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# An Evaluation of Performance of Indigenous Chicken and Irish Potato Value Chains by Smallholder Farmers under Kopia Project in Meru County, Kenya

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***Abstract:***
*Adequate, nutritious and safe food is a basic human need. A bilateral project on food security was implemented in Meru County with support from the Republic of South Korea and the County government of Meru between January 2020 and December 2022. The ordinary two-year handover period is ending in December 2024. Its objective was to improve the performance of indigenous chicken and Irish potato value chains among smallholder producers. Despite the existence of high demand for both Indigenous chicken and Irish potatoes, market supply remains low. A stratified sampling method was used to identify 4 Indigenous chickens, Ng'onyi, Mbaria, Ntalami, and Kangeta, and 2 Irish potatoes, Katheri and Murungurune villages, to serve as models. Two hundred practising farmers were selected from each village. All the farmers identified inadequate knowledge, poor genetic materials (Indigenous chicken and Irish potato), high disease incidences, and poorly developed market structures as the main challenges they faced. A training hall was constructed in each of the six model villages and equipped with a computer, a printer, and a monitor. Each chicken-keeping village had a hatchery unit, and those growing potatoes had a potato storage unit constructed and equipped. Egg incubators and Hatchers were provided to the Indigenous chicken-keeping villages. A motorcycle to assist lead-farmer movement was provided to each model village. A curriculum with 22 areas and another one with 20 units were developed to train the Indigenous chicken keepers and Irish potato farmers, respectively. Each curriculum included both technical and non-technical aspects. A total of 73, 837 day old Improved Indigenous chicks were equitably supplied to all the four model villages, with 41600 day old chicks procured from Kenya agriculture, livestock research organization (KALRO) and 32237 locally hatched. A total of 51 tonnes of assorted clean-seed potatoes were procured and supplied to the farmers. The total annual revenue from eggs (tray) rose from Ksh15583.3 before intervention to Ksh133588.7 after intervention. The quantity of eggs sold in trays increased from 54.4 to 193.7, while those sold in pieces increased from 482 to 969. The number of hens sold increased from 17 to 29, and that of cocks sold doubled from 15 to 30. However, all the variable cost components increased during the intervention period. Broilers Mash witnessed the biggest increase in cost by 217.6% from Ksh 1358.9 before intervention to Ksh 2956.5. Despite a rise in the total variable cost by 213%, the average annual gross margin rose from Ksh.7092 to Ksh 91523. The Irish potato farmers had an increase of 192 % in weight (Kg/acre) of total tubers, with production rising from 8711 to 16711 Kg. The potato farmers had a 75.4% increase in household incomes, and their gross margins increased by 76.9 %. The potato farm gate prices increased by 28.57%. After interventions, the potato farmer's gross margin recorded an increase from Ksh. 9 566.5 to 16927.4, translating to a 77% increase. The average total seasonal production increased from 1,394.5 Kg to 2,120.5 Kg. The revenue received from potatoes per season increased from Ksh.46855.2. to Ksh.91605.6 per season. The increase in revenue was a result of the increase in the quantity produced and the price per kg. From the results above, it can be concluded that the implementation of the Indigenous chicken and Irish potato value chains project helped to improve production and household incomes. It is recommended that policy-makers adopt this model village approach in all the agricultural-based value chains.*

***Keywords:*** *Performance, evaluation, indigenous chicken, Irish potato, production, village*

## 1. Introduction

A project on the improvement of the performance of indigenous chicken and Irish potato value chains among small-scale producers in Meru County was initiated in January 2020. It was a partnership between the government of the Republic of South Korea and the County government of Meru. The two value chains were selected because of their potential to contribute to food security. About 90 per cent of Meru County households keep chickens for food and income.

Despite the great desire to keep and consume indigenous chicken and eggs, the quantity supplied has increasingly failed to meet the local demand. This negative scenario has been precipitated by the many faced challenges. The main challenges faced include poor genetic material (breeds), low-quality feeds, and high mortality due to diseases. These findings were consistent with those of Musharaf (1990), who reported that in many sub-Saharan African countries, indigenous chickens are characterized by low productivity due to poor nutrition, prevalence of disease and lack of sound management. This project sought to mitigate the challenges of breed quality, nutrition, health, farmer knowledge and marketing.

