Competency Enhancement of Agricultural Extension Officers to Deliver Market-Oriented Services: A Comparative Analysis of the SHEP Approach in Kenya

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Competency Enhancement of Agricultural Extension Officers to Deliver Market–Oriented Services: A Comparative Analysis of the SHEP Approach in Kenya

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Agricultural extension is increasingly shifting its focus toward integrating production with marketing, and competency enhancement among extension officers plays a crucial role. There remains limited understanding of how the Smallholder Horticulture Empowerment and Promotion (SHEP) enhances extension officers' capacity to deliver market–oriented extension. This study examines the role of various competencies in delivering market–oriented extension, comparing public and private sector officers. We employ Exploratory Factor Analysis to identify key domains of market–oriented extension, followed by multivariate regression for in–depth analysis. Our findings show no difference in performance between the public and private extension officers. However, SHEP–trained public extension officers demonstrate significantly higher ability to identify market–oriented practices, while their private sector counterparts exhibit significantly greater capacity in market engagement. Leadership skills emerge as a critical competency, complementing the facilitation skills emphasized by SHEP. In addition, positive social factors significantly influence market–oriented outcomes, and County–level prioritization of agriculture positively influences service delivery. These findings underscore the importance of strengthening public–private partnerships, integrating social factors into program design, and expanding competency development efforts to include leadership skills alongside facilitation to enhance the effectiveness and sustainability of market–oriented extension.

Key words: Agricultural extension, Competency enhancement, Extension officers, Market–oriented, SHEP

INTRODUCTION

Agricultural extension promotes sustainable farming by bridging knowledge gaps between researchers and farmers, enabling informed decision–making and improved productivity (Jogender & Ayush, 2024). Historically grounded in adult education and rural development, extension services encompass knowledge transfer, project implementation, and community leadership, often supported by substantial government investment due to their public–good nature and alignment with national policy priorities (Sulaiman *et al.* 2022; Juan *et al.* 2024). Traditionally provided by the public sector, agricultural extension has evolved into a participatory, multi–stakeholder system focused on integrating production, processing, and marketing to drive the commercialization of agriculture (Cristóvão *et al.* 2012; MOALD, 2023). This shift has led to market–led extension, which frames farming as a business by promoting market–driven production and enhancing farmers' access to market information (Reddy & Chandrashekhara, 2002; Gebremedhin *et al.* 2012). Its effective implementation depends on skilled extension workers who act as intermediaries, requiring a broad range of competencies to facilitate innovation, strengthen farmer–market linkages, and drive inclusive agricultural development (Suheri *et al.* 2022; Issahaku, 2014).

Competency in agricultural extension encompasses skills, attitudes, values, and traits that enable professionals to deliver high–quality services and can be observed and evaluated through performance (Mi Ok Shim, 2008; Nwaogu & Akinbile, 2018). As agricultural systems face challenges, including resource constraints and increasing farmer expectations, extension officers must continuously develop core competencies such as communication, program planning, and farmer engagement to support knowledge transfer (Suvedi *et al.* 2015; Martina *et al.* 2022). However, public extension systems in developing countries are often hindered by logistical limitations, insufficient skills, weak market knowledge, and fragmented coordination with private actors, compromising service delivery and long–term sustainability (Nyambo *et al.* 2009; Kitajima, 2024). In response, governments have implemented reforms such as decentralization, outsourcing, and public–private partnerships to improve the reach of farmers and efficiency (Calabrese, 2008). While private extension services offer targeted, high–quality support, they often prioritize profitable regions and crops, neglecting marginalized areas (Muyanga & Jayne, 2008). These challenges underscore the need for integrated, inclusive extension models that leverage the comparative advantages of both public and private actors to ensure equitable service delivery across farming communities.

In Kenya, smallholder farmers access agricultural extension through three main systems: the government–

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led service focusing on food crops and livestock, commodity–based extension provided by parastatals and cooperatives supporting commercial crops like tea and coffee, and private extension from private companies, non–governmental (NGOs), and community–based organizations (Muyanga & Jayne, 2008; Nambiro *et al.* 2005). Since 2006, the Smallholder Horticulture Empowerment and Promotion (SHEP) approach, implemented through a Kenya–Japan partnership, has promoted market–oriented farming by enhancing farmers' skills, improving incomes and building the capacity of extension officers in horticultural potential regions (JICA, 2016). Central to the SHEP approach is the assignment of extension officers as facilitators for farmer groups, positioning them as agents of knowledge exchange rather than mere information transmitters, in line with facilitation theory (Koutsouris, 2014; Carroll *et al.* 2025).

While SHEP is recognized for its role in promoting market–oriented farming, there is limited understanding of how it enhances the competencies of extension officers and how these improvements contribute to their capacity to deliver market–oriented extension services. This study seeks to address this gap through a comparative analysis of public and private extension officers, focusing on three key questions:

1. Is the SHEP intervention associated with improving extension officers' competency levels?
2. Are there differences in competency levels between private and public extension officers?
3. How does competency enhancement among extension officers influence their ability to deliver market–oriented extension services?

Theoretical and conceptual framework

The conceptual framework for extension officers' performance is adopted and modified based on the Competency theory (Fig. 1). As proposed by McClelland (1973), this theory emphasizes that competencies encompassing knowledge, skills, and behaviors are key predictors of effective performance, unlike traditional intelligence measures. The competency–based approach has proven effective in enhancing human resource development systems (Arifin, 2021; Mi Ok Shim, 2008). In our context, an extension officer's performance is shaped by their competencies, which can be influenced by their working environment and geographical conditions (Shivamurthy & Madhushree, 2023; Yosef *et al.* 2023). We find this theory relevant to our study as it helps us explain how the SHEP intervention enhances the competencies of extension officers and provides a framework for understanding their impact on performance.

