	-3.09***	-3.38***
Number of traders	In this village, there are many milk traders (1 = completely disagree, 7 = completely agree)	4.92	5.47	4.59	4.60	4.60	-3.60***	-4.84***	-4.93***
Access to loan	Farmer accessed loan from a financial service provider in the past year = 1, 0 otherwise	0.26	0.11	0.26	0.37	0.34	3.32***	6.26***	5.79***

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

4.2. The effect of household membership on women empowerment

4.2.1. Decisions on agricultural production

The results in Table 3 show significant differences by gender between member and non-member households regarding their involvement in decisions on agricultural production. Columns (1) to (3) show simple comparisons without controlling for selection bias. In most of the outcome variables, differences can be observed in the effects of simple comparisons and entropy balancing estimates, indicating that bias would occur if we relied on the simple comparisons of means. Column (4) shows the differences after controlling for selection bias using entropy balancing. These differences are the impact of membership. The reported results focus on values in column 4.

Household membership in a PO reduces men's dominance in decisions on buying dairy inputs and choice of cow breed by 1.5 and 1.3 percentage points, respectively. More so, household membership increases women's independent and joint contribution to decisions on breed selection. There are no significant effects of household membership on land use decisions.

4.2.2. Access to and control over resources

Table 4 reports on the effect of household membership on gender concerning access to and control over resources. Household membership decreases men's independent decision-making concerning buying and selling of cows, and increases women's independent decision-making. Additionally, women's independent control over buying and selling of land increases by 2.75 percentage points as a result of household membership. Positive effects of household membership on credit are observed where women increase their independent decision-making on

Table 3
Decisions about agricultural production.

Production decisions	Simple comparison			Entropy balancing
	Member N = 299 (1)	Non-member N = 175 (2)	(3)	(4)
	Mean (SE)	Mean (SE)	t value	ATT (SE)
<i>Buying dairy inputs</i>				
Man	0.49 (0.50)	0.58 (0.49)	-1.85*	-1.52** (0.64)
Woman	0.15 (0.36)	0.22 (0.41)	-1.74*	1.02 (0.86)
Jointly	0.34 (0.47)	0.20 (0.40)	3.30***	1.33 (0.83)
<i>Decision on breeds of cows to be kept</i>				
Man	0.51 (0.50)	0.67 (0.47)	-3.50***	-1.27*** (0.49)
Woman	0.10 (0.31)	0.09 (0.30)	-0.23	2.84*** (0.70)
Jointly	0.38 (0.49)	0.23 (0.42)	3.32***	0.85* (0.50)
<i>Decision on land use</i>				
Man	0.44 (0.50)	0.54 (0.50)	-2.21**	-0.34 (0.48)
Woman	0.09 (0.29)	0.13 (0.34)	-1.28	-0.49 (0.81)
Jointly	0.46 (0.50)	0.33 (0.47)	2.92***	0.54 (0.49)

t value is the test statistics. ATT is the average treatment effect on the treated; SE is the standard error.

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

Table 4
Access to and control over resources.

