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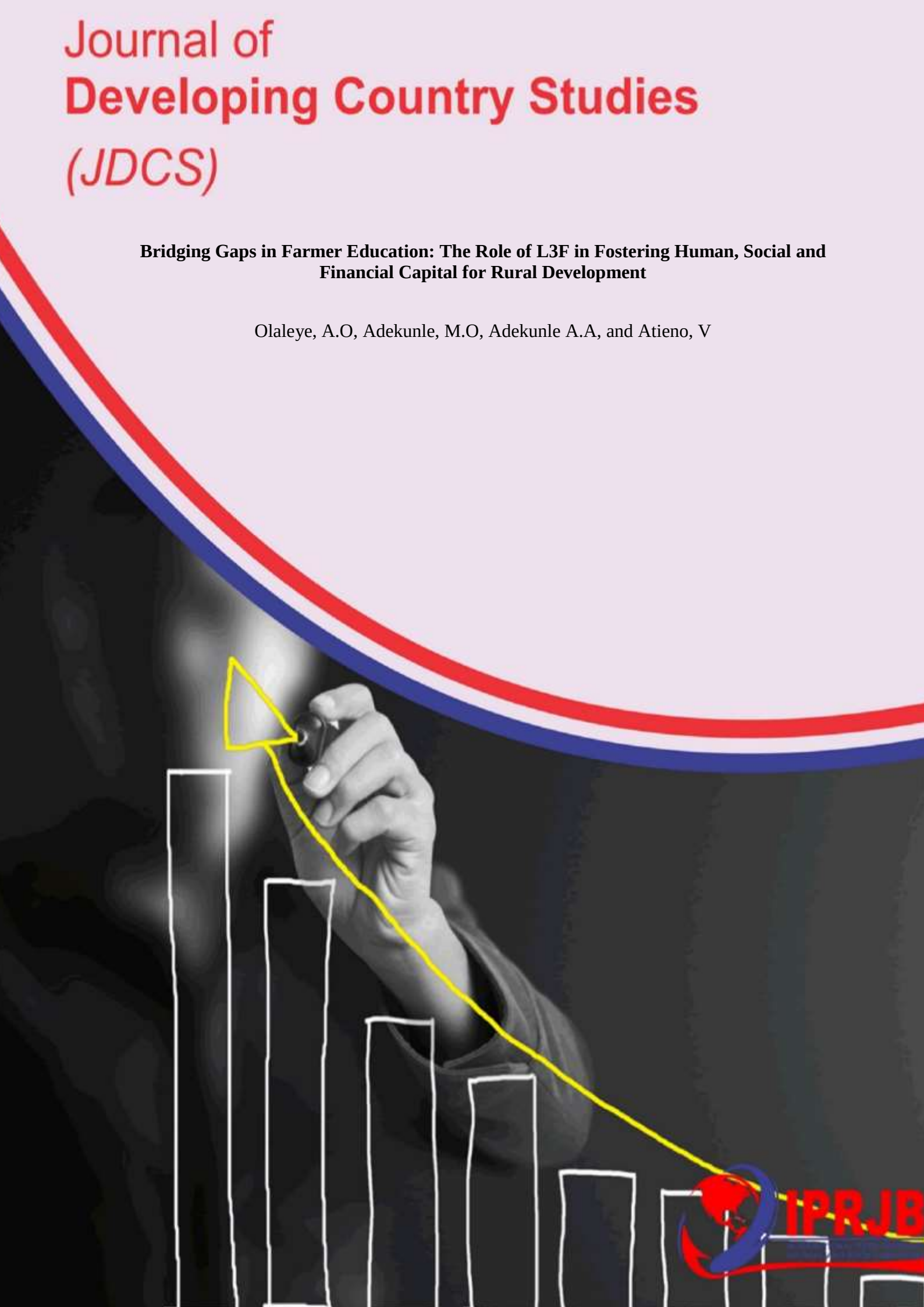

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Bridging Gaps in Farmer Education: The Role of L3F in Fostering Human, Social and Financial Capital for Rural Development

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Abstract

Purpose: This study examines how smallholder farmers in Siaya County, Kenya, are impacted by the Lifelong Learning for Farmers (L3F) initiative regarding revenue distribution, agricultural productivity, and access to learning resources.

Methodology: The analysis utilizes comprehensive statistical data, focusing on demographic characteristics and changes in agricultural production and income among local farmers.

Findings: Key outcomes include a notable gender skew towards females at 76%, aligning with regional trends in women's participation in agriculture. The intervention led to a substantial increase in poultry production, with an average rise of 109.63 birds per farm and a significant income enhancement, averaging a 7,053 Kenyan Shillings (KSH) increase per participant. Income distribution data unveiled a prevailing income disparity, with the bulk of participants (41%) falling into the lower income bracket of KSH 3000. A significant portion (57.89%) reported moderate income growth post-intervention, while 40.70% experienced considerable income boosts. The study also detailed changes in oilseed production volumes, showing moderate and significant increases for 43.86% and 29.47% of the cases, respectively. Challenges to L3F implementation included accessing learning resources, with 25.26% of respondents facing difficulties and a gap in technical expertise, as 39.65% felt the need for further training. Yet, 92.67% successfully adapted L3F strategies to their local agricultural contexts, indicating a high adaptability rate. Despite the financial constraints cited by 72.98% of participants, the initiative's positive outcomes suggest a promising potential for personalized digital extension services to impact agricultural productivity and poverty reduction in rural settings significantly. Notwithstanding the general success, issues were noted, including a lack of access to technology and technical know-how.

Unique Contribution to Theory, Practice and Policy: These results highlight how tailored digital extension services can improve agricultural productivity and spur economic growth. The L3F initiative shows a possible path for fostering sustainable agricultural growth and reducing poverty in rural communities by tackling technical and educational hurdles.

