POLICY BRIEF

Crop Diversification and Nutrition Outcomes in Smallholder Households: Panel Data Evidence from Southwestern and Northern Uganda

Racheal Namulondo and *Bernard Bashaasha*

August 2021 / No.757

Abstract

This study examined the effect of adopting crop diversification on nutrition outcomes of smallholder households in southwestern and northern Uganda. We constructed three models of correlates of household dietary diversity, minimum dietary diversity for women, and stunting of children aged 6–59 months. A 3-year panel multi-topic dataset collected in 2012, 2014 and 2016 by USAID's Feed the Future Nutrition Innovation Laboratory in southwestern and northern Uganda was utilized. Crop diversification was found to be positively and strongly associated with household dietary diversity, with the probability of achieving

the minimum dietary diversity for women, although the effect sizes were rather small. There was no clear association found between crop diversification and child stunting. Our findings point to an integrated approach that simultaneously addresses increasing crop diversification, access to improved farm production technology, access to nutritional knowledge, increasing formal education of mothers, increasing opportunities to do off-farm work, livestock diversification and food security to improve the nutritional outcomes of smallholder households.

Introduction

Malnutrition arising from an inadequate intake of energy and nutrients is still a major public health problem in sub-Saharan Africa. Most households affected by malnutrition are in rural areas and mainly depend on agriculture for their livelihood. Since the 1990 UNICEF conceptual framework and the 1992 International Conference on Nutrition that called for a multi-sectoral approach to tackling undernutrition, national governments in developing countries have been addressing population nutrition issues by intervening in various sectors. Due to its impact pathways, the agriculture sector demonstrates a higher potential than other sectors to influence nutritional outcomes in developing countries (Ruel et al., 2018; Ruel and Alderman, 2013).

Regional bodies such as the African Union have called on governments, through the Comprehensive Africa Agriculture Development Programme, to prioritize nutrition interventions in their agriculture investment plans. The Food and Agricultural Organization (FAO, 2014) identifies three nutrition-sensitive agricultural production implementation avenues. The first avenue relates to increasing agricultural production so that food can be accessed by all households at affordable prices. Second, food can be made more diverse through deliberate crop production diversity undertaken by farm families. Third, food can be made more nutritious by means of micronutrient fortification at the processing stage or biofortification at the breeding stage and by improving soil quality. Given these avenues, there are a range of policy options emanating from the agricultural sector that could influence the nutritional outcomes of a population largely dependent on agriculture. This study broadly focusses on the role crop production diversity plays in achieving the nutrition objectives of Uganda's 2013 National Agriculture Policy (NAP).

Nutritional outcomes in Uganda are still at undesirable levels. The 2016 Uganda Demographic Health Survey report showed that child stunting had reduced by 4% between 2011 and 2016. Stunting, however, remained higher in rural areas (30%) than urban areas (24%). The poor nutrition outcomes are also unevenly distributed within the regions of the country. As the 2006, 2011 and 2016 Uganda Demographic Health Survey reports show, the prevalence of stunting has consistently been higher in the southwestern and northern regions.

Intermediate nutritional outcomes such as household dietary diversity, which are known to have a positive influence on the nutritional status of children and adults (Arimond and Ruel, 2004; Ruel, 2002), are also still at undesirable levels in Uganda. A study by Ecker et al. (2010) found that farmers' diets in Uganda and other East African countries were dominated by grains and tuber-based staples with little or no consumption of vegetables and fruit. Additionally, an analysis of the food consumption module of the 2009/2010 Uganda National Panel Survey data shows that starchy staples and grains contributed, on average, to about 70% of calories consumed nationally (Namulondo, 2016). Based on the guidelines in Smith and Subandoro (2007), such a high proportion of starchy staples and grains in the diet is an indicator of low dietary diversity and micronutrient adequacy.

Various studies have examined the association between farm production diversification and better nutrition outcomes for developing countries. Pandey et al. (2016) identified two levels of nutrition outcome indicators, namely intermediate nutrition outcomes, which include dietary diversity, calorie intake and micronutrient intake, while final nutrition outcomes include anthropometric measures and disability adjusted life years. Jones et al. (2014) estimated dietary diversity outcomes of crop diversity using Malawian household-level cross-sectional data and concluded that farm production diversity had the potential to increase household dietary diversity. Herforth (2010) demonstrated a positive association between the number of crops grown and the farm households' dietary variety measured by the number of different foods in the diet in the East African countries of Kenya and Tanzania. Sibhatu et al. (2015) used household cross-sectional data from Indonesia, Kenya, Ethiopia, and Malawi and found a positive association between on-farm production diversity and household dietary diversity. However, the same study showed that market access was more effective than production diversity in increasing households' diet diversity.

