



COVID-19 and Smallholder Chicken Farmers in Eastern Kenya: Assessing Resilience and Coping Strategies

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Abstract | The study examined the impact of the COVID-19 pandemic on chicken farmers in Machakos County, Eastern Kenya, focusing on their resilience levels. A multistage random sampling approach was used to obtain primary data from 582 households engaging in chicken farming. Descriptive statistics revealed that a substantial portion of these farmers (67%) demonstrated low resilience in response to the pandemic's multifaceted disruptions spanning for instance from production, marketing, income, chicken enterprise operations, and social well-being. Furthermore, the research highlighted the key challenges such as feed shortages (75%), increased predation (70%), market disruptions (69%), and income declines (63%). Farmers adopted coping strategies like scavenging for feed, reducing flock sizes, and homemade feed formulations. Econometric analysis revealed that education, income, flock size, credit access, and extension services as resilience boosters, while high feed costs and distant markets reduced resilience. The study recommends that the National and County Governments collaborate with stakeholders to initiate gender disaggregated and accessible credit sources and utilize mobile input vendors to enhance access to feeds and vaccines for chicken farmers. Furthermore, increasing awareness of pandemic coping mechanisms through extension services and educated farmers should be strongly recommended. The study also calls for government and institutional interventions to enhance farmers' adaptive capacities against future shocks.

Keywords | Coping strategies, Resilience, COVID-19 crisis, Chicken, Smallholder farmer

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INTRODUCTION

Agriculture plays an integral part of the Kenyan economy accounting for 33% of gross domestic product (GDP) while creating employment to 40% of overall population and over 70% of rural population (KNBS, 2023; Tanui, 2024). However, the COVID-19 pandemic adversely

interrupted the food systems significantly disrupting the entire value chains from production through to distribution (Mishra *et al.*, 2022). This further affected most low- and middle-income countries (LMIC) and developing countries (DCs) thus nearing-economic-recession (Yuheng *et al.*, 2024; Bansak *et al.*, 2025). Moreover, millions of livelihoods were affected thus compelling government

interventions in safeguarding the well-being of its citizens and their livelihoods (Banks *et al.*, 2025). The COVID-19 pandemic crisis strain resources, resulting to widespread human suffering, loss of life, and a heightened demand for emergency assistance (Sharma and Leung, 2024). This calls for resilience to cushion them to absorb the shocks and preserve their socio-economic stability (Osabohien *et al.*, 2024).

The COVID-19 pandemic impacts was even worse to smallholder chicken farmers who account for over 70% of households in Sub-Saharan Africa (SSA) with Kenya included and who depend on chicken farming for both income generation and food security (Kasima, 2024). In an effort of curbing the spread of Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-Cov-2), the Kenyan government implemented a series of stringent public health measures. These included both full and partial lockdowns in major cities and their environs, curfews, social distancing in public places and schools, market closures, widespread fumigations, and the suspension of in-person learning (Kwena, 2024; Ngumi, 2023). While these interventions were necessary from a public health perspective, they had a significant ripple effect on the economic well-being its citizens, particularly by constraining household purchasing power. The rural poor households were hardly pressed by the new norm of COVID-19 pandemic restrictive measures. In response, the government worked on leveraging the situation and boosting resilience of their already affected population through economic stimulus package. These strategies entailed reduction of taxes of essential products plus cash transfer to the elderly and less privileged in the society, many of whom already experienced severe hardship (Mahomed and Saba, 2024; Tajudin *et al.*, 2021).

Specifically, poultry sector constitutes a vital sub-sector providing food and income security too many producers especially for smallholders in the rural areas (Mohamed, 2024). The sub-sector accounts for 7.8 percent of agricultural GDP and 0.7 percent of total GDP (KNBS, 2021; Tanui, 2024). The enterprise offers a reliable source of revenue and employment particularly among women and youths who are the major participants in this value chain (Musyoka *et al.*, 2025). Most chicken farmers were hardly hit by this pandemic despite the health measures enacted by the government. The adverse effects were largely driven by disrupted access to the critical chicken inputs such as feed and vaccines, alongside the collapse of market linkages for chicken and related products (Singh *et al.*, 2024). These containment measures posed unprecedented challenges particularly for the smallholder chicken farmers in the marginalised and remote areas. Consequently, failure to access key chicken inputs among the rural majority due to lockdowns and curfew resulted to a decline in chicken production and household income. This disruption also

triggered price volatility, and impaired food security status at household level (Galol *et al.*, 2022). Furthermore, smallholder chicken farmers who traditionally supplied chicken products—meat and eggs—to peri and urban markets were affected by travel limitation, effectively cutting them off from their primary customer base (Omondi, 2022).

The COVID-19 pandemic profoundly disrupted agricultural enterprises, significantly affecting key dimensions such as marketing and production (30%), food security (70%), health (82.7%) and income (86.7%) among members of agricultural enterprise in Thailand (Chumpanya and Panpakdee, 2025). In response, enterprise members curtailed working hours, instituted daily salary reductions, and embraced digital platforms to enhance market access as adaptive measures. Similarly, smallholder broiler farmers in Indonesia employed a range of adaptive strategies to curb the effects of the COVID-19 pandemic (Rusdiana *et al.*, 2024). The study found that COVID-19 pandemic disrupted supply chains, raised costs of production, lowered broiler yields, reduced incomes for farmers, and hampered broiler agricultural sustainability. In mitigating the effects, smallholder farmers strengthened supply chain resilience, regulated the markets, diversified marketing of broilers, strengthened multi-stakeholder partnerships and adopted digital technologies. In Nigeria, smallholder poultry farmers noted that COVID-19 pandemic shock interrupted the marketing systems (85%), leading to glut of poultry products (80%), flock decrease (25%) and closure of the poultry business (15%) for the poultry farmers (Adeniyi *et al.*, 2021). To cope with these challenges, farmers relied on cooperative financing, extended credit sales, and leveraged digital platforms to access timely market information. Despite these documented experiences in other regions, we only found one report on the impact of multiple stressors and COVID-19 shock on agro-food systems in Kenya (Odhiambo *et al.*, 2022). However, there remains limited information regarding the impact of COVID-19 pandemic that is specifically on chicken farming. Furthermore, there is also limited research evaluating the pandemic effects on resilience of smallholder chicken farmers. Addressing this gap, this study incorporates an econometric analysis to assess the impact of COVID-19 pandemic shock on the resilience levels of smallholder chicken farmers in Machakos County, Eastern Kenya.