Irish potato farmers face similar challenges to those faced by indigenous chicken keepers. Demand for Meru-grown potatoes in Kenya is high and remains unmet. The challenges facing Irish potato farmers include low farmer knowledge, lack of certified seed potatoes, high disease incidences and inadequate storage facilities. According to Kwambai *et al., in* 2023, most farmers produced potatoes under sub-optimal management, resulting in low yields despite the introduction of improved varieties. They found that the four most important constraints limiting optimal potato production were lack of quality seed, diseases (specifically late blight and bacterial wilt), poor marketing and lack of adequate technical knowledge on potato management. This project sought to address the challenges faced by facilitating farmers' training, supplying high-grade potato varieties and constructing seed potato storage units at the village centres.

## 2. Methodology

### *2.1. The Project's Field Activities*

#### 2.1.1. Project Area

Meru County lies on the Eastern side of Kenya's Central highlands at $0^{o}$, 38 $00^{o}$ E and covers 6936.4 $Km^2$. Six model villages were identified based on three key aspects: what the farmers were already practising (farming), geopolitical locations and climatic conditions. Figure 1 shows the locations of the project villages. Meru County is occupied by three sub-tribes. They occupy three regions (Igembe, Tigania and Imenti), while an extra sub-region is cosmopolitan (Buuri).

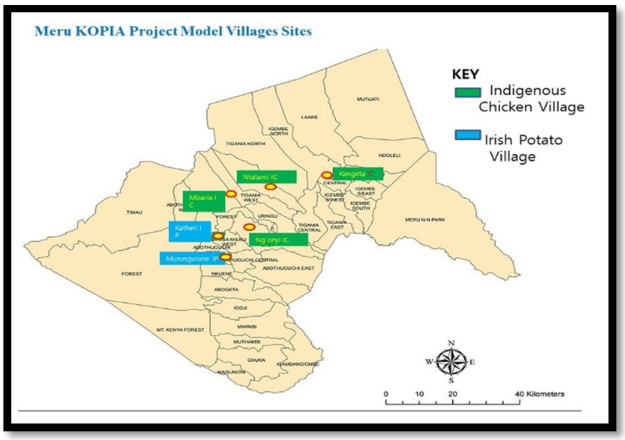


*Figure 1: A Map Indicating the Location of the Project Villages*

All the identified model villages were supported on the value chain that they were already undertaking. Table 1 indicates the names of the identified model villages, county regions and value chains.

| Model Village | Region | Climatic Condition | Value Chain |
|---|---|---|---|
| Kangeta | Igembe | Warm Lowland | Indigenous chicken |
| Ntalami | Tigania | Warm Lowland | Indigenous chicken |
| Ng'onyi | Imenti | Warm Lowland | Indigenous chicken |
| Mbaria | Buuri (Cosmopolitan) | Warm Lowland | Indigenous chicken |
| Katheri | Imenti | Cold highland | Irish potato |
| Murungurune | Imenti | Cold highland | Irish potato |

*Table 1: The Identified Model Village, Region, Climatic Condition and Value Chain*

#### 2.1.2. Initial Model Village Activities

Key opinion leaders at both the county and regional levels (stratified approach) were purposively selected to identify the most appropriate villages. The criteria given for choice included:

- If farmers were involved in the value chain activities (indigenous chicken or potato production),
- Level of performance (low), and
- Model village accessibility by road (the easier, the better).

After identification, the leaders (from the local community, church, retired civil servants living in the village and government administrators) delineated the model village boundary. The local government administrators, in conjunction with the county government agricultural officers, called for a meeting of farmers involved in the value chain within the

model village. Two hundred households involved in the value chain (keeping indigenous chicken or growing Irish potatoes) were identified and registered in each village. The second meeting involved only the identified 200 farmers, and they were assisted in generating the challenges and existing opportunities they faced. The challenges faced formed the basis for the interventions.

2.1.3 Other Activities in the Model Villages

A curriculum to guide the training of the Indigenous chicken and Irish potato farmers was developed (independently). Training materials were developed from various sources. They were mainly used to train Mbiuni Indigenous chicken model village farmers in Machakos County, Kenya. In the case of indigenous chicken farmers, the trainers focused on breeds and breeding, health, feeding, housing, rearing of day-old chicks, egg incubation and hatching, leadership, and marketing. The Irish potato farmers were trained on sources of clean seed potatoes, land preparation, fertilizer use, planting, disease control, harvesting, storage, leadership and marketing. The two sets of farmers (Indigenous chicken and potato) were trained in group dynamics, farming as a business and group marketing. Lead farmers from each of the villages were facilitated to travel to the Republic of South Korea for further learning. They also visited other older model villages, such as Mbiuni in Machakos County and Karai in Kiambu County in Kenya. Additionally, they visited successful farmers in Siaya and Vihiga Counties to learn about group production and marketing. The Indigenous chicken farmers also visited Kenya Agriculture and Livestock Research Organization (KALRO), which is the main source of breeding eggs and day-old chicks; they were trained at KALRO on incubation and hatching. The Indigenous potato farmers visited KALRO Tigoni and KALRO Molo centres to learn about clean seed potato production.

