

Women's Empowerment in Agriculture and Child Nutritional Outcomes in Rural Burkina Faso

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Women's Empowerment in Agriculture and Child Nutritional Outcomes in Rural Burkina Faso

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Abstract

Across developing countries, women play an important role both as producers of major food crops and in improving household nutrition. This research paper aims to assess the effect of improving women's empowerment on the nutritional status of children in rural Burkina Faso. Based on data from the 2014 Multisectoral Continuous Survey (EMC), the paper uses variables such as income control, access to land, autonomy in production decisions, access to credit and social group membership to compute a composite index of women's empowerment. Accounting for potential endogeneity of empowerment, the study adopts a dual-estimation approach that, first, uses average empowerment by stratum and, second, applies an instrumental variable. Results show a low baseline level of women's empowerment in rural areas, but an improvement in empowerment has a relatively high and positive correlation with children's nutritional outcomes. The study suggests that improving women's empowerment components will translate into significant gains in children's nutritional outcomes in rural households.

Key words: women, empowerment, agriculture, children's nutrition

JEL codes: D13, I12, Q12

1. Introduction

Policies aimed at improving women's status and reducing inequalities are expected to improve not only women's well-being but also that of their children. Because women are typically responsible for childcare, they have a greater responsibility for and role in their nutritional status (Malapit and Quisumbing, 2014). Women make up almost two-thirds of the agricultural workforce and produce most of Africa's food. However, studies have shown that women own only about 2% of the world's land, or 15% of the land in sub-Saharan Africa (Doss et al, 2013). These figures show that women still have unequal access to land compared to men. This is an impediment especially in areas where agriculture is the main activity. As they are often not the owners of agricultural land, women in agricultural production areas are limited in their production decisions; there is a strong correlation in many societies between the decision-making power of an individual and the quantity and quality of property rights held by the individual (FAO, 2002).

Historically, land is considered the primary source of wealth, social status and power. It is the basis of protection, nutrition and economic activity, is the most important source of employment opportunities in rural areas, and an increasingly scarce resource in urban areas (FAO, 2002). Therefore, women's lack of power over land indirectly leads to a loss of resources in land use. Investment in agriculture is generally seen as an important opportunity to reduce malnutrition (Webb, 2013). Ultimately, better integration of women in agriculture could have beneficial effects on food availability and thus improve nutrition at the household level. Indeed, women's participation in agriculture has the potential to help shift control of household resources to them, which are then more likely to be directed toward child feeding and care (UNICEF, 2019). According to Doss (2011), there is evidence that if women held land in the same proportion as men, they would do as much as men did in terms of production. But they often do not have access to essential inputs such as land, credit, fertilizer, new technologies, and other resources. As a result, they are limited in their agricultural production, which reduces the nutrition availability for the family. In Burkina Faso, women's agricultural productivity is 20%–40% lower compared to men, and these differences are mainly due to lower use of productive inputs (Udry, 1996).

In the literature, four broad areas are identified as the main pathways through which agriculture can influence nutrition (Carletto et al, 2015; Webb, 2013; Hawkes and Ruel, 2008). These broad areas are: (i) food prices, (ii) income from agriculture, (iii) consumption of own production, and (iv) factors linked to gender.

For the authors, the latter include issues such as women's social status and empowerment in agriculture, women's time, and women's health and nutritional

status, all of which can be both influenced by their role in agriculture, and affect their productivity in agriculture and their ability to care for their family and especially their young children. In the same way, for some authors empowering women is one of the ways in which agriculture impacts nutrition (Heckert et al, 2019; Ruel and Alderman, 2013). This research paper focuses on how women's empowerment in agricultural activities could improve child nutrition outcomes in rural households. It then provides empirical evidence on the effect of empowerment on child nutrition outcomes in agricultural households in Burkina Faso.

According to Herforth et al (2012), the burden of malnutrition is threefold. The first is the lack of energy and protein in the diet leading to starvation, reduced learning abilities, illness and premature death. The second is micronutrient deficiency causing deficits, physical and cognitive impairments, anaemia, blindness and weak resistance to various health risks. The last aspect is energy excess in diets causing overweight, obesity and chronic disease. Malnutrition continues to be an important aspect of public health problems and a major contributor to the reduction of economic growth, poverty differentials and the explanation of high rates of morbidity and mortality in developing countries (Pelletier et al, 1995). Malnutrition is estimated to be responsible for more than a fifth of the global disease burden in children under five years of age (Bhutta et al, 2010; Black et al, 2008) and for 45% of the 5.9 million deaths in children under five in 2015 (WHO, 2016).¹ Malnutrition can also harm a child's economic prospects and, as a consequence, broader socioeconomic development in numerous ways (UNICEF, 2019.)

Studies have shown that reducing gender inequality is a significant step forward in addressing the famine problem and improving children's nutrition (Njuki et al, 2016). The reason is that women with better decision-making status are more likely to eat better themselves and thus take better care of their children by giving them higher quality diets. The empowerment of women, especially in agricultural activities, can therefore be used as a catalyst in the reduction of child malnutrition. Thus, women's empowerment is considered crucial for improving nutritional outcomes (Malapit and Quisumbing, 2015; Malapit et al, 2015; Van den Bold et al, 2013; Bhagowalia et al, 2012). For Van den Bold et al (2013), studies using direct and indirect measures of women's empowerment have largely demonstrated the importance of the link between women's empowerment dimensions and their own nutrition and that of their children.

In the same way, Bhagowalia et al (2012) found that in Bangladesh there is a positive link between women's participation in decision-making, their mobility, freedom of movement and attitude towards domestic violence, and the prevalence of stunting and minimum dietary diversity. In the case of Ethiopia, Fafchamps et al (2009) found positive effects of female bargaining power on child nutrition and child education. In India, Shroff et al (2011) found that measures of maternal autonomy (such as financial autonomy, participation in decision-making within the household, acceptance of domestic violence, and freedom of movement) were associated with positive infant feeding and growth outcomes. Deiningner, Goyal and Nagarajan (2013)

show that improving women's likelihood to inherit land improves their children's socioeconomic outcomes in India. By focusing on women's inheritance rights, the authors show that systematic relationships between women's asset ownership and socioeconomic outcomes can emerge due to systematic differences in preferences between males and females. Indeed, the authors' results indicate a robust increase in educational attainment of daughters, suggesting an alternative channel of wealth transfer which could influence household consumption.

The issue of good nutrition is related to other factors such as household poverty status and decision-making issues. In the case of poverty, the level of household income is primarily involved. In rural areas specifically, the main source of income remains agricultural activities. As such, it is a question of examining how farm income can affect the nutritional status of the household and especially that of children. However, only taking income into account is not enough to grasp the complexity of the problem as a person can have a large income but misuse it. As reflected in the triple burden of malnutrition in many countries, income can also be used to purchase processed foods, contributing to malnutrition and overweight or obesity due to the high cost of healthy food or lack of consumer awareness about the importance of a good diet (Ecker, 2019). That is where decision-making comes in.

Studies have shown that an improvement in the decision-making power of women is accompanied by a more favourable allocation of household resources to the benefit of children (Smith et al, 2003; Seebens, 2011; Bhagowalia et al, 2012; Nordman and Sharma, 2016). Pandey et al (2016) report that women's empowerment and dietary knowledge play a crucial role in establishing the relationship between agriculture and nutritional status. Studies show that females attach higher value to family needs or children's welfare and thus devote a higher share of their resources to this, meaning that the extent to which females have control over assets will affect intrahousehold bargaining outcomes (Behrman, 1990; Strauss et al, 2000). I

n countries such as Cameroon, India, Kenya, Malawi and the Dominican Republic, women have been found to consistently devote higher proportions of their income to family needs than men (Strauss et al, 2000). Also, if mothers control a larger proportion of family resources, children tend to do better (Thomas, 1990). In South Africa, for example, pensions received by females rather than males affected girls' anthropometric status (Duflo, 2003). Therefore, the analysis of children's nutrition is simultaneously linked to the level of income and the distribution of decision-making powers in the household.

Objectives

This study assesses the impact of women's empowerment in agriculture on the nutritional status of children in rural areas of Burkina Faso. Specifically, the paper constructs an empowerment index in terms of women's capacity as decision-

making units in agricultural activities and assesses the effect of this index on children's nutrition. The paper assumes that more involvement of women in agricultural production decision-making will improve the nutritional status of children through access to improved food.

Motivation

This study is important due to the relatively high malnutrition level among children in Burkina Faso. Half of the Burkinabe population lives in extreme poverty and has limited access to basic services and health care. Structural food insecurity is exacerbated by high food prices and the recurrent indebtedness of the most vulnerable families. The country faces variable rainfall, land degradation and desertification, which has an impact on its agriculture. For example, despite fairly good harvests in 2014, nearly half of households failed to meet their cereal needs in 2015.² Even if agricultural production supports subsistence livelihoods, more than 3.5 million Burkinabe (20%) are food insecure (USAID, 2018).

The overall nutrition situation in Burkina Faso remains a public health concern with all five indicators of child undernutrition, namely low birth weight, global acute malnutrition, wasting, stunting and underweight, above the WHO thresholds (Ouédraogo et al, 2020). The country faces a double burden of malnutrition, including undernutrition and overweight/obesity (Ouédraogo et al, 2020). Also, many children under the age of five are suffering from acute malnutrition or stunting. In 2018, undernourishment stood at 21.8% and stunting at 27.3% for children under five (Bernstein and Wiesmann, 2019). According to the 2019 National Nutrition Survey, 25.4% of children under five are stunted and 8.1% are wasted (MoH, 2020). Malnutrition is responsible for over one-third of child deaths in Burkina Faso (PNDES, 2016). According to the Global Hunger Index (GHI), in 2018 Burkina Faso faced a serious level of hunger, with a hunger score of 27.7 (Bernstein and Wiesmann, 2019).

Agriculture is a major industry in Burkina Faso, and the majority of agricultural production is for self-consumption. The involvement of women in agricultural activities in Burkina Faso is so important that they form the backbone of the rural economy, and hence of the national economy. Women play a leading role in agricultural production. Despite this important role, they have limited access to land, credit facilities, agricultural inputs, equipment, extension services, markets for their produce, education and training facilities compared to their male counterparts (Wekwete, 2014).

The Government of Burkina Faso adopted the National Gender Policy (Politique nationale genre: PNG) in 2009, which addresses and promotes gender equality. The overall objective of the National Gender Policy is to “promote equitable and participatory development of men and women, as well as ensure access, equal control, equal access to resources, and equal access to the decision-making process, in respect to fundamental rights.” There is also an ingrained division of labour in agriculture in Burkina Faso. Women's main job is to produce food for the family in the family fields

that are owned by men. According to the PNG, 75% of food production for household consumption is produced by women.

This study is relevant for the African context, and specifically for Burkina Faso, as women's empowerment is not only crucial to achieve gender equity, but also to increase agriculture productivity and to reduce hunger and poverty in Africa. In Burkina Faso, as in other neighbouring countries, mothers generally fulfil caregiver roles and manage children's daily activities (Heckert et al, 2019). Assessing the impact of women's empowerment on children's nutrition is particularly important for developing countries like Burkina Faso, where women are major players in the agricultural sector as they are the primary labour force in crop production. Therefore, this study will highlight the role of women in fighting hunger and poverty in agricultural households where they and their children are the most vulnerable. Overall, this paper contributes to the literature linking women's empowerment in agriculture to child nutrition outcomes in developing countries, and in Burkina Faso in particular.

There is little evidence of a link between agriculture and nutrition outcomes in Burkina Faso. To the best of our knowledge, there are only two previous studies, by Belesova et al (2017) and Heckert et al (2019). The first study examines the relationship between household crop harvests and child nutrition in a largely subsistence farming population in rural Burkina Faso (Belesova et al, 2017). However, this study only showed the role of women in household agricultural activities and nutrition, but not the pathway through which agriculture affects nutrition. The second study is the only one on women's empowerment in agriculture and child nutrition outcomes in Burkina Faso. It is an experimental study which evaluates the impact of empowering women through a nutrition-sensitive agriculture programme (Heckert et al, 2019). However, in this study women's empowerment is the intermediate goal of the nutrition programme and does not consider empowerment indicators in agriculture.

Thus, this paper is an extension of previous studies that will provide empirical evidence for the link between women's empowerment in agriculture and children's nutritional status. It does so in two ways. First, it uses a national representative household dataset which will allow the determination of empowerment levels in agriculture. Second, based on the well-known Women's Empowerment in Agriculture Index (Alkire et al, 2013), this paper provides empirical evidence on the accurate effect of empowerment on children's nutrition outcomes in agricultural households in Burkina Faso. The research will, therefore, allow us to test the sensitivity of results based on empowerment measures and country context.

The rest of the study is organized as follows: The second section reviews nutrition policies in Burkina Faso, the third presents the literature review, the fourth presents the data and methodology of the study, the fifth presents the results, and the sixth and last section concludes the study.

2. Women's empowerment, nutrition policies and agriculture

This section focuses on two topics. The first is an overview of nutrition policies in Burkina Faso, and the second is a synthesis of the link between women's empowerment and agriculture.

Nutrition policies in Burkina Faso

Like most African countries, Burkina Faso is dominated by agriculture, which provides the bulk of household income and contributes to food and population nutrition security (PSSAR, 2017). In subsistence farming populations, the agricultural harvest is both a source of food and of income for food purchases (Kaufmann, 2008). As a result, the various development policies and strategies have always given priority to the growth of the agricultural sector and to the improvement of the living conditions of the rural populations involved in this sector. Nutrition and agriculture are taken into account in the different country development plans, such as the Accelerate Growth Strategy for Accelerated Growth and Sustainable Development (SCAAD 2011–2015) and the National Plan for Economic and Social Development (PNDES 2016–2020). The PNDES, which is the most recent country strategic development policy framework, places strong emphasis on rural sector performance improvement with food and nutrition security as the main support (PNDES, 2016).

Agriculture in Burkina Faso employs more than 80% of the population and contributes to 30% of GDP (PSSAR, 2017). Despite this, the country faces recurring food crises and permanent food insecurity. As in most developing countries, the causes of the food crises are both structural and cyclical (Destombes, 2003). In addition, poverty is the main cause of food and nutrition insecurity among populations. In 2014, poverty affected 40.1% of the population of Burkina Faso, with an incidence of 47.5% in rural areas (INSD, 2016). The typical poor household in Burkina Faso lives in a rural area, is employed on a farm, has no or little formal education, and has more than six children. The household income structure is dominated by crop production (67%), followed by livestock production (31%) (PNDES, 2016).³ Agriculture provides 61.5% of the monetary income of farming households (IFAD, 2019).

