INNOVATIONS IN EXTENSION
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QUALITY VERSUS QUANTITY OF AGRICULTURAL EXTENSION SERVICES IN RURAL LIVELIHOOD IMPROVEMENT IN MALAWI

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ABSTRACT

Studies were conducted to assess the effectiveness of the innovation systems concept in enhancing agricultural extension services for livelihood improvements in the central region of Malawi. Using quasi-experimentation with propensity score matching to establish a valid counterfactual and single differencing to measure impact, the study showed that, contrary to other studies, the frequency of extension contact did not lead to greater livelihood outcomes. Households in communities with lesser extension contact but who were involved in collaborative developmental agendas and initiatives driven by innovation systems concepts exhibited greater positive livelihood outcomes. Collaborative developmental agendas were set in a participatory manner with extension agents and researchers. The communities were involved in visually mapping and developing their intended future livelihood outcomes and local strategies for monitoring and evaluating progress. The study demonstrates that the quality and quantity of agricultural advisory services is a key factor in determining improved livelihood outcomes in rural communities. Policy should ensure greater budgetary support for intervention implementation and capacity-building to enable greater understanding and application of the agricultural innovation systems concept in which communities are participants, as opposed to being merely recipients of research outcomes.

KEY WORDS: *IMPACT, INNOVATION SYSTEMS CONCEPT, PROPENSITY SCORE MATCHING*

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INTRODUCTION AND OBJECTIVES

Agricultural research interventions that are driven by innovation systems concepts change the way in which rural farming households interact with the market and the way in which they make decisions on the development of their agro-enterprises and the scarce resources that are at their disposal. This is because innovation systems-driven agricultural research is centred on changing the orientation of small-scale agriculture from being subsistence-centred, to an agribusiness perspective in which farmers produce for the market as opposed to merely marketing any surplus that they have after their subsistence needs have been met (CIAT, 2007). Innovation systems-driven agricultural research differs from past research paradigms as there is emphasis on developing technologies to enhance production and productivity and on linking farmers to markets, whilst ensuring sustainability by strengthening farmers' capacities for research and on-farm experimentation and their capacity to identify and access markets.

Innovation system concepts focus on a network of actors and organisations that are linked by a common theme, with the aim of developing new technologies, methods and new forms of organisation for use by the end-users of technology to tackle identified problems (World Bank, 2007). This includes working with the end-users and other key players including different agricultural advisory service providers (public and private), researchers, as well as policy-makers and agribusinesses. Because of its dominance in practice and policy, there is an emerging literature on the impact of agricultural innovation systems on rural livelihoods (Barham and Chitemi, 2009; Kaaria *et al*., 2009; Kaganzi *et al*., 2009; Magreta *et al*., 2010; Mapila *et al*., 2010). The majority of innovation systems initiatives in Africa are initiated by private research and development institutes who work in collaboration with existing local agricultural extension services. Despite this, there are no studies in the literature that assess the effects of the emergence of innovation systems thinking on local public agricultural extension services. This study aimed to assess the effect of agricultural innovation systems initiatives on the work of local agricultural extension services. It tested the hypothesis that the quality of rural livelihood improvements is far greater when the work of local agricultural extension service providers is enhanced by the use of agricultural innovation systems concepts. The Enabling Rural Innovation (ERI) programme was used as a case-study of an innovation systems-driven initiative.

MATERIALS, METHODS AND DATA SOURCES

Place of study and data collection

The study used primary data collected from 300 farming households in two rural communities in Ukwe Extension Planning Area (EPA) in Lilongwe Agricultural Development Division (ADD) in the central region of Malawi. The two communities, Katundulu and Ukwe, represent an intervention community and a counterfactual community, respectively. The intervention community is one in which an innovative agricultural research intervention – Enabling Rural Innovation (ERI) initiative – was implemented. The ERI initiative is an agricultural research intervention that was developed by the International Centre for Tropical Agriculture (CIAT) and it is driven by innovation systems concepts. The main focus in Africa was on linking smallholder resource-poor farmers to markets and on strengthening their capacity to access market opportunities, thus creating an entrepreneurial culture in rural communities (Kaaria *et al*., 2009). This was achieved through the establishment of a multidisciplinary team of social scientists, extension agents from the Department of Agricultural Extension Services, local extension staff, researchers from the Department of Agricultural Research Services and other agricultural social scientists from the Ministry of Agriculture based in Lilongwe Agricultural Development Division. The research team and the community conducted a participatory diagnosis of the community challenges and opportunities. During this process, the community was involved in visually mapping and developing their intended future livelihood outcomes and local strategies for monitoring and evaluating progress in livelihood improvements. The visual materials were then

used by local extension agents and community leaders in subsequent meetings to reinforce community goals and to make the community and extension and researchers accountable to set goals.