Recognising the need to build capacity among farmers to withstand impact of COVID-19 pandemic presents not only the mitigation for the pandemic but also for future pandemics and economic shocks (Marsden *et al.*, 2023; Bene, 2020; Woodhill, 2020). Within this context, resilience is conceptualised as the capacity of smallholder farmers to guarantee that harmful shocks do not result in long-term detrimental effects on their ventures (Batung *et al.*, 2023). Previous study by Vaitla *et al.* (2012) also adopted a

“livelihood change” methodology that comprise of modeling the pre-existing conditions with assets, financial assets, natural resources, physical assets, human and social capital. These are the vital elements of resilience that interact both in a vulnerable context and institutional context enabling the households to react to a shock. Assessing resilience levels among smallholder farmers is instrumental in identifying strategic interventions that can strengthen their capacity to absorbing, to adapting, and recovering from the shocks (Clair *et al.*, 2023). In this study, the extent of resilience dependent on how different chicken farming households adapted capacity levels. Building on “livelihood change” approach, this study adapted the Resilience Index Measurement and Analysis (RIMA) which has been used by Food and Agriculture Organization (FAO) to measure resilience related to economic crisis among countries (Minkande, 2025). Kansiime *et al.* (2021) and Mathenge (2022) also found that COVID-19 pandemic shock coupled with climate change effects have continued to pose serious challenges in agricultural enterprises, thus justifying the need for this study.

Kenyan smallholder farmers were compelled to adopt various mitigation strategies to cushion the harmful impacts of COVID-19 pandemic, which significantly interrupted the supply and demand of agricultural produce (Otundo, 2024). For instance, many farmers relied on personal savings to meet the household expenses while digital credit enabled many farmers to smoothen consumption (Yawe *et al.*, 2022). Layoffs were frequently employed as a coping mechanism, though this often resulted in increased vulnerability among underpaid agricultural laborers (Kansiime *et al.*, 2021; Tabe *et al.*, 2022). Among smallholder chicken farmers, adaptive strategies included sourcing chicken feeds locally, blending locally available feed materials with commercial feeds, reducing the flock sizes, sourcing alternative local markets, diversifying agricultural enterprises, and embracing digital marketing (Senadhilankara *et al.*, 2024). All these were mitigation initiatives that aimed at building sustainable and resilient food production systems among the smallholder chicken farmers. The extent of resilience among smallholder chicken farmers has been hampered by both socio-economic and institutional factors (Tenza *et al.*, 2024; Amejo, 2024; Khan *et al.*, 2024; Nontu *et al.*, 2024; Belle *et al.*, 2024). A study conducted in Nigeria, for example, identified that gender, household size, geographic location, and monthly income significantly affected farmer’s resilience during COVID-19 period (Olawuyi and Ijila, 2023). Additionally, in evaluating growth performance and survivability of chicken in Nigeria, Bamidele *et al.* (2023) found that provision of improved chicken to smallholders had great potential for cushioning farmers especially in crises such as COVID-19 pandemic. Similarly, in Indonesia, factors such as age, land size, and farmer experience were found to significantly influence sustainability of chicken

farming decisions during COVID-19 period (Rondhi *et al.*, 2020).

The foregoing study was specifically done in Machakos County, Eastern Kenya where Kenya Climate Smart Agricultural Project (KCSAP) was launched in 2017 (Ogali *et al.*, 2022). The County is predominantly practicing livestock keeping with indigenous chicken meat accounting for 954 metric tonnes and eggs estimated at 191 million (County Government of Machakos, 2021). The chicken is majorly kept by smallholders operating informally within a loosely structured agricultural sub-sector. The producers—primarily residing in remote areas—predominantly market their chicken and chicken products at farm-gates, local trading centres, and district markets (Wambua *et al.*, 2023; Opondoh, 2023; Musyoka *et al.*, 2025). However, the COVID-19 pandemic shock disrupted entry to the viable markets for chicken and its products located at the peri- and urban areas in the region. Furthermore, at the community level, chicken production extension services by the livestock extension officers offered through farmers group were disrupted due to physical isolation. These were the barriers to chicken farming and exposed susceptible chicken farmers to increasing food insecurity and loss of income (Odhiambo *et al.*, 2022; Musyoka *et al.*, 2025). Therefore, the foregoing study seeks to critically assess the coping strategies and resilience of chicken farmers in Machakos County, in the context of COVID-19 pandemic, with the aim of informing policy interventions and resilience-building strategies within this vital sub-sector.

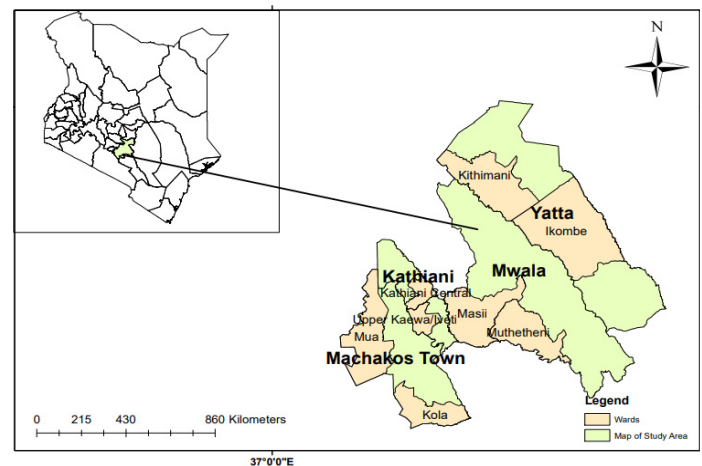


Figure 1: Map of Machakos county and the sampled wards.

MATERIALS AND METHODS

STUDY AREA

This study was carried out in Mwala, Kathiani, Yatta, and Machakos town Sub-Counties of Machakos County, located in Lower Eastern Kenya (Figure 1). The County is situated between latitudes 0°45’ and 1°31’ South and longitudes 36°45’ and 37°45’ East and has a total land area of

6,208.2 Km². The population distribution in the County is estimated at 1,421,998, with 710,707 males and 711,191 females, respectively (KNBS, 2019). The temperature varies between 18 °C and 29 °C, demonstrating a bimodal rainfall distribution with a minimum of 500 mm and maximum of 1250 mm. The primary agroecological regions of the County exhibit characteristics of arid and semi-arid regions, marked by very low to moderate levels of precipitation (Wambua *et al.*, 2023). The primary source of household income in the County is agriculture. Most farmers cultivate maize, beans, cowpeas, pigeon peas, and green grams, which are primarily termed as drought resistant for their own household consumption and source of feed for livestock. Chicken farming is the most preferred enterprise across the four Sub-Counties and dominates the livestock sector in the area due to their adaptive nature to these harsh climatic conditions experienced across the County (Musyoka *et al.*, 2025).