By analysing the nutrition policy landscape in Burkina Faso, Vanderkooy et al (2019) find that most policies, across almost all policy areas, include nutrition in their general and/or specific objectives. The authors reported 16 nutrition-relevant national policies currently in use in the country. Nutrition is featured most prominently in nutrition, health, and agriculture/food security policies. Thus, all these policies point to the importance of multisectoral coordination (Vanderkooy et al, 2019).

As part of its development plans, the government has implemented a number of policies, strategies and programmes related to agriculture, food security and nutrition. These include the: National Health Development Plan (PNDS 2011–2020); Multisectoral Nutrition Strategic Plan (PSMN 2017–2020); National Food and Nutrition Security Policy (PNSAN 2013–2025); National Nutrition Policy (PNN 2007, PNN 2016); Support Programme for Food and Nutrition Security, Sustainable Agriculture and Resilience in Burkina Faso (PASANAD 2017–2021); and Sustainable Agricultural Intensification Project for Food and Nutrition Security in Burkina Faso (PIDASAN 2018–2021).

To meet the challenge of recurrent food insecurity, at the national level the country adopted and implemented the National Nutrition Policy (PNN) in 2007, which was revised in 2016. The National Nutrition Policy (PNN) spells out the required nutrition-sensitive activities in agriculture, including small-scale irrigation, nutrition education, cultivation of nutritious legumes, and empowerment of women and their organizations through access to land and processing equipment (IFAD, 2019). The PNN enabled the country to make significant progress in reducing malnutrition in 2009 with the establishment of a system for monitoring the nutritional situation through a regular national nutrition survey (ENN), called “rapid survey for assessment of the nutritional status of children under 5”.⁴ Indeed, according to the 2019 ENN, the prevalence of acute malnutrition (wasting or thinness) decreased from 11.3% in 2009 to 8.5% in 2018, and chronic malnutrition (stunting or shortness) decreased from 35.1% in 2009 to 25% in 2018. As for underweight, the national prevalence decreased from 26% in 2009 to 17% in 2018 (MoH, 2020).

Although the management of acute malnutrition or emaciation (severe and moderate) has been a priority for the PNN, the prevention of chronic malnutrition or stunting has always been a challenge for Burkina Faso. In 2013, the country adopted a complementary policy called the National Food and Nutrition Security Policy (PNSAN), which aims to achieve sustainable food and nutrition security by 2025 (PNSAN, 2013). In line with the PNN, PNSAN aims to contribute to the fight against malnutrition in general and, more specifically, to chronic malnutrition. The overall goal is to guarantee equitable access by all people at all times to sufficient quantities of food and a balanced and healthy diet, and to contribute to poverty reduction, social peace and sustainable rural development (IFAD, 2019).

Malnutrition, specifically chronic malnutrition in the context of recurrent food crises, is aggravated by the vagaries of the weather often forcing the country to seek help from development partners, civil society organizations and humanitarian actors. Thus, the Support Programme for Food and Nutrition Security, Sustainable Agriculture and Resilience in Burkina Faso (PASANAD) was set up for 2017–2021 in the form of sectorial budget support and one-off projects aimed at improving the nutritional practices of poor households through a national strategic plan for infant and young child feeding (IYCF).⁵ This would result in actions and investments in favour of irrigated agriculture, small livestock, nutrition education and the provision of local nutritional inputs, in particular to improve food security and the incomes of vulnerable households. The overall goal of PASANAD is to contribute to poverty

reduction in Burkina Faso, through improved governance in the food area, nutrition security and strengthening resilience.

Apart from the nutrition-related policies, the Government of Burkina Faso has implemented a programme for poverty reduction with the support of the World Bank: the Burkina Faso Social Safety Net Project.⁶ This programme is set up for poor households that benefit from direct cash transfers in regions with the highest rates of chronic poverty, malnutrition and food insecurity. The project is designed to help the country to work towards more inclusive economic development that does not leave poor people behind. With an average of nearly eight members in a rural household, about 316,000 people would directly benefit from the project in the East, North, and Center-East regions.

At the international level, in 2011 Burkina Faso joined the Scaling Up Nutrition (SUN) movement, which is based on the principle of the right to food and good nutrition for all. Created to end global undernutrition following the 2008 food crisis, SUN is a global movement comprising 60 countries around the world that seek to end malnutrition in all its forms. SUN, launched in 2010 as a one-of-a-kind movement according to its founders (43 countries worldwide), unites people in a collective effort to improve nutrition and is committed to understanding that good nutrition is the best investment for the future. Governments in different countries set priorities and plans that are supported by different stakeholders, including civil society, the United Nations, development partners, business enterprises and researchers.⁷ After joining the SUN movement in 2011, Burkina Faso Government's commitment to improving their nutrition status has been translated into in-depth policy reforms and several programmes and projects taking a multisectoral approach (Vanderkooy et al, 2019). Thus, a multisectoral strategic nutrition plan (2020–2025) was developed in 2017 and a national food security policy (2017–2021) was endorsed. To expand the nutrition workforce for increasing interventions, a mass nutritionist recruitment policy was launched in 2017 with the aim to position at least one nutritionist in each region (Compaoré et al, 2020). Despite these substantial increases, the nutritional situation in Burkina Faso remains worrying as the situation remains a public health concern (Ouédraogo et al, 2020). According to Ouédraogo et al (2020), even if the country has formulated a number of good policies, strategies and plans, the country is still struggling to implement an effective programmatic response to reduce the burden of all forms of malnutrition. There are huge nutrition gaps in Burkina Faso's food system because agricultural production is not often nutrition sensitive, as agriculture is still traditional and based on subsistence farming with a focus on staple grains (maize, sorghum, rice and beans) rather than on producing a broader range of more diverse and healthier foods (animal foods, fruits, nuts and vegetables) (Ouédraogo et al, 2020).

Empowerment of women in agriculture

A great number of studies show that women in developing countries are at a disadvantage compared to men in terms of land ownership rights (UNECA, 2017; FAO, 2010). Evidence shows that in the majority of African countries, and in about half of Asian countries, women are disadvantaged by statutory and customary laws regarding access to and ownership of land and other types of property (UN, 2010; AfDB, 2015). The gender gap is particularly important in sub-Saharan Africa. Four key factors have been highlighted in recent studies to explain this gap: male preference for inheritance, male privilege in marriage, male bias in community programmes and state distribution of land, and men's bias in the land market (UN, 2010).

Gender inequality is pervasive in Burkina Faso (Malik, 2014). In 2014, Burkina Faso ranked 131 out of 149 countries in the United Nations Development Programme (UNDP) Gender Inequality Index (Malik, 2014), and ranked 147 out of 162 countries in 2019 (UNDP, 2019). Like many developing countries, Burkina Faso is a patriarchal and gerontocratic society influenced by sociocultural constraints (customs, religions, prohibitions). The "sociocultural weight of tradition" is said to be the largest obstacle to gender equality due to the traditionally patriarchal nature of Burkinabe society (Helmfrid, 2004). Evidence also suggests that the implementation of national policies and laws is hindered at the local level by deep-rooted sociocultural norms and practices, and a lack of resources. Nonetheless, women have the potential to actively participate in the country's development in a way that contributes to changing established rules and traditions (The Hunger Project, 2016b).

Women occupy a secondary position in society and are victims of discrimination and social injustices such as excision, levirate and forced marriage (JICA, 2013; Kevane and Wydick, 2001). Because of the patriarchal ideology and sociocultural practices, parents give priority to sons in all respects. These cultural and social norms create a climate where women and girls are discriminated against. Education, caste, religion, marital status, family income and housing conditions are the main factors that affect women's empowerment and development (Kevane and Wydick, 2001). It is traditional to marry young in Burkina Faso, and early pregnancies and births resulting from these marriages pose many problems in, for example, women's health and education, and the promotion of women's socioeconomic position. Also, the tradition of levirate, which requires a widow to marry her belated husband's brother, is still in practice in rural areas. It is recognized that the division between men's and women's work is a deeply ingrained concept in Burkinabe society (JICA, 2013).

In many traditional systems in Africa, women often only have indirect access to land (for example, through their husbands, brothers or fathers), which means they can access and use the land but do not have control over it, and they generally have no property rights (UNECA, 2017; Kevane and Gray, 1999). Women in western Burkina Faso often work on land controlled by men, but rarely exercise direct control over their land (only in exceptional circumstances). However, while married women from certain ethnic groups (for example, the Mossi) cultivate plots independently of their

husbands, and exercise considerable control over what is planted as well as the income from these plots, women from other ethnic groups, such as the Bwa and Lobi, have lesser access rights, which shows the significant difference between ethnic groups in the country (Kevane and Gray, 1999).

Several empirical studies have shown that redistributing inputs between men and women in the household can potentially increase productivity (Kilic et al, 2013; Peterman et al, 2010; Udry et al, 1995). There is also considerable evidence that increased maternal control over resources improves children's outcomes, particularly in nutrition and education (Quisumbing, 2003; Quisumbing and Maluccio, 2003). This has been recognized and reflected in discussions held at the United Nations in the 2030 Agenda for Sustainable Development report (United Nations, 2017). Sraboni et al (2014) find that improvements in women's empowerment are positively associated with caloric availability and dietary diversity within the household. Hence, there is a need to create well-targeted policies that will help women farmers increase yields and feed more hungry people.

On the whole, women make up the majority of the extreme poor in Burkina Faso (Helmfrid, 2004) making them the most vulnerable in rural areas. The typical poor household in Burkina Faso is in a rural area, with members employed on a farm with no or little formal education, and the household has more than six children. The household income structure is dominated by crop production (PNDES, 2016) and agriculture provides 61.5% of the monetary income of these households (IFAD, 2019). Two-thirds of all food produced is for direct household consumption, usually through small-scale subsistence farming (The Hunger Project, 2016b). Households dependent on food crop production as their primary income source spend the highest portion of their budgets on food purchases compared to households whose main income source come from other livelihood activities (Murphy et al, 2017). As a result, livelihood type is a potential indicator of poverty, considering that those who depend on earnings from staple crop production spend the highest proportion of their monthly expenditure on food (75%) compared to those with other primary livelihoods (WFP, 2014).

3. Literature review

The literature review focuses on three areas: first is the relationship between women's empowerment and child nutrition, second is the link between agricultural productivity and nutrition and, finally, an overview of the measures of women's empowerment.

Effect of women's empowerment on children's nutrition status

According to Doss (2002), gender often comes up in discussions about agricultural development programmes either through distinguishing between male-headed or female-headed households, or between men's and women's cultures. According to Doss (2002), it is often held that men are responsible for cash crops while women are responsible for subsistence crops. This demarcation shows that women and men do not have the same preferences in terms of crop choice. This is all the more reason why gender should be considered in analyses, as these cultural choices can strongly influence the nutritional status of the household. For Gillespie and Van den Bold (2017), malnutrition can be seen as the result of dysfunction in interactions between different systems such as agro-food, environment, health and, crucially, decision-making of individuals and households.

Across sub-Saharan Africa agriculture is the backbone of the economy, accounting for 30 to 40 per cent of countries' gross domestic product, and acting as a major source of employment for more than two-thirds of the population. Improving the productivity, profitability and sustainability of agriculture on the millions of farms that cover the African continent is essential to ending poverty and fostering shared prosperity in the region. Although women make up a large share of African farmers they are, for the most part, limited in land ownership, access to credit and productive agricultural inputs (O'Sullivan et al, 2014). This causes women, on average, to have lower productivity compared to men, which has an impact on their families, especially in terms of food availability.

Women's empowerment is considered crucial for improving nutrition outcomes. Since women are often the primary caregivers, they can influence their children's nutrition indirectly through their own nutritional status as well as directly through childcare practices (Bhagowalia et al, 2012; Smith et al, 2003). Several studies (using direct and indirect measures of female empowerment) have demonstrated the important associations between women's empowerment dimensions and their own nutrition, as well as that of their children.

According to Aitatie (2014), nutritional status is the manifestation of factors such

as access to and distribution of food in the household, availability and use of health services, and childcare. Given that women are more willing to take care of children in the household, they could be considered an effective lever for achieving good nutrition for children. Several studies have explored this by demonstrating the crucial role that women can play in the nutritional health of their children. It is in this sense that Branca et al (2015) note that good health and the nutritional status of women are essential for the good nutrition of children.

Using Ghanaian data, Malapit and Quisumbing (2014) constructed indexes of women's empowerment on several aspects of household decision-making and indicate that, in general, women's empowerment is strongly associated with child feeding practices and weakly associated with child nutrition status. These authors also find that women's power over credit improves the diversification of women's diets, but not their body mass index. The results suggest that different domains of empowerment may have different impacts on nutrition. The implication of these results is that empowering women in different areas can have various effects on household nutrition. Malapit et al (2015) developed an indicator of women's empowerment in Nepal to investigate whether women's empowerment interacts with agriculture outcomes in influencing maternal and child nutrition. They found that women's engagement in the community, control over income, reduced workload, and the overall empowerment score are positively associated with better maternal nutrition. Control over income is associated with better child height-for-age z-scores (HAZ), and a lower gender parity gap improves children's diets and HAZ. The authors' results suggest that women's empowerment has greater potential to improve nutrition outcomes in households with less diverse production.

According to the findings of Aitatie (2014), differences in the nutritional status of children appear when their areas of residence are taken into account. In the case of Ethiopia, this author found that children in rural areas suffer more from malnutrition than those in urban areas. This result leads to a questioning of the causes of such disparities when it is known that rural areas are supposed to be better supplied (in terms of quantity) with food. In fact, urban areas have been shown to have better quality food and higher dietary diversity levels. Also, in rural areas and for poor households, access to some services such as adequate health care, water and sanitation is poor. Carletto et al (2015) suggest that while agricultural income is important for rural households, it is not sufficient to improve nutrition, especially among poor farming households who lack access to other essential inputs to improve nutrition such as access to preventive and curative health services, and adequate water, sanitation and hygiene services. According to Aitatie (2014), to improve the nutritional status of children living in these areas, it is necessary not only to set up intervention mechanisms, but also to aim at empowering women by improving their decision-making powers in all aspects. In the same vein, Smith et al (2003) report that there has been sufficient interest in the causes of malnutrition and ways to reduce it, but the role of women in the nutritional status of children has often been ignored. Thus, these authors show unequivocally that the integration of policy aspects aimed at

improving the status of women in intervention policies against malnutrition produces better results. As a result, improving the status of women is a powerful way to improve the health, longevity, and physical and mental abilities, and also the productivity of future generations of young adults.