Data analysis

The study used a quasi-experimental research design with propensity score matching (PSM) to establish a valid counterfactual in order to identify a valid comparator group. Single differencing was used to determine the average effect of the ERI intervention on the participating households. According to Ravallion (2003), the underlying concepts of PSM are that two groups are identified, one that took part in the intervention (denoted $H_i = 1$ for household i) and another that did not participate in the intervention (denoted $H_i = 0$). Intervention households were matched to non-intervention households on the basis of the probability that the non-participants would have participated in the intervention and this probability is called the propensity score. It is given mathematically as follows:

$$P(X_i) = \text{Prob}\,(H_i = 1 | X_i)\ (0 < P(X_i) < 1)$$

where: X_i is a vector of pre-intervention control variables

These pre-intervention control variables are those that are based on knowledge of the programme under evaluation and on the social, economic and institutional theories that may influence participation in the intervention. The vector can also include the pre-intervention values of the outcome variables. PSM makes it possible to attribute changes in outcomes variables for participating households in the ERI initiative, as it removes the effects of other observable and non-observable time variant factors (other programmes) and sample selectivity bias, hence approximating randomised research designs. In this study, propensity scores for each household in the sample were estimated using logistic regression modelling. Using the estimated propensity scores, matched pairs of households were established based on the proximity of the propensity scores (which were generated from the logit model of participation) for households in the intervention and counterfactual communities. Unmatched counterfactual households were dropped from the analysis in order to remove bias and to increase robustness (Rubin and Thomas, 2000 in Ravallion, 2003). The best matched or 'nearest neighbour' to the *j*th intervention household is the counterfactual household that minimises $[P(X) - P(X_j)]^2$ over all *j*'s in the set of counterfactual households. A typical matching estimator of the average treatment effect of any intervention takes the following form (Ravallion, 2003):

$$\Delta\bar{Y} = \sum_{j=1}^{T} \omega_j \left(Y_{j1} - \sum_{i=1}^{C} W_{ij} Y_{ij0}\right)$$

where:

Y_{j1} is the post intervention outcome variable for the *j*th participating household

Y_{ij0} is the outcome indicator of the *i*th counterfactual household matched to the *j*th participation household

T is the total number of interventions/treatments

C is the total number of counterfactual households sampled

W_{ij}**'s** are the weights applied in calculating the average outcomes of the matched counterfactual households

ω_j are the sampling weights used to construct the mean impact estimator.

This effect; more commonly known as the average treatment effect on the treated (ATT); measures the average causal difference in selected outcome variables between the treated (intervention) group and the untreated (counterfactual) group. To avoid contamination by endogeneity of access to the programme, the regression model for the ERI programme participation was run only for the matched comparator group, which was matched with the intervention group using nearest neighbour matching. In such cases, the ATT becomes:

$$= \sum_{j=1}^{T} \omega_j \left[\left(Y_{ij} - X_j\hat{\beta}_0\right) - \sum_{i=1}^{C} W_{ij}\left(Y_{ij} - X_j\hat{\beta}_0\right)\right.$$

where:

$\hat{\beta}_0$ is the ordinary least squares estimate for the matched group.

The ATT is approximated without any assumptions about functional forms and error distributions, as

PSM does not require a parametric model linking programme participants to outcomes (Ravallion, 2003). This therefore makes it superior to non-experimental regression-based approaches.