Keywords: *Farmers, Information and Communication Technology (ICT) Kenya, Lifelong Learning, Open and Distance Learning (ODL)*

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INTRODUCTION

Lifelong learning encompasses a wide array of definitions, sharing core notions, as elucidated by significant bodies such as the European Commission, United Nations Educational, Scientific, and Cultural Organization (UNESCO), and the Organisation for Economic Co-operation and Development (OECD) (Volles, 2016). The European Commission (2001) interprets lifelong learning as purposeful learning endeavours undertaken throughout an individual's lifespan to enhance their knowledge, skills, and competencies from personal, municipal, societal, and occupational perspectives[1]. Lifelong Learning for Farmers (L3F) is a holistic model that emphasizes continuous learning among farmers. It uses information and communication technologies (ICT) for horizontal and vertical learning and stakeholder networking[2]. The L3F initiative focuses on linking human capital with social and financial capital[1]. The L3F model is designed to help improve farmers' livelihoods by linking capacity-building to social capital through mobilized farmer groups, professional networking, and financial capital in credit[6]. It has become a socially acceptable, economically feasible, and financially viable farmer extension system[6]. L3F has addressed problems related to agriculture and livestock management and introduced new knowledge and technology to ensure profit-making in the farming sector (Dissanayeke & Wickramasuriya, 2015; Thamizoli et al., 2011). It has played a major role in strengthening the agriculture and rural development sectors[5]. The financial and corporate literacy courses offered to semi-literate and illiterate women over mobile phones have strengthened their savings, credit management, and enterprise activities[6]. The L3F initiative is supported by the Commonwealth of Learning based in Canada, an intergovernmental organization that focuses on improving learning among small and marginalized farmers, rural women, and youth[3]. The project aims to build capacity among farmers, landless labourers, and extension officials through Open and Distance Learning (ODL) and Information and Communication Technology (ICT) to help them develop value-added farming, encourage more sustainable use of natural resources, strengthen their ability to deal with globalization, and ensure food and livelihood security[7].The L3F initiative strives to bridge human capital with social and financial capital (Bordoloi et al., 2020; Thamizoli et al., 2011). Kanwar et al. (2013) posited that lifelong learning embodies a fusion of three instructional paradigms: pedagogy (the art of teaching), andragogy (the theory of self-guided learning), and heutagogy (the theory of self-directed learning). In a recent study, Carr et al. (2020) concluded that L3F necessitates a harmonious amalgamation of formal, non-formal, and informal learning dimensions by intertwining the principles of pedagogy, andragogy, and heutagogy, while social ramifications such as empowerment can be significantly influenced through lifelong learning.

While COL has promoted needs-based continuous learning in rural communities, L3F has brought new knowledge and technology to guarantee profitability in the farming industry and has tackled agriculture and livestock management concerns. L3F has substantially contributed to the growth of rural communities and the agricultural industry[2]. For instance, COL says more than 600,000 L3F members use their mobile devices for learning[3]. Furthermore, research indicates that a 1% rise in empowerment translated into a 2.4% increase in profitability for

[1] European Commission. (2001). Making a European area of lifelong learning a reality—communication from the commission, COM(2001) 678 final

[2] https://www.col.org/skills/lifelong-learning-for-farmers/.

[3] https://www.mssrf.org/ongoing-projects/lifelong-learning-for-farmers/

women-owned enterprises in Kenya[3]. With a more than 54 million population, Kenya is the third-biggest nation in East Africa (Chege et al., 2023). The main focus areas for COL's work in Kenya are technology-enabled learning, lifelong learning for farmers (L3F), higher education, teacher preparation, and job skills. The study was conducted to evaluate the effectiveness and impact of the L3F project in Siaya County, Kenya, which aims to enhance agricultural practices and uplift the socio-economic status of local communities.

The study seeks to identify areas of successes and opportunities for improvement, ensuring that future initiatives can be more effectively tailored to meet the needs of stakeholders across the region. The objectives of this study are to (i) assess the Impact of Personalized Digital Extension Services on Smallholder Farmers' Productivity and Income Levels, (ii) investigate the Changes in Agricultural Enterprise Sizes and Production Volumes Post-L3F Implementation, and (iii) identify and Analyse Barriers to the Effective Implementation of L3F Strategies. Implementing personalized digital extension services through the Lifelong Learning for Farmers (L3F) initiative positively impacts smallholder farmers by increasing agricultural productivity, enhancing income levels, and improving agricultural enterprises' scalability while ensuring equitable access to learning resources and technical expertise. Personalized digital extension services are being implemented through the Lifelong Learning for Farmers (L3F) initiative, which benefits smallholder farmers by boosting agricultural productivity, raising income levels, and making agricultural enterprises more scalable while guaranteeing fair access to technical expertise and learning resources.

Theoretical Framework

Adult learning theories help to understand adult learning needs and their learning patterns. This understanding guides the way adult learning programmes are designed and implemented.

Andragogy Learning Theory

Andragogy, a theory proposed by Malcolm Knowles, maintains that adult learners differ from children in terms of their requirements and traits. Adults are experienced, goal-oriented, self-motivated, pertinent, and driven by internal forces. When it comes to motivation, adults react better to internal than to external stimulants. Adult learning is problem-centred, motivated by the adult's need to study things that will directly affect their personal or professional lives. Its foundation is built on experience, including mistakes. Adults take ownership of their educational choices by participating in preparing and assessing their training. Unlike content-oriented learning, adult learning is problem-centred. This nature of learning was dubbed "self-directed" learning by Blaschke (2012). Based on this theory, adult learners are to be supported to become self-directed (Blaschke & Hase, 2016; Anderson, 2010)

Constructivism Theory

Drawing on the work of Jean Piaget and Lev Vygotsky, this theory posits that learning is not a passive reception of information but rather an active construction of meaning from experiences. Learners actively participate in their environments and construct knowledge instead of passively consuming information. The mind creates its reality by filtering information from the outside environment. So, rather than gaining meaning, humans learn by creating it within. Individuals' worldviews are dynamic constructions informed by their experiences and interactions with the world around them. (Anderson, 2010). Given this theory, adult education programmes should allow students to explore, question, think, and collaborate on projects relevant to their lives and work in groups.

Heutagogy Theory

Heutagogy is a learning theory that advances the principle of constructivism and Andragogy to make the learner the agent of the learning venture. It emphasizes self-efficacy, and metacognition. The learner tries to understand their thought processes and how they learn, making decisions about what to learn and how. Self-efficacy and capability are central principles that allow for transformational learning. The learning is non-linear learning, where the learner directs the learning path. Learning how to learn is a key principle of heutagogy. (Blaschke & Hase, 2016). The overarching goal of pedagogy is scaffolding, providing students with the fundamental abilities they'll need to succeed in subsequent endeavours. The andragogical oriented education provides a framework for learners to engage in self-directed learning. In contrast, heutagogical focused education fosters an atmosphere where learners autonomously determine their learning objectives, strategies, and outcomes. The focus here is on the learner, not the instructor or the course material (Power School, 2022). Adult learners in this regard, take maximum control of their learning and try to understand how they learn.