Key competencies

This study identifies key competencies relevant to the SHEP intervention, which are essential for extension officers to deliver market–oriented extension services effectively. They include various skills and values that can be refined during implementation. Motivation skills foster personal commitment and resilience, with intrinsic motivation being key for sustained performance (Ryan & Deci, 2000). Facilitation skills promote participatory learning and collective decision–making (Carroll *et al.*

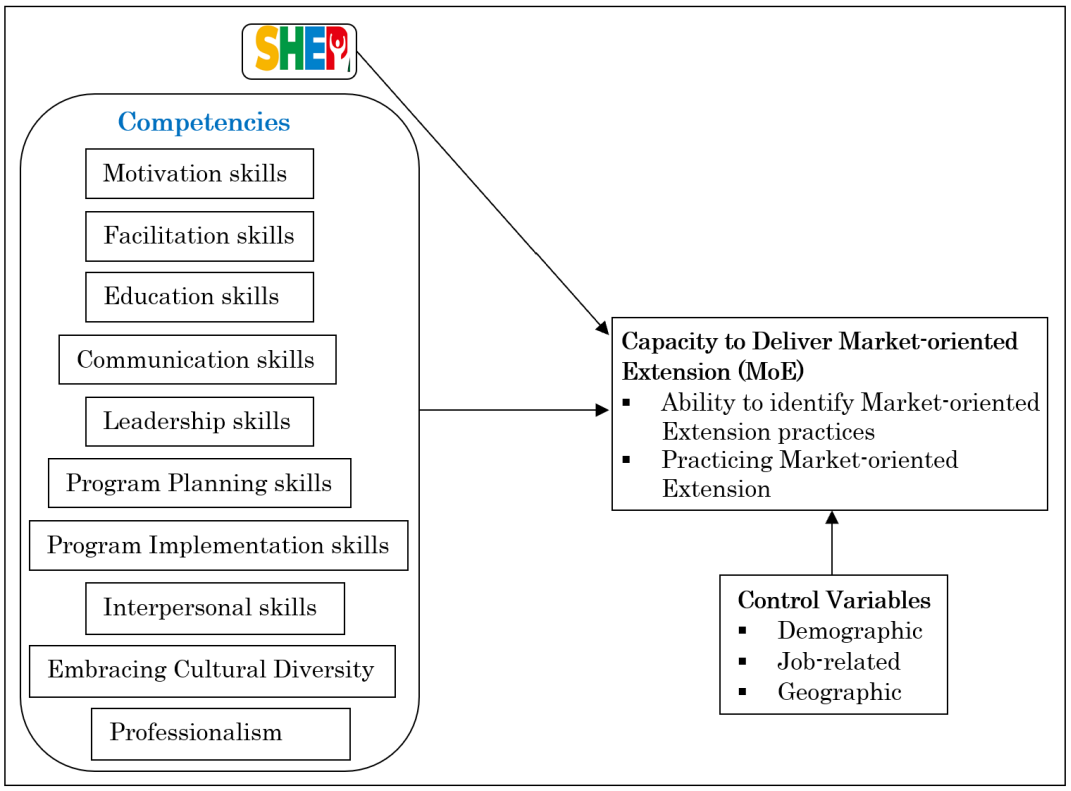

Fig. 1. The proposed conceptual model.

2025), while communication skills enable knowledge transfer, innovation promotion, and market access (Toader & Roman, 2015). Education skills help simplify complex information and tailor content for farmer training (Karbasioun *et al.* 2007). Leadership competencies guide change, encourage cooperation, and support conflict resolution (Khalil *et al.* 2008). Program planning and implementation skills ensure appropriate content delivery, efficient execution, and responsiveness to farmers' needs (Sanchez, 2016). Embracing cultural diversity allows for contextual adaptation and stronger community relations (Eldeen *et al.* 2022), while professionalism enhances service quality, credibility, and ethical standards (Olorunfemi & Oladele, 2021). Lastly, interpersonal skills foster trust and understanding between officers and farmers (Seli *et al.* 2023). SHEP enhances the competencies of extension officers through active involvement in program activities. We therefore propose the following hypothesis:

H1: SHEP–trained extension officers could exhibit higher competency levels than their non–trained counterparts.

The role of public and private extension officers

In recognizing limitations in public extension systems, many countries have promoted public–private collaboration to enhance service delivery (Muyanga & Jayne, 2008). In line with this, respective extension officers play a pivotal role by collecting and translating market information, connecting farmers with buyers, training on market–aligned practices, and fostering collective action (Gebremedhin *et al.* 2012). Given these responsibilities, extension professionals must continually develop competencies to offer relevant support in farming business. Notably, private extension officers often operate in more performance–driven settings, incentivized by measurable outcomes, while public officers may face bureaucratic limitations (Birner *et al.* 2009). Based on this rationale, the following hypothesis is proposed:

H2: Private extension officers may exhibit significantly higher competency levels than public–sector officers.

Delivering market–oriented extension

The primary goal of market–oriented extension is to enhance farm incomes by managing farms as business enterprises, emphasizing efficient resource use and profitability (Zhang *et al.* 2021). SHEP endeavours to connect smallholder farmers to markets promotes technology adoption and innovation, which can boost income, as noted by Promkhambut *et al.* (2023). Enhancing the competencies of the extension officers can improve their capacity to deliver market–oriented extension and the effectiveness of extension in fostering agricultural commercialization and improving livelihoods. We therefore believe that various competencies play a role in achieving this outcome and propose the following hypothesis:

H3: Enhanced competencies among extension officers potentially improve the delivery of market–oriented extension services.

RESEARCH METHODS

Study area, data collection, and analysis

This study focuses on the fourteen counties in Kenya that implemented the third phase of the SHEP intervention, known as the SHEP Project for Local and Up–Scaling (SHEP PLUS) from 2015 to 2020. These are Kiambu, Murang'a, Kirinyaga, Nakuru, Uasin Gishu, Elgeyo Marakwet, Kisumu, Homabay, Nyamira, Embu, Meru, Machakos, Kitui, and Makueni. By focusing on these counties, we targeted the entire eligible population, ensuring the sample reflects the real scenario of the program. The extension officers in the SHEP and non–SHEP implementing sub–counties formed our treatment and control groups, respectively. We leveraged the original randomized controlled trial (RCT) design established in 2015 during SHEP PLUS (Shimizutani *et al.* 2021) and surveyed public and private officers across both groups. This enabled us to estimate the causal impact of the intervention while accounting for potential informal knowledge diffusion (Saloni, 2022).

Although Kenya's devolved governance structure has minimized cross–county transfers, some interaction between treated and control officers may have occurred. However, based on existing literature, key competencies such as market–oriented extension skills are not easily transferred informally but require structured training and continued practice to develop (McClelland, 1973). Thus, any informal exchanges are unlikely to have significantly influenced the outcomes of interest.