Resources	Simple comparison		(3)	Entropy balancing
	Member N = 299 (1)	Non-member N = 175 (2)		(4)
	Mean (SE)	Mean (SE)	t value	ATT (SE)
<i>Decisions on buying and selling of cows</i>				
Man	0.52 (0.50)	0.70 (0.45)	-3.99***	-0.94** (0.45)
Woman	0.08 (0.27)	0.05 (0.23)	0.94	2.03*** (0.64)
Jointly	0.40 (0.49)	0.24 (0.43)	3.54***	0.65 (0.46)
<i>Ownership of cows</i>				
Man	0.47 (0.50)	0.59 (0.49)	-2.40**	-0.76 (0.49)
Woman	0.09 (0.29)	0.07 (0.26)	0.72	0.34 (0.82)
Jointly	0.42 (0.50)	0.34 (0.47)	1.89*	0.67 (0.52)
<i>Decisions on buying and selling of land</i>				
Man	0.52 (0.50)	0.67 (0.47)	-3.15***	-0.24 (0.48)
Woman	0.05 (0.21)	0.03 (0.17)	0.98	2.75*** (1.06)
Jointly	0.43 (0.50)	0.30 (0.46)	2.72***	0.06 (0.48)
<i>Ownership of land</i>				
Man	0.79 (0.41)	0.83 (0.37)	-1.19	-0.22 (0.50)
Woman	0.00 (0.06)	0.00 (0.00)	0.76	0 (.)
Jointly	0.20 (0.40)	0.17 (0.37)	1.03	0.18 (0.50)
<i>Decision on the loan amount</i>				
Man	0.12 (0.33)	0.03 (0.18)	3.21***	-0.38 (0.75)
Woman	0.03 (0.16)	0.02 (0.13)	0.67	3.39*** (0.91)
Jointly	0.19 (0.40)	0.06 (0.23)	4.17***	0.14 (0.57)
<i>Decision on loan use</i>				
Man	0.09 (0.29)	0.03 (0.17)	2.60***	-0.70 (0.77)
Woman	0.02 (0.15)	0.02 (0.15)	0.04	3.25*** (0.92)
Jointly	0.23 (0.42)	0.06 (0.23)	4.94***	0.33 (0.56)

t value is the test statistics. ATT is the average treatment effect on the treated; SE is the standard error.

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

the amount of loan to be borrowed and on loan use. However, household membership does not change gender ownership of livestock and land.

4.2.3. Control over and use of income

The effect of household membership on control over income is shown in Table 5. Women in member households increase their probability of receiving dairy income. Non-significant effects are reported on receiving and use of dairy income among men and jointly by men and women.

4.2.4. Access to and control over opportunities

Household membership in a PO significantly reduces men's independent decisions on the market outlet but increases joint decisions (Table 6). A positive membership effect is observed regarding extension where men in member households increase their access to these services.

4.2.5. Distribution of farm responsibilities

Regarding the distribution of responsibilities on the dairy farm, several gender implications of membership are observed (Fig. 1). All household members are involved in dairy production and marketing activities. Men dominate purchasing dairy feeds, feeding and watering the cows, while women dominate cleaning of milk vessels and milk storage. The boy child performs feeding, milking and cleaning activities while the girl child is involved in cleaning of milking vessels.

Distinguishing by membership, a higher percentage of men in member households are responsible for purchasing feeds, cleaning the milking area, transportation of milk and watering the cows compared to men in non-member households. Transportation of milk in non-member

Table 5
Control and use of income.

Control and use of income	Simple comparison			Entropy balancing
	Member N = 299 (1)	Non-member N = 175 (2)	(3)	(4)
	Mean (SE)	Mean (SE)	t value	ATT (SE)
<i>Recipient of dairy income</i>				
Man	0.51 (0.50)	0.37 (0.48)	2.96***	-0.45 (0.48)
Woman	0.26 (0.44)	0.38 (0.48)	-2.71***	1.89*** (0.48)
Jointly	0.22 (0.42)	0.25 (0.44)	-0.76	-0.57 (0.52)
<i>Decision on the use of dairy income</i>				
Man	0.30 (0.46)	0.22 (0.42)	1.85*	0.27 (0.47)
Woman	0.13 (0.34)	0.25 (0.43)	-3.12***	-0.12 (0.78)
Jointly	0.56 (0.50)	0.53 (0.50)	0.5	-0.20 (0.48)

t value is the test statistics. ATT is the average treatment effect on the treated; SE is the standard error.

* Significant at 10% level.

*** Significant at 1% level.

Table 6
Access to and control of opportunities.

Extension	Simple comparison			Entropy balancing
	Member N = 299 (1)	Non-member N = 175 (2)	(3)	(4)
	Mean (SE)	Mean (SE)	t value	ATT (SE)
<i>Decision on market outlet</i>				
Man	0.39 (0.49)	0.47 (0.50)	-1.57	-0.88* (0.48)
Woman	0.17 (0.38)	0.26 (0.44)	-2.31**	-0.12 (0.68)
Jointly	0.42 (0.49)	0.27 (0.44)	3.37***	1.09** (0.48)
<i>Access to extension services</i>				
Man	0.62 (0.49)	0.39 (0.49)	4.96***	0.86* (0.48)
Woman	0.25 (0.43)	0.14 (0.34)	2.96***	1.09 (0.67)

t value is the test statistics. ATT is the average treatment effect on the treated; SE is the standard error.

