POLICY BRIEF

# Technology Adoption and Access to Credit in Tanzania: A Spatial Econometric Analysis

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## Abstract

This paper aims to analyze the relationship between technology adoption and access to credit by farmers in Tanzania, with particular focus on spatial spillover effects on technology adoption. We examine new technology diffusion by farmers through their peers and measure geographical proximity using farms' GIS localization data. Using the 2012-2013 Tanzanian Household Survey and a spatial lag probit model, we find evidence that farmers' access to finance leads to increased agricultural technology adoption, and that the spillover effect plays a role in this process. In addition, our results are robust over a 3-year period (i.e.,

2008-2009, 2010-2011, and 2012-2013). Finally, evidence of the existence of spillover effects in the adoption of agricultural technology suggests that interactions between farmers who are 'geographical neighbours' should be supported/exploited to achieve substantial efficiency and savings in new agricultural technology extension.

# Introduction

Harnessing the potential of Tanzania's agricultural sector is key to the country's sustainable growth and export promotion. A significant increase in agriculture productivity is needed not only to supply domestic demand, but also to tap into larger markets at regional and global levels. In addition to helping generate more growth from agriculture, increased productivity would also free up labour to be employed in other higher value-added activities. Productivity trends were positive in Tanzania over several decades but have declined in recent years. While agriculture production rose by 3% on average between 1961 and 2015, it still represented only half of South Africa's production and remains low compared to average middle-income countries. Furthermore, it has declined since 2012, reaching a -15% low in 2015.

Relatively low agricultural productivity may be due to a number of factors, including low levels of mechanization, limited access to inputs and/or financing, poor quality of infrastructure, and insufficient innovation. Innovation is essential to bringing about a sustainable increase in productivity in Tanzania is low by international standards. As an illustration, Tanzania's agricultural total factor productivity (TFP) index decreased by 3% over the period 1962-2015, while it rose by 41% in Asian countries. Investment in the adoption of new technologies in the sector can strengthen agricultural production in Tanzania. However, accomplishing such an aim will require strengthening financial inclusion for farmers to enable them not only to access credit but also to transact in a manner that is convenient and does not require undue time, effort, or expense.

Financial inclusion refers to all initiatives that make formal financial services available, accessible, and affordable to all segments of the population (African Development Bank, 2013), including farmers and agricultural workers. Farmers and agricultural workers have historically been excluded from the formal financial sector for various reasons primarily related to their education and economic background. Inadequate access to financial services mainly occurs in the agricultural sector, which employs a sizeable portion of Africa's labour force. The factors hindering access to financial services in the agricultural sector include high delivery costs, low farming profits, lack of access to banking technology, the necessity of collateral, low productivity, long distance to the source of credit, type of credit source, lack of education, and price risk (Etonihu et al., 2013).

In Tanzania, a significant part of the population remains excluded from access to financial services, especially those living in rural areas and working in the agricultural sector; in Tanzania, 54% of the agricultural labour force is excluded from all formal and informal financial services (National Financial Inclusion Framework - NFIF, 2014). Indeed, until recently, the Tanzanian financial system has not been particularly inclusive; it is small and dominated by the banking sector, which accounts for 71% of the financial sector's total assets (International Monetary Fund, 2016).

Credit guarantee schemes have been designed and established to increase credit availability to support agriculture, given its prominence in Tanzania's economy. These schemes have made and continue to make a significant contribution to the expansion of credit in Tanzania (FSDT, 2016). Four of these schemes are currently active in Tanzania: (a) Private Agricultural Sector Support, funded by the Danish International Development Agency; (b) Sustainable Agriculture Guarantee Fund, funded by a private bank, Rabobank; (c) Agricultural Credit Guarantee, funded by Alliance for a Green Revolution in Africa, OPEC Fund for International Development, and Kilimo Trust; and (d) Cooperative and Rural Development Bank Guarantee, funded by African Development Bank and United States Agency for International Development and focused exclusively on agriculture (Financial Sector Deepening Trust - FSDT, 2016).

Because financial services are evolving in rural areas of Tanzania, their impact on the agricultural sector must be comprehensively assessed to support financial inclusion policies. The literature highlights the fact that inadequate access to formal financial services, including agricultural credit, impedes the adoption of new technologies and productivity (Giné and Yang, 2009; Meyer, 2015; Ogada et al., 2014).

While extensive work exists on credit impact on technology adoption and productivity (Abate et al., 2016; Duflo et al., 2006; Kumar et al., 2020), the role of a spillover effect induced by geographical proximity among farmers warrants further investigation. Indeed, two compelling questions are: (a) Is there a neighbourhood effect (i.e., a 'contagion effect') in the adoption of new technologies? and (b) What is the role of the 'neighbourhood effect' in the impact of access to credit on technology adoption in agriculture? Against this backdrop, this paper aims to explore the relationship between technology adoption and credit access in Tanzania, while highlighting the role of a spillover effect induced by geographical proximity among farmers.

The choice of Tanzania as our subject is justified for two primary reasons. First, Tanzania has a National Financial Inclusion Framework, which aims to address obstacles to financial inclusion by designing, monitoring, and evaluating necessary policies and actions. Such a framework is important as it serves to put the results of the analysis and related policy actions into perspective. Second, while it focuses

on the most recent household survey available (2012-2013), the analysis also takes advantage of structured data to offer new insights into the dynamics of farmers' behaviour over a three-year period (i.e., 2008-2009, 2010-2011, and 2012-2013). Furthermore, this study is relevant for several reasons: (a) The role of spillover effects in the relationship between access to credit and technology adoption, especially in the case of Tanzania, has not been extensively investigated; (b) This research improves the identification of neighbourhood effects on technology adoption; indeed, neglecting the role of neighborhood effects could produce an under-estimation of the effect of financial inclusion on technology adoption; and (c) This research is policy-relevant because improving our understanding of the relationship between financial inclusion and technology adoption is helpful in designing sound policies and achieving better value for money/return on investments in their implementation.

# Conclusion

In this study, we examine the relationship between technology adoption and credit access of farmers in Tanzania. We test specifically the role of farmers' diffusion of new technology through their peers and focus on their geographical proximity using farms' GIS localization data. We assume that geographical proximity increases the availability of accurate information and accelerates technology diffusion. The results of the spatial lag probit models used support the hypothesis that financial access leads to increased agricultural technology adoption, and that the spillover effect has an impact on this process.

We find that improved access to credit leads to greater spillover effects in the adoption of inorganic fertilizers and pesticides. As farmers' level of credit increases, their purchasing power, and the probability of their adopting new agricultural technology, such as inorganic fertilizer, also increases. Therefore, improving financial access to agricultural technology, including fertilizers and pesticides, is relevant to policy. The existence of spillovers in the adoption of agricultural technology suggests that a typical policy aimed at easing access to inorganic fertilizers or pesticides could generate an impact that goes well beyond the original target, leading to increased efficiency and lower cost. We conclude that by promoting inorganic fertilizers (through credit facilitation, for instance) to a small set of farmers, the government could indeed achieve increased acceptance and adhesion and higher agriculture productivity thanks to spillover effects.

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