Data was collected from 164 extension officers, comprising 143 public (99 SHEP–trained and 44 non–SHEP–trained) and 21 private (8 SHEP–trained and 13 non–SHEP–trained) officers. Although modest, this sample represents a specialized population within Kenya's SHEP RCT framework, which is inherently limited by the scope of the intervention. The smaller number of private officers reflects SHEP's initial focus on public sector engagement, with recent expansions to include NGOs and private actors (Kitajima, 2024). Data was collected via a standardized online questionnaire between November and December 2023.

We conducted an Exploratory Factor Analysis (EFA), a method of reducing a large set of variables into relevant factors (Watkins, 2018), to extract variables defining our outcome variables (shown in Appendix Table 1). Variables with factor loadings >= 0.4 were retained and labeled according to their defining indicators (Hair *et al.* 2010; Watkins, 2018), as shown in Appendix Table 2. The four factors, namely Identifying Market–Oriented Practices (IMoP), Market Engagement (ME), Records Management and Business Planning (RMBP), and Establishing Linkages and Collective Action (ELCA), formed the domains for Market–Oriented Extension (MoE), hence our outcome variables (shown in Appendix Table 3).

Using multivariate regression on our four outcome variables, we introduced county dummy variables to account for potential county–level differences (Appendix Table 4). The county with the lowest mean

values of outcome variables, Elgeyo Marakwet, was selected as the reference. The estimation equation was adopted from Johnson & Wichern (2007) as follows:

$$\begin{bmatrix} Y_{1i} \\ Y_{2i} \\ Y_{3i} \\ Y_{4i} \end{bmatrix} = \begin{pmatrix} \beta_{10}+\beta_{11}X_{1i}+\beta_{12}X_{2i}+\beta_{13}X_{3i}+\beta_{14}(X_{1i}*X_{2i})+\varepsilon_{1i} \\ \beta_{20}+\beta_{21}X_{1i}+\beta_{22}X_{2i}+\beta_{23}X_{3i}+\beta_{24}(X_{1i}*X_{2i})+\varepsilon_{2i} \\ \beta_{30}+\beta_{31}X_{1i}+\beta_{32}X_{2i}+\beta_{33}X_{3i}+\beta_{34}(X_{1i}*X_{2i})+\varepsilon_{3i} \\ \beta_{40}+\beta_{41}X_{1i}+\beta_{42}X_{2i}+\beta_{43}X_{3i}+\beta_{44}(X_{1i}*X_{2i})+\varepsilon_{4i} \end{pmatrix}$$

Where Y_1, Y_2, Y_3, Y_4 represent the outcome variables, X_1, X_2, X_3 are the predictors, $X_1 * X_{2i}$ is the interaction term and ε_1, ε_2, ε_3, ε_4 are the error terms.

RESULTS

Socio–demographic characteristics

The empirical analysis was done using STATA 17. Table 1 presents the descriptive statistics of the respondents.

Age and gender

Age distribution showed that public officers were generally older (SHEP public: 52 years; non–SHEP public: 49 years) than private officers (SHEP private: 33 years; non–SHEP private: 34 years). Across all groups, males dominated.

Education

Educational attainment differed between sectors: while 41.4% of SHEP public officers held diplomas and 29.3% bachelor's degrees, 75% of SHEP private officers had bachelor's degrees, though none had master's degrees. Similarly, non–SHEP public officers primarily held diplomas (50%) or bachelor's degrees (34.1%), while non–SHEP private officers showed a higher concentration of bachelor's degrees (61.5%). Generally, private sector officers exhibit higher levels of educational attainment, particularly in bachelor's degrees, while the public sector has a more balanced distribution between diploma and bachelor's degree holders.

Academic background and continuing education

Public officers exclusively majored in agriculture (100%), whereas private officers showed slightly more academic diversity. Among private officers, 75% of SHEP and 77% of non–SHEP officers had agriculture–related majors, with the remainder in other disciplines. Continuing education was more prevalent among SHEP private officers (75%), followed by SHEP public (59%), non–SHEP private (54%), and non–SHEP public officers (50%).

Training and years of service

Specialized and skills development training was widespread across all groups, with participation rates exceeding 80%. SHEP and non–SHEP Public officers had longer service periods (16 years on average) compared to private officers (6–7 years).

Project implementation

Project implementation was highest among SHEP public officers (average of 6 projects), while other groups averaged around 5 projects each.

Table 1. Profile of Extension Officers

Profile		SHEP Extension Officers (n=107)		Non–SHEP Extension Officers (n= 57)	
		Public (n=99) Mean (SD)	Private (n=8) Mean (SD)	Public (n=44) Mean (SD)	Private (n=13) Mean (SD)
Age of Extension Officers		52 (9.62)	33 (7.48)	49 (9.72)	34 (7.04)
Sex (%)	M	61	75	57	61.5
	F	39	25	43	38.5
Education level (%)					
Masters		11.1		4.5	7.7
Bachelors		29.3	75	34.1	61.5
Diploma		41.4	25	50.0	15.4
Certificate		18.2		11.4	15.4
Major in College (%)					
i). Agriculture–related		100	75	100	77
ii). Non–agriculture–related		0	25	0	23
Continuing education (%)					
Yes		59	75	50	54
No		41	25	50	46
Specialized training (%)					
Yes		98	87.5	91	92
No		2	12.5	9	8
Skills development training (%)		89	87.5	82	85
Yes		11	12.5	18	15
No					
Years of service		16 (12.13)	6 (4.31)	16 (10.71)	7 (4.54)
Number of projects implemented		6 (3.64)	5 (1.85)	5 (2.41)	5 (2.75)

Source: Own calculation from the survey data

Comparative analysis of competencies and MoE Outcomes

We conducted independent sample t–tests separately for public and private extension officers, comparing the mean scores of SHEP and non–SHEP extension officers across key outcome and competency variables as shown in Table 2.

Public officers

SHEP public officers consistently scored higher in market–oriented practices, specifically in Identifying Market–Oriented Practices, Market Engagement, Records Management and Business Planning, and Establishing Linkages and Collective Action. They also outperformed their non–SHEP counterparts in key competencies, including Motivation, Facilitation, Education, Communication, Leadership, Program Planning, Program Implementation, Professionalism, and Interpersonal skills (all p–values < 0.05). The only area with no significant difference was Embracing Cultural Diversity (t = 0.12, p = 0.9038).