But the problem of malnutrition is not directly related to decision-making problems in the household. For example, authors like Iannotti et al (2012) assume that increased poverty and rising food prices could reduce the consumption of high-quality food commodities, leading to a likely mismatch in terms of several nutrients. These authors demonstrate that while income and food prices influence nutrients in diets differently, income remains an important determinant of good nutrition. In such a context of budgetary constraint, one could highlight studies that have shown that an increase in women's income has more of an effect on the well-being of children than an increase in men's income. In other words, if the woman has the decision-making power or is involved in making household consumption decisions, she will direct them towards more beneficial expenditures for the children. Following this, Schmidt (2012) emphasizes that an increase in the decision-making power of women is accompanied by a shift in spending towards goods that support children's welfare functions. In the same vein, Olney et al (2016) show that agricultural and nutritional programmes that target women or mothers of children contribute to improving the nutrition of these women as well as their empowerment. This strengthens their ability to take care of children.

Agricultural productivity and nutrition

Following the findings of Kiresur et al (2010), agricultural productivity significantly reduces rural poverty, and rural poverty determines the level of food security. In other words, agricultural productivity affects nutrition through poverty reduction. It is recognized that the relationship between agriculture, health and nutrition is bi-directional (Dury and Bocoum, 2012). As agricultural households are essentially consumers of their own production, agriculture has an effect on members' health and nutrition through the products they produce. This effect is equally observed in the quantity, diversity and accessibility of products, sanitary quality and nutritional composition. Health and nutrition also have an effect on agriculture through the work capacity of more or less well-fed people. It is in this sense that Haddad (2000) and Hawkes and Ruel (2006) encourage more consideration of these agriculture-health/nutrition relations for the implementation of agricultural or health policies. Thus, sustainable agricultural growth is generally effective in reaching the poor as most of the poor and undernourished live in rural areas and depend on agriculture as a major part of their livelihoods (UNSCN, 2014).

Baiphethi and Jacobs (2009) point out that smallholder food production could play a key role in reducing the vulnerability of rural and urban households to food insecurity, improving standards of living, and helping to control high inflation in food

prices. As a result, a household's food security will depend on its income and assets, such as land and other productive resources. In their study of Swaziland, Panin and Hlope (2013) find that subsistence agriculture can guarantee food security among farm households. Ambagna et al (2012) find a positive relationship between food production and food security in Cameroon. However, in their study of Mali, Dury and Bocoum (2012) suggest there is a paradox in the link between productivity and nutritional health. Indeed, while agricultural production has grown and poverty has decreased, malnutrition rates remain surprisingly high. For the authors this is due to inadequate food consumption. Their results suggest that child stunting is linked to less diversified food consumption and probably a lack of care, because of an oversupply of agricultural labour (Dury and Bocoum, 2012).

In the case of Burkina Faso, Belesova et al (2017) examine the relationship between household crop harvests and child nutrition measured by MUAC (mid-upper arm circumference) in rural subsistence farming populations. The authors find that low per capita household crop production is associated with poorer nutritional status of children in a rural farming population. However, Ouédraogo et al (2020) point at poor infant and young child feeding (IYCF) practices as the key drivers of child stunting. Also, because agriculture is still traditional and subsistence farming focuses on staple crops rather than diverse and healthier foods, agricultural production in Burkina Faso is often not considered nutrition-sensitive. As a result, malnutrition remains pervasive in most agricultural households in the country.

Overview of women's empowerment measures

Kabeer (2001) defines empowerment as "the expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them". Malhotra et al (2002) emphasize two elements important for understanding empowerment: process and agency. First, empowerment as a *process* involves change from a condition of disempowerment and denial of choice to one of empowerment. Second, agency means that "women themselves must be significant actors in the process of change that is being described". In other words, agency is the "ability to define one's goals and act upon them" (Kabeer, 1999). According to Van den Bold et al (2013), because processes of empowerment and the exercise of agency cannot be easily observed, proxy indicators are most commonly used in the literature to measure women's empowerment. There are various dimensions along which women can be empowered (economic, sociocultural, familial, interpersonal, legal, political and psychological) and also different levels at which empowerment can occur: household and community, as well as national, regional and global (Malhotra et al, 2002).

In this conceptualization, individual- and household-level indicators are more related to direct measures than those at the aggregate level, such as national and regional, which are more related to indirect measures (Van den Bold et al, 2013). The main indirect measures of empowerment most frequently cited in the literature

include: education (for example, female enrolment rate in secondary school, maternal education and female literacy); status in the labour market (labour laws, female labour force participation, gender wage differentials and women's share of earned income); legal framework (such as property rights law, marriage and family laws, inheritance law and labour laws); marriage and kinship (e.g., whether marriage is endogamous or exogamous, age difference between spouses, family structure and number of children); land ownership (proportion of women who own land according to legal or customary tenure systems, control over income generated from land and legal reform on inheritance laws); social norms (women's physical mobility); and political representation (proportion of seats in parliament held by women).

These indirect measures may not always translate into women's empowerment. At the individual and household level, there are attempts to measure women's empowerment more directly through the following (van den Bold et al, 2013): participation of women in household decision-making (economic decisions such as expenditure, spending and resource allocation, and social and child-related decisions, i.e., about schooling, health and nutrition); women's access to or control over resources (access to or control of cash, assets, household income, unearned income, and participation in paid employment); women's freedom of movement and mobility; power relations between husband and wife; spouses' attitudes towards domestic violence, and sources of power such as media exposure, education, or paid employment.

For Malhotra et al (2002) this means a causal relation between these measures or proxies and empowerment. The authors conclude that as causality is often ambiguous, these measures are better defined as correlates or indirect measures of empowerment; where causality is clear, they may be defined as determinants or direct measures of empowerment (Samman and Santos 2009; Malhotra et al, 2002).

Women play a crucial and potentially transformative role in agricultural growth in developing countries, but they face persistent constraints and barriers that limit their inclusion in agriculture (IFPRI, 2012). This means that they do not have a priori the same level of decision-making autonomy as men. Empowerment in agriculture occurs when a person: (i) has the resources and opportunities to participate in productive agricultural activities; (ii) has a role in decision-making regarding agricultural production management; and (iii) receives and controls the benefits and returns on investment from agricultural efforts.

A specific index was developed to measure the empowerment of women in agriculture, the Women's Empowerment in Agriculture Index (WEAI). The WEAI is a survey-based tool co-developed by the International Food Policy Research Institute (IFPRI), the Oxford Poverty and Human Development Initiative, and the U.S. Agency for International Development (USAID) (Alkire et al, 2013). The WEAI is a new index designed to measure the empowerment, agency and inclusion of women in the agricultural sector. This index was originally designed as a monitoring and evaluation tool for the U.S. government's Feed the Future initiative to directly capture women's

empowerment and inclusion levels in the agricultural sector (Alkire et al, 2013).

The WEAI is an aggregate index based on individual-level data collected by interviewing men and women within the same households. It has two sub-indexes: the five domains of empowerment (5DE), shown in Table 1 (Alkire et al, 2013), and the gender parity index (GPI). The first sub-index, 5DE, assesses the degree to which women are empowered in five domains: (1) agricultural production decisions; (2) access to, and decision-making power over, productive resources; (3) control over use of income; (4) leadership roles within the community; and (5) time allocation. The second sub-index, GPI, measures the percentage of women whose achievements are at least equal to those of men in their households and, for women lacking parity, the relative empowerment gap with respect to the male in their household (Alkire et al, 2013). Both these indexes have values ranging from 0 to 1, with higher values reflecting greater empowerment. The overall WEAI is a weighted average of the 5DE and GPI, with weights of 0.9 and 0.1, respectively. A woman is defined as empowered if she has adequate achievements in four of the five domains, or has achieved adequacy in 80% or more of the weighted indicators.

Table 1: Components of women's empowerment in agriculture

Domain	Indicator	Definition of indicator	Weight
Production	Input in productive decisions	Sole or joint decision-making over food and cash crop farming, livestock and fisheries	1/10
	Autonomy in production	Extent to which respondent's action reflects his or her own values rather than a desire to please others or avoid harm	1/10
Resources	Ownership of assets	Sole or joint ownership of major household assets	1/15
	Purchase, sale or transfer of assets	Whether respondent participates in decisions to buy, sell or transfer assets	1/15
	Access to and decisions about credit	Access to and participation in decision-making about expenditures	1/15
Income	Control over use of income	Sole or joint control over income and expenditures	1/5
Leadership	Group member	Whether respondent is an active member of at least one economic or social group	1/10
	Speaking in public	Whether respondent is comfortable speaking in public concerning issues relevant to them or their community	1/10
Time	Workload	Allocation of time to productive and domestic tasks	1/10
		Satisfaction with time for leisure activities	1/10

Source: Alkire et al, 2013

The index is a relevant tool for tracking progress toward gender equality as one of the Sustainable Development Goals (IFPRI, 2012). The WEAI is very practical as it

shows, for example, women who are under-empowered in one domain, and comparing them to women who are under-empowered in three domains. This property of the index makes it possible to know the key dimensions on which interventions could be carried out.

Since the original WEAI was released, multiple versions have been developed. The Abbreviated WEAI (A-WEAI) is a shorter version of the original that can be used in population-based surveys to measure women's empowerment (Malapit et al, 2015b). The pro-WEAI is a project level WEAI; it is a WEAI adapted to meet the need for monitoring projects and assessing their impact. Indeed, the Project WEAI (Pro-WEAI) instrument seeks to measure women's empowerment within project-specific contexts, and includes optional modules tailored to livestock and/or nutrition and health programmes (Yount et al, 2019; Malapit et al, 2019).

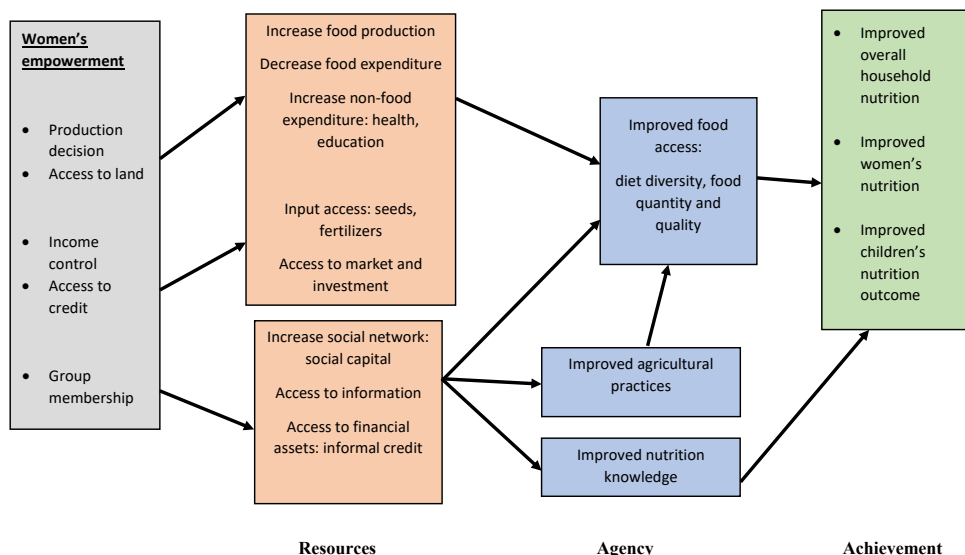
Furthermore, in 2016 The Hunger Project (THP) constructed a Women's Empowerment Index (WEI) for eight countries, including Burkina Faso.⁸ The WEI is built on the Women's Empowerment in Agriculture Index (WEAI), which was developed by the International Food Policy Research Institute. The WEI is a composite index designed to measure progress in the multi-dimensional aspects of women's empowerment. Empowerment is considered a factor in both women's achievements and in gender parity with men. The WEI measures women's empowerment by aggregating results across five domains: time, resources, leadership, agency and income (The Hunger Project, 2016a). THP considers a WEI score to be "high" if it is over 80%. WEI indicator scores are on a scale of 0-10, with 10 being the highest level of empowerment. The WEI scores show that Burkina Faso lags behind the other countries (The Hunger Project, 2016a). Indeed, for income, leadership and resources, the country's score is among the lowest. Also, for business ownership and operating business indicators, Burkina Faso has the lowest scores (The Hunger Project, 2016b).

To mobilize communities in countries, THP uses the "Epicenter Strategy" (an approach created in Africa by Africans). This Strategy unites people in neighboring villages to form a central hub called "epicenter" where community members can access resources that meet their needs, including health, education, and microfinance services (The Hunger Project, 2016b).

The Hunger Project has been working in Burkina Faso since 1997 and empowers community partners in 15 epicentre areas to help end their own hunger and poverty.⁹ The Hunger Project works through 10 key programmes: nutrition, education, women's empowerment, environment, microfinance, health, community mobilization, agriculture and food security, maternal health, and clean water and sanitation (The Hunger Project, 2016b). THP believes that empowering women to be key change agents is an essential element in achieving the end of hunger and poverty.

Conceptual framework

The framework shows how women’s empowerment in agricultural activities could improve nutrition outcomes within households.



Source: Authors' compilation

According to the framework, empowering women can affect children’s nutrition outcomes through different pathways. The framework shows that women’s access to land and credit, their control over income and production and their membership in an association enable nutrition improvements for women themselves as well as for the overall household. When a woman has more input in productive decisions and autonomy in production, as well as more ownership of assets such as land, they can not only improve food production and, consequently, access to food, but also the income that is obtained from food production. Increases in food production should lead to increased food availability, access and, ultimately, food intake (Hawkes and Ruel, 2008).

The result is a positive effect on a child’s diet, which has a positive effect on a child’s nutritional status. It is expected that when women have more control over the use of income and access to credit, it means that they would spend more money on both food and non-food expenditure. Indeed, cash controlled by women is more likely to be used to purchase food (Quisumbing and Maluccio, 2003), but also, more income also means more non-food expenditure, and therefore more money for health care and education (Santoso et al, 2019).

When women have control over income, they more frequently use it to buy food and health care for the family, especially for children (UNICEF 2011; Smith et al 2003). Also, if agricultural income accrues to household members more concerned with diet quality and nutrition, it may lead to more spending on goods and services linked to

nutrition outcomes (Quisumbing, 2003). Therefore, this can lead to a healthier diet and a better health status for the child. Lastly, a social group is believed to have a positive influence on women regarding caring capacity and practices. In a social group, women can benefit from more information on agricultural activities and knowledge of good practice, which may help them develop their abilities in farming and nutrition. Therefore, according to Hawkes and Ruel (2008), programmes with components devoted to educating beneficiaries and informing them about the nutritional qualities of the foods they produce and consume have better nutritional outcomes than those that do not. Also, a social group might lead a woman to participate in a lending and savings group, increasing the availability of cash for her household (Santoso et al, 2019). This results in better food security and the availability of higher caloric foods for the household, specifically for children.

4. Methodology and data

To assess the impact of women's empowerment on child nutrition, a precise measure of women's decision-making power is needed, on the one hand and, on the other, a measure of children's nutrition. First, the data source is discussed.