In a similar study finding, Koppmair et al. (2016) indicated that the effect of farm diversity on households', mothers' and children's dietary diversity was smaller than that of market access and agricultural technology adoption in Malawi. Chegere and Stage (2020) also reported that diversifying agricultural production increases the dietary diversity of households in Tanzania, although effect sizes are small. Kavitha et al. (2016) concluded that crop diversity alone does not improve household dietary diversity in the semi-arid regions of India. A separate strand of studies investigated the association between farm diversification and children's nutritional status. Kumar et al. (2015) found a negative association between production diversity and stunting of children aged 24–59 months in Zambia. Similarly, Lovo and Veronsi (2019) found a positive, albeit small, effect of crop diversification on child height-for-age Z-scores for subsistence farm households in Tanzania. Evidence from Nepal (Shively and Sununtnasuk, 2015) showed positive correlations between the consumption of own production and better outcome indicators of child stunting and child height-for-age Z-scores.

Within this context, this study adds to the body of research that aims to understand the influence of crop diversification on nutrition by utilizing a household panel dataset that captures the changing behaviour of smallholders and holds information on dietary patterns from 24-hour food recalls. Existing panel-data studies concerning this research question assess dietary diversity using food consumption modules of household surveys where data are not collected for dietary purposes. A notable limitation is that these data do not consider food acquired and then stored (Smith and Subandoro 2007). Consequently, a misrepresentation of dietary patterns might arise if acquired food was not wholly consumed daily or was consumed after the recall period. While we acknowledge that each dietary assessment methodology has limitations, collecting 24-hour food recall data on at least two non-consecutive days provides reliable information regarding the average dietary patterns of households (FAO, 2018). 24-hour food recall data also considers intra-household food allocation, which is essential for understanding the dietary patterns of vulnerable members of a household such as women and children under five.

Furthermore, several previous studies have concluded that farm diversification alone is not enough to improve dietary diversity and compared the importance of farm diversification vis-à-vis market access. However, the evidence on the importance of markets in delivering dietary diversity for farm households in predominantly subsistence production is mixed. There is also limited evidence on the role of agricultural technology in improving nutrition outcomes for small farm households. Further research is therefore necessary to clarify the factors that are important for improving nutrition outcomes other than farm diversification for predominantly subsistence farm households. The objective of this study is to examine the effect of food-crop diversification on nutrition outcomes of smallholder households in southwestern and northern Uganda. This study has two hypotheses: i) a higher level of crop diversification is associated with a higher level of household dietary diversity and increases the probability of achieving the minimum dietary diversity for women; and ii) the risk of stunting for children aged 6–59 months is lower in households with a higher level of crop diversification.

Policy context

Uganda has incorporated explicit nutrition objectives in its agriculture policy and national development plan. The goal of Uganda's 2013 NAP is "to achieve food and nutrition security and improve household incomes" (MAAIF, 2013). The first specific objective of this policy requires that all households and individuals be food and nutrition secure in Uganda. One strategy to achieve this objective relates to farm production diversification whereby the Government of Uganda promotes: "the production of nutritious foods to meet household needs and for sale…" (MAAIF, 2013). Accordingly, in operationalizing this strategy, 12 food commodities were

prioritized for investment in the areas of research, extension, provision of quality inputs, pest, vector and disease control, post-harvest handling, and improving market access and value addition. The 12 food commodities are: bananas, beans, maize, rice, cassava, Irish potatoes, tea, coffee, fruit and vegetables, dairy, fish, and livestock.