Transformative Learning

This theory developed by Jack Mezirow centres on how learning causes adults to alter their worldviews and viewpoints. When learners encounter a perplexing problem, a circumstance that contradicts their preconceived notions and worldview, and if they can overcome it, they engage in transformative learning through critical thought, discussion, and action.

METHODOLOGY

Description of Data Collection Site

This assessment involved the participation of key stakeholders in Siaya County, Kenya (Fig 1). Siaya County is one of the 47 counties in Kenya and is located in the country's western region. This area comprises seven sub-counties, namely Ugenya, Ugunja, Gem, Siaya, Alego Usonga, Rarieda, and Bondo, with a total population of 935,555 residents, spread across an area of approximately 2,498 square kilometres. A combination of in-person and online survey questionnaires was utilized to gather information on the ongoing L3F (Life Long Learning) project with these stakeholders. The administration of these surveys was facilitated by members of the Sustainable Environment and Economic Development (SEED) team, who collaborated with respective farmers and utilized local dialects through an application called Kobo Collect. This approach was chosen to guarantee clear understanding, comfort, and data accuracy (Nampa et al., 2020). From approximately 1000 stakeholders, a sample size of 286 was used. This structured approach ensures a thorough understanding of the project's footprint, drawing from organizational insights and personal narratives from those directly impacted by the project's endeavours. Data were collected between 1st December and 20, 2023. The research methodology employed ethical practices by obtaining informed consent from all participants and ensuring their anonymity and confidentiality throughout the study. Moreover, using local dialects and culturally sensitive approaches in the administration of surveys underscored respect for participant diversity and promoted equitable engagement in the research process. The collected data underwent a thorough analysis, which involved the application of descriptive and summary statistics. These statistics included measures such as sample size (n), maximum (max), minimum (min), mean, and standard error. The analytical procedures utilized for this purpose were performed using SAS (Statistical Analysis System) procedures,

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specifically Proc Mean, Proc Logistic, Proc Correlation, and Proc Regression, as described by the SAS Institute (2011).

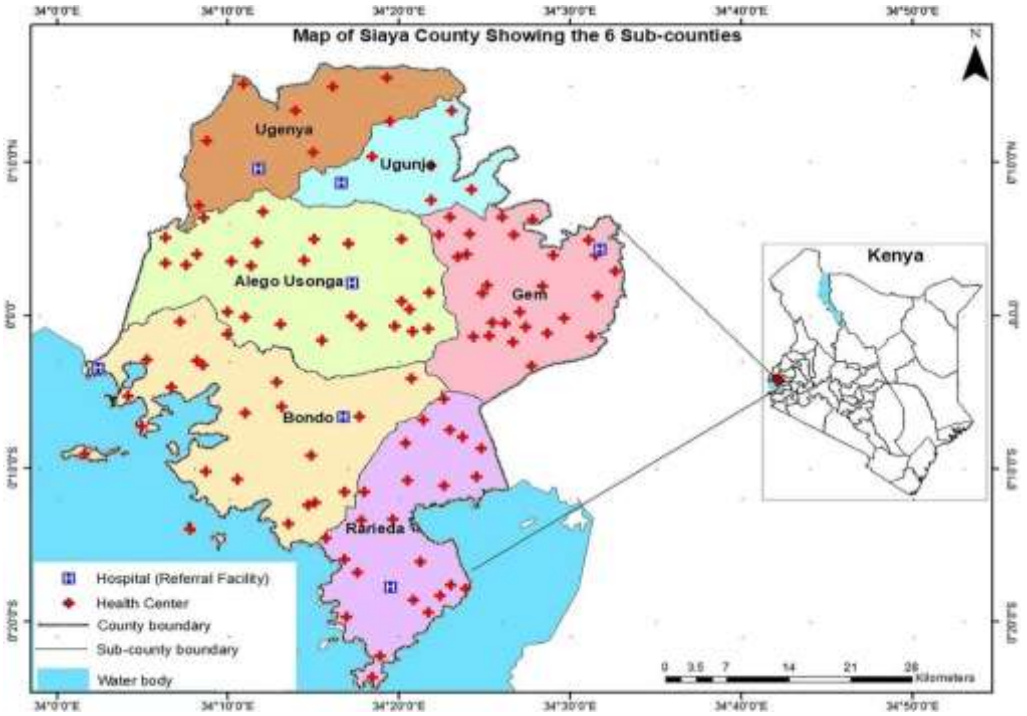

Figure 1: Map of Siaya County Showing the Sub-Counties

Source: Ouko et al., (2019)

RESULTS AND DISCUSSION

The summary statistics of the selected data are presented in Table 1. This table offers valuable statistical insights. Notably, it encompasses various variables, including gender, education, marital status, changes in poultry production, income, and oil seed quantity. These variables shed light on the characteristics and transformations of the sample. Gender, a binary variable with two levels, appears slightly skewed towards females (76%). This range represents the proportion of women in agriculture in different parts of sub-Saharan Africa, which has been stated as 80%. The change in the number of poultry birds produced indicated a substantial average increase in poultry production, with a mean change of approximately 109.63. Aside from proof of continuous increase in the enterprise's profitability, it could also be explained by the fact that the L3F is scaling up in SIAYA county as in other areas. Respondents experienced noteworthy improvements regarding income changes, with an average change of approximately 7,053 Kenyan Shillings (KSH). This finding suggests a positive economic impact. The variable "Change/Increase in Oil Seeds (Kg)" exhibits moderate increases in oil seed quantity, as reflected in the mean change of approximately 124.78 kg.

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Table 1: Summary Statistics of Selected Stakeholders Data, Siaya County, Kenta

Variables	N	Maximum	Minimum	Mean	Std Error (±)
Gender	285	2.00	1.00	1.758	0.025
Education	285	6.00	1.00	2.54	0.055
Marital Status	285	4.00	1.00	2.34	0.046
Change Poultry No.	281	3000.00	5.00	109.63	14.261
produced	283	16500.00	500.00	7053.00	279.359
Change in Income (KSH)	205	1500.00	3.00	124.78	12.914
Change/IncreaseOil Seeds (Kg)					

The distribution of participants across each sub-county showed that most participants were from Unguja. Over 98.25% of the stakeholders were farmers with a primary educational level and about 80% reported marriage. The population's demographic composition consisted of 76% females and 24% males.