Data source

This research uses data from the 2014 Continuous Multisectoral Survey (EMC) conducted by the National Institute of Statistics and Demography (INSD) of Burkina Faso.¹⁰ The EMC is nationally representative of households (agricultural and non-agricultural). A two-stage stratification procedure was used as sampling technique to select more than 10,000 households from around 900 enumeration areas in all 13 regions of the country. The EMC collected a wide range of information on households and individuals, including household demographics, food and non-food expenditures, food security, agricultural production (such as land tenure, inputs costs and fertilizers), the economic situation of households, the occupational situation of persons over 15 years of age, possessing assets, access to information and communication technologies (ICT), health, education, savings and access to credit, access to social services (clean water and electricity) and anthropometric information on children under five. As empowerment in the agricultural sector is measured in this study, we restrict our sample to farm households in rural areas with a woman present and with complete information on children's anthropometrics. This prevents the potential misclassification of individuals as empowered or not when they do not belong to agricultural communities (Malapit et al, 2015a).

Measurement of women's empowerment in Burkina Faso agriculture index

Several authors have highlighted the fact that empowerment is a multidimensional concept, and a complex process that can be interpreted differently as women empowered in one dimension are not necessarily empowered in others (Sharaunga et al, 2019; Bayissa et al, 2018; Pradeep and Deeksha, 2016; Malhotra et al, 2002). A review of the literature on women's empowerment shows that there is no agreement on the variables to be considered in measuring the degree of women's empowerment. Thus, variables ranging from participation in household decisions to those capturing violence

are taken into account. The framework proposed by Golla et al (2011) incorporates elements such as women's participation in activities, improving women's level of control over household resources, the degree of mobility, autonomy and responsibilities related to women such as the number of hours devoted to domestic work, the sharing of domestic duties and gender discrimination in relation to jobs. Hunt and Samman (2016) consider education, skills and training, access to quality employment, unpaid work, access to property and financial services, collective action and leadership and social protection as factors directly impacting women's empowerment. These various proposed measures are essentially aimed at the economic empowerment of women. Considering the work of authors such as Lépine and Strobl (2013) and Arulampalam et al (2016), we use factors such as decisions concerning health care, visits to women's relatives, purchases, management of the husband's income, and the ability to make independent decisions as measures of empowerment. In the same way, Bhagowalia et al (2012) focus on women's participation in decision-making, their mobility, freedom and attitude towards domestic violence. This shows the diversity of empowerment measures used in the literature.

In this study, we base our choice of variables on two criteria: the availability of data and the common variables in the literature (Alkire et al, 2013; Lépine and Strobl, 2013; Arulampalam et al, 2016; Bourdier, 2019). Given that the study specifically addresses the rural environment, with a particular emphasis on agricultural activities that constitute a main occupation, we adopt a measurement approach that is consistent with the Women's Empowerment Index in Agriculture (WEAI) proposed by Alkire et al (2013). The difference between our approach and this index is that we focus more directly on empowerment indicators rather than dimensions. Based on a set of questions presented in Appendix 5, we therefore consider five variables as indicators of empowerment: (i) control of production decisions; (ii) access to land; (iii) control over income; (iv) access to credit; and (v) social group membership. As presented in Table 2, a woman is defined as empowered if she has adequate achievement in four of the five indicators or has achieved adequacy in 80% (4/5) or more of the weighted indicators. These variables emphasize the degree of women's responsibility not only in agricultural activities, but also in the decision-making process within the household. These two components (activities and decisions) provide a broad view of the decision-making power of women and go beyond the mere participation of women in agriculture. Given the plurality of indicators, we chose to adopt a dual measure of empowerment. The first measure combines the variables into a composite index. The second step, as a robustness check, is to independently use these indicators to establish their individual effect on children's nutrition.

Table 2: Indicators of women's empowerment used in the study

Indicator	EMC variables used	Modalities
Production decision	Woman decides on agricultural production activities	Yes, No
Access to land	Woman uses and/or owns land for production	Yes, No
Control over use of income	Woman has control over at least one type of income	Yes, No
Access to credit	Woman had credit from a financial institution/informal source in the last twelve months	Yes, No
Group member	Woman participates in a social group	Yes, No

Source: Authors' compilations from EMC 2014 data

Like Lépine and Strobl (2013), we used Multiple Correspondence Analysis (MCA) data to generate a women's empowerment index, taking into account the five variables presented in Table 2. MCA is more suited to discrete or categorical variables (our five variables are categorical) (Booyesen et al, 2005; Burger et al, 2006). Also, MCA makes fewer assumptions about the underlying distribution of indicator variables (Booyesen et al, 2005), i.e., MCA imposes fewer constraints on the data (Greenacre and Blasius, 2006). However, we use more detailed modalities on empowerment indicators to add heterogeneity to the index and make it more precise. For example, for the indicator production decision we have three modalities: no control, individual control and collective control denoting, respectively, that a woman has no control over production, a woman alone controls production, and a woman controls production alongside other family members. Details of the modalities of empowerment indicators and the MCA results are presented in Appendix 1. The empowerment index is constructed as a variable named "empowerment" using the Burt matrix approach on five categorical variables. Appendix 1 shows that access to land and control over production are variables that count the most in empowerment, while group membership contributes much less. Our aim is to determine how the level of empowerment affects children's nutrition.

Measurement of nutrition outcomes

The nutritional outcome of the child is measured by nutritional status. In general, two types of surveys can be used to assess the nutritional status of a population: consumption or food expenditure surveys, and anthropometric surveys. Although useful for finding deficiencies of certain nutrients that may affect children's growth, household food consumption surveys (by weighting) are rarely used because they are labour intensive and imprecise. Household food expenditure indicates average consumption per household member, which is an abstract figure. The figure does not indicate the actual consumption of each individual because the researcher does not know the distribution of food between household members. By contrast, anthropometric measures are simple statistical indicators that have the advantage of considering each individual. Indeed, an anthropometric measure is a variable that accounts for changes in the body size of any specific individual.

The main anthropometric indicators commonly used to assess a child's nutritional status are "height-for-age", "weight-for-height" and "weight-for-age". Anthropometric indicators are used because they are a good general measure of child health (De Onis et al, 1993). To measure the prevalence of malnutrition in children, there are three different systems by which a child or a group of children can be compared to the reference population: Z-scores (standard deviation), percentiles, and percent of median (De Onis and Blössner, 1997). These measures indicate whether a child is suffering from malnutrition or chronic and acute illness. In this study, the z-score indicator is chosen in order to comply with the recommendations of the World Health Organization Growth Standards (WHO, 2006). Also, the z-score (or standard deviation) is widely recognized as the best system for analysing and presenting anthropometric data because of its advantages compared to other methods, and it constitutes the most appropriate descriptor of malnutrition and health (De Onis and Blössner, 1997).

The universal reference threshold value of "-2 standard deviation units (SD)" is used as the delimitation measure to separate malnourished children from those who are not malnourished. According to the WHO's conventional definition of child malnutrition, children are not considered malnourished when the indexes are between -2SD and +2SD. However, when indexes are below -2SD, children are malnourished and when indexes are below -3SD, malnutrition is severe. Children are considered overweight or obese when the z-score index is greater than +2 standard deviations (+ 2SD).

This study includes all indicators, namely the weight-for-height (short-term indicator) index, the height-for-age (long-term indicator) index and the weight-for-age (composite indicator) index to analyse the nutritional status of children under five in Burkina Faso. These indicators are calculated using the 2006 WHO Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006). Thus, a child is defined as stunted if their height-for-age z-score (HAZ) is 2 or more SD below the median of the reference group. When the weight-for-height z-score (WHZ) is two or more standard deviations below the median of the reference group, the child is defined as wasted. For the weight-for-age z-score (WAZ), a child is defined as underweight if their WAZ is two standard deviations below the median of the reference group. Therefore, low HAZ is an indication of chronic malnutrition (shortness), low WHZ is an indication of acute malnutrition (thinness), and low WAZ indicates a combination of both chronic and acute malnutrition.

Estimation and identification strategy

To assess the impact of women's empowerment in agricultural activities on the nutritional status of children, we estimate a model of the following form:

$$Y_{ij} = \beta_0 + \beta_1 E_j + \beta_2 H_j + \beta_3 M_j + \beta_4 C_{ij} + \varepsilon_{ij} \quad (1)$$

where E_j is the empowerment index in agriculture for each woman in household j ; Y_{ij} represents the nutrition outcome for child i in household j including height-for-

age (HAZ), weight-for-height (WHZ) and weight-for-age (WAZ) z-scores. and then three separate regressions are run for each nutrition outcome; household j characteristics (H_j); woman in household j characteristics (M_j); and child's characteristics (C). β_0 is the constant term which captures other factors and the error term is $\varepsilon\varepsilon$, which is assumed to be uncorrelated with all regressors. Household characteristics include household size, gender, age and literacy of the household head, food expenditures, number of crops produced, and whether the household has access to clean water or sanitation. Women's control variables include age and age squared, education and literacy, and marital status. Children's characteristics include age and age squared, gender and birth type (single or multiple).

Equation 1 allows us to test the robustness of the effects. We run the same regression (sub-regressions) using each empowerment indicator to check the difference in results compared to the unique empowerment index (E). These equations can be estimated by a simple ordinary least squares (OLS) method. However, there is a chance that the estimate may be biased by different sources. We examine this possibility in two cases.

First case: Cluster effect

There may be unobserved factors that are common to the strata that may influence the outcome variable, which is nutritional status. As a result, the effect could be biased. In this case it is appropriate to consider the effect of clusters in the estimation, as Cameron and Trivedi (2005) recommended. This procedure is used for the estimation of models to have robust estimators.

Second case: Endogeneity of empowerment measure

This case examines the potential endogeneity of women's empowerment as one possible source of bias in estimating Equation 1. Indeed, empowerment is likely to be affected by the very same factors that influence children's nutrition (Malapit et al, 2015a; Malapit et al, 2018). According to Lépine and Strobl (2013), there are at least two explanations for the likely endogeneity of empowerment. The first is that women's decision-making power could be associated with healthy children if mothers with better intrinsic characteristics have the most independence. In this case, the effect of empowerment could be overdetermined. By contrast, the second explanation assumes that if "neglected women" are more autonomous, the high degree of subsequent empowerment may be associated with poor nutritional health for children. In this case, the effect of empowerment would be underestimated (Lépine and Strobl, 2013).

Given the possibility of an endogeneity bias, two solutions can be envisaged. The first solution is to use the technique by Strauss (1986). This technique consists of building an empowerment indicator that assigns average values of empowerment to all women in the same stratum. This circumvents the endogeneity that would come from an individual measure of empowerment. The second solution is the use of instrumental variables with the risks of validity and robustness of instruments. For

Malapit et al (2015a) estimating using a standard instrumental variable (IV) technique allows to correct for potential endogeneity bias. The present study attempts these two techniques to correct for potential endogeneity bias.

We estimated Equation 1 using the OLS method with the average empowerment index by stratum as empowerment measure to take account of the external effect at the community level. This is because a woman who could be considered less empowered individually, but living in a community where women's empowerment is high, will benefit from this externality. We also attempted to address the potential endogeneity bias with standard IV techniques.

According to Wouterse (2016), one may use instrumental variable methods to obtain consistent estimates in the presence of endogeneity. Thus, the instruments that the researcher uses must be sufficiently correlated with the empowerment variable, but not correlated with the nutrition outcome. In their study, Malapit et al (2015a) use human resources brought to the marriage as instruments, including age and education. For these authors, human capital is a useful indicator of bargaining power because it reflects the empowerment of individuals more broadly in the productive sphere. Following Sraboni et al (2014), we use the difference in age between spouse and the household head as instrument. For Sraboni et al (2014), the difference in age is likely to be correlated with women's empowerment and is exogenous to the period decisions regarding children's nutrition. The difference in age reflects differences in human capital between the primary female and her spouse, and therefore reflects the relative bargaining power of a woman within a household (Quisumbing and Hallman, 2005).

Descriptive statistics

This section presents the descriptive statistics of selected variables used in this study. Table 3 shows that, on average, an under five child in Burkina Faso is 29 months old, and 39% of children are under two years of age. In addition, 49% of children are female, and over 80% are the son or daughter of a household head. Table 3 shows, on average, a z-score of -1.071 for the long-term indicator height-for-age and -0.299 for the short-term indicator. About 28% of children are stunted, 9% wasted and almost 16% are underweight. Table 3 also shows that 42.3% and 21.1% of children, respectively, are enrolled in a growth and a nutrition programme.

Households are large, with a mean household size of 11 members and a maximum of 53 members. Fewer than 5% of households are headed by a woman, and 75% of household heads are not literate. On average, rural adults have a low level of education. While a household head would have spent fewer than two years at school, women had less than one year of schooling. On average, over 60% of households have access to clean water, but only 5% have access to sanitation. Households spent 55% of their total expenditures on food. Over 90% of households used local seed to produce, on average, five crops per plot and, on average, households have four plots for cultivation. However, 75% of these plots are used by households to produce only one crop for

consumption. The main crops produced by households are sorghum, millet, maize, cowpeas, peanuts and cotton. While cereals are food crops in Burkina Faso, cotton and peanuts are considered cash crops.

Table 3 shows that women are more empowered on certain variables and less on others. Table 3 shows that production decisions contributed most to the empowerment of rural women, while access to credit contributed the least: 87% of women had made decisions about agricultural production and about 42% of women controlled at least one source of income, while less than 5% had access to credit. While 20% of women participated in a social group, only 9% had access to and/or owned land. However, Appendix 1 shows that production control (42%) and access to land (44%) contribute more to the empowerment index from the MCA computation. Appendix 2 reveals that production control and access to land contribute to the empowerment of women who are head of a household, spouse and other relative. While the income contribution is higher for a head of household (18.4%), access to land contributes more to empowering a spouse (46.4%) and other women (41.7%) in a household.