RESEARCH DESIGN AND SAMPLING TECHNIQUE

This study employed a cross-sectional research design through administering of the questionnaire and collecting data among chicken farming households in the selected Sub-Counties. This research design facilitated the simultaneous collection of data without altering the study context. The design eased gathering of sufficient qualitative as well as quantitative data for analysis. Prio to the main data collection exercise, the questionnaire underwent a pre-test to ascertain the reliability and validity, as well as its alignment to the research objective. The data was collected from 582 sampled chicken farmers in the Machakos County. The respondents were chosen using multi-stage sampling technique. Within Machakos County, four Sub-Counties; namely (Kathiani, Yatta, Mwala and Machakos town) were purposively selected. In the second step, two wards were randomly chosen from each Sub-County. The Wards with a higher dominance and knowledge in chicken farming were randomly selected using a list from Ward agricultural extension officers. Later, probability proportionate to size (PPS) technique was adopted to establish the number of chicken farming households to be interviewed from each Ward, thereby ensuring representative coverage across the study area (Table 1).

The smallholder farmers engaging in chicken production as per the time of survey were then randomly chosen and interviewed by trained enumerators using a semi-structured questionnaire. The semi-structured questionnaire was coded and administered via KoboCollect data collection software. Information collected was on the farm and farmers characteristics, farmers’ chicken production and operation capacity such as number of birds, chicken farm status, and the type of chicken raised; farmers’ insight on the impacts of COVID-19 pandemic shock on chicken production and farmers coping mechanisms against the pandemic. Before

the commencement of data collection, ethical approval was obtained from NACOSTI, referenced under license number NACOSTI/P/22/20050. Formal correspondence was sent to the four Sub-County Livestock Extension officers via the County Livestock Extension officers based at Machakos town Headquarters. Following the ethical board approval, the study used both verbal and written consent to allow respondents participate in the survey.

Table 1: Chicken farming households per ward sampled.

County	Sub-Counties	Wards	Number of Households	Sampled Households
Machakos	Kathiani	Kathiani central	13,812	71
		Upper Kaewa	13,192	68
	Machakos	Mua	13,992	72
		Kola	10,433	53
	Mwala	Muthetheni	11,276	58
		Masii	16,965	86
	Yatta	Kithimani	17,499	90
		Ikombe	16,372	84
Total			113,541	Sample size = 582

Source: Ministry of agriculture livestock and fisheries, Machakos county (2022).

THEORETICAL AND ANALYTICAL FRAMEWORK

This study was anchored to resilience theory to analyze the impacts of COVID-19 pandemic shock on the resilience levels of smallholder chicken farmers. Resilience theory conceptualizes resilience as a meta-capability and defines it into three stages including anticipation, adaptation and coping (Duchek, 2020). Resilience has several implications, yet they all share certain traits (Gwaka and Dubihlela, 2020). All definitions place a strong emphasis on the traits of resilience that are common to them, that is, coping, recovering, withstanding shocks, and recovering from shocks. In this study, resilience was operationally defined as the ability of chicken farming households to bounce back from the effects brought about by the commencement of the COVID-19 pandemic.

The central assumption was that households had the capacity to sustain a specific level of chicken production, income, the enterprise operations, or social life during and after COVID-19 pandemic were termed as resilient. This capacity was shaped by both the coping strategies for earning a livelihood and the capacity to deal with the pandemic. Therefore, it refers to both *ex post* activities to deal with the pandemic and *ex ante* actions intended to reduce or mitigate the impacts of COVID-19 pandemic shock. Accordingly, this study considered farmers level of resilience as the available options for earning a living and strategies deployed to ensure continuity of agricultural production and household welfare amidst the effects of shock due to

This study employed the [FAO \(2020\)](#) Resilience Index Measurement and Analysis (RIMA) approach to assess the resilience levels of chicken farming households to the effects of COVID-19 pandemic. Four resilience criteria were considered and grouped as farmer’s perception of the impact of COVID-19 pandemic on production, marketing, household income, chicken enterprise operations and social life. The responses on each statement for the criteria’s mentioned above were captured in Likert scale where each positive statement was scored as 1= Strongly Disagree (SD), 2= Disagree (D), 3= Agree (A) and 4 = Strongly Agree (SA) while it was scored inversely for the negative statements. The RIMA approach was used to obtain the descriptive statistics which included frequencies, percentages, actual mean, weighted mean and standard deviation ([Awatade and Ghosh, 2019](#)). The actual mean for each statement was compared to the weighted mean and used to make decision on the household level of resilience (high resilience or low resilience). When the actual mean was found to be higher compared to the weighted mean, it indicated high resilience to the effects of COVID-19 pandemic shock on either production, marketing, income, chicken operations activities, social life and vice versa.

To analyse the impact of COVID-19 pandemic shock on the resilience levels, Cumulative Link Mixed Models (CLMM) with a logit link were employed as outlined in the models by [Christensen \(2019\)](#) and [Miriti et al. \(2024\)](#) for the analysis. The selection of this model was guided by the ordinal characteristics of the dependent variable (resilience levels) and the clustered structure of the sampling design utilized to gather data from chicken farming households across the four Sub- Counties. The CLMM function in the R-statistical software version 4.3.3 ordinal package was used to build these models ([Christensen, 2019](#)). To identify the suitable explanatory variables to run the multivariable analysis, the univariable CLMM model was first fitted for all explanatory variables. The key variables with a p-value of ≤ 0.05 were used to run the multivariable CLMM. The Univariable model was presented in the following form:

$$P(Y \leq j) = \frac{1}{1 + e^{-(\alpha_j - \beta X)}}$$

Where, $P(Y \leq j)$ is the likelihood that the response of variable Y falls in the category of j or lower, α_j represent the threshold parameters or each category, β is the coefficient associated with the predictor X . e is the base of the natural logarithm.