Income Distribution

The data illustrate the income distribution percentages across various income levels of the L3F participants, revealing distinct trends. The largest proportion of the population, at 41%, falls into the income level of KSH 3000, followed by 32.2% in the KSH 8000 income level (Fig. 2). As income levels increased beyond 8000, the percentages gradually declined, with only 12.7% of the population in the KSH 13000 income level and 9.5% in the highest bracket of the KSH 16500. These findings highlight income inequality, with a skewed distribution favouring lower income levels, indicating a limited upper-income segment in the population, and designating the KSH 8000 income level as the middle-income group. With this kind of skewness, innovative, well-targeted extension services could help improve prosperity levelsacross the board rapidly.

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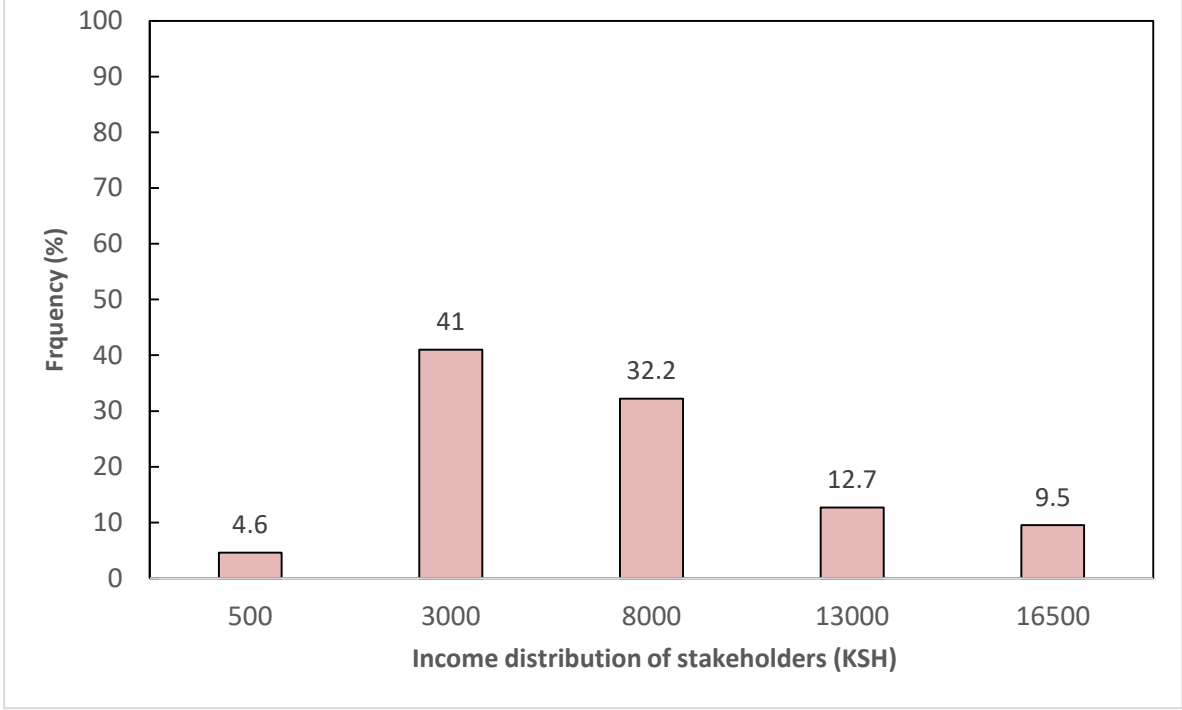

Figure 2: Income Distribution across the Stakeholders Participating in L3F

The data illustrate the income distribution percentages across various income levels of the L3F participants, revealing distinct trends. The largest proportion of the population, at 41%, falls into the income level of KSH 3000, followed by 32.2% in the KSH 8000 income level (Fig. 2). As income levels increased beyond 8000, the percentages gradually declined, with only 12.7% of the population in the KSH 13000 income level and 9.5% in the highest bracket of the KSH 16500. These findings highlight income inequality, with a skewed distribution favouring lower income levels, indicating a limited upper-income segment in the population, and designating the KSH 8000 income level as the middle-income group. With this kind of skewness, innovative, well-targeted extension services could help improve prosperity levels across the board rapidly. Findings from Kenyan stakeholders highlight the potential benefits of personalized digital extension services in improving agricultural outcomes for smallholder farmers, thereby contributing to rural economic development and poverty reduction (KANSIIME et al., 2022; Kieti et al., 2022; Naika et al., 2021). This is consistent with the findings in the literature. A study found that using personalized digital extension services is positively and significantly associated with input intensity, production diversity, crop productivity, and crop income for smallholder farmers (Rajkhowa & Qaim, 2021). Our findings further show that personalized digital extension services have promising potential to promote agricultural development in the small-farm sector, indicating the value of such services in enhancing agricultural performance.

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Income Change due to L3F Intervention

Among these individuals, a significant proportion (57.89%) reported experiencing a moderate increase in their income, while a substantial portion (40.70%) indicated a significant increase in income (Table 2). Only a small fraction (1.40%) reported that their income remained unchanged. These data suggest that most individuals in the group saw positive changes in their income, with moderate but significant increases being the most common.

Change in the Size of Poultry Enterprises

The data reveal that these enterprises fall into three distinct categories. First, 30 enterprises, constituting 10.53% of the total, remained the same in size (Table 2). Second, a notable portion, consisting of 134 enterprises (47.02%), reported a moderate increase in size. Finally, 121 poultry enterprises (42.46%) indicated a significant increase in size. These data underscore the variations in the growth of poultry enterprises, with a substantial number experiencing either moderate or significant increases in size, while others have remained relatively stable.