Table 3: Summary statistics for selected variables

Variable	Obs.	Mean	Std. dev	Min	Max	Definition
Nutrition outcomes						
HAZ	6,443	-1.071	1.771	-6	5.93	Height-for-age z-score
WHZ	6,443	-0.299	1.414	-5.68	5.85	Weight-for-height z-score
WAZ	6,443	-0.827	1.266	-5.9	6	Weight-for-age z-score
Stunted	6,443	0.278	0.448	0	1	1 if HAZ<-2
Wasted	6,443	0.091	0.288	0	1	1 if WHZ<-2
Underweight	6,443	0.155	0.362	0	1	1 if WAZ<-2
Empowerment indicators						
Empowerment score	5,710	1.648	0.853	0	5	Women empowerment score generated
Empowerment index	6,443	-0.033	0.983	-0.88	5.06	Women empowerment index generated
Empowered	5,710	0.020	0.140	0	1	1 if woman empowerment score ≥ 4
Control over production	6,351	0.873	0.332	0	1	1 if woman makes production decision
Control over land	6,436	0.086	0.278	0	1	1 if woman has access or owns land
Control over income	6,443	0.415	0.492	0	1	1 if woman controls at least one income
Access to credit	6,350	0.046	0.211	0	1	1 if woman got credit in last 12 months
Group member	5,889	0.192	0.394	0	1	1 if woman is a social or economic group member
Woman's individual characteristics						
Age of woman	6,443	32.822	15.365	15	99	Age of woman in completed years
Education of woman	6,369	0.683	2.33	0	16	Number of years education

Woman literacy	6,427	0.134	0.341	0	1	1 if woman is literate
Woman level of education						
No education	6,368	0.910	0.285	0	1	1 if no education obtained
Primary education	6,368	0.055	0.229	0	1	1 if obtained primary education
Secondary education	6,368	0.033	0.179	0	1	1 if obtained secondary education
Woman marital status						
Single	6,430	0.224	0.417	0	1	1 if woman is single or in a simple cohabitation relationship
Monogamous union	6,430	0.408	0.491	0	1	1 if woman is married and in monogamous household
Polygamous union	6,430	0.366	0.481	0	1	1 if woman is married and in polygamous household
Household characteristics						
Age of household head	6,443	45.703	14.62	16	99	Age of household head in completed years
Sex of household head	6,443	0.952	0.212	0	1	1 if household head is male, 0 otherwise
HH literacy	6,443	0.245	0.430	0	1	1 if household head is literate
HH education years	6,443	1.420	4.439	0	16	Number of years of household head education
HH education level						
No education	6,443	0.905	0.293	0	1	1 if no education obtained
Primary education	6,443	0.077	0.267	0	1	1 if obtained primary education
Secondary education	6,443	0.017	0.130	0	1	1 if obtained secondary education
Household size	6,443	11.07	6.516	2	53	Number of household members
Number of plots	6,437	4.042	2.582	0	29	Number of household-owned plots
Local seed	6,351	0.924	0.264	0	1	1 if household uses local seed, 0 if improved seed
Cultivated crops	6,346	0.749	0.433	0	1	1 if household produces only one crop, 0 otherwise
Crop number	6,358	4.977	3.263	1	29	Number of crops produced by household
Food expenditures	6,443	0.555	0.112	0.06	0.92	Share of food expenditures

Clean water	6,443	0.609	0.488	0	1	1 if household has access to clean water source
Sanitation	6,433	0.050	0.218	0	1	1 if household has access to sanitation
Poor	6,443	0.479	0.499	0	1	1 if household is poor
Child's individual characteristics						
Age (months)	6,443	29.038	16.106	0	59	Child age in months
Child under 2	6,443	0.386	0.486	0	1	1 if child is under 2 years old (23 months)
Child sex (female)	6,443	0.487	0.499	0	1	1 if child is female, 0 otherwise
Household child	6,430	0.813	0.389	0	1	1 if child is of household head
Growth programme	6,436	0.423	0.494	0	1	1 if child participates in growth programme
Nutrition programme	6,437	0.211	0.408	0	1	1 if child participates in nutrition programme
Birth	6,405	0.965	0.181	0	1	1 if single birth, 0 otherwise
Instrument (spouse sub-sample)						
Difference in age	3,961	12.667	9.448	-15	58	"Household head age" minus "woman's age"

Source: Data analysis from EMC 2014

Table 3 shows that the average empowerment score for each woman was 1.648. This implies that, on average, each woman had access to fewer than two empowerment indicators. Table 4 shows that the distribution of empowerment score reveals that over 95% of women had an empowerment score below 4, and fewer than 1% had all the indicators of empowerment. Most women had access to one (43%) or two (37%) empowerment indicators. Appendix 2 reveals that while women who are household heads had access to three empowerment indicators, spouses and "other" women had access to fewer than 2 indicators.

Table 4: Distribution of women's empowerment score

Empowerment score	Freq.	Per cent
0	268	4.69
1	2,444	42.80
2	2,111	36.97
3	767	13.43
4	112	1.96
5	8	0.14
Total	5,710	100.00

Source: Data analysis from EMC 2014

5. Results and discussion

This section presents and discusses the estimation results taking into account the different possibilities analyzed in the methodology. Table 5 presents the ordinary least squares (OLS) regression results for the effect of empowerment index on child nutritional status. IV diagnostics are presented in Appendix 3, however, first-stage and 2SLS results are excluded (available from authors upon request). The Anderson-Rubin and endogeneity test results imply that our endogenous variable is irrelevant and, in fact, not endogenous in our context. Also, for the validity of the instrument the Kleibergen-Paap F-statistics show that the null hypothesis for weak instruments is not rejected. The identification test results (over-identification and under-identification) confirm the models that were identified, but the instrument was not valid.

Additionally, the F-statistic does not exceed the critical value of 4.79, which is associated with a bias relative to OLS of less than 30% (Stock and Yogo, 2005). This suggests that our instrument used for the effect of women's empowerment on child nutrition is not strong for the model. Thus, in the absence of suitable instruments, one must interpret results from OLS and treat the estimated coefficients as correlations rather than causal relationships (Malapit et al, 2015a; Malapit et al, 2018; Bourdier, 2019). Even controlling for the endogeneity of the empowerment measures using the average index by stratum, we chose to interpret the coefficients as associative or as correlation rather than causal. Our regressions are clustered and based on all women sampled and we control when a woman is an only spouse or head of a household. While columns 1, 3 and 5 of Table 5 present OLS results without controlling for empowerment, i.e., using the computed empowerment index for HAZ, WHZ and WAZ, respectively, columns 2, 4 and 6 show the results for controlling for endogeneity of empowerment using the average index by stratum. This enables us to check how sensitive our results are depending on empowerment measures.

Table 5's results reveal that once we control for endogeneity, the empowerment coefficient rises by more than five times, but coefficients of other control variables remain substantially similar. This suggests that not controlling for endogeneity of women's empowerment tends to underestimate its effect on child nutrition. Our interpretations are then based on OLS using the average empowerment index.

Table 5: Women's empowerment index and children's nutrition outcomes

Variable	HAZ		WHZ		WAZ	
	Index (1)	Avg. index (2)	Index (3)	Avg. index (4)	Index (5)	Avg. index (6)
Empowerment index	0.062** (0.027)	0.353** (0.177)	0.045* (0.023)	0.397** (0.175)	0.067*** (0.018)	0.482*** (0.123)
Child characteristics						
Child is female	0.017 (0.041)	0.018 (0.041)	-0.099*** (0.036)	-0.098*** (0.036)	-0.056* (0.031)	-0.055* (0.031)
Child is of household head	0.026 (0.108)	0.018 (0.065)	0.011 (0.056)	0.001 (0.057)	0.029 (0.046)	0.018 (0.046)
Age in months	-0.151*** (0.008)	-0.150*** (0.008)	0.004 (0.007)	0.004 (0.007)	-0.073*** (0.006)	-0.073*** (0.006)
Age in months squared	0.001*** (0.000)	0.001*** (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000*** (0.000)	0.000*** (0.000)
Age group: compl. feeding (24-59 months)	0.558*** (0.095)	0.555*** (0.095)	0.338*** (0.085)	0.335*** (0.085)	0.495*** (0.071)	0.491*** (0.071)
Child birth (twin)	-0.698*** (0.143)	-0.697*** (0.144)	-0.241* (0.133)	-0.241* (0.134)	-0.610*** (0.119)	-0.610*** (0.120)
Child is in nutrition programme	-0.303*** (0.059)	-0.296*** (0.059)	0.017 (0.050)	0.026 (0.050)	-0.176** (0.046)	-0.166*** (0.047)
Woman characteristics						
Woman age	-0.001 (0.001)	-0.001 (0.001)	-0.002* (0.001)	-0.002* (0.001)	-0.002** (0.003)	-0.002** (0.001)
Woman education (ref. no educ)						
Primary education	-0.075 (0.100)	-0.064 (0.101)	0.181 (0.113)	0.192* (0.113)	0.091 (0.087)	0.105 (0.087)
Secondary/tertiary education	-0.262** (0.132)	-0.263** (0.132)	0.217* (0.129)	0.214* (0.128)	0.022 (0.111)	0.019 (0.110)
Tertiary education	0.684 (0.778)	0.752 (0.805)	-0.012 (0.196)	0.057 (0.184)	0.401 (0.300)	0.489 (0.324)
Marital status						
Monogamous union	-0.148* (0.079)	-0.137* (0.079)	-0.095 (0.171)	-0.086 (0.071)	-0.165*** (0.175)	-0.153** (0.061)
Polygamous union	-0.166* (0.019)	-0.162* (0.092)	-0.043 (0.080)	-0.042 (0.080)	-0.130* (0.070)	-0.127* (0.070)
Woman status in household						
Woman is head of household	-0.397*** (0.148)	-0.280** (0.138)	0.076 (0.137)	0.153 (0.132)	-0.183* (0.110)	-0.062 (0.104)
Woman is spouse	0.064 (0.069)	0.078 (0.068)	0.043 (0.062)	0.052 (0.064)	0.068 (0.055)	0.083 (0.056)
Household characteristics						
Age (in years) of household head	0.000	0.000	-0.004	-0.004	-0.002	-0.003

	(0.006)	(0.005)	(0.005)	(0.004)	(0.003)	(0.003)
Age-squared of household head	0.000	0.000	0.000	0.000	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education of household head						
Primary education	0.074	0.086	0.020	0.032	0.048	0.071
	(0.074)	(0.074)	(0.067)	(0.068)	(0.077)	(0.060)
Secondary/tertiary education	0.180	0.189	0.296**	0.304**	0.323*	0.316***
	(0.173)	(0.170)	(0.132)	(0.135)	(0.161)	(0.116)
Tertiary education	-0.860***	-0.790***	0.640***	0.717***	0.204	0.052
	(0.165)	(0.147)	(0.183)	(0.206)	(0.207)	(0.164)
Household size	-0.002	-0.001	-0.004	-0.004	-0.004	-0.004
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Access to clean water	-0.006	-0.012	0.033	0.025	0.017	0.008
	(0.056)	(0.056)	(0.051)	(0.051)	(0.041)	(0.041)
Constant	1.080***	1.088***	-0.260	-0.244	0.360**	0.377***
	(0.219)	(0.218)	(0.192)	(0.194)	(0.145)	(0.146)
Cluster	538	538	538	538	538	538
Observations	6,300	6,300	6,300	6,300	6,300	6,300
F	39.30	39.50	5.12	4.98	13.22	13.08
Prob>F	0.000	0.0000	0.0000	0.0000	0.000	0.0000
R-squared	0.1374	0.1376	0.0218	0.0235	0.0630	0.0652

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Women's empowerment index

The results of the clustered OLS estimates in Table 5 show that women's empowerment is positively correlated with HAZ, WHZ and WAZ. This result shows that there is evidence that empowerment is associated with short- and long-term effects of nutrition outcomes. Column 4 shows that empowerment favours WHZ by a standard deviation of 0.397 (against 0.045 standard deviation for a simple index). These results are in line with those previously found in the literature (Lépine and Strobl, 2013; Malapit and Quisumbing, 2015; Arulampalam et al, 2016; Shiwakoti et al, 2017; Heckert et al, 2019). Malapit et al (2015a) found similar results when combining OLS and IV. Also, our result is robust compared to Malapit and Quisumbing (2015) who, by using OLS without controlling for empowerment endogeneity, found a slight association between empowerment and child nutrition outcomes. Shiwakoti et al (2017) show that Nepalese women with low empowerment have children who are underweight and stunted. This suggests that improving women's position in household-level decision-making translates into significant gains for the nutritional status of the children. Ibrahim et al (2015) highlighted this further by pointing out that there is a positive relationship between women's active participation in decision-making and children's health, and the correlation is underestimated when endogeneity is not

taken into account. Ibrahim et al (2015) incorporate variables such as decisions about health care, visits to relatives, shopping, and managing the husband's income as measures of women's empowerment. The results of Smith et al (2003) are even more positive, showing that there is no doubt that better statuses for women have a positive and significant impact on the nutritional status of children. Scantlan and Previdelli (2013) found a positive and independent effect of women's empowerment on child nutrition. According to these authors, women's empowerment alone could serve as a lever for targeting the goal of reducing child malnutrition. Scantlan and Previdelli (2013) considered participation in household decisions, attitudes towards violence and experiences with domestic violence to measure women's bargaining power. However, Malapit et al (2018), using the difference in age and education between spouse and husband as empowerment measures, found that women's empowerment has no direct correlation with child nutrition outcome in Bangladesh.

Child characteristics

Child sex has a significant correlation with nutrition outcome. Indeed, being a girl is negatively related to WHZ and WAZ. This means that girls benefit less from empowerment than boys. This is because in a rural household child sex preference could lead parents to take more care of boys than girls. This result contradicts Malapit et al (2015b) who found a negative correlation with being a girl when empowerment is measured by credit decision. Other authors also found no significant effect of child sex (Horton, 1988; Handa, 1999; Radhakrishna and Ravi, 2004; Badji, 2006). Child age is correlated negatively to HAZ and WAZ, and age-squared indicates that there is a threshold where age is positively associated with HAZ and WAZ. Indeed, the age group variable shows that children beyond two years of age benefit more from women's empowerment than those under two. This can be explained by the fact that children above two benefit more directly from agricultural production and diet quality and diversity as they are nourished in the same way as household adults. This result is consistent with Makoka (2013), Lépine and Strobl (2013), Robert (2014) and Malapit et al (2018). Malapit et al (2018) found a negative correlation between children under two's nutrition outcome and women's empowerment. Also, when the child is a twin, HAZ, WHZ, and WAZ are highly and negatively affected. This negative result could reflect the fact that a woman's (parent's) time allocated for childcare is fixed, so using the same allocated time to raise more than one child may lead (women) parents to take less care of each child if they have twins. As a result, a twin birth contributes to the deterioration of child nutritional status (Gira, 2007). However, the results show a negative correlation between nutrition programme and HAZ indicator: when a child participates in a nutrition programme his/her z-score reduced by 0.30 SD in the long term. This observation could be explained by the fact that sometimes, because of low literacy levels, women cannot fully understand Infant and Young Child Feeding (IYCF) practices. Also, the financial cost could prevent some women from participating regularly, as could the lack of complementary nutritious food distribution for children.