The variables considered insignificant with a p-value ≥ 0.05 in the univariable CLMM model were dropped through backward stepwise selection to achieve a final minimal

CLMM that has the lowest Akaike’s Information Criteria (AIC) and includes only important variables. The key variables with a p-value ≤ 0.05 were subsequently employed to execute the multivariable CLMM. The specifications for this model are outlined as follows:

$$P(Y \leq j) = \frac{1}{1 + e^{-(\alpha_j - \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n)}}$$

Where, $P(Y \leq j)$ is the likelihood that the response of variable Y falls in the category of j or otherwise, α_j represent the threshold parameters or each category. β_1, β_2 to β_n are coefficient of the predictor variables considered. The final logit model adopted from [Christensen \(2019\)](#) was specified by the equation below:

$$\text{logit} \left(\frac{P(\leq j)}{P(> j)} \right)$$

α_j - β_1 (gender of respondent)- β_2 (age of respondent)- β_3 (education)- β_4 (household size)- β_5 (farming experience)- β_6 (household income)- β_7 (farm size)- β_8 (flock size)- β_9 (access to credit)- β_{10} (access to extension services)- β_{11} (cost of chicken feeds) - β_{12} (distance to the input market)- μ (Sub-county ID).

Table 2: Farm and farmers characteristics of the sample respondents.

Variable	Mean	Std.Dev
Gender of the respondent (0=female,1male)	0.44	0.50
Age of the respondent (number of years)	55.40	13.38
Education level (Years spent in school)	11.09	5.71
Household size (number of persons)	5.45	9.50
Farming experience (years)	19.85	10.98
Household income per month	3465.8	2842.5
Land size (hectares)	3.65	2.98
Farm size (hectares)	2.62	2.07
Flock size (numbers)	37.35	19.6
Access to credit (1=yes, 0=no)	0.33	0.45
Access to extension services (1=yes,0=no)	0.42	0.52
Cost of the feeds per month(Kenyan shillings)	1530.4	950.2
Distance to the nearest input market (Kilometers)	3.50	3.01

Source: Authors computation from survey data (2025).

RESULTS AND DISCUSSION

DESCRIPTIVE STATISTICS OF THE SAMPLED HOUSEHOLDS’ CHARACTERISTICS

[Table 2](#) shows the descriptive statistics of the sampled household characteristics within the study region. The results indicated that, 44% of the respondents were male-head-

ed chicken farmers, while the remaining 56% were female, suggesting a notable dominance of female representation in chicken farming across the study area. The average age of the respondents was 55 years with an average household size of 5 people. Most of the household head had attained 11 schooling years of formal education which is equivalent to secondary level of education. Furthermore, farmers had, on average, 20 years of chicken production with average monthly household income from chicken farming being KES 3465.8, pointing to the relatively modest earnings among smallholder producers. Furthermore, the average land holding per household was 3.65 hectares, of which approximately 2.62 hectares were utilized for agricultural activities, including chicken farming. The average flock size maintained by respondents post COVID-19 pandemic was 37 birds, reflecting small-scale, yet substantive level of production. The results further indicate that, 33% of the respondents had accessed credit which enabled them to purchase inputs such as chicken feeds and vaccines.

Additionally, about 42% of the farmers had received agricultural extension services specifically related to chicken farming. These services provided farmers with valuable information on best practices and modern technologies, such as formulating their own chicken feed to reduce costs associated with commercial feeds. This aspect was especially significant as feed prices varied in response to the economic impacts of the COVID-19 pandemic. The study further revealed that the average monthly expenditure on poultry feed among smallholder farmers stood at KES 1,530 per month. This figure underscores the financial burden feed costs imposed on household-level poultry enterprises during the crisis. Furthermore, on average it takes about 3.5 kilometers to reach the nearest input market thus, highlighting potential logistic barriers to timely procurement of essential inputs such as feeds, vaccines and other forms of supplies.

IMPACT OF COVID-19 PANDEMIC SHOCK ON CHICKEN ENTERPRISE IN KENYA

Figure 2 illustrates the extent of disruptions experienced within the chicken enterprises because of COVID-19 pandemic. The majority (75%) of the chicken farmers reported scarcity of feeds as a key challenge which affected chicken enterprise. In addition (70%) of the farmers allowed their chickens to scavenge, exposing them to predators due to scarcity and shift of the cost of chicken feeds. Furthermore 69% of respondents reported to have experienced challenges in accessing viable markets to sale their chicken and chicken products. Because of the COVID-19 pandemic shock, 66% of the farmers suffered a rise in the cost of the feeding equipment due to inflation while 57% of the smallholder households stated a rise in the cost of vaccines. Furthermore, 63% of the respondents indicated reduced

income in chicken enterprise. Alarminglly, 26% of the smallholder chicken farmers reported to have completely shut down their chicken enterprise, redirecting their effort towards alternative agricultural ventures to sustain household livelihood.



Figure 2: Challenges and disruptions caused by COVID-19 pandemic in chicken enterprise.

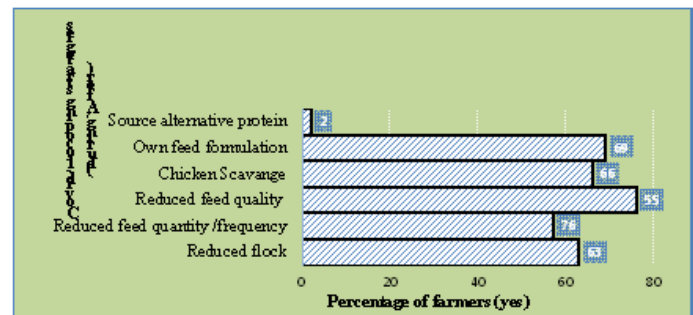


Figure 3: Smallholder chicken farmers coping strategies during COVID-19 period.

COVID-19 COPING STRATEGIES AMONG SMALLHOLDER CHICKEN FARMERS IN KENYA

The results illustrated in Figure 3 highlight the different coping strategies applied by the chicken farmers during and afterwards the COVID-19 period. A predominant strategy, reported by 76% of the farmers, involved reducing both the quantity of feeds and frequency of feeding chicken each day, while 55% reduced the quality as a coping strategy to COVID-19 pandemic shock. The findings indicated that 69% of the farmers adopted their own feed formulation practice as a coping strategy to cut the cost of commercial feeds which increased because of the COVID-19 crisis.

Notably, 66% of the farmers allowed the chicken to scavenge in a free environment because of scarcity of chicken feeds. Moreover, 63% of the smallholder chicken farmers decided to reduce their flock as coping strategy for ease of management of the enterprise using the locally available scarce resources. Furthermore, only 2% of the farmers adopted alternative protein sources to feed their chicken through either local formulation of black soldier fly or use

of white ants which were found to be cheaper and accessible compared to commercial feeds with proteins such as Omena, fish meals and soybean meal.