Private officers

Unlike the public sector findings, the t–test analysis for private extension officers revealed no significant differences between SHEP and non–SHEP groups across all outcomes and competency variables.

Determinants of market–oriented extension domains

Tables 3 and 4 present the effects of the treatment variable (SHEP vs. non–SHEP), officer type (public vs. private officers), various competencies, control variables, job–related and geographical factors on four domains of market–oriented extension. For each domain, we present results with interaction effects (IE) and without (W/IE).

Effect of variables on identifying market–oriented practices

Treatment and officer type

In both the model without interaction effects (W/IE) and the model with interaction effects (IE), there were

Table 2. T–Test Analysis: Competencies and market–oriented extension outcomes

Variable	Type of Ext. officers	Public Means (SD)	t–test	Private Means (SD)	t–test
IMoP	SHEP	3.81 (0.416)	4.28***	3.42 (0.460)	–0.32
	Non–SHEP	3.46 (0.519)		3.51 (0.620)	
ME	SHEP	3.65 (0.049)	4.43***	3.67 (0.189)	0.65
	Non–SHEP	3.26 (0.073)		3.49 (0.183)	
RMBP	SHEP	3.85 (0.390)	3.74***	3.91 (0.105)	1.98
	Non–SHEP	3.59 (0.054)		3.54 (0.130)	
ELCA	SHEP	3.73 (0.042)	2.10*	3.79 (0.153)	0.977
	Non–SHEP	3.58 (0.056)		3.61 (0.106)	
Motivation skills	SHEP	4.15 (0.419)	7.43***	3.87 (0.237)	1.00
	Non–SHEP	3.54 (0.522)		3.63 (0.652)	
Facilitation skills	SHEP	3.69 (0.398)	5.45***	3.42 (0.392)	1.24
	Non–SHEP	3.30 (0.375)		3.2 (0.408)	
Education skills	SHEP	3.47 (0.415)	2.27*	3.35 (0.553)	0.42
	Non–SHEP	3.27 (0.582)		3.26 (0.403)	
Communication skills	SHEP	4.46 (0.533)	2.20*	4.25 (0.630)	–1.39
	Non–SHEP	4.25 (0.492)		3.91 (0.494)	
Leadership skills	SHEP	3.83 (0.329)	4.31***	3.72 (0.399)	1.53
	Non–SHEP	3.56 (0.369)		3.45 (0.409)	
Program planning skills	SHEP	3.84 (0.428)	3.00**	3.87 (0.260)	1.19
	Non–SHEP	3.62 (0.388)		3.66 (0.457)	
Program Implementation	SHEP	3.98 (0.361)	5.07***	3.92 (0.212)	1.25
	Non–SHEP	3.64 (0.363)		3.72 (0.421)	
Cultural Diversity	SHEP	3.98 (0.345)	0.12	3.60 (0.888)	–0.21
	Non–SHEP	3.98 (0.151)		3.66 (0.465)	
Professionalism	SHEP	4.14 (0.399)	6.28***	3.97 (0.225)	0.85
	Non–SHEP	3.62 (0.585)		3.75 (0.703)	
Interpersonal skills	SHEP	4.29 (0.464)	2.29*	4.10 (0.595)	–0.03
	Non–SHEP	4.12 (0.303)		4.11 (0.620)	

Source: Own calculation from the survey data

NB: The t–value > = 1.96 indicates significance

Table 3. The Effect of treatment, officer type, and competencies on outcome variables

	Identify Market–Oriented Practices		Market Engagement		Records & Business Planning		Linkages & Collective Action	
Competencies and Control Variables	**Model 1 (W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**	**Model 1(W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**	**Model 1(W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**	**Model 1(W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**
Treatment (1=SHEP, 0=non–SHEP)	0.066 (0.080)	0.215 (1.002)	0.179 (0.109)	2.498 (1.332)*	0.044 (0.079)	1.222 (1.011)	–0.057 (0.082)	–0.775 (1.062)
Public or Private (1=Public; 0=Private)	0.160 (0.113)	–0.040 (0.164)	–0.062 (0.153)	–0.268 (0.218)	0.058 (0.111)	0.106 (0.165)	0.027 (0.115)	0.033 (0.173)
SHEP # Public		0.400 (0.206)*		0.214 (0.274)		–0.120 (0.208)		–0.061 (0.219)
Education skills	0.290 (0.089)***	0.408 (0.134)***	–0.140 (0.122)	–0.176 (0.178)	0.126 (0.088)	0.047 (0.135)	0.078 (0.092)	0.062 (0.142)
Treatment#education		–0.184 (0.184)		0.152 (0.244)		0.278 (0.186)		–0.004 (0.195)
Communication skills	–0.131 (0.068)*	–0.207 (0.113)*	–0.109 (0.092)	–0.129 (0.149)	0.065 (0.066)	0.127 (0.114)	0.017 (0.069)	–0.076 (0.119)
Treatment#Communication		0.124 (0.157)		0.044 (0.209)		–0.219 (0.159)		0.071 (0.167)
Facilitation skills	–0.083 (0.095)	–0.549 (0.212)**	0.278 (0.129)*	–0.142 (0.282)	–0.037 (0.093)	–0.209 (0.214)	–0.075 (0.097)	–0.098 (0.225)
Treatment#Facilitation		0.022 (0.240)**		0.533 (0.319)*		0.216 (0.243)		0.039 (0.255)
Motivation skills	0.126 (0.084)	0.196 (0.130)	–0.064 (0.114)	–0.172 (0.173)	0.065 (0.083)	0.047 (0.132)	0.180 (0.086)**	0.229 (0.138)
Treatment#Motivation		–0.130 (0.173)		0.148 (0.229)		0.056 (0.174)		–0.040 (0.183)
Leadership skills	0.264 (0.109)**	0.622 (0.185)***	0.173 (0.149)	0.866 (0.247)***	0.238 (0.108)**	0.406 (0.187)**	0.136 (0.112)	0.153 (0.197)
Treatment#Leadership		0.152 (0.224)**		–0.186 (0.298)***		–0.216 (0.226)		0.026 (0.238)
Program planning skills	0.082 (0.089)	0.006 (0.145)	0.208 (0.121)*	0.283 (0.193)	0.038 (0.088)	0.133 (0.146)	0.141 (0.091)	–0.033 (0.154)
Treatment#Program planning		0.162 (0.185)		–0.235 (0.246)		–0.164 (0.187)		0.293 (0.196)
Program Implementation	0.147 (0.104)	–0.060 (0.180)	0.168 (0.137)	0.222 (0.239)	0.260 (0.102)**	0.318 (0.182)*	0.112 (0.106)	0.000 (0.191)
Treatment#Prog Implementation		0.287 (0.226)		–0.203 (0.300)		–0.077 (0.228)		0.201 (0.239)
Embracing Cultural Diversity	0.066 (0.105)	0.432 (0.235)*	–0.062 (0.142)	0.327 (0.313)	0.147 (0.103)	–0.118 (0.238)	–0.196 (0.107)*	0.068 (0.250)
Treatment#Cultural Diversity		–0.012 (0.259)*		–0.386 (0.345)		–0.008 (0.262)		–0.365 (0.275)
Interpersonal skills	0.289 (0.081)***	0.269 (0.152)*	0.145 (0.109)	–0.057 (0.202)	0.083 (0.079)	0.161 (0.153)	0.235 (0.082)**	0.212 (0.161)
Treatment#Interpersonal		–0.011 (0.179)		0.352 (0.238)		–0.074 (0.181)		–0.005 (0.190)
Highest education								
Diploma	–0.222 (0.117)*	–0.215 (0.119)*	–0.076 (0.158)	–0.156 (0.159)	–0.137 (0.115)	–0.161(0.120)	–0.054 (0.119)	–0.064 (0.127)
Bachelors		–0.108 (0.122)	0.062 (0.160)	–0.016 (0.163)	–0.041 (0.116)	–0.056 (0.123)	–0.020 (0.121)	–0.012 (0.130)
Masters		–0.071 (0.140)	0.092 (0.186)	–0.014 (0.186)	–0.002 (0.135)	–0.019 (0.141)	0.047 (0.140)	0.078 (0.148)
Age	–0.005 (0.004)	–0.006 (0.004)	–0.002 (0.006)	–0.003 (0.006)	–0.004 (0.004)	–0.004 (0.004)	–0.001 (0.004)	–0.001 (0.004)
Sex of Extension Officer	0.070 (0.063)	0.077 (0.063)	–0.146 (0.085)*	–0.110 (0.084)	–0.143 (0.062)**	–0.127 (0.063)**	0.046 (0.064)	0.039 (0.067)
Years of service	–0.003 (0.003)	–0.003 (0.003)	0.003 (0.004)	0.004 (0.004)	–0.000 (0.003)	–0.000 (0.003)	–0.004 (0.003)	–0.005 (0.003)