Women's characteristics

Overall, women's characteristics have a mixed correlation with child nutrition outcome. A woman's age is negative but very weakly related to WHZ and WAZ. This result is found in Malapit et al (2015b and 2018), who used the difference in age as empowerment measure. Compared to single women, women in polygamous and monogamous relationships yield a negative and significant correlation with child nutrition outcome. While polygamy reduces child HAZ more, monogamy reduces the higher child WAZ more. These results are partially consistent with Bourdier (2019) who found a mixed effect of women's marital status in Ghana. Indeed, this author found that in polygamous households, women's empowerment is positively correlated with HAZ but negatively correlated with WHZ. Bourdier (2019) also finds that in monogamous households women's empowerment has no direct influence on any nutrition outcomes. Our results reveal that if women are household heads there is a negative effect on a child's long-term nutrition status, HAZ, but being a spouse does not affect child nutrition. We assume here that women's status in a household is not a sufficient condition for child well-being. For us, women's status (spouse or head) has an indirect effect on their children and there are pathways through which their status could affect nutrition within the household.

In addition, women's education has a mixed effect on nutrition outcome. While secondary-level education has a negative correlation with HAZ, WHZ is positively associated with secondary education. The primary and tertiary levels have no relation to nutrition outcome. In the literature, education is found to positively affect child nutrition (Radhakrishna and Ravi, 2004; Glewwe, 1999; Thomas, 1994). However, some previous studies on the determinants of child nutrition outcomes found that the education effect is indirect (Maïga, 2011; Webb and Block, 2004; Glewwe, 1999; Handa, 1999). For Maïga (2011), female education has threshold effects on child nutrition outcomes. Using a natural experiment, her study estimations indicate that the largest impact of a mother's years of education on a child is at 13 years of education for WHZ and 12 years for HAZ. This could explain our results as indicated in the descriptive statistics, where the women's education is too low to influence nutrition outcome.

Household characteristics

Table 5's results reveal that age of household head and household size are not linked to child nutrition outcomes in rural households. These results are consistent with Bourdier (2019) and Malapit et al (2018). Household head education has a significant but mixed relationship with child nutrition outcomes. Indeed, the household head's secondary education is positively related to WHZ and WAZ. While the head of the household's tertiary education is negatively and highly (-0.79SD) associated with HAZ, it highly and positively affects WAZ. In their study, Malapit et al (2018) found that household head education is positively and highly correlated to HAZ and WAZ

but has no relationship with WHZ. For the authors, this can be explained by a “wealth” effect, where households with a well-educated head are also more likely to have sufficient resources to invest in children’s nutrition. Results also show that access to social services does not affect nutrition outcomes. Indeed, household access to clean water has no relationship with nutrition outcome. However, Robert (2014) and Bossolé (2007) found that access to clean water improves child nutrition status. Meanwhile, Malapit et al (2018) found that access to electricity is positively associated with WHZ and WAZ. These negative effects (education and access to clean water) could be explained by the existence of an interaction effect. Some variables only have an effect in the presence of other variables; these are the indirect effects of education and access to social services on nutrition.

Robustness checks

For a robustness check, a clustered OLS was run using the five empowerment indicators as empowerment measures. We also used the difference in age (between head of the household and the woman) as a measure of a woman’s age. The results in Appendix 4 reveal that all control variables have similar coefficients when compared with the results in Table 5. Only slight exceptions in coefficient significance are observed. Indeed, it appears that women’s education has no significant association with nutrition outcome. While polygamy and monogamy are only correlated with HAZ, child sex is only significant for WAZ.

As for empowerment indicators, results show mixed effects, i.e., while some indicators are positively correlated to nutrition outcome, others are negatively associated or not significant. Appendix 4 shows that access to land is positively correlated to all nutrition outcomes, indicating that women’s access to land favours short- and long-term nutritional status. While access to credit is negatively related to WHZ, social group membership is positively correlated with the long-term outcome of HAZ. Control over income has a double effect on nutrition outcomes. Income control is negatively associated with HAZ (long-term outcome), but positively with WHZ (short-term outcome) indicating that current income is not sufficient to support long-term nutrition. Appendix 4 indicates that production control is the only indicator that has no direct correlation with nutrition outcome. In Appendix 1, figures reveal that although production control highly contributes to the empowerment index(0.421), only individual decisions really matter (0.328). Indeed, among the 87% of women who participated in production decisions, 88% decide collectively or jointly, but this collective decision contribution to empowerment is too low to matter (0.073 in Appendix 1). We suggest that the positive correlation with the empowerment index is from land access, income control and group membership. This justifies the multidimensionality of empowerment. Indeed, a woman could be empowered in one indicator and not in another. Therefore, empowerment must be measured by a set of indicators instead of using single indicators, and the components must relate to the domain in which empowerment is measured.

6. Conclusion and policy implications

This study analyzed the effect of women's empowerment on child nutrition in rural Burkina Faso. We assumed that an improvement in women's empowerment is beneficial for the nutritional status of children. We used nationally representative data from the 2014 Multisectoral Continuous Survey to develop a composite measurement of empowerment and explored two techniques to deal with the potential endogeneity of empowerment. Children's nutrition outcomes were measured by the following anthropometrics: height-for-age z-score, weight-for-height z-score and weight-for-age z-score. Our results show that women's empowerment has a positive and high correlation with child nutrition outcomes. While child characteristics are related to their nutrition outcomes, women and households' characteristics are weakly correlated with nutrition outcomes. Even in the literature, there is no consensus on the variables to be included in the measure of empowerment, but our results are convergent with several studies in different socioeconomic contexts. Our results point to three recommendations. First, as results indicate that our measure of women's empowerment is highly correlated with children's nutritional status, we suggest that programmes targeting women's empowerment could be implemented at the community level to reach most women. Second, public policies aimed at improving empowerment should be integrated with measures facilitating women's access to land and other agricultural inputs by updating laws on land ownership and land inheritance for women. There are national policies and laws, but they are hindered at the local level by socio-culturally rooted norms and practices, and a lack of resources. Third, policies should ensure women's financial inclusion by providing easy access to credit through microfinance institutions. In addition, continual efforts should be made to promote women's and girls' education, which should include nutrition and agriculture courses in school curricula and literacy programmes. Education will provide women and girls with the knowledge and skills necessary for good nutrition.

Notes

- 1 In Belesova et al, 2017.
- 2 European Commission http://ec.europa.eu/echo/files/aid/countries/factsheets/burkina_faso_fr.pdf
- 3 PNDES 2016–2020, Transformer le Burkina . .
- 4 The survey is conducted according to the SMART methodology: Standardized Monitoring and Assessment of Relief and Transition.
- 5 http://eeas.europa.eu/delegations/burkina_faso/index_fr.htm, accessed on 28 December 2017.
- 6 World Bank Support New Safety Net System in Burkina Faso, at <https://www.worldbank.org/en/news/press-release/2014/04/23/world-bank-safety-net-system-burkina-faso>, accessed on 23 February 2021.
- 7 www.ScalingUpNutrition.org
- 8 The eight countries are: Benin, Burkina Faso, Ethiopia, Ghana, Malawi, Mozambique, Senegal and Uganda
- 9 <https://thp.org/what-we-do/where-we-work/africa/burkina-faso/>, accessed 17 February 2021.
- 10 The 2014 EMC survey is part of the Living Standard Measurement Survey (LSMS) collection from the World Bank and represents the first one in Burkina Faso. Data are downloadable on the World Bank website at <https://microdata.worldbank.org/index.php/home>.

References

- AfDB (African Development Bank). 2015. "Economic empowerment of African women through equitable participation in agricultural value chains". *African Development Bank report*. African Development Bank, Abidjan, Côte d'Ivoire.
- Aitatikie, H. 2014. "The Role of Women's Status on Children's Nutrition Security in Ethiopia." Thesis, Addis Ababa University, Department of Economics, Ethiopia.
- Alkire, S., R. Meinzen-Dick, A. Peterman, A. Quisumbing, G. Seymour and A. Vaz. 2013. "The Women's Empowerment in Agriculture Index". *World Development*, 52: 71–91.
- Ambagna, J.J., G.Q. Kane and A.S. Oyekale. 2012. "Subsistence farming and food security in Cameroon: A macroeconomic approach". *Life Science Journal*, 9(4): 3949–54.
- Arulampalam, W., A. Bhaskar and N. Srivastava. 2016. "Does Greater Autonomy Among Women Provide the Key to Better Child Nutrition?" IZA Discussion Paper No.9781, Institute for the Study of Labor, <http://ftp.iza.org/dp9781.pdf>.
- Badji, M.S. 200. "Analyse de l'évolution des déterminants de la santé nutritionnelle des enfants âgés de moins de cinq ans au Sénégal". *Perspective Afrique*, 2(2–3), Art. 1.
- Baiphethi, M.N. and P.T. Jacobs. 2009. "The contribution of subsistence farming to food security in South Africa". *Agrekon*, 48(4): 459–82, DOI: [10.1080/03031853.2009.9523836](https://doi.org/10.1080/03031853.2009.9523836)
- Bayissa, F.W., J. Smits and R. Ruben. 2018. "The multidimensional nature of women's empowerment: Beyond the economic approach." *Journal of International Development*, 30(4): 661–90, DOI: [10.1002/jid.3268](https://doi.org/10.1002/jid.3268)
- Bassolé, L. 2007. "Child Malnutrition in Senegal: Does Access to Public Infrastructure Really Matter? A Quantile Regression Analysis." *Job Market Paper*. CERDI-CNRS, Université d'Auvergne.
- Behrman, J.R. 1990. "Intrahousehold allocation of nutrients and gender effects: A survey of structural and reduced form estimates". In S.R. Osmani, ed., *Nutrition and Poverty*. Oxford: Oxford University Press.
- Belesova, K., A. Gasparrini, A. Sié, R. Sauerborn and P. Wilkinson. 2017. "Household cereal crop harvest and children's nutritional status in rural Burkina Faso." *Environmental Health*, 16: 65, DOI: [10.1186/s12940-017-0258-9](https://doi.org/10.1186/s12940-017-0258-9)
- Bernstein, J. and D. Wiesmann. 2019. "Global Hunger Index: A closer look at hunger and undernutrition in Burkina Faso." Welthungerhilfe (Bonn) and Concern Worldwide (Dublin). Available at: <https://www.globalhungerindex.org/case-studies/2018-burkina-faso.html>
- Bhagowalia, P., P. Menon, A.R. Quisumbing and V. Soundararajan. 2012. "What Dimensions of Women's Empowerment Matter Most for Child Nutrition? Evidence Using Nationally Representative Data from Bangladesh." IFPRI Discussion Paper No.1192. International Food Policy Research Institute (IFPRI), Washington D.C.

- Bhutta, Z.A., M. Chopra, H. Axelson, P. Berman, T. Boerma, J. Bryce, et al 2010. "Countdown to 2015 decade report (2000-10): taking stock of maternal, newborn, and child survival." *Lancet*, 375:2032–44.
- Black, R.E., L.H. Allen, Z.A. Bhutta et al 2008. "Maternal and child undernutrition: global and regional exposures and health consequences." *Lancet*, 371: 243–60.
- Booyesen, F., S. van der Berg, R. Burger, G. du Rand and M. von Malitz. 2005. "Using a household index to assess trends in poverty in seven sub-Saharan African countries." Paper presented at Conference on Multidimensional Poverty hosted by the International Poverty Center (IPC) of the United Nations Development Programme (UNDP), Brasilia, Brazil, 29–31 August
- Bourdier, T. 2019. "Women's Empowerment and Child Nutrition in Polygynous Households of Northern Ghana". IFPRI Discussion Paper No. 01809. International Food Policy Research Institute (IFPRI), Washington D.C, USA.
- Branca, F., E. Piwoz, W. Schultink and L.M. Sullivan. 2015. "Nutrition and women's, children's and adolescents' health". *BMJ* (Clinical research ed.), 351, h4173. <https://doi.org/10.1136/bmj.h4173>.
- Burger, R., F. Booyesen, S. van der Berg and M. von Malitz. 2006. "Marketable Wealth in a Poor African Country: Using an Index of Consumer Durables to Investigate Wealth Accumulation by Households in Ghana." Research Paper No. 2006/138. Helsinki: UNU-WIDER.
- Cameron, A.C. and P.K. Trivedi. 2005. *Microeconometrics: Methods and Applications*. Cambridge University Press, New York.
- Carletto, G., M. Ruel, P. Winters and A. Zezza. 2015. "Farm-level pathways to improved nutritional status: Introduction to the special issue." *The Journal of Development Studies*, 51:8: 945–57. Available at: <http://dx.doi.org/10.1080/00220388.2015.1018908>
- Compaoré, E., J. Kaboré, M. Ouédraogo, N. Meda and L.C. Sorgho. 2020. "Mobilising innovative financing and domestic resources for nutrition: Progress and challenges in Burkina Faso." *Nutrition Exchange*. Available at: www.enonline.net/nex/13/burkinafaso
- De Onis, M. and M. Blössner. 1997. "WHO global database on child growth and malnutrition." WHO/NUT/97.4, World Health Organization. Available at: <https://apps.who.int/iris/handle/10665/63750>.
- De Onis M., C. Monteiro, J. Akré and G. Clugston. 1993. "The worldwide magnitude of protein energy malnutrition: An overview from the WHO global database on child growth." *Bulletin of the World Health Organization*, 71: 703–12.
- Deining, K., A. Goyal and H. Nagarajan. 2013. "Women's inheritance rights and intergenerational transmission of resources in India." *Journal of Human Resources*, 48(1): 114–41.
- Destombes, J. 2003. "Les causes structurelles de l'insécurité alimentaire chronique en Afrique. Études de cas: Éthiopie, Burkina Faso et Zambie." Rapport, Ministère des affaires étrangères français.
- Doss, C. 2011. "If women hold up half the sky, how much of the world's food do they produce?" ESA Working Paper No.11-04, March 2011, Agricultural Development Economics (ESA), Food and Agriculture Organization (FAO), Rome, Italy.
- Doss, C.R. 2002. "Men's crops? Women's crops? The gender patterns of cropping in Ghana." *World Development*, 30(11): 1987–2000.