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

households is mostly done by women. A lower proportion of women in member households are involved in feed collection, feeding and watering duties than their counterparts in non-member households.

The results on two dimensions of women empowerment, that is, (i) decisions on nutrition and (ii) workload, are not further discussed since household membership does not significantly influence men's and women's involvement in these activities. The results are presented in

Appendixes 3 and 4.

4.3. Effects of household membership across POs

To analyze differential membership effects, we estimate the effect of household membership in bargaining and processing POs. In the first stage of modelling, we reweight the data of household members of bargaining POs versus non-member households, and household members of processing POs versus non-member households, using variables presented in Table 2. The second stage is the ATT estimate with selected dependent variables including control over production decisions, resources and income by man, woman and jointly. Household membership in a bargaining PO has a negative effect on men's independent decision-making on buying inputs but has a positive effect on joint decision-making between men and women (Table 7). More so, women's independent decision-making on choice of breeds and buying and selling of cows increases by 2 and 1.4 percentage points, respectively, among household members of a bargaining PO compared to non-members.

Comparing households belonging to processing POs versus non-member-households, the effect of household membership reduces men's role in production decisions and increases women's decision-making just like in bargaining POs, but the coefficients and magnitude are lower. Contrary to membership effects in bargaining POs, effects of membership in processing PO on men's and women's decision-making on buying and selling of cows and their ownership of cows are non-significant.

4.4. Does woman membership matter for women empowerment?

Following Fischer and Qaim (2012), we evaluate the effect of woman membership in POs by comparing households in which the woman is the member (=1) versus those where the man is the member (=0). We further distinguish woman membership effects by PO type: bargaining versus processing POs. Focusing on woman versus man membership in all POs, we find that membership has strong positive effects on women's independent decision-making on agricultural production, buying and selling of cows, ownership of cows, and receiving and use of dairy income (Table 8). There is increased joint decision-making between men and women regarding cow ownership when the woman in the household is the member versus when the man is the member. A significant reduction of men's independent decisions as well as reduced men's independent ownership of the mentioned outcomes are shown.

Results in Table 8 also show that distinguishing by PO type, women independent ownership of cows and joint ownership between men and women in a household increases by 5.7 and 2.1 percentage points, respectively, if the woman in the household belongs to a bargaining PO (but not when the woman in the household belongs to a processing PO) compared to when the man is the member. A 3.5 percentage point increase in women's independent decision-making on the use of dairy income is attained through woman membership in a bargaining PO (but not in a processing PO). A woman increases her chances to receive dairy income by 2.7 percentage points when she is the member of the processing PO as compared to the man being the member.

5. Discussion

This article explores the relationship between PO membership and women empowerment in dairy value chains in Kenya. We use quantitative data from 267 men and 207 women in member and non-member households, and use probit models with entropy weights to assess the effect of membership. Using the Women Empowerment Livestock Index, we capture various dimensions of women empowerment. In answering the first question on the effect of household membership in PO on women empowerment, overall, we find that household membership (i.e., either man or woman in the household is the member) in all POs increases women's independent decision-making on agricultural