no statistically significant differences between SHEP and non–SHEP officers or between public and private officers. However, in the interaction model, SHEP public officers exhibited significantly greater ability to identify market–oriented practices than their non–SHEP counterparts. Specifically, being a SHEP–trained officer was associated with a 0.400–unit increase in identifying market–oriented practices.

Competencies

In the W/IE model, education, leadership, and interpersonal skills were significantly and positively associated with identifying market–oriented practices, while communication skills showed a negative association. In the IE model, education and interpersonal skills remained significant for non–SHEP officers, with one–unit increases associated with 0.408 and 0.269–unit improvements, respectively. Leadership skills remained significant across both models, with stronger effects observed among non–SHEP officers (0.622 units) compared to SHEP officers (0.152 units). Facilitation skills showed a negative effect among non–SHEP officers (–0.549) but a slight positive effect for SHEP officers (0.022). Conversely, embracing cultural diversity had a positive effect among non–SHEP officers (0.432) but a marginally negative effect among SHEP officers (–0.012).

Education level, social factors, and county context

Certificate holders outperformed diploma holders in both models (W/IE & IE). Positive social factors (gender issues, ethnicity, culture) showed positive significance in the IE model. Extension officers in Kiambu, Uasin Gishu, and Makueni counties demonstrated higher abilities in identifying market–oriented practices than their counterparts in Elgeyo Marakwet.

Table 4. The Effect of job-related and geographical factors on outcome variables

	Identify Market–Oriented Practices		Market Engagement		Records & Business Planning		Linkages & Collective	
Job–related & Geographical variables	**Model 1 (W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**	**Model 1 (W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**	**Model 1 (W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**	**Model 1 (W/IE) Coeff. (SE)**	**Model 2 (IE) Coeff. (SE)**
Skills development training	–0.094 (0.085)	–0.119 (0.085)	–0.109 (0.115)	–0.131 (0.113)	–0.031 (0.084)	–0.053 (0.086)	0.031 (0.087)	0.036 (0.090)
Projects implemented	–0.009 (0.010)	–0.011 (0.010)	–0.036 (0.014)**	–0.040 (0.014)***	0.002 (0.009)	0.005 (0.010)	–0.004 (0.010)	–0.005 (0.110)
Morale level	–0.004 (0.089)	0.022 (0.092)	–0.169 (0.121)	–0.183 (0.122)	–0.075 (0.088)	–0.109 (0.093)	–0.006 (0.091)	0.050 (0.097)
Irrigation water access	–0.091 (0.061)	–0.064 (0.062)	–0.178 (0.083)**	–0.189 (0.083)**	–0.037 (0.060)	–0.030 (0.063)	0.001 (0.063)	0.026 (0.066)
Distance to the main market	0.002 (0.002)	0.002 (0.002)	–0.001 (0.002)	–0.001 (0.002)	0.001 (0.002)	0.001 (0.002)	0.002 (0.002)	0.002 (0.002)
Drought situation	0.080 (0.069)	0.093 (0.071)	0.132 (0.095)	0.063 (0.095)	–0.043 (0.069)	–0.077 (0.072)	0.104 (0.071)	0.137 (0.076)*
Infrastructural development	–0.034 (0.066)	–0.019 (0.068)	0.002 (0.089)	–0.001 (0.090)	0.086 (0.065)	0.060 (0.068)	–0.056 (0.067)	–0.071 (0.072)
Social factors	0.092 (0.064)	0.115 (0.066)*	0.170 (0.087)	0.218 (0.088)**	0.114 (0.063)*	0.113 (0.066)*	0.164 (0.065)**	0.166 (0.069)**
Priority of Agriculture	0.001 (0.038)	0.006 (0.038)	–0.021 (0.051)	–0.011 (0.050)	0.077 (0.037)**	0.077 (0.038)**	0.064 (0.038)*	0.049 (0.040)
Kiambu	0.539 (0.188)***	0.507 (0.198)**	0.562 (0.254)	0.561 (0.263)**	0.305 (0.185)	0.381 (0.200)*	0.256 (0.192)	0.306 (0.210)
Murang'a	0.414 (0.221)	0.336 (0.224)	0.579 (0.299)	0.694 (0.298)**	0.027 (0.218)	0.138 (0.226)	0.153 (0.226)	0.133 (0.238)
Uasin Gishu	0.496 (0.169)***	0.573 (0.173)***	0.190 (0.229)	0.245 (0.230)	0.094 (0.167)	0.143 (0.175)	0.021 (0.173)	0.043 (0.184)
Makueni	0.275 (0.157)*	0.256 (0.161)	0.354 (0.212)*	0.401 (0.214)*	0.023 (0.154)	0.083 (0.163)	0.146 (0.160)	0.169 (0.171)
Kisumu	0.203 (0.175)	0.188 (0.181)	0.369 (0.237)	0.408 (0.240)*	0.056 (0.172)	0.153 (0.182)	0.302 (0.178)*	0.298 (0.192)
R–square (F) values	0.648 (5.867)***	0.692 (5.221)***	0.446 (2.563)***	0.532 (2.658)***	0.494 (3.106)***	0.533 (2.658)***	0.474 (2.864)***	0.502 (2.341)***
Model fit			Wald chi2(26) = 70.77, ***	Wald chi2(36) = 100.86, ***				
LR test vs Linear model			Chibar2(01) =2.03 , *	Chibar2(01) =0.71 ,				