In a complementary strategy, the policy supports the consumption of diversified nutritious foods through promotion of the production of bio-fortified foods, including indigenous foods, at household and community levels. The second objective of the policy identifies farm diversification as one of the strategies that would lead to an increase in farming households' incomes. Additionally, the policy provides for the development of extension systems through which farmers acquire new knowledge and information on good agricultural practices. Diversified farm production systems are a component of the recommended agricultural practices included in training manuals of extension systems whereby farmers are taught to intercrop and plant micro-nutrient rich varieties. Clearly, production diversification is recognized as a policy instrument that is expected to influence household nutrition directly and indirectly. Uganda's NAP is operationalized by the Agricultural Sector Strategic Plan and is being implemented by state and non-state actors such as donor agencies who work in partnership with Uganda's Government. An example of this partnership was the USAID–Uganda Community Connector Project, which supported the implementation of the 2010–2015 Agricultural Sector Development Strategy and Investment Plan in Uganda.

USAID's community connector project in Uganda

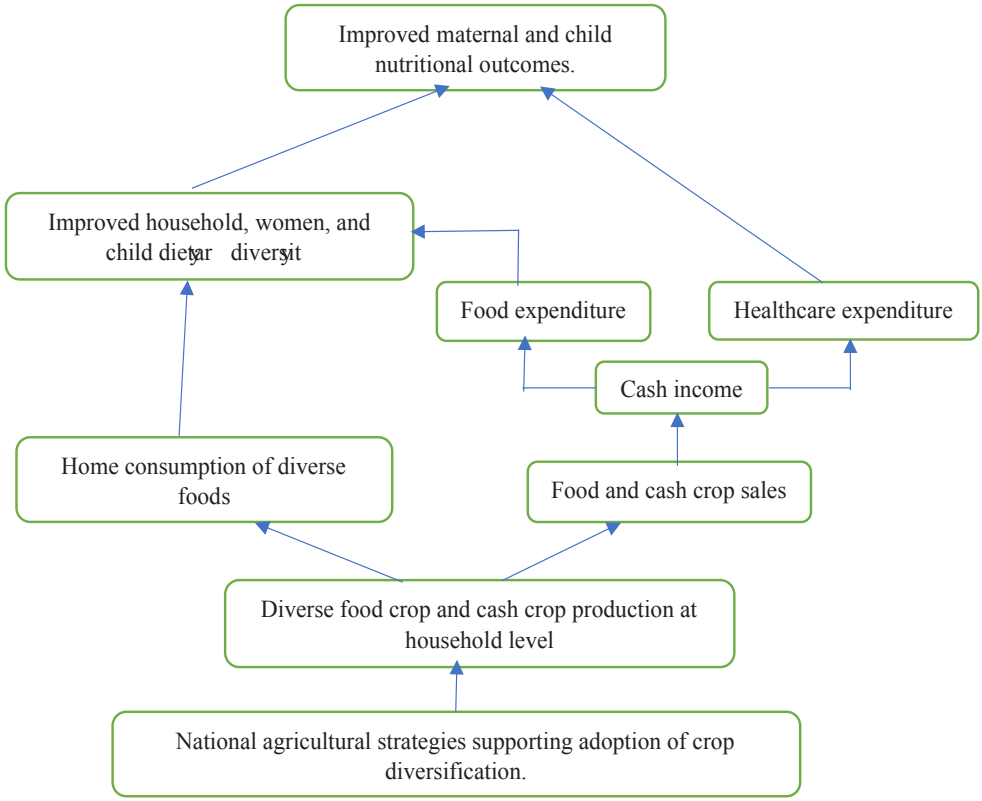
This project was a Feed the Future initiative with the objective of improving the nutrition, health, and livelihood of poor rural households dependent on subsistence farming, through integrated agricultural and nutrition interventions. The project that began in 2012 and lasted five years was implemented in 15 districts in northern and southwestern Uganda. USAID worked with local governments in these districts to implement evidence-based interventions that would improve agricultural production and livelihood activities, household nutrition, hygiene practices and gender equitable practices. Beneficiary households were expected to adopt 10 intervention components (USAID and FHI 360, 2015) that comprised: creating homestead gardens with nutritious foods such as pumpkin, amaranth and other traditional vegetables; at least a pawpaw tree, an avocado tree or other fruit tree near the homestead; an agricultural income-generating activity; rearing of goats, keeping chickens or having an apiary; acquisition of production assets such as hoes, ox-ploughs, watering cans, and spray pumps; availability of water, sanitation and hygiene facilities; clean and neat homestead compounds; family members supporting each other in production

and feeding decisions; stocks of enough food to last up to three months in the garden or store; and women or family who are saving. The mid-term review report of the project indicated that these intervention components had been widely adopted by the beneficiary households (USAID and FHI 360, 2015).