A training hall was constructed in each village. In each of these six halls, 100 seats, a computer, a printer and a monitor were supplied. Each model village got a new motorcycle, too. A hatchery unit for each of the indigenous chicken villages was constructed and was issued with a 1050-egg capacity incubator and a hatcher. A power backup generator was donated to each of the four villages. Concurrently, each Irish potato model village had a cold storage unit constructed.

With the emergence of COVID-19 and a long drought over the project period, a need to prop up production and diversify streams of income was hatched. In each of the three Indigenous chicken-keeping villages (Mbaria, Ntalami and Kangeta), water boreholes were sunk, equipped and solarised. Ng'onyi village, which had accessible piped water, was supplied with a 10,000 litre water tank. Water accessibility was improved, and members got an extra source of income by selling water and growing tree seedlings. Five farmers from all the model villages were trained as trainers on how to use locally available materials to make energy-saving Jikos. Additionally, the other three members from each model village were trained on how to make apparel for their own use and sale.

*2.2. Data Collection*

Data were collected in September/October 2022, and the focus was to compare the treatment group (before and after the situation) and control households. All the participating farmers in the 6 model villages were included in the sample selection. Households were randomly selected from the ones who were still actively involved in KOPIA project activities. A group of non-participating farmers from the same villages were also sampled, as shown in table 2.

| Village | Target Population | Sample Size | Control Group |
|---|---|---|---|
| Potato model villages | 200 | 132 | 75 |
| Poultry model village | 400 | 150 | 86 |

*Table 2: Sample Selection*

A household was considered as treated if it was selected by the programme to be a beneficiary for support. The treated households were recruited in 2019, and the activities started in 2020. The control households belong to the same villages but have not participated in the KOPIA project activities. Detailed information was collected from both the treatment and control households. 2 focus groups using semi-structured protocols with 9 farmers each from 2 groups (Mbaria and Murungurune) were carried out. Since baseline data were inadequate, the recall method was used on treated farmers to collect data before the project. An analysis of project spillover effects was not presented in this paper. Qualitative data collected during the FGD allowed the researchers to explore and understand the experiences, opinions, and perspectives of the beneficiaries in greater depth.

Data collection occurred over a period of 2 weeks between September and October 2022. Personal communication with staff directly involved in the project at Meru County aimed at clarifying the uptake and coordination of the program at the farmer level. The qualitative methods were to augment the quantitative survey to capture the factors that could influence the project's impact.

## 3. Results and Discussion

*3.1. Indigenous Chicken Value Chain*

3.1.1. Training

The 200 farmers in each village were divided into four clusters to ease training. Each of the 16 clusters was trained 22 times (sessions). The training was in both theory and demonstration. There were 14 technical areas, such as breeding and nutrition, and 8 non-technical areas, such as marketing, group dynamics and leadership. In total, more than the

targeted 352 sessions were held because some sessions were repeated. Table 3 presents the achievements of training carried out.

| Year | Focus Area | Targeted No. of Training/Demos | Achieved | Remarks |
|---|---|---|---|---|
| 2020 | Technical skills | 336 | 322 | Meetings were reduced during the COVID-19 period |
| | Non-technical skills | 96 | 65 | |
| 2021 | Technical skills | 144 | 156 | |
| | Non-technical skills | 96 | 78 | |
| | Staff and Farmers | 10 | 10 | At KALRO, Naivasha on Hatchery management, incubation to hatching |
| 2022 | Technical skills | 80 | 96 | |
| | Non-technical skills | 32 | 32 | |
| 2023 | Non-technical skills | 60 | | Training was held at the cluster, village and county level. The farmers were sensitized to the need to produce and market as a group. The officials were trained together as value chain apex organization management. The areas of training included sourcing for the product market, resource mobilization and scheduled production. |

