An econometric estimation of the influence of extension and farmer networks on technology knowledge and uptake amongst Kenyan dairy farmers.

Hypothesis

The influence of agricultural extension and farmers' networks[1] on technology knowledge and uptake varies with particular farmer, household, and network traits.

I hypothesise that:

- The impact of open-access extension on knowledge and adoption increases with education,
- The impact of all forms of extension on adoption increases with education,
- The impact of private extension increases with market-orientation of production,
- Those will little social capital are expected to gain least from network diffusion, and
- Network and extension effects interact in determining technology knowledge/uptake,

amongst others.

Rationale

The poor outcomes of public extension systems[2] and pressures to reduce costs at the end of the last century spurred a shift away from direct extension, towards cheaper network-driven methods of diffusion such as farmer-to-farmer extension[3] (Kiptot and Franzel, 2015, p.505; Takahashi, Muraoka and Otsuka, 2020, p.32). The current economic climate of high inflation and rising interest rates is recreating these circumstances, pushing private and public entities to cut budgets (Clarke, 2021) whilst reducing the purchasing power of each dollar spent; this will undoubtedly further limit the scale of direct extension.

However, the need for effective knowledge and technology dissemination in Sub-Saharan Africa (SSA) is higher than ever. In addition to stagnant productivity growth (Fuglie and Wang, 2012, pp.4-5) and climate change (IPCC, 2022), SSA farmers are in need of knowledge, skills and technologies to deal with the disruption of input and feedstuff supplies due to Russian aggression in Ukraine (Hatab, 2022), and droughts in the East of the continent (Button, 2022; Toreni *et al.*, 2022). Effective extension delivery will be critical in limiting the poverty, food insecurity, and instability these crises are causing.

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[1] This refers to social networks of a farmer, which will be evaluated and incorporated using principles of social network analysis (Serrat, 2017)

[2] Organised and run by the state

[3] A model of extension whereby farmers are the agents of knowledge/technology diffusion, informing and training other farmers themselves

By studying the impact different forms of extension[4] and farmer social networks have on knowledge and uptake of technology, this research contributes to the literature[5] in two ways. Firstly, it provides insights into improving the efficiency of extension by identifying farmers most likely to benefit from a given form of extension. Secondly, it serves to improve the equity of extension by helping to identify those farmers likely to benefit *least* from the diffusion of knowledge and technology through a network, and what forms of extension are likely to serve them best. This research therefore allows scarce – and increasingly scarcer - direct extension resources to be deployed more efficiently and equitably at a time of heightened need.

Furthermore, the primary dataset available is unique in that it brings together information on farmer characteristics, network structures, technology knowledge/adoption, and preferred forms of extension. This research is therefore well-poised to generate new insights by being able to integrate and jointly analyse models used in the literature[6].

Research Questions

1. What model/s[6] is/are appropriate to quantify the influence of farmers' social network on their likelihood to know about or adopt a technology in the context of developing country dairy systems.
2. What is the impact of private, public, open-access extension, as well as farmers' social network on:
    a. Knowledge of technology
    b. Technology uptake
3. How does 2 vary with:
    a. Farmer characteristics
    b. Household characteristics
    c. Network characteristics
4. What is the impact of the interaction[7] of different forms of extension and social network influence on:
    a. Knowledge of technology
    b. Technology uptake

Objectives

To determine a succinct model to capture the how technology knowledge and uptake in a farmer's network influence that farmer's likelihood to know about or adopt a technology, based on existing models[6].

To identify how the impact of different forms of extension and social networks on knowledge/uptake of technology varies with farmer, household, and network traits.

To evaluate how the interaction of different forms of extension affects technology knowledge/uptake.

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[4] Namely private, public and open-access (radio, tv, newspapers) forms of extension

[5] This proliferated rapidly in the early 2000s following the increase interested in Farmer-to-Farmer Extension, see Chavas and Nauges, 2020; Takahashi, Muraoka and Otsuka, 2020, p.38; Ochieng, Silvert and Diaz, 2022)

[6] See Krishnan and Patnam, 2014; Maertens, 2017; Barham *et al.*, 2018; Beaman and Dillon, 2018; Fisher *et al.*, 2018; Chavas and Nauges, 2020, pp.47–48; Takahashi, Muraoka and Otsuka, 2020, pp.38–39

To identify traits linked with farmers being less likely to benefit from diffusion through networks.

Based on findings, to draw insights on how to direct extension resources to optimise efficiency and equity.

Methods

The dataset available consists of qualitative and quantitative variables on the individual, household, and network characteristics of dairy farmers in four rural communities in Western Kenya (Fig2), as well as information on their previous exposure to and preferences of different forms of extension. The author was thoroughly involved in data collection whilst on placement last March.

From this dataset, variables to measure traits of interest – including social capital and network characteristics – will be constructed for subsequent use.

Next, a model will have to be determined to quantify the knowledge and uptake pressure exerted on a farmer by his network.

Figure 1: Locations of communities where data collection was conducted (Morrison, 2022)

Summary statistics and figures will then be calculated.

A logistic regression will then be constructed, regressing a binary measure of knowledge of, or uptake of, different dairy technologies[8] against;

1. farmer traits
2. household traits
3. network/community traits
4. exposure to different forms of extension
5. the influence of social networks
6. the interaction of 4 with 5
7. the interaction of 4 and 5 with 1
8. the interaction of 4 and 5 with 2, and
9. the interaction of 4 and 5 with 3.

Testing and comparison of regression terms will be carried out, and visualisations constructed to communicate the significance of each.

These will subsequently be compared with farmers' (self-reported) preferred forms of extension to see how the two are related, if at all.

Finally, these findings will then be used to interpret how the distribution of extension resources affects the efficiency and equity of extension.

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[8] Namely vaccinations, improved fodder, artificial insemination and/or crossbreeding

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