Conceptual framework

The UNICEF conceptual framework (UNICEF, 1991), which explains the causes of malnutrition, forms the theoretical basis of our analysis. As it highlights the linkages between agriculture and nutrition, this framework implies that the complex and multiple causes of malnutrition require broader strategies to be integrated with nutrition interventions to curb the malnutrition problem in developing countries.

Figure 1: Pathways of the effect of a crop diversification strategy on household nutrition outcomes



Source: Adapted from Kadiyala et al. (2014) and Headey et al. (2011)

Kadiyala et al. (2014) and Headey et al. (2011) modified the UNICEF conceptual framework for malnutrition and provided specific pathways that explain the linkages between agriculture and nutrition. These were mainly: consumption of own

production; income earned from agricultural-related activities that are used to acquire nutritious foods and healthcare; and women's socioeconomic status and position in household decision-making in utilizing resources.

Data description

The data for this study were collected as part of the Community Connector Project by Feed the Future Innovation Laboratory for Nutrition (ILN) in Uganda. Panel surveys were conducted in 2012, 2014 and 2016 in six districts in southwestern and northern Uganda. A multi-stage sampling framework was employed to identify 3,597 households with a caregiver/mother of a child 0–23 months old, or a woman of reproductive age (18–49 years) as the main respondent in the baseline survey. Of these households, 3,302 and 3,196 were surveyed in 2014 and 2016, respectively. The sampling framework involved randomly selecting 17–25 parishes from each of the six districts and then randomly selecting 5–8 villages from each selected parish. Households were then randomly selected from a list generated for each selected village. This was a multi-topic survey covering household characteristics such as diet intake in a 24-hour recall period for mothers and children under five, sanitation, breastfeeding, health status of the caregiver and children under 5 years of age, food security, crop and livestock production, income and expenditure, gender and decision-making, and anthropometric measurements of mothers and children under five. The low attrition rate of 8% and 7% between the survey waves was assumed to be random and was addressed by controlling for household demographics in the estimation models.

Our study examined the effect of crop diversification on nutrition outcomes of farm households following a methodology like that in studies where a dietary diversity score or child anthropometrics is regressed on indices of farm production diversity and control variables of socioeconomic characteristics, market access and participation indicators, and farm characteristics. Three outcome variables were considered: Household Dietary Diversity (HDD), Minimum Dietary Diversity for Women (MDD-W) and the anthropometric indicator of stunting in children under five scores. Hoddinott and Yohannes (2002) and Ruel (2002) define household dietary diversity as the number of different foods or food groups consumed by a household at a point in time. According to Ruel (2003), food items are grouped together when they have similar nutrients and have the same role in the diet. In this study, the HDD score was calculated based on 12 categories of foods consumed by the household in a 24-hour recall period, i.e., cereals; white tubers, roots, and plantain; vegetables; fruit; meat; eggs; fish and other seafood; pulses; nuts and seeds; milk and milk products; oils and fats; and sugar, condiments, and beverages.

MDD-W measures the number of food groups consumed by women of reproductive age out of the following 10 food groups (FAO and FHI 360, 2016): Grains, roots, tubers, and plantain (starchy staples); pulses (beans, peas, lentils); nuts and seeds; dark

green leafy vegetables; other Vitamin A-rich fruit and vegetables; other fruit; other vegetables; meat, poultry and fish; eggs; and dairy (milk and milk products). Thus, while the HDD score measures access to a diverse diet, the MDD-W with a cut-off of 5 food groups reflects the micronutrient adequacy of the diet of women of reproductive age in a household. Data on food intake were gathered from households based on a 24-hour recall period and the respondent was a caregiver/mother, aged 18–49 years, who prepared and served the meals.

Stunting is a widely used indicator of child nutritional status. From our conceptual framework, child nutritional status is depicted as an outcome influenced by crop diversification via the mechanism of a child's consumption of diverse foods from own production and household food expenditure on diverse foods. We therefore focussed on young children who were assumed to have started complementary feeding and older children below five years of age. The stunting variable was constructed based on the height-for-age Z-scores in the dataset, which were calculated using growth standards compiled by the World Health Organization. A 6–59-month-old child was considered stunted if her/his height-for-age Z-score was two or more standard deviations below the median height of the reference population (WHO, 2006). The analysis used data on an index child of 6–59 months old from 2,060 households.