FARMERS’ PERCEPTION ON RESILIENCE TO COVID-19 PANDEMIC SHOCK

This section delves into smallholder chicken farmers’ self-resilience in reaction to the COVID-19 pandemic shock. It dwells on key dimensions such as production, marketing, household income, chicken enterprise operations and overall social well-being. In this study, the mean for each statement was obtained and compared with the weighted average in order to make the decision with regard to the resilience level (high resilience or low resilience). For instance, if the actual mean for the statement was higher than the weighted mean, it suggested that farmers were highly resilient and effectively adapted and recovered from COVID-19 pandemic shock. Contrary, if the actual mean for the statement was lower than the weighted average, it indicated low resilience implying that smallholder farmers were struggling to adapt and were more vulnerable to COVID-19 pandemic. The RIMA-based evaluation revealed that majority (67%) of the households perceived low resilience to COVID-19 pandemic shock, while 33% considered themselves highly resilient. These findings underscore the pressing need for targeted interventions aimed at bolstering adaptive capacities of smallholder chicken farmers.

Table 3: Farmer’s perception on the impact of COVID-19 on chicken production.

Production/Marketing	SD	D	A	SA	Mean	Std
Did your production increase during and after COVID 19	226 (38.8)	314 (54)	38 (6.5)	4 (0.7)	1.69	0.62
I was able to access quality inputs easily and cheaply	238 (40.9)	331 (56.9)	10 (1.7)	3 (0.5)	1.62	0.55
I would easily access the market to sale chicken and eggs	194 (33.3)	301 (51.7)	80 (13.7)	7 (1.2)	1.81	0.70
I was able to access the market of eggs at the premium price	243 (41.8)	304 (52.2)	32 (5.5)	3 (0.5)	1.65	0.64
I was able to access the market of chicken at the premium price	229 (39.3)	313 (53.8)	38 (6.5)	2 (0.3)	1.68	0.61

Note: N=582; SD=Strongly Disagree; D=Disagree; A=Agree and SA=Strongly Agree; The percentages are in parentheses; Decision= Weighted average (8.45/5= 1.70).

FARMER’S PERCEPTION ON THE IMPACT OF COVID-19 ON CHICKEN PRODUCTION: The findings presented in Table 3 reveal that smallholder farmers perceived low resilience in production and marketing during COVID-19 pandemic

with an average mean of 1.69, slightly below the weighted average of 1.70. This implies that most of the smallholder farmers experienced a decline in chicken production during the pandemic. The low resilience could be associated with high production costs and reduced access to essential services. In addition, the restriction of movement during the pandemic disrupted the input-output markets for agricultural products thus significantly affecting the level of production. This concurs with the results of *Ahmed et al. (2022)* who observed that COVID-19 crisis-related lockdown hindered agricultural production due to input shortages and limited market access.

With respect to chicken inputs, the results indicated low resilience to accessibility and affordability of chicken inputs among smallholder farmers with a mean of 1.62 compared to the weighted mean of 1.70. This shows that smallholder chicken farmers were faced with difficulties in accessing quality feeds probably due to input supply chains disruptions and the inflated prices. This aligns with the global reports from the *FAO (2020)*, which highlighted increased feed prices due to disrupted supply chains and import restrictions during COVID-19 period.

Distance to the market was used as a proxy for input market access. The results revealed a high resilience level in market access for chicken and eggs, evidence by a mean of 1.81 compared to a weighted mean of 1.70. This implies that smallholder farmers were able to access market despite of the disturbances due to the COVID-19 pandemic. This resilience can be attributed smallholder farmers who leveraged alternative choice of market channels probably farmgate-consumer, farm-gate broker and village market-broker, which was efficient and easily accessible. Similar adaptive strategies were observed by *Chumpanya and Panpakdee (2025)* who found that smallholder farmers adopted alternative market channels to enhanced resilience amid the supply chain disturbances arising from the COVID-19 pandemic.

Regarding market prices, smallholder farmers perceived low resilience in prices from the sale of eggs and chicken with a mean of 1.65 and 1.68 respectively compared to the weighted mean of 1.70. The plausible explanation is that smallholder farmers faced reduced bargaining power due to market saturation and disruptions to viable and high-end market channels such as district market-hotels and restaurants during the pandemic. Aligning with study conducted by *Ahmed et al. (2022)*, who detected that price volatility for agricultural produce occurred as a result of COVID-19 pandemic.

FARMER’S PERCEPTION ON THE IMPACT OF COVID-19 ON HOUSEHOLD INCOME: We illustrated the findings of chicken farmers’ perception on the impact of COVID-19

pandemic shock on household income in Table 4. The findings indicated low level of resilience to the income obtained from the sale of chicken, eggs, and manure with a mean of 1.58. This implies that smallholder chicken farmers did not experience an increase in income from the sale of chicken and chicken products. The COVID-19 pandemic disruptions resulted to fluctuation of prices for the chicken and its products thus affecting the level of income among smallholder farmers. This aligned with findings reported by Satter *et al.* (2021), where decreased earnings had been noted for smallholder poultry farmers in Bangladesh due to supply chain inefficiencies caused by the COVID-19 pandemic. The results further corroborated with the findings of Odhiambo *et al.* (2022) who found that COVID-19 pandemic resulted to decline household income in Kenya.

Table 4: Farmer’s perception on the impact of COVID-19 on household income.

Income	SD	D	A	SA	Mean	Std
I was able to increase my income from the sale of both chicken, eggs and manure	220 (37.8)	327 (56.2)	31 (5.3)	4 (0.7)	1.58	0.60
Availability of credit services was not affected	238 (40.9)	323 (55.5)	17 (2.9)	4 (0.7)	1.58	0.58
Loan repayment was not a problem	273 (46.9)	290 (49.8)	17 (2.9)	2 (0.3)	1.57	0.57

Note: N=582; SD=Strongly Disagree; D=Disagree; A=Agree and SA=Strongly Agree; the percentages are in parentheses; Decision= Weighted average (4.73/3= 1.58).

The findings further revealed that smallholder farmers’ perceived themselves to have low resilience level on access credit services with a mean of 1.58. This implies that access to credit services among smallholder farmers was affected during the pandemic. The credible explanation was that COVID-19 crisis made financial institutions tighten up their lending requirements due to economic uncertainty restricting smallholder farmers from accessing credits for agricultural production. These results concur with the findings of Kansiime *et al.* (2021) and Uyanga *et al.* (2021) who reported that reduced availability of agricultural credit and financial challenges during COVID-19 pandemic limited farmers access to credit. Furthermore, smallholder farmers perceived to have experienced low resilience level to loan repayment during and after COVID-19 pandemic with a mean of 1.57. This was attributed by reduced income and disruption of the cashflows among smallholder farmers during the period. This was consistent with the findings by Ayeni and Okunlola (2024) who found that smallholder poultry farmers in Nigeria faced challenges in repaying loans because of COVID-19 pandemic shock.