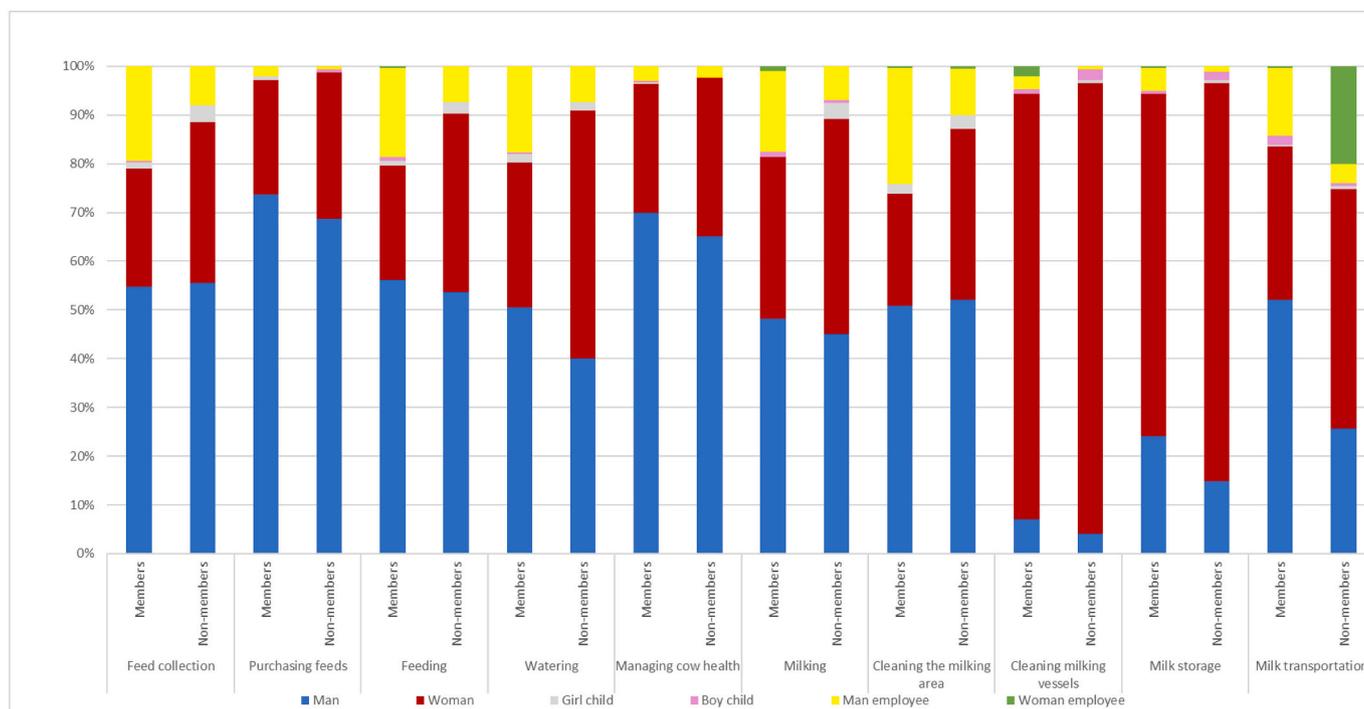


Fig. 1. Distribution of responsibilities on the dairy farm.
 Note: some farms do not perform certain activities. 6.9% of non-members did not purchase feeds, 15.7% of members do not clean the milking area and 6.7% of members said milk transportation was not an activity on their farm.

production, control over resources, buying and selling land and cows, using loans and receiving dairy income. Men experience a reduced role in independent decisions regarding production, buying and selling of cows and marketing. Household membership in all POs does not affect gender-based ownership of cows and land.

Our study comports with several studies which show that POs facilitate empowerment of women (Burchi & Vicari, 2014; Ferguson & Kepe, 2011; Groot-Kormelinck, 2014). However, this empowerment is limited as it does not change structures of ownership of livestock, in line with findings by Price et al. (2018). They show how, according to interviewed female livestock keepers in Tanzania, livestock is a traditional commodity in rural communities which is entrenched in long-standing gender norms. Changing these norms entails difficult shifts in power, belief and behavior.

The absence of change in ownership implies that PO membership may be important but not sufficient in achieving empowerment. Studies have shown that women's control over income is not satisfactory if cows are still owned by men (Basu et al., 2019). Noteworthy, our ownership data reflect an individual respondent's perception of who owns assets. According to the literature, people may define ownership differently: using an asset, selling or inheriting an asset, deriving benefits from the asset, or investing in the asset (Basu et al., 2019; Galiè et al., 2015; Quisumbing et al., 2015). Thus, asset ownership is complex and its assessment needs nuances that could not be made in this study. Knowing how farmers understand and interpret asset ownership is important for POs in introducing policies aimed at reducing gender constraints.