Change in Oil Seed Volume

This dataset examines changes in the volume of oilseed production, categorizing these changes into three distinct groups. First, 76 instances, constituting 26.67% of the total, indicate that oilseed production remained unchanged. Second, 125 cases (43.86%) reported a moderate increase in oilseed volume (Table 2). Finally, 84 instances (29.47%) demonstrated a substantial increase in oilseed volume. These data highlight variations in oilseed production volume, with a substantial portion experiencing moderate or significant increases, while others have remained relatively stable. These impressive results may even improve as the oil seeds that have just been introduced become a familiar commodity to farmers.

Table 2: Responses of Stakeholders of the Impact of L3F on Income, Size of Poultry and Oil Seeds Enterprises, Siaya County, Kenya

	Frequency	Percent (%)	Cumulative Frequency	Cumulative Percent (%)
Change in income (Ksh)				
Remained the same	4	1.40	4	1.40
Moderately increased	165	57.89	169	59.30
Significantly increased	116	40.70	285	100
Change in size of poultry enterprise				
Remained the same	30	10.53	30	10.53
Moderately increased	134	47.02	164	57.54
Significantly increased	121	42.46	285	100
Change in oil seed production (Kg)				
Remained the same	76	26.67	76	26.67
Moderately increased	125	43.86	201	70.53
Significantly increased	84	29.47	285	100

Barriers to Implementing L3F in Siaya County, Kenya

The stakeholders were requested to provide binary responses, either affirmative (yes) or negative (no), to predefined criteria that could impede the widespread adoption of the L3F initiative within their respective geographical regions (Table 3). The elicited responses are presented below:

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Table 3: Barriers to the Adoption of L3F

Options (Yes/No)	Frequency	Percent (%)	Cumulative Frequency	Cumulative Percent (%)
	----------Difficulty in Accessing Learning Resources ---------			
No	213	74.74	213	74.74
Yes	72	25.26	285	100
	------Insufficient Technical Expertise to Utilize L3F Methods Effectively ------			
No	172	60.35	172	60.35
Yes	113	39.65	285	100
	--------Challenges in Adapting L3F Strategies to Local Agricultural Contexts----			
No	264	92.60	264	92.60
Yes	21	7.40	285	100
	--------Limited Access to Technology or Digital Tools for L3F Learning------			
No	249	87.50	249	87.50
Yes	36	12.50	285	100
	-------Behavioural Barriers: Reluctance or Resistance to New Learning Methods--			
No	256	90	256	90
Yes	29	10	285	100
	----------Financial Constraints in Implementing L3F Practices --------			
No	77	27.02	77	27.0
Yes	208	72.98	285	100

Difficulty in Accessing Learning Resources or Materials for L3F

The data showed that the majority of respondents, comprising 74.74% (213 individuals) of the total, reported that they did not encounter difficulty in accessing learning resources or materials (answered "No") (Table 3). In contrast, a smaller proportion, accounting for 25.26% (72 individuals) of the total, responded affirmatively, indicating that they experienced difficulties in accessing these resources (answered "Yes").

Is There Sufficient Technical Expertise to Utilize L3F Methods Effectively?

The availability of technical expertise in implementing the L3F approach was also explored. This is of increasing necessity as the L3F continues its mission of scaling up the approach within current areas of operation and beyond. Like other projects of the L3F, the project in Kenya engenders a component of capacity building for farmers and partners, during which partners are trained on the L3F approach, ODL, and ICT, as well as other models of COL, including gender. This is the forum where the foundation is laid for acquiring the technical expertise required for implementing the L3F approach. While some respondents indicated a need for further technical knowledge (39.65%), 60.35% felt confident in using L3F methods (Table 3) effectively. This highlights a strong foundation of technical knowledge among the

majority of the staff in the partner organization. The implication of these results is twofold: the fact that a substantial percentage of partners feel confident in their ability to use L3F methods suggests that the program has successfully built technical capacity among its partners. This is a positive outcome, as many are equipped with the knowledge and skills to leverage ICT and ODL for farmers' learning and empowerment. However, the fact that some partners (approximately 40%) indicated a need for further technical expertise suggests room for improvement in the program's capacity-building efforts directed at partners who help implement the projects. This could mean the program must invest more in technical training to ensure all partners can use the L3F methods effectively. While the L3F program appears to be effectively building technical capacity among a majority of its partners, there is still a need for continued investment in technical training to ensure that all partners can fully leverage the benefits of ICT and ODL, thereby serving as effective foot soldiers to help COL scale up the L3F approach in Kenya and beyond. L3F may think of reinforcing existing programs through other platforms, including webinars, zoom, and other social media platforms. This balance between recognizing successes and identifying areas for improvement is crucial for the ongoing development and refinement of the L3F program.

Are There Challenges in Adapting L3F Strategies to Local Agricultural Contexts?

About 92.67% of respondents reported not facing challenges in adapting L3F strategies to their local agricultural contexts (Table 3). This demonstrates a positive trend, indicating that a significant portion of respondents find the topics or themes explored by the L3F approach to be topical and adaptable to various situations across the Commonwealth. The implication is that some of these stakeholders may need further training on applying the L3F approach in their local settings.

Is There Sufficient Access to Technologies to Demonstrate Learning from L3F?

Do farmers have access to technologies for production, processing, and marketing before they can convert learning into increased yields and income? They must access seeds, fertilizers, and other improved inputs, including finance, before they can transform learning from L3F into socio-economic benefit. The L3F uses LINDEP (Adekunle, 2024) as the institutional innovational structure to create a useful and productive engagement between the value chain players, including agencies for input and output marketing, policies, and researchers. This was introduced to replace the serialized engagement of these agencies. While 12.5% of respondents faced limited access to technologies to enhance the utilization of L3F learning, a majority (87.5%) did not encounter this limitation (Table 3). This means that most respondents have access to necessary production, processing, and meeting technologies to support their L3F learning and help them transform learning into socio-economic benefits.

Is Accessing Learning Resources or Materials for L3F Difficult?