Table 5: Farmer’s perception on the impact of COVID-19

on chicken enterprise operations.

Operations	SD	D	A	SA	Mean	Std
The operational activities were not affected by physical distancing among the workers	187 (32.1)	360 (61.9)	29 (5)	6 (1)	1.75	0.59
The restriction of movement did not affect the operations of the farm	166 (28.5)	206 (35.4)	143 (24.6)	67 (11.5)	2.08	0.68
Availability of PPES did not affect the operations of the farm	175 (30.1)	229 (39.3)	135 (23.2)	43 (7.4)	2.12	0.91
Availability of labour was not affected	137 (23.5)	99 (17)	297 (51)	49 (8.4)	2.44	0.94

Note: N=582; SD=Strongly Disagree; D=Disagree; A=Agree and SA=Strongly Agree; the percentages are in parentheses; Decision= Weighted average (8.39/4= 2.10).

FARMER’S PERCEPTION ON THE IMPACT OF COVID-19

ON CHICKEN ENTERPRISE OPERATIONS: Table 5 presented the findings on smallholder farmers’ perception on the impact of COVID-19 pandemic shock on the operations of chicken enterprise. The results indicate that smallholder chicken farmers experienced low resilience level to physical distancing restriction measure on chicken operations with a mean of 1.75 compared to the weighted mean of 2.10. This implies that COVID-19 pandemic disrupted operational vulnerabilities of the smallholder chicken farmers. The results align with the observations made by Hammond *et al.* (2022), who highlighted that physical distancing measures on individuals disrupted farm operations declining production and reducing income among smallholder farmers. Smallholder farmers perceived to have experienced low level of resilience to the effect of movement restrictions on chicken operations with a mean of 2.08 compared to weighted mean of 2.10. This implies that restriction of movement regulation by the government during COVID-19 pandemic-era had a significant effect on the operations of chicken farms. Chicken farmers experienced challenges related to accessing inputs and market feasibility that affected production scale and earnings. This agrees with Kansiime *et al.* (2021), who claimed that movement restriction affected the supply chains, resulting in shortages of inputs and limiting market access.

In addition, the results also show a high resilience level to Personal Protective Equipment (PPEs) availability by smallholder chicken farmers amid the COVID-19 pandemic with an average of 2.12. This showed that smallholder farmers were in a position to access the necessary PPEs or adjust their farming practices in a way that would meet the guidelines and regulations for health (Wamwere *et al.*,

2021). In addition, the smallholder farmers also appeared to possess high degree of resilience towards availability of labor for agricultural activities during COVID-19 period. The likely reason for it was that majority of the farmers employed the family laborers during the pandemic time, which were less affected by the movement restrictions and other government rules and regulations during the time. The findings align with the conclusions drawn by Ouko *et al.* (2020) and Uyanga *et al.* (2021), indicating that small-scale farmers relied on family workers during the COVID-19 pandemic, as it was a cost-effective and sustainable resource for farming activities. Conversely, a study by Kansiime *et al.* (2021) indicated that labor shortages was a major issue for smallholder farmers, especially in areas severely impacted by the pandemic.

corroborate with Wanda *et al.* (2023), who found that governmental initiatives to mitigate the widespread of COVID-19 virus, such as physical distance and lockdowns limited leisure activities in Kenya. The findings further demonstrate a low degree of resilience in food supply among households over the COVID-19 period, with a mean score of 1.74. This resulted from the disruption of agricultural supply chains, low household income, and high food prices instigated by COVID-19 pandemic shock. These results concur with those reported by Workie *et al.* (2020) and Erokhin and Gao (2020), who illustrated that COVID-19 disrupted the primary economic activities like closures of markets for food supplies, affecting food availability and accessibility in the developing world.

Table 6: Farmer’s perception on the impact of COVID-19 on overall social well-being.

Social Life	SD	D	A	SA	Mean	Std
Leisure activities were not interfered by COVID-19	414 (71.1)	157 (27)	7 (1.2)	4 (0.7)	1.31	0.53
COVID-19 did not affect the household food availability	250 (43)	258 (44.3)	47 (8.1)	27 (4.6)	1.74	0.80
COVID-19 did not affect the household consumption	196 (33.7)	290 (49.8)	56 (9.6)	40 (6.9)	1.90	0.84
No member of the household was infected by COVID-19 pandemic	45 (7.7)	21 (3.6)	217 (37.3)	299 (51.4)	3.32	0.87
No member of the household lost their jobs due to COVID-19 pandemic	147 (25.3)	38 (6.5)	232 (39.9)	165 (28.4)	2.71	1.13
No member of the household stopped schooling due to COVID-19	239 (41.1)	12 (2.1)	262 (45)	69 (11.9)	2.28	1.12

Note: N=582; SD=Strongly Disagree; D=Disagree; A=Agree and SA=Strongly Agree; the percentages are in parentheses; Decision= Weighted average (13.26/6= 2.21).

FARMER’S PERCEPTION ON THE IMPACT OF COVID-19 ON OVERALL SOCIAL WELL-BEING: The results in Table 6 presents the findings on farmers’ perception on the impact of COVID-19 pandemic shock on social life. The results revealed a low resilience level to recreational activities among chicken farmers during the COVID-19 pandemic with a mean of 1.31 against a weighted mean of 2.21. The implication is that restrictions in movement, social interaction, and economic distress during the pandemic period limited the recreation activities. The study findings

Further, the findings indicated that smallholder farmers experienced low resilience level to food consumption status and pattern during and after COVID-19 era with a mean of 1.90. The change in food consumption habits was linked to heightened costs of basic food items, lower income, and restricted access to markets during the crisis. Workie *et al.* (2020) demonstrated that rural households reduced their food purchasing abilities and usage due to the COVID-19 pandemic. Cavallo *et al.* (2020) and Odhiambo *et al.* (2022) observed that families responded to the COVID-19 pandemic shock by reducing daily food intake and opting for less expensive food options, underscoring the economic pressure on consumption. Besides, the study reveals high resilience to the reported number of COVID-19 pandemic infections among households with a mean of 3.32. The survey data indicated that households in the study region mostly adhered to the public health measures instituted by the Ministry of Health, demonstrating significant resilience facilitated by centered communities’ health officers. Abdullahi *et al.* (2020) and Kaseje *et al.* (2024) observed that community health initiatives significantly contributed to reduced number of people infected by COVID-19 virus among rural populations.