Concerning access to opportunities, household membership in all POs increases men's access to extension services but does not affect women's access. We argue that this is because men in member households have more responsibilities in dairy production activities than women (Fig. 1) and thus need knowledge on dairy farm management. Additionally, through our interviews, we found that men have fewer responsibilities in family care than women, and therefore have more time to attend training programs. Women's domestic workload has been cited as a major hindrance to participation in development programs

(Altenbuchner et al., 2017; Haile et al., 2012).

Our second question assesses the varying membership effects across POs. Household membership in a bargaining PO increases women's independent decision-making on buying and selling of cows and joint ownership of cows, but household membership in a processing PO does not have a significant effect on these dimensions. A significant effect among women from member-households of a bargaining PO reflects a small move towards women empowerment regarding asset ownership. Our descriptive statistics reveal that members of a processing PO are commercial farmers as indicated by their ownership of pure breeds, years of education and milk production. Previous studies have shown that women control fewer market-oriented farms (Fischer & Qaim, 2012; Sell & Minot, 2018), which may explain why women in households belonging to a processing PO have less control.

Thirdly, we compare the effect on women empowerment, of woman's membership versus man's membership in all POs. We find evidence that when women themselves join POs (without distinguishing between bargaining and processing POs), they increase their independent decision-making on agricultural production, buying and selling of cows, ownership of cows, receiving of dairy income and use of dairy income. Women gain independent access to and control over resources. Our results contradict those of Dohmworth and Hanisch (2017), who find that woman membership in dairy POs has a negative effect on women empowerment. Galiè and Farnworth (2019) discuss the relational nature of empowerment which entails that the empowerment of a given individual may need to be enhanced by purposefully supporting both the empowerment of that very person and also the empowerment of people significant to that person.

In the fourth research question, we distinguish the effect of woman membership across POs and find that woman membership in a bargaining PO increases women's independent ownership of cows in a significant way, but membership in a processing PO does not have any significant effect. Theoretically, woman membership in a processing PO could improve empowerment because of the multiple services of this PO compared to those offered in a bargaining PO. However, our study

Table 7
Distinguishing effect of membership across POs.

	Household membership in a bargaining PO and non-membership N = 266	Household membership in a processing PO and non-membership N = 383
	ATT (SE)	ATT (SE)
<i>Production decisions</i>		
Buying of dairy inputs		
Man	-1.232*** (0.445)	-0.910** (0.415)
Woman	0.578 (0.666)	0.211 (0.649)
Jointly	1.331*** (0.463)	1.007** (0.461)
Decision on breeds of cows to be kept		
Man	-0.649 (0.418)	-0.586 (0.385)
Woman	2.037*** (0.615)	1.537*** (0.462)
Jointly	0.189 (0.433)	0.309 (0.396)
<i>Resources</i>		
Decisions on buying and selling of cows		
Men	-0.293 (0.420)	-0.587 (0.384)
Woman	1.407** (0.685)	1.030 (0.657)
Jointly	-0.007 (0.435)	0.416 (0.396)
Ownership of cows		
Men	-0.741* (0.412)	-0.617 (0.389)
Woman	0.069 (0.913)	0.278 (0.927)
Jointly	0.798* (0.794)	0.561 (0.389)
<i>Control and use of income</i>		
Recipient of dairy income		
Men	-0.588 (0.398)	0.052 (0.371)
Woman	0.756* (0.422)	0.708* (0.407)
Jointly	0.152 (0.474)	-0.661 (0.426)
Decision on the use of dairy income		
Men	-0.005 (0.435)	0.463 (0.396)
Woman	0.152 (0.638)	-0.112 (0.563)
Jointly	-0.067 (0.408)	-0.318 (0.375)

ATT is the average treatment effect on the treated; SE is the standard error.

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

reveals that membership of women in processing POs does not necessarily mean that women benefit or become empowered. Cultural norms in some parts of Kenya that cows, especially improved breeds, belong to men could be the limiting factor for ownership of cows among women members in processing POs (Tavener & Crane, 2018). Ravichandran et al. (forthcoming) studied how women-only and gender-mixed dairy POs affect women's empowerment in India and conclude that women's empowerment can only be enhanced by creating environments that allow women's agency to be exercised, regardless of the PO type. The authors discuss which factors, rather than the PO type, affect women empowerment in their ability to exercise their agency in the PO. They show that women-only dairy cooperatives supported women's empowerment only when women are entitled to leadership positions across the entire cooperative, both in village-level cooperatives as well as up to the top levels of management. On the other hand, a mixed dairy PO where a man champion consistently mediated the involvement of women in the PO activities did not result in women's empowerment because women were not given space to exercise their agency. Their access to information and opportunities always relied on the facilitation of the man champion.