Most respondents, 74.74% (213 individuals), reported not having difficulties accessing learning resources or materials for L3F (Table 3). Learning materials are accessed through technologies such as the telephone. Studies have shown a positive association between mobile phone use for agricultural activities and reported maize yields in Tanzania. Many farmers report that mobile phone use increases agricultural profits and decreases farming costs and time investment (Quandt et al., 2020). In earlier studies from some Asian L3F sites, the use of mobile phones as a learning tool has been shown to impact gender dynamics in farming communities by empowering female farmers with knowledge and skills and providing them with a platform

to voice their concerns and participate in decision-making processes (Augustine et al., 2013; Balasubramanian et al., 2011). However, the limitations and challenges of implementing mobile-based learning in rural areas include limited network coverage, low literacy levels, and lack of access to affordable smartphones (Maredia et al., 2018; Thamizoli et al., 2011, 2018). In Kenyan studies, most of these challenges are addressed by the L3F through digital training, community-based approaches such as LINDEP, and partnerships with NGOs, and government agencies. These results align with the suggestions of Henze and Ulrichs in 2016 (Henze & Ulrichs, 2016). The issue of lack of literacy is addressed through audio messaging in local languages. The issue of the rate of telephony is another possible area of challenge. When there is sufficient telephone penetration, there will be no particular problem in accessing the materials. However, when there are low levels of telephony, the access problem may become magnified. The data obtained suggest that a significant portion of respondents have convenient access to the necessary materials, which can facilitate farmers' smooth adoption of technologies when the L3F approach is used. This is consistent with the findings of Quandt and others (Quandt et al. 2020), which show that the number of mobile phone connections on the continent was approximately 747 million, representing a 75% penetration rate. Increased connectivity is helping smallholder farmers in rural areas get connected, leading to economic transformation[4]. They said further that Africa is transitioning into digital agriculture, with mobile telephony playing a significant role. Without a doubt, mobile technology is the largest platform in Africa, and it can access a wide range of income groups. In Africa today, as in other parts of the globe, data is transmitted through smartphones and, often, through non-profit means. Non-profit mobile technology is not aimed at advanced smartphones but ranges from sending out bulk Short Messages Services (SMSs)) or Unstructured Supplementary Service Data (USSD), sometimes referred to as "**quick codes**" or "**feature codes**" to mobile sites and mobile communities. USSD has several applications, including being used for Wireless Application Protocol (WAP) browsing, prepaid callback services, mobile money services, location-based content services, menu-based information services, and configuring the phone on the network. There are specific advantages associated with the use of USSD. These include the fact that the service does not require a messaging app, and does not incur charges.[2]AppsAfrica in quoting what seems more like a global trend, optimistically suggested that the next 1 billion phone users will come from rural areas (Carter, 2023). The ultimate aim of non-profit mobile technology is to make services free, or as close as possible to free, for the end user. This may mean enlisting donors and getting mobile networks on board. Internationally, companies such as TextToChange, FrontlineSMS, RapidSMS, and Ushahidi all work with mobiles in health, disaster relief, and aid management. COL can work with any or all of them to expand its reach and reduce the penetration cost.

Behavioural Barriers: Reluctance or Resistance to New Learning Methods

Most respondents (90 %) do not resist new learning methods (Table 3). This positive attitude suggests a willingness among participants to embrace the L3F approach to learning. This phenomenon also bodes well for the approach being scaled up.

Financial Constraints in Implementing L3F Practices:

While 72.98% of respondents face financial constraints, it is important to note that 27.02% do not encounter this issue (Table 3). This suggests that a portion of the respondents have the

[4] https://www.un.org/africarenewal/web-features/africa-leapfrogging-digital-agriculture

financial resources needed for successful L3F implementation, while the bulk of them require engagement with financing agencies. Farmers need finance to procure the inputs on which the training programs have been hinged. L3F upholds financial capital empowerment as one of its pillars and uses the Learning Innovation and Development Platform (LINDEP) as a mechanism to engage banks. However, the fact of the matter is that many banks do not want to participate in agricultural lending because of anachronistic beliefs about the level of risks involved. L3F must proactively present business plans that portray the advantages of LINDEP in resolving most risks and improving the level of comfort in agricultural lending. Efforts should also be made to continue to promote the use of Table Banking, which is emerging as a potent alternative to regular banking in the agricultural sector in many countries. Table Banking played a pivotal role in the implementation of L3L in Kenya.

Logistic Regression (LR)

Preselected factors, such as difficulty accessing resources, insufficient expertise, limited access to technology, behavioural barriers, lack of support, and financial constraints, did not demonstrate statistically significant associations with the outcome, except for the "Challenge to Adapt L3F Strategies," which showed a marginally significant positive association. The results indicated that certain unspecified factors ("Others") exhibited a significant and positive impact on the outcome (Table 4). These findings underscore the importance of considering these factors when planning interventions or addressing issues related to L3F strategy adoption. The analysis suggests that "Others" (unspecified factors) significantly and positively impact the outcome.

- Other factors, such as difficulty accessing resources, insufficient expertise, limited access to technology, behavioural barriers, lack of support, and financial constraints, did not show statistically significant associations with the outcome.
- Other factors could also be associated with the networking arrangement that goes along with the training and connects the training better with social and economic benefits.
- "Challenge to Adapt L3F Strategies" shows a marginally significant positive association.
- The significance of these factors should be considered when planning interventions or addressing issues related to outcomes.

Table 4: Logistic Regression Results for Factors Affecting L3F Initiative

Analysis of Maximum Likelihood Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq‡**
Intercept	1	-7.6085	1.8551	16.8207	<.0001
Difficulty Access Resources	1	0.3813	0.6531	0.3409	0.5593
Insufficient Expertise to UtilizeL3F knowledge	1	-0.4842	0.6307	0.5893	0.4427
Challenge to Adapt L3F Strategies	1	1.1253	0.6597	2.9093	0.0881
Limited Access to Technology Tools	1	0.9027	0.6799	1.7627	0.1843
Behavioural Barrier to L3F	1	-0.5076	0.6663	0.5803	0.4462
Lack of Support for Sharing L3F Knowledge	1	-0.9613	0.6651	2.0891	0.1484
Financial Constraints	1	0.2109	0.7511	0.0788	0.7789
Others	1	3.4837	1.2644	7.5912	0.0059**

Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Difficulty Accessing Resources	1.464	0.407	5.267
Insufficient Expertise Utilized for L3F	0.616	0.179	2.121
Challenge to Adapt L3Fstrategies	3.081	0.846	11.227
Limited Access Tech. Tools	2.466	0.651	9.350
Behavioural Barrier to L3F	0.602	0.163	2.222
Lack of Support for Sharing L3F Knowledge	0.382	0.104	1.408
Financial Constraints	1.235	0.283	5.381
Others	32.579	2.733	388.314

** Significant at 1%

Multiple Regression Analysis (MRA)

From Table 5 below, one can see that the Change in Income (KSH) explains a substantial proportion of the variance in the dependent variable (R-Square = 0.7265), and it significantly improves the model's prediction accuracy ($p < .0001$). The significant variables in this analysis suggest that changes influence the L3F initiative's success in income, the extent to which it addresses needs and priorities, behavioural barriers to learning methods, gender influence, available resources, and the delivery of intended outcomes. These variables should be considered when implementing or improving the L3F initiative to maximize its effectiveness.