Additionally, results identified high level of resilience to the loss of jobs among members of households during the pandemic period with a mean of 2.71. This is explained by the fact that during this period most of the smallholder farmers engaged themselves with farming activities for livelihoods and this was less affected by pandemic-induced layoffs compared to formal employment. The results align with the International Labour Organization report of 2020 that agricultural related employment opportunities in rural areas demonstrated resilience during the COVID-19 pandemic era. Furthermore, Bordi *et al.* (2021), Sitko *et al.* (2022) and Nolte *et al.* (2022) similarly found that rural households who engaged in subsistence farming were less distressed by job losses during the pandemic period.

DETERMINANTS OF RESILIENCE TO COVID-19 PANDEMIC AMONG CHICKEN FARMERS

The univariable cumulative link mixed model was used to assess the association between explanatory variables with Sub-County ID as the random effect and the dependent variable (resilience) without controlling for other variables. In cumulative linked mixed models, the interpretation is made based on the estimates and the odd ratio (OR), which indicates each variable’s probability and direction of change included in the model (Christensen, 2019; Miriti *et al.*, 2024). The univariable cumulative link mixed model results showing the impact of the COVID-19 pandemic shock on resilience amongst chicken farmers are presented in Table 7. The findings showed that factors such as the respondent’s gender, duration of education, experience with farming, household income, flock size, access to credit, and extension services increased the probability of resilience to the COVID-19 crisis among chicken farmers. Conversely, a rise in the prices of chicken feeds and distance from the input market decreased the likelihood of resilience to the COVID-19 pandemic shock among chicken farmers. This finding aligns with the results of Odhiambo *et al.* (2022) who reported that COVID-19 resulted to a decline in the purchasing power among smallholder farmer’s agri-food systems actors in Kenya.

Table 7: Univariable cumulative link mixed model (CLMM) results.

Variables	Estimate (SE)	Odd ratio (95% CI)	P-value*
Gender of the respondent	0.42 (0.12)	1.50(1.16, 2.00)	0.005 ^a
Age of the respondent	-0.02(0.01)	0.99(0.96, 1.02)	0.351
Education (years in school)	0.14 (0.05)	1.12(1.05, 1.20)	0.002 ^a
Household size	-0.06(0.03)	0.95(0.86, 1.03)	0.134
Farming experience	0.08 (0.02)	1.07(1.02, 1.14)	0.003 ^a
Household income	0.23 (0.06)	1.24(1.10, 1.35)	0.001 ^a
Farm size	0.05(0.03)	1.05(0.96, 1.15)	0.256
Flock size	0.12 (0.01)	1.14(1.07, 1.22)	0.001 ^a
Access to credit	0.58 (0.16)	1.80(1.33, 2.45)	0.001 ^a
Access to extension	0.51 (0.14)	1.67(1.22, 2.14)	0.001 ^a
Cost of chicken feeds	-0.11(0.02)	0.90(0.84, 0.96)	0.002 ^a
Distance to input market	-0.13(0.02)	0.88(0.81, 0.92)	0.001 ^a

^a P-values* indicates significant variables at P ≤ 0.05; SE is the Standard error; CI is the confidence Interval.

The estimates from the multivariable cumulative link mixed model, incorporating Sub-County ID as a random effect, are detailed in Table 8. All the variable identified insignificant (P>0.05) in Univariable model were dropped from the analysis and the Multivariate CLMM performed. The variables which were dropped at univariable analysis model include the age of the respondent, household size and farm

size. The multivariable analysis controlled for other variables and focused on the factors that remained significant level at P ≤ 0.05^b after adjusting for potential confounding factors. The multivariable CLMM revealed that years in schooling, monthly household income, flock size, access to credit, extension services, a rise in price of chicken feeds and distance to the input market had significant effects on the likelihood of resilience to the impacts of COVID-19 pandemic shock among smallholder chicken farmers.

Table 8: Multivariable cumulative link mixed model (clmm) results.

Variables	Estimate (SE)	Odd ratio (95% CI)	P-value
Gender of the respondent	0.24 (0.15)	1.30(0.94, 1.72)	0.086
Education (years in school)	0.08 (0.02)	1.07(1.02, 1.15)	0.024 ^b
Farming experience	0.06 (0.03)	1.05(0.99, 1.12)	0.082
Household income	0.19 (0.05)	1.24(1.09, 1.35)	0.002 ^a
Flock size	0.11 (0.03)	1.12(1.05, 1.18)	0.002 ^a
Access to credit	0.37(0.18)	1.45(1.03, 2.06)	0.036 ^b
Access to extension	0.33(0.14)	1.40(1.01, 1.95)	0.045 ^b
Cost of chicken feeds	-0.06(0.02)	0.92(0.87, 1.00)	0.048 ^b
Distance to input market	-0.08(0.03)	0.90(0.85, 0.99)	0.034 ^b

Note: ^a and ^b denote 1% and 5% levels of significance; SE is the Standard error; CI is the confidence Interval.

The number of years spent in school increased the likelihood of resilience to the impacts of COVID-19 pandemic crisis among chicken farmers by 7%. The plausible explanation is that more educated smallholder famers accessed information through various channels of communication and also made right decisions at the household level coping up with COVID-19 pandemic effects. This contributed to higher resilience enabling smallholder farmers to diversify their sources of income by adopting innovative farming techniques. The smalholder farmers who were more educated adopted digital platforms to connect to the buyers due to restriction of movement and market closures. Similarly, a study by Alemayehu and Bewket (2017) found education level of the respondent positively and significantly influenced the probability of farmers to cope with the climate change shocks as it facilitated better decision making and access to adaptation strategies in Ethiopia. Furthermore, Gwambene and Saria (2024), reported that smallholder farmers with higher level of education adopted various climate resilience technologies in Tanzania as a coping strategy to the effects of climate change thus increasing their level output.

A one-shilling increment in household income improved the probability of resilience to the impact of the COVID-19 pandemic shock among smallholder chicken farmers by 24%. The credible explanation is that chicken farm-

ing households who had higher level of incomes during the pandemic period had better accessibility to essential commodities such as food, health care and inputs for chicken production enabling them to coping with the adverse impacts of COVID-19 pandemic. Similarly, [Bene et al. \(2021\)](#) and [Headey et al. \(2020\)](#) emphasized that rich households managed to tolerate the challenges posed by food scarcity and economic shocks during the COVID-19 pandemic, as they could leverage economic safety nets.