Table 8
Effect of woman membership on women empowerment.

	Woman membership and man membership in a bargaining PO N = 91	Woman membership and man membership in a processing PO N = 208	Woman membership and man membership in all POs N = 299
	ATT (SE)	ATT (SE)	ATT (SE)
<i>Production decisions</i>			
Buying of dairy inputs			
Man	-0.621 (0.710)	-1.270*** (0.403)	-1.124*** (0.320)
Woman	5.123*** (0.915)	1.900** (0.904)	2.640*** (0.580)
Jointly	-1.160 (0.726)	0.222 (0.395)	-0.197 (0.331)
Decision on breeds of cows to be kept			
Man	-1.079 (0.771)	-0.909** (0.396)	-0.779** (0.319)
Woman	-	1.522 (1.050)	3.094*** (1.031)
Jointly	-0.557 (0.777)	0.275 (0.388)	-0.245 (0.328)
<i>Resources</i>			
Decisions on buying and selling of cows			
Man	-1.108 (0.777)	-0.643 (0.391)	-0.878*** (0.312)
Woman	-	1.085 (1.028)	2.518*** (0.900)
Jointly	-0.094 (0.770)	0.262 (0.383)	0.171 (0.317)
Ownership of cows			
Man	-2.940*** (0.662)	-1.183*** (0.410)	-1.748*** (0.302)
Woman	5.740*** (1.147)	1.323 (0.900)	2.339*** (0.725)
Jointly	2.085*** (0.633)	0.572 (0.403)	0.978*** (0.290)
<i>Control over income</i>			
Recipient of dairy income			
Man	-1.896** (0.836)	-2.400*** (0.466)	-2.184*** (0.359)
Woman	1.547 (1.045)	2.709*** (0.769)	2.296*** (0.524)
Jointly	0.448 (0.673)	0.257 (0.476)	0.190 (0.350)
Decision on the use of dairy income			
Man	-1.711** (0.810)	-1.392*** (0.451)	-1.378*** (0.357)
Woman	3.522*** (0.965)	1.283* (0.712)	1.487** (0.670)
Jointly	-0.070 (0.706)	0.317 (0.391)	0.168 (0.306)

ATT is the average treatment effect on the treated; SE is the standard error; - model generates missing values because women members of bargaining POs did not take part in these decisions at all.

* Significant at 10% level.

** Significant at 5% level.

*** Significant at 1% level.

6. Conclusions

Smallholder households join POs to access modern marketing channels. Commercializing farm produce that is traditionally controlled by women often leads to a transfer of control rights to men once households join POs (Johnson et al., 2016; Quisumbing et al., 2015). One could argue therefore that POs contribute to women disempowerment. Using quantitative household data from Kenyan dairy value chains, we contribute to the discussion about PO membership and women empowerment. We find that joining a PO, regardless of who in the household is the registered member, facilitates women

empowerment. Women in member households improve their independent decision-making on agricultural production and independent control over resources, specifically, buying and selling of land and cows, borrowing and use of loans and receiving dairy income. The effects are stronger if the women themselves are members. Our study clearly shows that POs can spur and support women empowerment.

In terms of societal contribution, the observed increase in women's independent control over resources, decrease in men's independent control and the non-significant impact in joint control reflect increased independent responsibilities among member households in the allocation of resources in dairy production. This raises the question of whether increased women's independent control over resources is beneficial for women empowerment or means that women assume the role of providers while men become less involved in this role.