*NB: W/IE means without interaction effect; IE means Interaction effect, while ***, **, *denote significance at 1%, 5% & 10% levels*

Effect of variables on market engagement

Treatment and officer type

In the W/IE model, no significant differences were observed between SHEP and non–SHEP or between public and private extension officers on market engagement. However, the IE model revealed that SHEP–trained private officers exhibited significantly greater market engagement capacity, with a 2.498–unit increase compared to their non–SHEP counterparts.

Competencies

In the W/IE model, both facilitation and program planning skills were positively associated with market engagement. In the IE model, facilitation skills showed a significant average effect, with a one–unit increase linked to a 0.533–unit improvement among SHEP officers. Conversely, leadership skills demonstrated a positive main effect but a negative average effect; a one–unit increase corresponded to a 0.866–unit improvement among non–SHEP officers, and a 0.186–unit decrease among SHEP officers.

Gender, projects, irrigation, social factors, and county context

In the W/IE, female extension officers exhibited lower market engagement than their male counterparts. Additionally, a higher number of implemented projects was consistently associated with reduced market engagement across both models, with each additional project linked to a 0.040–unit decrease. Similarly, increased access to irrigation water was associated with decreased market engagement (–0.189 units). In contrast, positive social factors such as favorable gender dynamics, cultural norms, and ethnic inclusion were positively associated with market engagement in the IE model, contributing a 0.218–unit increase. County–level differences also emerged: officers in Kiambu, Murang'a, Makueni, and Kisumu exhibited higher market engagement than those in Elgeyo Marakwet.

Effect of variables on records management and business planning

Treatment and officer type

No significant differences were found between SHEP and non–SHEP officers or between public and private officers in supporting records management and business planning.

Competencies

In the W/IE model, leadership and program implementation skills were significantly associated with improved records management and business planning. The IE model maintained significance for the main effects of these skills among non–SHEP officers, where a one–unit increase in leadership and program implementation skills corresponded to 0.406 and 0.318–unit improvements, respectively. However, the average effects were non–significant.

Gender, social factors, priority for agriculture, and county context

Male extension officers demonstrated significantly

higher performance than their female counterparts in records management and business planning across both models (W/IE & IE), with a 0.127–unit advantage. Positive social factors (e.g., gender equity, ethnicity, and culture) were also positively associated with performance in both models, with a 0.113–unit improvement. Similarly, counties prioritizing agriculture reported a 0.077–unit increase in performance. Additionally, in this domain, officers in Kiambu exhibited stronger performance in the IE model.

Effect of variables on establishing linkages and collective action

Treatment and officer type

No significant differences were found between SHEP and non–SHEP officers or between public and private officers.

Competencies

In the W/IE model, motivation and interpersonal skills were positively associated with supporting linkages and collective action, while embracing cultural diversity showed a negative association. However, these effects became non–significant in the IE model.

Social factors, drought situation, priority for agriculture, and county context

Positive social factors (gender, ethnicity, and culture) were significantly associated with improved performance in both models (W/IE & IE), with a one–unit increase linked to a 0.166–unit improvement. Reduced drought situation was significantly associated with better performance in the W/IE model, with a one–unit increase linked to a 0.137–unit improvement. County–level prioritization of agriculture was positively significant only in the W/IE model, and officers in Kisumu County exhibited higher performance in establishing linkages and collective action in the W/IE model compared to officers in Elgeyo Marakwet.

DISCUSSION

This study advances the understanding of market–oriented extension by analyzing competency enhancement among extension officers and underscores the importance of public–private partnerships, highlighting the complementary strengths of both sectors to improve service delivery. The findings reveal a persistent gender imbalance in the extension workforce but also distinct differences between the two sectors: public officers seem older, possess longer service experience, implement more projects and have exclusively specialized in agriculture–related fields, with qualifications evenly distributed between diplomas and bachelor's degrees. In contrast, private sector officers are generally younger, exhibit higher educational attainment, particularly at the bachelor's level, and demonstrate slightly greater academic diversity. These complementary characteristics highlight the potential for partnerships that leverage the experience and sectoral focus of public officers alongside the educational attainment and diverse perspectives of private officers to improve service delivery (Umali–Deininger, 1997; Muyanga & Jayne, 2008).

First, we identify four core domains of market–oriented extension and map them to relevant competencies. Findings show that SHEP–trained public officers outperform non–SHEP counterparts across all domains and in most competencies, highlighting the program's effectiveness in building extension capacity to spearhead market–oriented extension. In contrast, similar gains were not seen among private officers, likely due to limited sample size, necessitating further investigation. Second, the study illustrates how specific competencies align with distinct domains of market–oriented extension (Fig. 2). Embracing cultural diversity, Education, facilitation, leadership, and interpersonal skills are key to identifying market–oriented practices, which serves as a foundational domain for the successful implementation of others. Facilitation, leadership, and program planning skills are critical for market engagement, while leadership and program implementation skills support records management and business planning. Interpersonal and motivation skills enhance the establishment of linkages and collective action. These findings suggest that identifying market–oriented practices, which involves engaging with technologies, interventions, and key market stakeholders, requires a broad range of competencies.