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Table 5: Stepwise Selection Summary for Variables in a Regression Model of Factors That Will Influence L3F Adoption

Summary of Stepwise Selection							
Step	**Variable Entered**	**Variable Removed**	**Partial R-Square**	**Model R-Square**	**C(p)**	**F Value**	**Pr > F‡**
1	Change in income (KSH)		0.7265	0.7265	32.5515	746.37	<.0001
2	Has L3F addressed needs and priorities ?		0.0148	0.7413	17.6964	16.01	<.0001**
3	Behavioural Barrier to Learning Method		0.0047	0.7460	14.3164	5.19	0.0235*
4	Gender Influence on L3F		0.0038	0.7498	12.0252	4.19	0.0417*
5	Available Resources to implementing L3F		0.0068	0.7565	6.3097	7.71	0.0059**
6	Has L3F delivered intended outcomes?		0.0038	0.7603	3.9830	4.37	0.0374*

* Significant at 5%; **‡Significant at 1%

Correlation Analysis

The results of the correlation analysis between these variables and change in income (KSH), change in bird numbers produced, increase in oil seed (kg) output, gender, and Educational status) are presented in Table 6. The correlation matrix displays the relationships between variables, including change in income (KSH), change in the number of birds produced, Increase in Oil (kg) seed output, gender, and Educational status. *Change in income (KSH) and Change Poultry Number Produced (r = 0.311***)*: This suggests that poultry production increases as income increases. This is supported by a study in Kenya, Malawi, Tanzania, Uganda, and Botswana that found a positive correlation between income and livestock ownership (Taruvinga et al., 2022; Zampiga et al., 2021). *Change Poultry No produced and Increase Oil kg seed output (r = 0.232***):* This indicates that as poultry production increases, oilseed output also increases. This observation suggests a potential correlation with a more comprehensive strategic approach to improve poultry farming practices. As the scale of chicken production increases, there is a corresponding surge in the demand for poultry feed (VAARST et al., 2015). This increase in demand subsequently necessitates a heightened emphasis on the cultivation and production of essential feed components, such as oilseed grains. The interplay between poultry farming and feed production underscores the interconnected nature of agricultural systems and the need for strategic planning in both areas. A study on feed efficiency for sustainable intensification of chicken meat production highlighted the importance of feed efficiency improvements in terms of overall sustainability for the broiler chicken production chain (Bryan et al., 2023). *Increase Oilkg seed output and gender (r = -0.349***):* This suggests a gender-related difference in oilseed output. While we could not find a direct study on this, a study on oil discoveries and gender inequality found that resource-rich countries tend to allocate talent and investment toward the resource sector and away from sectors such as agriculture, which could indirectly impact gender roles in oilseed output (Taruvinga et al., 2022). *Gender and Educational status (r = -0.211**) and Change in income (KSH) and Educational status (r = 0.139**)*: These correlations suggest that as gender shifts towards male, educational status tends to decrease, but as income increases, educational status

tends to increase. A study on gender and education in Canada found that women with a bachelor's degree earned considerably more than women with college, high school, or trade education[5]. Another study found that education is strongly related to income and wealth (Taruvinga et al. 2021; Taruvinga et al. 2022). Change Bird No produced and Gender (r = -0.169**) and Change Poultry No produced and Educational status (r = 0.077ns): These correlations suggest a moderate negative relationship between poultry production and gender and a lack of a statistically significant relationship between poultry production and educational status. A study on the role of animal and human movements in poultry production and trade networks in the global spread of avian influenza viruses found that more emphasis is placed on socio-economic value dimensions (Siles et al., 2021; Zampiga et al., 2021). Change Poultry No produced and gender displayed a moderate negative correlation (r = -0.169**) (Reithmayer et al., 2021; Weissmann et al., 2014). These results imply that the number of poultry produced by a farm is negatively correlated with the gender of the farmer, meaning that female farmers tend to produce fewer poultry than male farmers. However, there may be other factors that affect poultry production besides gender. Finally, a change in Poultry No produced and educational status had a correlation of 0.077^{ns}, which suggests a lack of a statistically significant relationship between these two variables.

Table 6. Correlation Coefficient between Change in Income (KSH), Change Bird No Produced, Increase in Oilkg Seed Output, Gender, and Educational Status

	Change in income (KSH)	Change Poultry No produced	Increase Oilkg seed output	Gender	Educational status
Change in income (KSH)	1.00				
Change Poultry Number produced	0.311***	1.00			
Increase Oil seed output (Kg)	0.425***	0.232***	1.00		
Gender	-0.163**	-0.169**	-0.349***	1.00	
Educational status	0.139**	0.077^{ns}	0.241***	-0.211**	1.00

*** Significant at 1%

Performance of L3F in Delivering Outputs and Outcomes

The data presented (Fig 3) pertains to the assessment of L3F's performance in delivering outputs and outcomes, where respondents were asked to provide their opinions or evaluations, and it reveals that a significant majority, comprising 73.7% of the respondents, expressed a high level of agreement or satisfaction with L3F's delivery, as indicated by their choice of "Yes," suggesting a positive perception of the organization's effectiveness in achieving its intended results; additionally, a notable proportion, accounting for 25.3% of the respondents, selected "Somewhat," indicating a more nuanced stance with some reservations or mixed

[5] https://www150.statcan.gc.ca/n1/pub/36-28-0001/2021009/article/00004-eng.htm

feelings, possibly implying that there may be room for improvement or that the outcomes and outputs delivered by L3F are not uniformly perceived as highly satisfactory; conversely, a very small minority, representing just 1.1% of the respondents, opted for "No," implying a clear disagreement or dissatisfaction with L3F's performance, suggesting that there may be significant concerns or issues to address; it is worth noting that the "Unsure" option received no responses, indicating that none of the surveyed individuals were uncertain or had no opinion about L3F's delivery of outputs and outcomes, suggesting that the majority of respondents had a clear stance, either positive or negative, regarding L3F's performance in this regard. The L3F in the past year has created a structure to ensure that they work together in a win-win scenario. They created the Learning Innovation and Development Platform (LINDEP), which brings together all the players along the value chain to work together with farmers to set targets and work towards their accomplishment, benefiting each partner financially. Financial institutions are part of this network. This has improved it efficiency in ensuring an increase in income which the farmers found as the primary factor in considering an approach.