Our other contribution relates to development policy regarding women empowerment in different types of POs. We argue that while woman membership in a bargaining PO improves empowerment, membership in a processing PO fails to challenge traditional gender inequalities in ownership of cows. In these POs, woman membership alone cannot eliminate gender disparities but should be complemented by other interventions that improve men's and women's awareness of women empowerment. There is a need to incorporate the inequalities

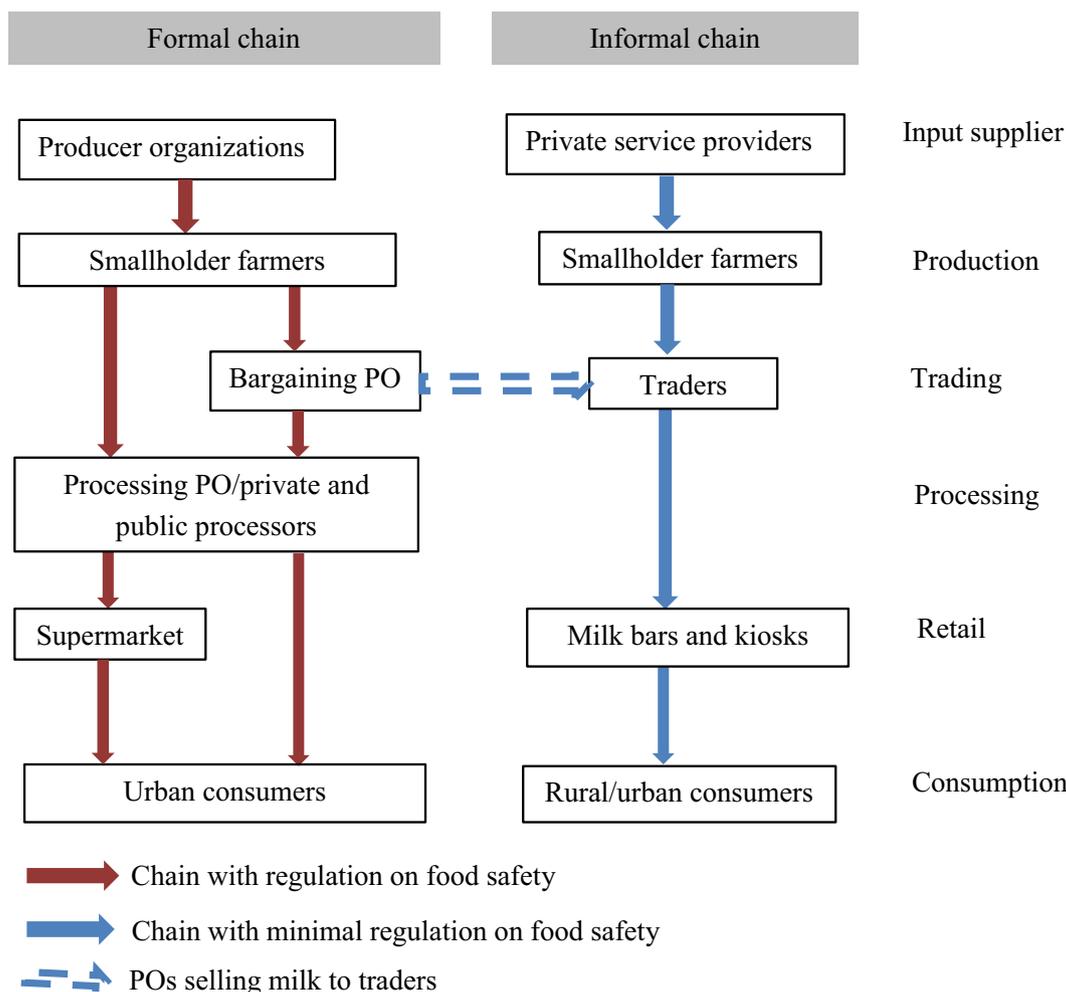
that characterize the household in the implementation of development programs in processing POs, for instance, regarding how men and women share the benefits received through membership. From a research perspective, our findings challenge those analyses that focus too narrowly upon one specific PO model. We argue that rather the type of PO is key to understanding empowerment.

We use a cross-sectional survey approach which provides limitations to our estimation. A randomized control trial of PO membership would allow a rigorous and unbiased evaluation of the impact of PO membership on empowerment.