Conclusion and policy implications

The conventional wisdom is that when small farmers integrate vegetables, legumes and fruit into their farming systems, dietary diversity and diet adequacy of their households improve. We found statistically significant associations between food-crop diversification and household dietary diversity, and between food-crop diversification and achieving minimum dietary diversity for women. As crop diversification is an existing strategy of the NAP to improve household incomes and nutrition outcomes, our findings serve as reassurance for the policy and agricultural programmes in Uganda. However, due to the small effect size of crop diversification observed, our results point at an integrated approach that simultaneously addresses increasing crop diversification, access to improved farm production technology, access to nutritional knowledge, increasing the formal education of mothers, increasing opportunities to do off-farm work, livestock diversification, and food security of households to improve the nutritional outcomes of smallholder households.

With an average of 5–6 food-crop species cultivated (composed mostly of staples of grains, plantains, tubers, and legumes) households need to be sensitized to diversify along food-crop families to produce vegetables and fruit in addition to the food-crop families that are largely produced. The use of improved seed varieties increases crop productivity and provides a surplus that can be sold. The positive association between the use of improved seeds and household dietary diversity implies that

incomes realized, due to increased crop productivity and by extension increased crop sales, would be utilized by households to buy diverse foods. Similarly, incomes from off-farm work would be used to acquire diverse foods. The formal education of mothers/caregivers would improve their health practices and access to and use of nutrition information needed to prepare diverse diets for household members. The positive effect of food security on diet diversity indicates that households only begin to consider the quality of their diets if there is enough food to eat for every household member. With livestock diversification, subsistence households can increase their access to animal-source foods, hence diversifying their diets.

References

Arimond, M. and M.Y. Ruel. 2004. "Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys". *Journal of Nutrition*, 134(10): 2579–85.

Chegere, M.J. and J. Stage. 2020. "Agricultural production diversity, dietary diversity and nutritional status: Panel data evidence from Tanzania". *World Development*, 129, 104856.

Ecker, O., K. Weinberger and M. Qaim. 2010. "Patterns and determinants of dietary micronutrient deficiencies in rural areas of East Africa". *African Journal of Agricultural and Resource Economics,* 4(2): 1–20.

Food and Agricultural Organization (FAO). 2014. "Rome Declaration on Nutrition. Why it matters and what can be done". Conference Outcome Document of the Second International Conference on Nutrition (ICN2), Rome, 19–21 November.

Food and Agricultural Organization (FAO). 2018. *Dietary Assessment: A Resource Guide to Method Selection and Application in Low Resource Settings.* Rome: Food and Agriculture Organization of the United Nations. At http://www.fao.org/3/I9940EN/i9940en.pdf (accessed 2 June 2020).

Food and Agricultural Organization (FAO) and FHI 360. 2016. *Minimum Dietary Diversity for Women: A Guide for Measurement*. Rome: Food and Agriculture Organization of the United Nations. At http://www.fantaproject.org/monitoring-and-evaluation/minimum-dietary-diversity-women-indicator-mddw (accessed 22 April 2020).

Fekadu, Y., A. Mesfin, D. Haile and B.J. Stoecker. 2015. "Factors associated with nutritional status of infants and young children in Somali Region, Ethiopia: A cross- sectional study". *BMC Public Health*, 15(846).

Headey, D., A. Chiu and S. Kadiyala. 2011. *Agriculture's Role in the Indian Enigma: Help or Hindrance to the Crisis of Undernutrition?* IFPRI Discussion Paper No. 01085. International Food Policy Research Institute, Washington, D.C.

Herforth, A. 2010. "Promotion of traditional African vegetables in Kenya and Tanzania: A case study of an intervention representing emerging imperatives in global nutrition". PhD Dissertation. Graduate School of Cornell University, Ithaca, NY.

Hoddinott, J. and Y. Yohannes. 2002. *Dietary Diversity as a Food Security Indicator*. FCND Discussion Paper No. 136. International Food Policy Research Institute, Washington, D.C.

Jones, A.D., A. Shrinivas and R. Bezner-Kerr. 2014. "Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data". *Food Policy*, 46: 1–12.