- Doss, C., C. Kovarik, A. Peterman, A.R. Quisumbing and M. van den Bold. 2013. "Gender Inequalities in Ownership and Control of Land in Africa: Myths versus Reality." IFPRI Discussion Paper No. 1308. International Food Policy Research Institute (IFPRI), Washington D.C., USA.
- Duflo, E. 2003. "Grandmothers and granddaughters: Old-age pensions and intrahousehold allocation in South Africa." *World Bank Economic Review*, 17(1): 1–25.
- Dury, S. and I. Bocoum. 2012. "Le « paradoxe » de Sikasso (Mali): pourquoi « produire plus » ne suffit-il pas pour bien nourrir les enfants des familles d'agriculteurs?" *Cahiers Agricultures*, 21(5): 324–6, DOI: 10.1684/agr.2012.0584
- Ecker, O. 2019. "Reshaping agriculture to reduce obesity." In *Agriculture for improved nutrition: Seizing the momentum*. Chapter 8. S. Fan, S. Yosef and R. Pandya-Lorch, eds., Wallingford, UK: International Food Policy Research Institute (IFPRI) and CABI, Washington D.C., USA. <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/133101>
- Fafchamps, M., B. Kebede and A.R. Quisumbing. 2009. "Intrahousehold welfare in rural Ethiopia." *Oxford Bulletin of Economics and Statistics*, 71(4): 567–99.
- FAO (Food and Agriculture Organization of the United Nations). 2010. *Gender and land rights database*. Rome: FAO. Available at: <http://www.fao.org/gender/landrights/en/>
- FAO (Food and Agriculture Organization of the United Nations). 2002. "Gender and access to land." *Land Tenure Studies 4*. Rome: FAO. Available at: <http://www.fao.org/3/a-y4308e.pdf>.
- Gillespie, S. and M. van den Bold. 2017. "Agriculture, foods systems, and nutrition: Meeting the challenge." *Global Challenges*, 1(3): 12p, DOI: 10.1002/gch2.201600002
- Glewwe, P. 1999. "Why does mother's schooling raise child health in developing countries? Evidence from Morocco." *Journal of Human Resources*, 34(1): 124–59.
- Golla, A.M., A. Malhotra, P. Nanda and R. Mehra. 2011. "Understanding and measuring women's economic empowerment: Definition, framework and indicators." International Centre for Research on Women (ICRW). Available at: <https://www.icrw.org/wp-content/uploads/2016/10/Understanding-measuring-womens-economic-empowerment.pdf>.
- Greenacre, M. and J. Blasius, eds. 2006. *Multiple Correspondence Analysis and Related Methods*. Chapman and Hall/CRC Press, London, 4-40..
- Grira, H. 2007. "Les déterminants du statut nutritionnel au Matlab: Une analyse empirique." CES Working Paper No. 39, Centre d'Economie de la Sorbonne, September 2007, Paris.
- Haddad, L. 2000. "A conceptual framework for assessing agriculture-nutrition linkages." *Food and Nutrition Bulletin*, 21(4): 367–73. Available at <https://doi.org/10.1177/156482650002100405>
- Handa, S. 1999. "Maternal education and child height." *Economic Development and Cultural Change*, 47(2): 421–39.
- Hawkes, C. and M.T. Ruel. 2008. "From Agriculture to Nutrition: Pathways, Synergies and Outcomes." Agriculture and Rural Development Notes No. 40. The World Bank, Washington, D.C.
- Hawkes, C. and M. Ruel. 2006. "The links between agriculture and health: An intersectoral opportunity to improve the health and livelihoods of the poor." *Bulletin of the World Health Organization*, 84(12): 984–90.

- Heckert, J., D.K. Olney and M.T. Ruel. 2019. "Is women's empowerment a pathway to improving child nutrition outcomes in a nutrition-sensitive agriculture programme? Evidence from a randomized controlled trial in Burkina Faso." *Social Science and Medicine*, 233: 93–102.
- Helmfrid, S. 2004. "Towards gender equality in Burkina Faso: A profile on gender relations." Art. no: SIDA3965en, Department of Policy and Methods, Swedish International Development Cooperation Agency (Sida), Stockholm Sweden.
- Herforth, A., A. Jones and P. Pinstrup-Andersen. 2012. "Prioritizing Nutrition in Agriculture and Rural Development: Guiding Principles for Operational Investments." Health, Nutrition and Population (HNP) Discussion Paper No. 74152. , The World Bank, Washington D.C.
- Horton S. 1988. "Birth order and child nutritional status: Evidence from the Philippines." *Economic Development and Cultural Change*, 36(2): 341–54.
- Hunt, A. and E. Samman. 2016. "Women's economic empowerment: Navigating enablers and constraints." Development Progress Research Report, Overseas Development Institute (ODI), London. Available at: <https://www.odi.org/sites/odi.org.uk/files/resource-documents/10683.pdf>
- Iannotti, L.L., M. Robles, H. Pacheco and C. Chiarella. 2012. "Food prices and poverty negatively affect micronutrient intakes in Guatemala." *The Journal of Nutrition*, 142(8): 1568–76.
- Ibrahim, A., S. Tripathi and A. Kumar. 2015. "The effect of women's empowerment on child health status: Study on two developing nations." *International Journal of Scientific and Research Publications*, 5(4): 2250–3153.
- IFAD. 2019. *Burkina Faso Country Strategic Opportunities Programme 2019–2024*. Document EB 2019/126/R.17, The International Fund for Agricultural Development (IFAD), Executive Board — 126th Session Rome, 2-3 May 2019.
- IFPRI (International Food Policy Research Institute). 2012. "Women's Empowerment in Agriculture Index." IFPRI, Poverty and Human Development Initiative (OPHI) and Feed The Future, Washington, D.C.
- INSD. 2016. *Annuaire Statistique 2015*. Institut National de la Statistique et de la Démographie (INSD)-Burkina Faso.
- JICA. 2013. "Country gender profile: Burkina Faso". Japan International Cooperation Agency (JICA), Mitsubishi UFJ Research and Consulting, Burkina Faso.
- Kabeer, N. 2001. "Conflicts over credit: Re-evaluating the empowerment potential of loans to women in rural Bangladesh." *World Development*, 29(1): 63–84.
- Kabeer, N. 1999. "Resources, agency, achievements: Reflections on the measurement of women's empowerment." *Development and Change*, 30(3): 435–64.
- Kaufmann, S. 2008. "The nutrition situation in Northern Laos – determinants of malnutrition and changes after four years of intensive interventions." PhD thesis. Justus Liebig University Giessen, Faculty of Agricultural Science, Nutritional Science and Environmental Management, Germany.
- Kevane, M. and B. Wydick. 2001. "Social norms and the time allocation of women's labor in Burkina Faso." *Review of Development Economics*, 5(1): 119–29.
- Kevane, M. and L. Gray. 1999. "A woman's field is made at night: Gendered land rights and norms in Burkina Faso." *Feminist Economics*, 5(3): 1–26.

- Kilic, T., A. Palacios-Lopez and M. Goldstein. 2013. "Caught in a productivity trap: A distributional perspective on gender differences in Malawian agriculture." Policy Research Working Paper No. 6381. Washington, D.C.: World Bank, March 2013.
- Kiresur, V.R., V.P. Melinamani, V.S. Kulkarni, P. Bharati and V.S. Yadav. 2010. "Agricultural productivity, rural poverty and nutritional security: A micro evidence of inter-linkages from Karnataka State." *Agricultural Economics Research Review*, 23(June): 29–40.
- Lépine, A. and E. Strobl. 2013. "The effect of women's empowerment on child nutrition in rural Senegal." *World Development*, 45(5): 17–30. Available at: <https://doi.org/10.1016/j.worlddev.2012.12.018>
- Maïga, E.W.H. 2011. "The impact of mother's education on child health and nutrition in developing countries: Evidence from a natural experiment in Burkina Faso." Report No. I15, I25, I28. African Center for Economic Transformation (ACET), Accra, Ghana.
- Makoka, D. 2013. "The Impact of Maternal Education on Child Nutrition: Evidence from Malawi, Tanzania, and Zimbabwe." DHS Working Paper No. 84, ICF International Calverton, Maryland, USA.
- Malapit, H.J.L., E. Sraboni, A.R. Quisumbing and A.U. Ahmed. 2018. "Intrahousehold empowerment gaps in agriculture and children's well-being in Bangladesh." *Development Policy Review*, 37:176–203.
- Malapit, H.J.L. and A.R. Quisumbing. 2015. "What dimensions of women's empowerment in agriculture matter for nutrition in Ghana?" *Food Policy*, 52: 54–63.
- Malapit, H.J.L. and A.R. Quisumbing. 2014. "What Dimensions of Women's Empowerment in Agriculture Matter for Nutrition-related Practices and Outcomes in Ghana?" IFPRI Discussion Paper No.1367. International Food Policy Research Institute (IFPRI), Washington D.C., USA. Available at: <https://ssrn.com/abstract=2486810>
- Malapit, H.J.L., E. Sraboni, A.R. Quisumbing and A. Ahmed. 2015a. "Gender Empowerment in Agriculture and Children's Well-Being in Bangladesh." IFPRI Discussion Paper 01470, International Food Policy Research Institute (IFPRI).
- Malapit, H.J.L., S. Kadiyala, A.R. Quisumbing, K. Cunningham and P. Tyagi. 2015b. "Women's empowerment mitigates the negative effects of low production diversity on maternal and child nutrition in Nepal." *The Journal of Development Studies*, 51(8): 1097–123. Available at: <https://doi.org/10.1080/00220388.2015.1018904>
- Malapit, H., A.R. Quisumbing, R. Meinzein-Dick, G. Seymour, E.M. Martinez, J. Heckert, D. Rubin, A. Vaz and K.M. Yount. 2019. "Development of the project-level Women's Empowerment in Agriculture Index (pro-WEAI)." *World Development*, 122: 675–69.
- Malhotra, A., S.R. Schuler and C. Boender. 2002. "Women's empowerment as a variable in international development." Background Paper for the World Bank Workshop on Poverty and Gender: New Perspectives, Washington D.C: World Bank.
- Malik, K. 2014. *Human Development Report 2014. Sustaining Human Progress: Reducing Vulnerabilities and Building Resilience*. United Nations Development Programme(UNDP), New York, USA. <http://hdr.undp.org/sites/default/files/hdr14-report-en-1.pdf>
- MoH (Ministry of Health). 2020. "Enquête Nutritionnelle Nationale 2019." Rapport final Smart 2019, Ministère de la Santé, Burkina Faso (February 2020).

- Murphy, E., L.L. Oot and K. Sethuraman. 2017. "USAID Office of Food for Peace Food Security Desk Review for Burkina Faso." United States Agency for International Development (USAID), Washington, D.C.: FHI 360/FANTA.
- Njuki, J., J.R. Parkins, A. Kaler and S. Ahmed. 2016. "Gender, agriculture and food security: Where are we? In J. Njuki, J. R. Parkins and A. Kaler, eds, *Transforming Gender and Food Security in the Global South*. Routledge Studies in Food, Society and the Environment. International Development Research Center, London and New York.
- Nordman, C.J. and S. Sharma. 2016. "The power to choose: Gender balance of power and intra-household educational spending in India." WIDER Working Paper 2016/ 61. UNU-WIDER, Helsinki (May 2016). Available at: <https://doi.org/10.35188/UNU-WIDER/2016/104-8>.
- Olney, D.K., L. Bliznashka, A. Pedehombga, A. Dillon, M.T. Ruel and J. Heckert. 2016. "Agriculture-nutrition program benefits women." *The Journal of Nutrition*, 146(5): 1109–17, DOI: 10.3945/jn.115.224261
- O’Sullivan, M., A. Rao, R. Banerjee, K. Gulati, M. Vinez. 2014. "Levelling The Field: Improving Opportunities for Women Farmers in Africa (English)." World Bank Working Paper No. 86039. The World Bank, Washington, D.C, March 2014.
- Ouédraogo, M., O. Ouédraogo, U. Zongo, S. Kabore, E.A. Bambara and D. Sanou. 2020. "Nutrition situation of Burkina Faso: A narrative review". *North Africa Journal of Food and Nutrition Research*. Special Issue, 04(09): S36–S45. Available at: <https://doi.org/10.5281/zenodo.4286605>
- Pandey, V.L., S.M. Dev and U. Jayachandran. 2016. "Impact of agricultural interventions on the nutritional status in South Asia: A review." *Food Policy*, 62: 28–40. Available at: <https://doi.org/10.1016/j.foodpol.2016.05.002>
- Panin, A. and S.S. Hlope. 2013. "Does subsistence agriculture play a crucial role in food security in Swaziland? *Developing Countries Studies*, 3(4):32-37. ISSN 2224-607X (Paper) ISSN 2225-0565 (Online).
- Pelletier, D.L., E.A. Frongillo Jr., D.G. Schroeder and J.P. Habicht. 1995. "The effects of malnutrition on child mortality in developing countries." *Bulletin of the World Health Organization*, 73(4): 443–8.
- Peterman, A., J. Behrman and A. Quisumbing. 2010. "A Review of Empirical Evidence on Gender Differences in Nonland Agricultural Inputs, Technology, and Services in Developing Countries." IFPRI Discussion Paper No. 975, International Food Policy Research Institute (IFPRI), Washington, D.C.
- PNDES (National Plan for Economic and Social Development). 2016. "Transformer le Burkina". National Plan for Economic and Social Development (PNDES 2016-2020), Burkina Faso.
- PNN. 2016. *Politique Nationale de Nutrition*. Ministère de la Santé, Burkina Faso. Available at : <http://extwprlegs1.fao.org/docs/pdf/bkf172927.pdf>
- PNSAN. 2013. "Politique nationale de sécurité alimentaire et nutritionnelle (version finale)." Burkina Faso. Available at: <http://extwprlegs1.fao.org/docs/pdf/bkf141993.pdf>
- Pradeep, M.D. and Deeksha. 2016. "Multi-dimensional approach for empowerment-effective strategies to face problems and challenges of women in India." *International Journal of Scientific Research and Modern Education (IJSRME)*, 1(1):744-755. Available at SSRN: <https://ssrn.com/abstract=2817267>