High educational competence enables officers to facilitate farmer learning, and sensitivity to cultural diversity allows tailoring advisory services to farmers' sociocultural contexts, improving trust and uptake (FAO, 2021). Although communication is essential for knowledge exchange, its impact may be limited without specific instruction, such as market analysis to address market–oriented challenges, possibly explaining its weaker association with identifying market–oriented practices (Udemezue, 2019).

Facilitation and leadership skills emerged as critical and complementary competencies for market–oriented extension. Consistent with the emphasis in SHEP training, facilitation skills were positively associated with identifying market–oriented practices and enhancing market engagement, particularly among SHEP officers (JICA, 2018). These skills enable extension officers to create inclusive environments where farmers can collaborate, negotiate with buyers, and adapt to dynamic market systems. Conversely, the negative association for non–SHEP officers may reflect an overemphasis on group consensus at the expense of technical guidance (Ackermann, 2023). Leadership skills, meanwhile, demonstrated broader relevance across multiple domains, supporting the formation of networks, market linkages, and structured planning for sustainable extension delivery (FAO, 2007). These findings underscore that while facilitation skills are essential for engaging farmers in market systems, leadership competencies are vital for driving adoption, innovation, and long–term success. However, the diminished effect of leadership skills among SHEP officers could be attributed to their higher baseline leadership competencies due to prior training.

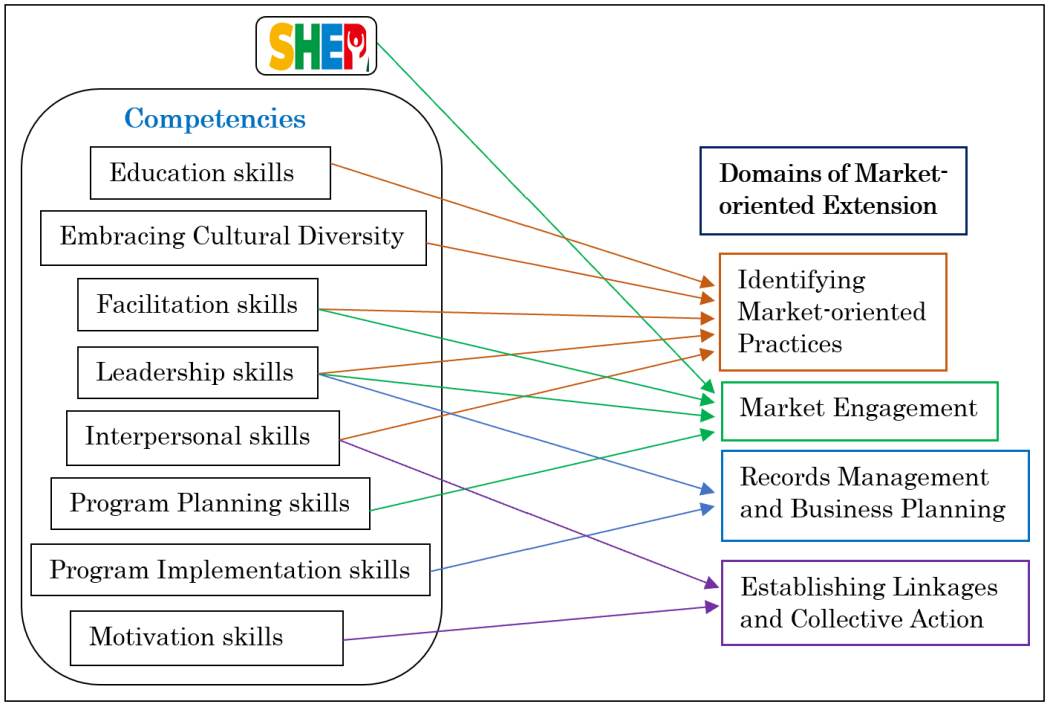

Fig. 2. Model illustrating alignment of competencies with domains of market–oriented extension.

Both skills should therefore be strategically developed to sustain effective market–oriented extension services.

Interpersonal skills facilitate effective collaboration with stakeholders and enhance the cohesion of farmer groups hence vital in identifying market–oriented practices and fostering linkages and collective action (Akpoko *et al.* 2000). While cultural diversity can enrich group dynamics, it may also hinder collective action due to conflicting norms and priorities, necessitating intentional efforts to build cooperation (van Knippenberg *et al.* 2020). Program planning skills support the design of structured activities that address market challenges such as buyer identification and supply chain management (Autry & Burnette, 2019), while program implementation skills ensure these plans translate into actionable strategies, including record–keeping (FAO, 2023). Additionally, motivational skills empower officers to encourage farmer participation in collective efforts by articulating benefits such as cost reduction and enhanced bargaining power (Sabu & Raj, 2020).

Participation in structured programs such as SHEP may moderate or diminish the impact of individual skills, particularly in culturally diverse contexts. This phenomenon could account for the non–significant effect observed in certain skill sets when assessed within the framework of the SHEP intervention. The superior performance of certificate holders in identifying market–oriented practices may stem from their more frequent and direct interactions with farmers. Additionally, the comparatively lower market engagement of female extension officers, relative to their male counterparts, could be attributed to their assignment to non–market–focused roles, such as nutrition training, which limits their exposure to market–based activities.

Although managing multiple projects may indicate active extension engagement, it can compromise service quality when officers are stretched thin across multiple projects, resulting in fragmented farmer support. FAO (2019) stresses the importance of coordinated extension to provide structured, market–oriented guidance. While irrigation access is generally linked to improved productivity, it may increase production and shift farmers' focus toward yield maximization at the expense of market alignment (Jones *et al.* 2022). Furthermore, the financial burden of accessing irrigation can limit farmers' ability to invest in market–oriented initiatives (Giordano *et al.* 2023). This explains its negative association with market engagement. In contrast, Lesala *et al.* (2025) argue that reduced drought fosters long–term planning, including forming connections with value chain actors, reinforcing the importance of sustainable irrigation management in enhancing market participation.