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Appendix 1. The dairy value chain in Kenya



Appendix 2. Empowerment dimensions, indicators and their description

Dimension	Indicator	Description
1. Decisions about agricultural production	a. Input into production decisions	Who made most decisions on; - (i) buying of dairy inputs, (ii) breeds of cows to be kept and (iii) land use. (0 = man, 1 = woman, 2 = jointly)
	b. Autonomy in production	Who was mostly responsible for managing cow health, milking, cleaning the milking area, cleaning the milking vessels, milk storage, and milk transportation? 0 = man, 1 = woman, 2 = male child, 3 = female child, 4 = male employee, 5 = female employee, 6 = no such activity in the farm
2. Decisions related to nutrition	a. Input into nutrition decisions	Who made most decisions on the amount of milk to be left for home consumption? (0 = man, 1 = woman, 2 = jointly)
3. Access to and control over resources	a. Ownership and control of livestock assets	Who makes most decisions on buying and selling of cows; who owned most of the cows (0 = man, 1 = woman, 2 = jointly)
	b. Ownership and control of land	Who makes most decisions on buying and selling of land; who owned most of the land (0 = man, 1 = woman, 2 = jointly)
	c. Credit access	If any member of the household took a loan or borrowed cash in the past 12 months? (1 = yes, 0 = no)
	d. Control of credit	If yes, who decided on the amount of money to be borrowed?; who decided on how to use the money? (0 = man, 1 = woman, 2 = jointly between man and woman, 3 = male child, or 4 = female child)
4. Control and use of income	a. Control and use of income	"Who received most of the income from the sale of milk?"; "who made most decisions on how the income got from sale of milk was to be spent?" (0 = man, 1 = woman, 2 = jointly)
5. Access to and control of opportunities	a. Access to markets	Who made most decisions on where to sell milk? (0 = man, 1 = woman, 2 = jointly)
	b. Access to training, information, and groups	Who mostly accessed agricultural extension services? (0 = man, 1 = woman, 2 = jointly)
6. Extent of work time	a. Total workload	The person that was most responsible for various dairy farm activities (0 = man, 1 = woman, 2 = male child, 3 = female child, 4 = male employee, 5 = female employee, 6 = no such activity in the farm) A module of detailed time allocation capturing information on a log of the activities carried out in the last complete 24 h

Source: Adapted from the WELI tool (Galiè et al., 2018).

Appendix 3. Decisions related to nutrition

Nutrition	Simple comparison			Entropy balancing
	Member			Non-member
	Mean (SE)	Mean (SE)	t	ATT (SE)
<i>Decision on amount of milk kept for consumption</i>				
Male heads	0.12 (0.32)	0.12 (0.33)	-0.10	0.73 (0.75)
Female spouses	0.66 (0.47)	0.74 (0.44)	-1.84*	-0.44 (0.59)
Jointly	0.21 (0.41)	0.14 (0.34)	2.00**	0.14 (0.70)

t value is the test statistics. ATT is the average treatment effect on the treated; SE is standard error.

* Significant at the 10% level.

** Significant at the 5% level.

Appendix 4. Extent and control of work time

	Simple comparison			Entropy balancing
	Member	Non-member	t	ATT (SE)
	Mean (SE)	Mean (SE)		
<i>Hours spent in dairy farm</i>				
Male heads (n = 267)	4.66 (2.13)	3.64 (1.99)	0.13***	0.16 (0.38)
Female spouses (n = 207)	2.93 (2.02)	2.90 (1.91)	0.03*	0.04 (0.64)
<i>Total workload</i>				
Male heads (n = 267)	8.95 (2.74)	10.18 (2.72)	3.39***	0.66 (0.49)
Female spouses (n = 207)	12.74 (3.80)	11.91 (2.49)	1.82*	-0.42 (0.85)
<i>Total leisure time</i>				
Male heads (n = 267)	11.87 (2.36)	13.35 (2.73)	-4.48***	-0.92 (0.55)
Female spouses (n = 207)	11.02 (2.48)	11.35 (2.11)	-1.04	0.45 (0.46)

t value is the test statistics.

* Significant at the 10% level.

*** Significant at the 1% level.

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