- PSSAR. 2017. "Plan Stratégique pour les Statistiques Agricoles et Rurales du Burkina Faso (PSSAR-BF 2016–2020)." Ministère de l'Agriculture et des Aménagements Hydrauliques, Burkina Faso.
- Quisumbing, A.R. 2003. "What have we learned from research on intrahousehold allocation?" In A.R. Quisumbing, ed., *Household Decisions, Gender, and Development: A Synthesis of Recent Research*. Washington, D.C.: International Food Policy Research Institute (IFPRI).
- Quisumbing, A.R. and J.A. Maluccio. 2003. "Resources at marriage and intrahousehold allocation: Evidence from Bangladesh, Ethiopia, Indonesia, and South Africa." *Oxford Bulletin of Economics and Statistics*, 65(3): 283–327.
- Quisumbing, A. R., and K. Hallman. 2005. "Marriage in Transition: Evidence on Age, Education, and Assets from Six Developing Countries." In C. B. Lloyd, J. R. Behrman, N. P. Stromquist, and B. Cohen, eds., *The Changing Transitions to Adulthood in Developing Countries: Selected Studies, Panel on Transitions to Adulthood in Developing Countries*. Committee on Population, Division of Behavioural and Social Sciences and Education. Washington, DC: National Academies Press.
- Radhakrishna, R., and C. Ravi. 2004. "Malnutrition in India : Trends and Determinants." *Economic and Political Weekly*, 39(7): 671-676.
- Robert, A. 2014. "A study of anthropometric measures as a determinant of health of the household in Chennai, Tamil Nadu." Paper presented at the Second International Conference on Global Business, Economics, Finance and Social Sciences (GB14Chennai Conference), India, 11–13 July.
- Ruel, M. and H. Alderman. 2013. "Nutrition sensitive interventions and programmes: how can they help accelerate progress in improving maternal and child nutrition?" *Lancet*, 382(9891): 536–51.
- Samman, E. and M.E. Santos. 2009. "Agency and Empowerment: A review of concepts, indicators and empirical evidence." OPHI Research Paper 10a, Oxford Poverty and Human Development Initiative (OPHI), University of Oxford.
- Santoso, M. V., R. B. Kerr, J. Hoddinott, P. Garigipati, S. Olmos, and S.L. Young. 2019. "Role of women's empowerment in child nutrition outcomes: A systematic review". *Advances in Nutrition*, 10:1138–1151. doi: <https://doi.org/10.1093/advances/nmz056>.
- Scantlan, J. and A. Previdelli. 2013. "Women's empowerment and childhood malnutrition in Timor-Leste: A mixed-methods study." Portland, Oregon: Mercy Corps, **1**, 1–53.
- Schmidt, E.M. 2012. "The effect of women's intrahousehold bargaining power on child health outcomes in Bangladesh." *Undergraduate Economic Review*, 9(1), Art. 4.
- Seebens, H. 2011. "Intra-household bargaining, gender roles in agriculture and how to promote welfare enhancing changes." ESA Working Paper No. 11–10. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.
- Sharaunga, S., M. Mudhara and A. Bogale. 2019. "Conceptualisation and measurement of women's empowerment revisited". *Journal of Human Development and Capabilities*, 20(1): 1–25. DOI: [10.1080/19452829.2018.1546280](https://doi.org/10.1080/19452829.2018.1546280)
- Shiwakoti, R., M. Devkota and R. Paudel. 2017. "Women's empowerment and nutritional status of their children: A community-based study from villages of Bhaktapur District, Nepal." *Universal Journal of Public Health*, 5(1): 8–16. Available at: <https://doi.org/10.13189/>

[ujph.2017.050102](https://doi.org/10.1186/1475-2875-10-102)

- Shroff, M.R., P.L. Griffiths, C. Suchindran, B. Nagalla, S. Vazir and M.E. Bentley. 2011. "Does maternal autonomy influence feeding practices and infant growth in rural India?" *Social Science and Medicine*, 73(3): 447–55.
- Smith, L.C., U. Ramakrishnan, A. Ndiaye, L. Haddad and R. Martorell. 2003. "The importance of women's status for child nutrition in developing countries." Research Report No. 13. International Food Policy Research Institute (IFPRI), Washington, D.C.
- Sraboni, E., H.J. Malapit, A.R. Quisumbing and A.U. Ahmed. 2014. "Women's empowerment in agriculture: What role for food security in Bangladesh?" *World Development*, 61: 11–52. Available at: <http://dx.doi.org/10.1016/j.worlddev.2014.03.025>
- Stock, J. H. and M. Yogo. 2005. "Testing for weak instruments in linear IV regression." In D.W.K. Andrew and J.H. Stock, eds, *Identification and Inference for Econometric Models: Essays in Honour of Thomas Rothenberg*. Cambridge University Press, Massachusetts. Available at: <https://doi.org/10.1017/CBO9780511614491.006>
- Strauss, J. 1986. "Does better nutrition raise farm productivity?" *Journal of Political Economy*, 94(2): 297–320.
- Strauss, J., G. Mwabu and K. Beegle. 2000. "Intrahousehold allocations: A review of theories and empirical evidence." *Journal of African Economies*, 9:83–143.
- The Hunger Project (THP). 2016a. *The Women's Empowerment Index*. [New York, USA](#).
- The Hunger Project (THP). 2016b. "Learning from the Women's Empowerment Index: Case studies on the income and time domains." School of International and Public Affairs (SIPA) Workshop Team 2015–2016, Columbia University New York, USA.
- Thomas, D. 1994. "Like father like son: Like mother like daughter: Parental resources and child health." *Journal of Human Resources*. 29(4): 950–88.
- Thomas, D. 1990. "Intrahousehold resource allocation – An inferential approach." *Journal of Human Resources*, 25(4): 635–64.
- Udry, C. 1996. "Gender, agricultural production, and the theory of the household." *Journal of Political Economy*, 104: 1010–46.
- Udry, C., J. Hoddinott, H. Alderman and L. Haddad. 1995. "Gender differentials in farm productivity: Implications for household efficiency and agricultural policy." *Food Policy*, 20(5): 407–23.
- UN (United Nations). 2017. "The sustainable development goals report 2017." United Nations, New York.
- UN (United Nations). 2010. "The world's women 2010: Trends and statistics." UN Department of Economic and Social Affairs, New York.
- UNECA (United Nations Economic Commission for Africa). 2017. "Measuring gender equality and women's empowerment in Africa." African Gender and Development Index Regional Synthesis Report, Addis Ababa.
- UNICEF. 2019. "The state of the world's children 2019. Children, food and nutrition: Growing well in a changing world. UNICEF, New York.
- UNICEF (United Nations Children's Fund). 2011. "Gender influences on child survival, health, and nutrition: A narrative review." Liverpool School of Tropical Medicine and UNICEF, New York.

- UNDP. 2019. "Human development report 2019: Beyond income, beyond averages, beyond today: Inequalities in human development in the 21st Century." United Nations Development Programme (UNDP), New York.
- UNSCN. 2014. "La contribution à la nutrition des politiques alimentaires et agricoles: Synthèse de huit études de cas nationales." United Nations System, Standing Committee on Nutrition, Geneva, Switzerland.
- USAID (The United States Agency for International Development), USAID 2018. "Burkina Faso: Nutrition Profile." Available at: <https://www.usaid.gov/sites/default/files/documents/1864/Burkina-Faso-Nutrition-Profile-Mar2018-508.pdf>.
- Van den Bold, M., A.R. Quisumbing and S. Gillespie. 2013. "Women's Empowerment and Nutrition: An Evidence Review." IFPRI Discussion Paper No. 1294. International Food Policy Research Institute (IFPRI), Washington D.C. <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/127840>
- Vanderkooy A., R. Verstraeten, E. Becquey, A. Dogui Diatta, E. Buttarelli, L. Diop and M. Touré. 2019. "Nutrition policy in Burkina Faso (Transform nutrition West Africa." Evidence Note #1). International Food Policy Research Institute (IFPRI), Dakar, Senegal.
- Webb, P. 2013. "Impact pathways from agricultural research to improved nutrition and health: Literature analysis and research priorities." The Food and Agriculture Organization of the United Nations (FAO) and World Health Organization (WHO), Rome, Italy.
- Webb, P. and S. Block. "2004. Nutrition Information and Formal Schooling as Inputs to Child Nutrition." *Economic Development and Cultural Change*, 801-820.
- Wekwete, N.N. 2014. "Gender and economic empowerment in Africa: Evidence and policy." *Journal of African Economies*, 23(Suppl_1): i87-i127. DOI: doi:10.1093/jae/ejt022
- WFP (World Food Programme). 2014. "Analyse Globale de la Vulnérabilité, de la Sécurité Alimentaire et de la Nutrition (AGVSAN)." World Food Programme (WFP), Vulnerability Analysis and Mapping (VAM) Unit, Rome.
- WHO (World Health Organization) Multicentre Growth Reference Study Group. 2006. "WHO child growth standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development." World Health Organization, Geneva.
- Wouterse, F. 2016. "Empowerment and Agricultural Production Evidence from Rural Households in Niger." IFPRI Discussion Paper No. 01509. International Food Policy Research Institute (IFPRI), Washington D.C.
- Yount, K.M., Y.F. Cheong, L. Maxwell, J. Heckert, E.M. Martinez and G. Seymour. 2019. "Measurement properties of the project-level Women's Empowerment in Agriculture Index." *World Development*, 124, 19pp DOI: <https://doi.org/10.1016/j.worlddev.2019.104639>

Appendixes

Appendix 1: Construction of women's empowerment index: Multiple correspondence analysis (n=5,710)

Categories	Contribution to index
Production control	0.421
No control	0.020
Individual	0.328
Collective	0.073
Access to land	0.442
No access	0.041
User or owner	0.401
Control over source of income	0.1
No income	0.013
Transfer	0.084
Household savings	0.003
Access to credit	0.03
No credit	0.001
Credit the last 12 months	0.029
Social group membership	0.006
No membership	0.001
Member or decision maker	0.005
Percentage explained by dimension	63.95

Source: Authors' calculations

Appendix 2: Statistics on empowerment and nutrition outcomes by woman's status in household

Variable	Woman is head (I)	Woman is spouse (II)	Woman is other relative (III)	(I)+(II)
Empowerment				
Empowerment score	2.938	1.719	1.366	1.774
Empowerment index	0.915	0.030	-0.291	0.119
Difference in age with HH	-	12.667	14.159	12.081
Difference in education with HH	-	1.1610	0.086	1.106

Indicators of empowerment contribution				
Production control	0.492	0.468	0.479	-
Access to land	0.243	0.464	0.417	-
Control over income	0.184	0.068	0.096	-
Access to credit	0.016	0.000	0.006	-
Group membership	0.064	0.000	0.002	-
Nutrition outcomes				
Household child	0.760	0.907	0.667	0.900
Height-for-age Z-score (HAZ)	-1.338	-1.11	-1.150	-1.1210
Weight-for-height Z-score (WHZ)	-0.156	-0.2457	-0.240	-0.2415
Weight-for-age Z-score (WAZ)	-0.8846	-0.8180	-0.8474	-0.821
Child is stunted	0.3489	0.2814	0.2975	0.2846
Child is wasted	0.119	0.0855	0.1039	0.0871
Child is underweight	0.156	0.1570	0.1598	0.156

Source: Authors' calculations

Appendix 3: IV diagnostics results

	HAZ	WHZ	WAZ
Hansen J p, Ho: Instruments valid	0.000	0.000	0.000
Under ID test p, Ho: Underidentified	0.267	0.275	0.275
Weak ID test stat (Kleibergen-Paap rk Wald F)	1.219	1.18	1.175
Anderson-Rubin, Ho: endogvars irrelevant			
A-R Wald test, p-value	0.911	0.377	0.511
A-R Wald Chi2 test, p-value	0.911	0.375	0.509
Endogeneity test p, Ho: exogenous	0.858	0.405	0.569

Source: Authors' calculations

Appendix 4: Empowerment indicators and child nutrition outcomes

Variable	HAZ (1)	WHZ (2)	WAZ (3)
Empowerment indicators			
Production	-0.023 (0.057)	-0.047 (0.050)	-0.021 (0.042)
Land access	0.181* (0.099)	0.144* (0.083)	0.203*** (0.067)
Access to credit	0.036 (0.117)	-0.205** (0.100)	-0.106 (0.099)
Control over income	-0.094*** (0.052)	0.056** (0.024)	-0.017 (0.019)
Social group membership	0.151** (0.061)	-0.032 (0.055)	0.075 (0.047)

Child characteristics			
Child is female	-0.000	-0.103	-0.070**
	(0.043)	(0.038)	(0.033)
Child is of household head	0.026	0.001	0.021
	(0.068)	(0.058)	(0.050)
Age in months	-0.147***	0.001	-0.072***
	(0.008)	(0.007)	(0.006)
Age in months squared	0.001***	-0.000	0.000***
	(0.000)	(0.000)	(0.000)
Age group: compl. feeding	0.573***	0.346***	0.503***
	(0.100)	(0.089)	(0.075)
Child birth (twin)	-0.682***	-0.288**	-0.638***
	(0.155)	(0.139)	(0.133)
Child is in nutrition programme	-0.288***	0.022	-0.160
	(0.061)	(0.052)	(0.047)

Women characteristics			
Difference in age	-0.002	-0.001	-0.002
	(0.002)	(0.001)	(0.001)
Woman education (ref. no educ)			
Primary education	-0.180	0.226	0.059
	(0.116)	(0.138)	(0.107)
Secondary education	-0.172	0.071	-0.019
	(0.139)	(0.121)	(0.110)
Tertiary education	0.835	-0.023	0.471
	(0.806)	(0.127)	(0.350)
Marital status			
Monogamous union	-0.158*	-0.026	-0.120
	(0.089)	(0.085)	(0.074)
Polygamous union	-0.175*	-0.005	-0.105
	(0.098)	(0.088)	(0.082)
Woman status in household			
Woman is head of household	-0.376**	0.172	-0.106
	(0.160)	(0.149)	(0.119)
Woman is spouse	0.078	0.066	0.092
	(0.076)	(0.067)	(0.060)
Household characteristics			
Age (in years) of household head	-0.000	-0.004	-0.003
	(0.005)	(0.004)	(0.004)

Age-squared of household head	0.000	0.000	0.000*
	(0.000)	(0.000)	(0.000)
Education of household head			
Primary education	0.116	-0.003	0.063
	(0.077)	(0.069)	(0.062)
Secondary education	0.149	0.378***	0.341***
	(0.193)	(0.137)	(0.124)
Tertiary education	-0.919***	0.677***	-0.050
	(0.165)	(0.159)	(0.157)
Household size	-0.001	-0.003	-0.002
	(0.005)	(0.004)	(0.003)
Access to clean water	0.000	0.060	0.040
	(0.057)	(0.052)	(0.044)
Constant	1.097***	-0.337*	0.304
	(0.229)	(0.204)	(0.159)
Cluster	535	535	535
Observations	5,580	5,580	5,580
F	29.94	4.28	9.93
Prob>F	0.000	0.0000	0.0000
R-squared	0.1372	0.0242	0.0618

Robust standard deviations in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Appendix 5: Questions used to construct empowerment index from survey questionnaire

Indicator	Question	Code
Production control	How is household plot managed?	1: individual, 2: collective
Land	The code of the person managing the plot	1: head, 2: spouse, 3-7: another member (son/daughter, father/mother, brother/sister)
	Who is plot owner?	1: head, 2: spouse, 3-9: another member
Income	Who controls income from crop sale?	1: head, 2=spouse, 3-9: other
	Household savings?	1: yes, 2: no
	Who receives transfers in the household?	1: head, 2=spouse, 3-7: another member
Credit	Did you request credit from a financial institution?	1: yes, 2: no
	Did you obtain credit in the last 12 months?	1: Yes, 2: No
Group membership	Are you a member of an organization or association?	1: yes, 2: no
	Are you member of a decision-making committee in an association or organization?	1: yes, 2: no



Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

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