RESULTS AND DISCUSSION

Table 1 below presents the results of the assessment of the differences between the livelihood outcomes of households in the participating communities which had the ERI initiative and those in the counterfactual community where there were no innovative agricultural research and development initiatives. The table shows differences between the value of production outcomes, maize productivity, value of household assets and marketing outcomes. From Table 1, it is possible to see that on average, households in the intervention community had greater livelihood outcomes, as demonstrated by statistically significant differences for some aspects of production outcomes – with total value of livestock, total value of upland crop production (in both 2007/08 and 2008/09) and value of maize harvest in the 2008/09 season being significantly higher at the 10%, 1%, 5% and 10% levels of confidence, respectively. In addition, some aspects of marketing outcomes and value of household assets were found to be statistically higher for participating households with the total cash income earned by a household in both the 2007/08 and 2008/09 season and the total value of household assets being statistically significant at the 5% and 10% confidence levels, respectively. Other outcome variables were found to be affected by participation in the ERI intervention.

An analysis of the level of extension contact between the 2004/05 and 2008/09 cropping seasons shows that, on average, 81.2% of the sampled households in the counterfactual community stated that they had contact with an extension agent at least once a month, while only 52.6% of the sampled households in the intervention community had the same level of contact with extension agents over the same time period. The difference in percentage of households having extension contact at least once a month was found to be highly statistically significant. This was the case, despite counterfactual community households being on average further from the

TABLE 1: DIFFERENCES IN HOUSEHOLD LIVELIHOOD OUTCOMES

	Intervention community		Counterfactual community		Programme effect (ATT)
	Mean	Standard deviation	Mean	Standard deviation	
Value of production outcomes (USD)					
Value of livestock	445.03	1620.99	144.82	926.47	300.12*
Value of upland crop production 2007/2008	1349.48	0.016	537.14	0.0114	812.34***
Value of upland crop production 2008/2009	992.24	0.0179	365.14	0.0084	627.10**
Value of maize harvest 2007/2008	259.35	308.77	180.01	340.24	79.33
Value of maize harvest 2008/2009	506.76	0.013	219.66	490.80	287.09*
Maize productivity (tons/hectare)					
Maize yield 2007/2008	0.84	1.00	0.85	1.47	0.0055
Maize yield 2008/2009	1.17	2.61	0.88	1.33	0.287
Value of household assets (USD)					
Total value of assets	550.74	3008.51	159.65	581.58	391.00*
Marketing outcomes (USD)					
Total cash income for 2007/2008 season	511.49	0.0072	231.28	465.61	280.21**
Total cash income for 2008/2009 season	636.21	0.0088	299.56	655.75	340.54**
Total income from livestock sales 2008/2009	51.34	138.48	23.60	186.08	27.78

extension officers' houses and offices (20.0 km) as compared to the intervention community households (7.5 km). Informal interviews with counterfactual community households revealed that the contact with the extension officer in the counterfactual community was more unplanned, and tended to occur on occasions in which the extension officer had to pass through several villages in the counterfactual community to get to the main tarmac road on his way to Lilongwe city. Community members used such opportunities for gathering information and relaying their problems to the extension agent.

CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

The results of this study demonstrate that households who participated in agricultural research and development activities that were driven by innovation systems thinking had higher livelihood outcomes, when compared to households that did not. This was the case even when participating households had significantly less contact with local extension agents than the non-participating households. The extension contact in the community with innovation systems initiatives was well-planned and structured, involved the community, was based on community developed action plans and all stakeholders, including researchers, extension, agribusiness and community members were kept accountable through a set of monitoring and evaluation indicators developed in a participatory manner with the community. This study shows that the quality and the quantity of agricultural advisory services is a key factor in determining improved livelihood outcomes amongst resource-poor farming communities in Malawi. The use of innovation systems concepts in agricultural research and development activities in which agricultural extension and other stakeholders, such as agribusiness owners, are involved is one way of enhancing the quality of public agricultural advisory services – which are often under-funded and overstretched.

The policy implications are that there is the need to support grass roots public extension agents through increased budgetary support for intervention implementation and capacity-building. There is also a need to generate greater understanding and application of agricultural innovation systems concepts in the communities (who are the intended end-users of agricultural research and development outcomes), and that the communities are intellectually involved. This will require innovation systems concepts to be mainstreamed in national agricultural research, extension and development policies and programmes. Mainstreaming of innovation systems concepts will ensure that the support and capacity-building of agricultural extension agents is institutionalised and thus is sustainable.

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