

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

## Hypothesis

The influence of agricultural extension and farmers' networks<sup>1</sup> on technology knowledge and uptake varies with particular farmer, household, and network traits.

I hypothesise that:

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

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

## Rationale

Poor outcomes of public extension systems<sup>2</sup> 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<sup>3</sup> (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.

By studying the impact different forms of extension<sup>4</sup> and farmer social networks have on knowledge and uptake of technology, this research contributes to the literature<sup>5</sup> in

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<sup>2</sup> Organised and run by the state

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

<sup>4</sup> Namely private, public and open-access (radio, tv, newspapers) forms of extension

<sup>5</sup> 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

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.

## Research Questions

1. What model is appropriate to quantify the influence of farmers' social network on farmers' knowledge or adoption of 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 traits, including education and social capital

- b. Household characteristics, including market-orientation
- 4. What is the impact of the interaction of different forms of extension and social network on:
  - a. Knowledge of technology
  - b. Technology uptake

## Objectives

To determine a model to capture the how a farmer's network influences that farmer's likelihood to know about or adopt a technology, based on existing models<sup>6</sup>.

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 and network effects affect technology knowledge/uptake.

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

Based on findings, to establish who can benefit most from a given form of extension, who is most dependent on extension, and how to target extension resources and systems throughout a network to maximise overall impact. These findings can be directly applied<sup>7</sup> in-field by development organisations or governments/government

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<sup>6</sup> See Banerjee *et al.*, 2013; Krishnan and Patnam, 2014; Maertens, 2017; Barham *et al.*, 2018; Beaman and Dillon, 2018; Fisher *et al.*, 2018; Beaman *et al.*, 2021; Fafchamps, Söderbom and van den Boogart, 2022; Varshney *et al.*, 2022

<sup>7</sup> But must be done so with caution given variation in socio-cultural and economic contexts across sub-Saharan Africa

entities to maximise the effectiveness, efficiency, and equity of their work, or be used as a groundwork for future research.

## Methods<sup>8</sup>



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

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 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 be determined to quantify the knowledge and uptake pressure exerted on a farmer by his network.

Summary statistics on the data will then be calculated, and figures generated as fitting.

A logistic regression will then be constructed, regressing a binary measure of knowledge of, or uptake of, different dairy technologies<sup>9</sup> against;

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<sup>8</sup> As approved by supervisor

<sup>9</sup> Namely vaccinations, improved fodder, artificial insemination and/or crossbreeding

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 also be compared with farmers' (self-reported) preferred forms of extension to see how the two are related.

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

## Ethics and risk assessments

Ethical concerns mostly pertained to the data collection stages, which have been completed. Multiple measures were taken to address ethical concerns with the study. Surveys were only conducted amongst individuals of at least 18 years of age who were able to give informed consent. Prospective participants were briefed about the scope and format of the study and asked to sign a consent form containing details of the study and the researchers, of which they retained a copy. Surveys were conducted by local, trained enumerators with knowledge of English, Swahili, and some local

languages to address concerns relating to a lack of English proficiency. Any individuals mentioned by survey participants who were not interviewed or chose not to participate were pseudonymised, ensuring that details of individuals who had not given consent was not retained. To address ethical concerns regarding individuals feeling pressured to participate, individuals approached to participate after being mentioned by others were not told by whom they were referred, and it was emphasised that participation is voluntary and that they may withdraw at any time. It was made clear by Morrison (2022) that dataset, in anonymised form, would be made available to other members of the original research project, including myself.

There are no other noteworthy ethical concerns for the remainder of this research.

The raw data on which this study is to be conducted is very rich, in that it consists of household and village characteristics in addition to sensitive personal details, including names and contact numbers. This implies considerable risk to participants' right to data protection, as well as a risk that participants may be identified. To address this, all sensitive details collected during surveys - including participant and group names, and village details - have been anonymised or dropped from the dataset which I have access to. All data and documentation related to this research will be stored on a password-protected personal computer, which will not be left open or unattended in public or where others may gain access to it. Data will be stored until September 2023<sup>10</sup>. Raw data will at no stage be shared, and particular attention will be paid when writing and reporting findings to not disclose more information than purely necessary.

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<sup>10</sup> To allow for the conclusion of dissertation research, and any possible subsequent work on related research papers

Furthermore, Morrison's original study (2022), during which the data here used was collected, was approved by the R(D)SVS and Easter Bush Campus Human (Research) Ethical Review Committee, as will be my study, to ensure that all processes comply with University and UK standards.



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