Social dynamics, including gender equity, cultural beliefs, and ethnic cohesion, positively influence all four domains of market–oriented extension, indicating that they create a favorable environment for performance. Veiga and Junqueira (2021) highlight that cultural diversity enhances the responsiveness of extension services to varied community needs. These social factors are thus essential for the effectiveness of market–oriented extension. The higher abilities demonstrated by extension officers in Kiambu, Murang'a, Uasin Gishu, and Makueni counties could be due to favorable climatic conditions, horticultural potential, and proximity to major markets as compared to their counterparts in Elgeyo Marakwet, a county that, though has favorable climatic conditions with horticultural potential, is far from the main markets. Interestingly, the higher performance

exhibited in Kisumu County in establishing linkages and collective action likely reflects the impact of market–oriented extension in a region traditionally dominated by subsistence farming.

Finally, prioritization of agriculture at national and local levels drives the adoption of strategic farm management practices, including record–keeping and business planning. According to FAO (2010), such prioritization increases investment in extension systems and stakeholder collaboration. In Kenya, where agriculture is central to the economy, aligning national and county policies to strengthen market–oriented extension is vital for sustainable agricultural and economic development.

CONCLUSION AND POLICY IMPLICATIONS

This study highlights the importance of enhancing competencies among extension officers in delivering market–oriented extension. Participation in program activities appears to enhance competency and improve performance, as evidenced by the higher levels observed among SHEP–trained officers and their improvements in identifying market–oriented practices and engaging with markets. Additionally, leadership skills emerge as a crucial complement to the facilitation skills traditionally emphasized by SHEP in maintaining effective market–oriented services. Social dynamics, including gender equity and cultural norms, significantly influence market–oriented extension outcomes, highlighting the need for culturally responsive and inclusive intervention designs. Furthermore, county–level prioritization of agriculture positively impacts market–oriented extension, reinforcing the value of coordinated policy efforts across levels of governance. These insights underscore the need to integrate social and cultural considerations into extension program design and to prioritize leadership development alongside facilitation skills in market–oriented extension. Also, strengthening public–private partnerships is key to improving service delivery. This study focuses on the Kenyan context, and while we acknowledge a relatively small sample size, particularly for private extension officers, it provides insightful findings on the competency enhancement of extension officers. Future research should explore more of this in diverse contexts and with larger samples to generate broader insights.

AUTHOR CONTRIBUTIONS

Conceptualization: Peter Orangi, Hisako Nomura, Lydiah O. Nyambok; Methodology: Peter Orangi, Hisako Nomura, Lydiah O. Nyambok; Formal analysis and investigation: Peter Orangi, Hisako Nomura, Lydiah O. Nyambok; Writing – original draft preparation: Peter Orangi; Writing – review and editing: Peter Orangi, Hisako Nomura, Lydiah O. Nyambok; Supervision: Hisako Nomura. All authors read and approved the final manuscript.

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APPENDIX

Appendix Table 1. Initial assumptions of Exploratory Factor Analysis

Variables	KMO	BTS			DCM
		Approx. Chi-square	df	Significance	
Identifying Market-oriented Practices (MoP)	0.844	232.091	10	0.000	0.235
Practicing Market-oriented Extension (MoE)	0.797	593.848	66	0.000	0.023

Appendix Table 2. Summary of Exploratory Factor Analysis

Variables	Extracted factors	No. of items	Eigenvalue	Variance explained	Factor loadings	Cronbach's alpha value
Identifying MoP	1. IMoP	5	2.83907	56.8%	0.7053 → 0.7906	0.8074
Practising MoE	1. ME	3	3.84025	34.9%	0.7812 → 0.8428	0.7777
	2. RMPB	4	1.44815	13.2%	0.4418 → 0.8129	0.7256
	3. ELCA	3	1.17151	10.6%	0.6836 → 0.7903	0.6839

Appendix Table 3. Constructs and indicator items

Construct and indicator items	λ	Measurement
Capacity to identify market–oriented practices		**1–5 Likert scale (Capability)**
IMoP1. Improved market–oriented practices	0.7845	1 = Very low
IMoP2. Interventions from other organizations	0.7906	2 = Low
IMoP3. Maintaining constant contacts	0.7441	3 = Moderate
IMoP4. Engage with input suppliers	0.7399	4 = High
IMoP5. Relevant market stakeholders	0.7053	5 = Very high
Market Engagement (ME)		**1–5 Likert scale (Frequency)**
ME1. Facilitate market visits	0.7812	1 = Very rare
ME2. Organize traders' visits	0.8428	2 = Rare
ME3. Assist in contract negotiations	0.7870	3 = Moderate
Record Management and Business Planning (RMBP)		4 = Frequent
RMBP1. Training on record keeping	0.7441	5 = Very frequent
RMBP2. Supporting simple records management	0.8129	
RMBP3. Supporting profitability analysis	0.7587	
RMBP4. Supporting business planning	0.4418	
Establishing Linkages and Collective Action (ELCA)		
ELCA1. Facilitate linkages with input suppliers	0.6836	
ELCA2. Support collective action	0.7721	
ELCA3. Technical support in farming operations	0.7903	

NB: λ, standardized factor loadings; For ME, RMBP & ELCA, we used the same Likert scale

Appendix Table 4. Means of Outcome variables across counties

S/No.	County Name	Identifying Market-oriented Practices	Market Engagements	Records Management and Business Planning	Establishing Linkages and Collective Action
1.	Kiambu	3.84	3.81	3.94	3.63
2.	Murang'a	4.0	4.0	3.94	3.92
3.	Kirinyaga	3.59	3.47	3.60	3.67
4.	Elgeyo Marakwet	3.42	3.18	3.55	3.59
5.	Uasin Gishu	3.95	3.55	3.75	3.58
6.	Nakuru	3.47	3.55	3.77	3.78
7.	Meru	3.73	3.27	3.61	3.64
8.	Embu	3.61	3.48	3.86	3.59
9.	Machakos	3.58	3.48	3.64	3.54
10.	Makueni	3.73	3.65	3.79	3.79
11.	Kitui	3.71	3.41	3.67	3.67
12.	Kisumu	3.74	3.83	3.85	3.93
13.	Homabay	3.57	3.26	3.77	3.77
14.	Nyamira	3.71	3.73	3.92	3.55
	Average	3.67	3.53	3.76	3.68

Source: Own calculation from the survey data
NB: Elgeyo Marakwet had the lowest mean values in three outcome variables and was therefore considered the reference county.