Kadiyala, S., J. Harris, D. Headey, S. Yosef and S. Gillespie. 2014. "Agriculture and nutrition in India: Mapping evidence to pathways". *Ann. N.Y. Acad. Sci.*, 1331(1): 43–56.

Kavitha, K., P. Soumitra and R. Padmaja. 2016. "Understanding the linkage between crop diversity and household dietary diversity in the semi-arid regions of India". *Agricultural Economics Research Review,* 29: 129–37.

Khamis, A.G., A.W. Mwanri, J.E. Ntwenya and K. Kreppel. 2019. "The influence of dietary diversity on the nutritional status of children between 6 and 23 months of age in Tanzania". *BMC Pediatrics*, 19: 518.

Koppmair, S., M. Kassie, and M. Qaim. 2016. "Farm production, market access and dietary diversity in Malawi". *Public Health Nutrition*, 20(2): 325–35.

Kumar, N., J. Harris, and R. Rawat. 2015. "If they grow it, will they eat and grow? Evidence from Zambia on agricultural diversity and child undernutrition". *The Journal of Development Studies,* 51(8): 1060–77.

Lovo, S. and M. Veronsi. 2019. "Crop diversification and child health: Empirical evidence from Tanzania". *Ecological Economics,* 158(C): 168–79.

MAAIF (Ministry of Agriculture, Animal Industry and Fisheries). "National agriculture policy". Ministry of Agriculture, Animal Industry and Fisheries, Entebbe, Uganda.

Namulondo, R. 2016. "Food demand, nutrient consumption and food price changes in Uganda". PhD Dissertation. University of Dar es Salaam, Dar es Salaam, Tanzania.

Pandey, V.L., D.S. Mahendra and U. Jayachandran. 2016. "Impact of agricultural interventions on the nutritional status in South Asia: A review". *Food Policy*, 62: 28–40.

Ruel, M.T. 2002. *Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs.* FCND Discussion Paper No. 140. International Food Policy Research Institute, Washington, D.C.

Ruel, M.T. 2003. "Operationalising dietary diversity: A review of measurement issues and research priorities". *Journal of Nutrition*, 133(11, Suppl 2): 3911S–26S.

Ruel, M.T. and H. Alderman. 2013. "Nutrition-sensitive interventions and programmes: How can they help to accelerate progress in improving maternal and child nutrition?" *The Lancet,* 382(9891): 536–51.

Ruel. M.T., A.R. Quisumbing and M. Balagamwala. 2018. "Nutrition sensitive agriculture: What have we learned so far?" *Global Food Security*, 17: 128–53.

Shively, G., and C. Sununtnasuk. 2015. "Agricultural diversity and child stunting in Nepal". *The Journal of Development Studies*, 51(8): 1078–96.

Sibhatu, K.T., V.V. Krishna and M. Qaim. 2015. "Production diversity and dietary diversity in smallholder farm households". PNAS. 112(34): 10657–62.

Smith, L.C., and A. Subandoro. 2007. *Measuring Food Security Using Household Expenditure Surveys.* Washington, D.C.: International Food Policy Research Institute.

United Nations Children's Fund (UNICEF). 1991. "Strategy for improved nutrition of children and women in developing countries". *The Indian Journal of Pediatrics*, 58(1): 13–24.

USAID and FHI 360. 2015. *Uganda Community Connector Project: Barriers and Facilitators to the Uptake of CC See 10 Elements.* Technical Notes Series No. 6. U.S. Agency for International Development and FHI 360. At https://www.fhi360.org/resource/usaiduganda-community-connector-technical-note-series

World Health Organization (WHO). 2006. "The WHO Child Growth Standards". World Health Organization, Geneva. At http://www.who.int/childgrowth/standards/en/

World Health Organization (WHO). 2008. "Indicators for assessing infant and young child feeding practices: Part 1 definitions". World Health Organization, Geneva. At https://www.who.int/nutrition/publications/infantfeeding/978241596664/en/

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.

www.aercafrica.org

Learn More

www.facebook.com/aercafrica

www.instagram.com/aercafrica_official/

twitter.com/aercafrica

www.linkedin.com/school/aercafrica/

Contact Us
African Economic Research Consortium
Consortium pour la Recherche Economique en Afrique
Middle East Bank Towers,
3rd Floor, Jakaya Kikwete Road
Nairobi 00200, Kenya
Tel: +254 (0) 20 273 4150
communications@aercafrica.org