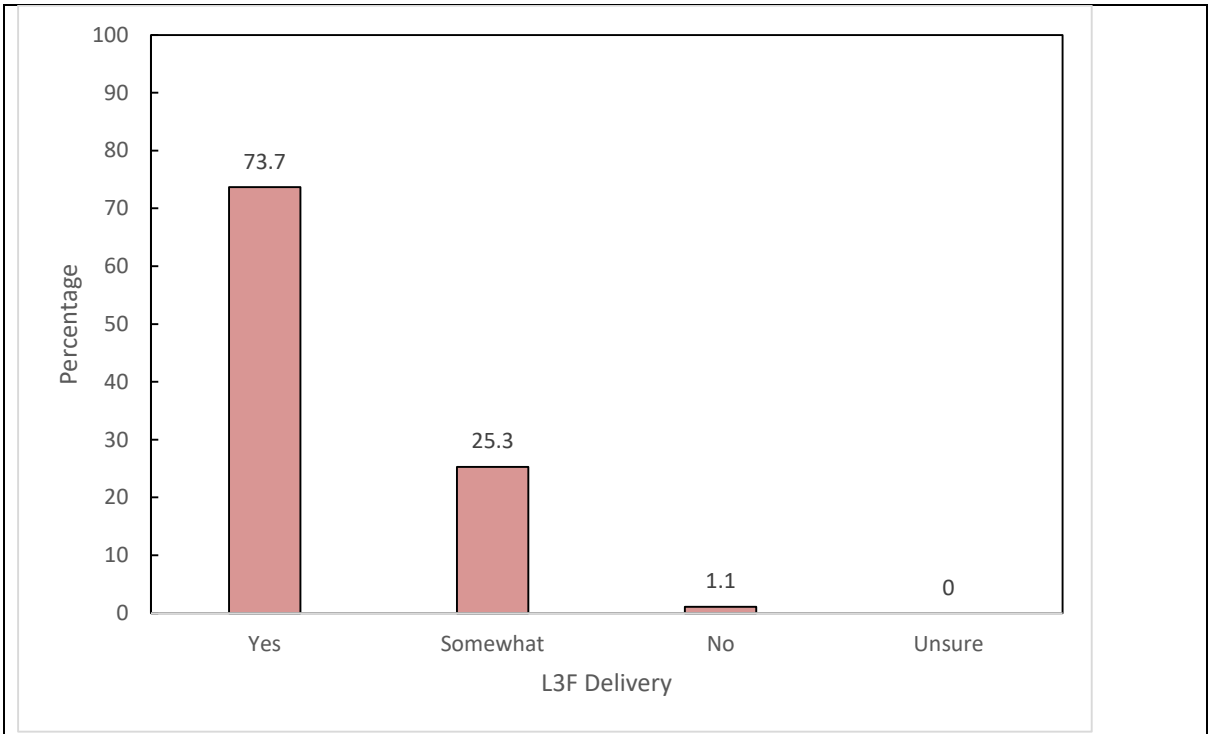

Figure 3: The Delivery of L3F Initiative Output/Outcomes, Siaya County, Kenya

Conclusion

The Commonwealth of Learning institution focuses on learning for sustainable development. It has an initiative called Lifelong Learning for Farmers(L3F), which aims to improve the livelihoods of smallholder farmers by bridging their learning deficits in the production, processing, marketing and running of farming enterprises. It uses Open and Distance Learning (ODL) modulated by ICT. It helps build capital in three dimensions - human capital dealing with the learning in the Recommended Agricultural Practices (RAP) for the production, processing and marketing of their commodities, and in the running of their businesses; social

capital including the mobilization of farmers into formidable business based clusters, and the engagement of inclusive business based network to complement the training and support farmers; and financial capital to bring the training to practicality. L3F therefore undertakes transformational training to ensure farmers become wealth creators. The program is being implemented in different parts of the world. In Kenya, it has been implemented with a group of public and private sector stakeholders led by the Sustainable Environment and Economic Development Agency. This study was conducted to gauge the level of impact if any of the L3F approach and the adoptability of the approach by partners.

The study showed that a significant portion of the population from Siaya County reported experiencing increased income. This includes both moderate, and significant income increases. These positive changes in income are promising and suggest opportunities for economic growth in rural areas when the L3F approach is applied. Increase in income is derived through increase in yields, as affected by effective and profitable marketing, all on the spine of beneficial training. Another important driver of these income improvements is access to institutional finance, as discussed in another context. Access to loans and credit enables individuals, particularly smallholder farmers, to invest in agriculture. This includes purchasing essential inputs, acquiring equipment, expanding production, and improving marketing. Financial resources play a pivotal role in facilitating the adoption of modern agricultural technologies, which are precursors to increased production and productivity. The fact that financial resources obtained were used to acquire inputs taught through the training programs emphasizes the importance of training. It is hardly possible for the provision of finance to achieve the same outcome without accompanying training. L3F experiences have consistently shown that access to institutional finance significantly impacts the adoption and extent of technology use in agriculture. These findings have significant implications for policymakers and development practitioners in rural areas. A multifaceted approach is necessary to address income inequality and foster rural development. It involves enhancing access to credit and financial services while simultaneously promoting the adoption of modern agricultural technologies among smallholder farmers. Tailored policies and interventions that consider the unique needs of different farm sizes and financial institutions can be instrumental in achieving these objectives.

Another factor albeit with implied importance in the analysis is the networking that took place through the Learning Innovation and Development Platforms, a platform that L3F promotes to harvest and domesticate an inclusive coterie of service providers, both public and private, needed to effectuate the learning obtained from training. This has been discussed in another paper.

Results from here however show the potential of the L3F approach in frog leaping food production as desired, to help the world bridge existing deficit in food production, avert a global crisis, and attain the targets of the SDG.

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