An increase in flock size by one chicken improved the probability of resilience to the impacts of COVID-19 pandemic among chicken farmers by 12%. The possible explanation is that smallholder farmers with larger flock sizes improved their food security status through consistent provision of eggs and chicken meat for domestic consumption. This reduced the dependence on the external food markets that were adversely affected by the restriction of movement and overall supply chain interruption due to the COVID-19 crisis. The ability of the farmers to maintain the level of production despite the disruptions improved the level of resilience among smallholder chicken farmers with a larger flock size. Similarly, [Singh et al. \(2024\)](#) discovered that smallholder poultry producers with larger flock sizes were more likely to endure financial shocks from COVID-19 since they had a higher potential for income generation. On the contrary, [Uyanga et al. \(2021\)](#) determined that smallholder chicken farmers with large flock size were confronted with difficulties in sustaining the same level of production and incurred huge losses as they could not afford resources for quality veterinary care and access to stable markets. [Uyanga et al. \(2021\)](#) approach resilience in terms of risk of exposure of the flocks to disease infection while the current study approach resilience in terms of food security aspect.

The findings further indicated that the likelihood of accessing credit enhanced resilience level to the impact of the COVID-19 crisis by 45%. The smallholder chicken farmers who had accessed credit during the pandemic were able to sustain the chicken enterprise by purchasing the necessary inputs despite the economic disruptions. Furthermore, access to credit enabled the smallholder farmers to invest in adaptive strategies such as digital marketing and diversify income thus improving their ability to tolerate the economic constraints triggered by COVID-19 pandemic. [Quarshie et al. \(2022\)](#) found that maize farmers in SSA with access to financing appeared more inclined to adopt innovative techniques for farming and sustain production levels during the crisis.

The findings indicated that access to extension service by smallholder farmers increased the probability of resilience to the impact of COVID-19 pandemic shock by 40%. The plausible explanation is that smallholder farmers who ac-

cessed extension services during COVID-19 pandemic era were better informed about the coping strategies such as alternatives sources of feeds and marketing options. The plausible explanation is that extension services increased resilience to disruptions caused by COVID-19 pandemic by equipping the smallholder chicken famers with timely information on the best practices for maintaining chicken production despite supply chain disruptions. Similarly, [Panda et al. \(2022\)](#) found that smallholder farmers in Sub-Saharan Africa who accessed extension services during COVID-19 pandemic period were able to traverse market disruptions by adopting alternative trading strategies. In addition, [Kansiime et al. \(2021\)](#) noted that smallholder farmers in East Africa who interacted with agricultural extension officers during the pandemic period were more likely to access financial assistance, make use of digital marketing platforms, and maintain productivity.

A rise in the cost of chicken feeds by one shilling decreased the likelihood of resilience to the impacts of COVID-19 pandemic shock by 92%. The drastic reduction in the level of resilience indicated that increased cost of feeds were a major challenge which lead to declining production, financial strain and in some cases closure of the chicken enterprise. The results corroborates with the findings of [Uyanga et al. \(2021\)](#), [Attia et al. \(2022\)](#) and [Madula \(2022\)](#) who found that increased cost of essential inputs such as chicken feeds and vaccines during COVID-19 pandemic made smallholder farmers reduce the quantity and quality of feeds as a coping strategy significantly reducing the level of production.

An increment in distance to the input market by one kilometer decreased the probability of resilience to the impacts of COVID-19 pandemic crisis by 90%. The plausible explanation is that, during this period, chicken farming households located further from the input markets experienced challenges in acquiring essential inputs for chicken farming such as chicken feeds and veterinary drugs. This resulted due to restriction of movement making it serious challenge among smallholder farmers located in rural areas to access essential chicken production inputs thus reducing their level of resilience. Similarly, [Uyanga et al. \(2021\)](#) and [Odhiambo et al. \(2022\)](#) found that smallholder farmers experienced significant disruption in accessing inputs for farming during the COVID-19 crisis period due to the input markets closure that made those in remote areas more vulnerable.

CONCLUSION AND RECOMMENDATIONS

The study assessed the impact of COVID-19 pandemic on the resilience levels of smalholder chicken households

in Machakos County. The findings revealed that significant challenges were encountered including, feed shortage (75%), increased exposure of chicken to predators due to scavenging (70%), limited market access (69%) and reduced household income (63%). In response to these challenges, smallholder farmers predominantly adopted self-initiated coping strategies. Majority of the farmers stated to have reduced the quantity of the feeds (76%), own chicken feed formulation (69%), chicken scavenging (66%) and reduced flock (63%). The RIMA-based assessment revealed that the majority (67%) of the households perceived themselves as having low resilience to COVID-19 pandemic shock, while 33% considered themselves highly resilient.

Further analysis using the Multivariable Cumulative Link Mixed Model (CLMM) identified that higher education level, increased household income, larger flock sizes, access to credit, and availability of extension access significantly increased the likelihood of farmers withstanding the COVID-19 shock. Conversely, the increased feed costs and greater distance to the input markets decreased resilience to COVID-19 shock. In light of these findings, the National and County governments, in collaboration with stakeholders, should initiate accessible sources of credit and establish mobile input vendor linkages that are gender disaggregated to enhance chicken production. Furthermore, the Ministry of Agriculture should create awareness on pandemic coping mechanisms through enhanced extension services, targeting smallholder farmers who depend on chicken for income generation, leveraging educated to help disseminate and decode the information. The study also underscored the need for targeted government and institutional actions to improve the adaptive capacity of farmers in the face of future disruptions.

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NOVELTY STATEMENT

There is a notable gap on the coping strategies, mitigation measures, and determinants of resilience among smallholder chicken farmers in Kenya in the wake of the COVID 19 crisis. This study bridges that gap by integrating socio-economic, institutional and behavioral factors to quantify and

assess resilience levels within this demographic. The study also employs robust and rigorous econometric modelling technique and provides empirical insights influencing smallholder farmers' adaptive capacities. By focusing on chicken farming, which is a vital enterprise for food security and rural livelihoods, the findings provide targeted policy recommendations to enhance resilience against future economic shocks, making this research highly relevant for policy makers and stakeholders.

AUTHOR'S CONTRIBUTIONS

John K. Musyoka: Conceptualized the study, compiled the data, analyzed the data and wrote the draft manuscript.

Wilckyster Nyarindo: Writing- review and editing, supervision, methodology, formal analysis.

Robyn Alders: Reviewing and editing, supervision.

Hezron Isaboke: Writing- review and editing, supervision, methodology, investigation. All authors have read and agreed to publish the version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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