*Table 3: Training Areas, Targeted Number of Training Sessions and Performance*

3.1.2. Sourcing of Improved Indigenous Breed (Chicks)

A total of 73,837-day-old improved indigenous chicks were equitably supplied to all four model villages. 41600-day-old chicks were procured from KALRO, while 32237 were locally hatched. Chicks procured from KALRO were procured mainly for farmer training, disease control theory and demonstrations, feeding and caring for a day-old. The mortality of the procured chicks was below 10 per cent. Table 4 presents the number of chicks procured and those hatched over time.

| Year | Number Procured Day Old Chicks | Number of Eggs Incubated | Number Hatched | Remarks |
|---|---|---|---|---|
| 2020 | 11000 | 0 | 0 | No hatchery/Incubator |
| 2021 | 14600 | 1000 (414 hatched) | 414 | Continued training and consultations carried out |
| 2022 | 16000 | 24000 | 19732 | 22718 were fertile |
| 2023 | 0 | 20770 | 12091 | 18720 eggs were fertile |

*Table 4: The number of High-Grade Chicks Available to the Beneficiaries*

3.1.3. Number of Chickens per Household and Economic Status

A study was carried out in the project area at the beginning of the project period (June 2020) and provided the information presented in table 5. These findings are similar to those obtained by Tarwireyi and Fanadzo (2023) in a study in KwaZulu-Natal, South Africa.

| Item Description | Mean (N=90) | Standard Deviation and Range |
|---|---|---|
| The number of chickens kept | 16.38 | 20.48 (158[a]) |
| Land size owned (acres) | 1.33 | 1.36 (6.99) |
| Number of chickens owned last year | 19.67 | 25.28 (150) |
| Price of live chicken (Ksh.) | 679.67 | 201.22 (1000) |
| Number of eggs laid per laying period | 14.36 | 3.43 (25) |
| Number of eggs consumed at home last year | 275.72 | 363.73 (2800) |
| Number of eggs sold last year | 225.14 | 443.99 (2520) |
| Price per egg (Ksh.) | 15.17 | 2.54 (10) |
| Number of chickens sold last year | 17.07 | 14.92 (123) |

| | | |
|---|---|---|
| Marital status of Household head (1=Youth, 2=Single parent and 3=Married) | 2.79 (Married=85.6%, Singles=7.8%, Youth=6.7%) | 0.55 (2) |
| Age of farmer (years) (1=18-25; 2=36-45; 3=46-65; 4=over 65 years of age) | 2.27 (Youth=24.4%; 36-45 years =30%; 46-65 years=40%; Over 65 years=5.6%) | 0.90 (3) |
| Education level attained by the farmer (1=No formal education; 2=primary level; 3=secondary school level; 4=Tertiary level and 5=University level of education) | 2.56 (Informal=8.9%; Primary=53.3%; Secondary=24.4%; Tertiary=10%; University=3.3%) | 0.91 (4) |
| Household size (ranged between 1 and 8 persons) | 4.46 (75% were between 3 & 6 No.) | 1.68 (7) |

*Table 5: A Summary of Descriptive Statistics of Relevant Variables.*
*The Range in Parenthesis*
*Source: Mugambi (2020) Survey*

3.1.4. Poultry Gross Margins

Another study to assess the performance of the project after the interventions was carried out in October 2023. The gross revenue included the value of eggs sold either in pieces or trays, as well as the value of chicken sold as hens or cocks during the year. Results indicate that the total value of eggs and chicken sold increased during the intervention period, as shown in table 6.

| | | **Before** | **After** |
|---|---|---|---|
| Revenue | Eggs (sold in trays) | 15583.3 | 133588.7 |
| | Eggs (sold per piece) | 5112.7 | 15645.2 |
| | Hens | 7530.9 | 15855.9 |
| | Cocks | 10626.3 | 25937.8 |
| | Total revenue | 38853.25 | 191027.5 |
| Variable costs | Day old chicks | 645 | 4880.2 |
| | Month old chick | 1512.3 | 2282.7 |
| | Chick Marsh | 3057.6 | 12649 |
| | Layers Marsh | 5077.1 | 13238.1 |
| | Broilers Marsh | 358.9 | 2956.5 |
| | Growers Marsh | 3953.4 | 9738.5 |
| | Own feed formulation | 1610.4 | 4685 |
| | Labour costs | 13840.7 | 45484.4 |
| | Other costs | 1706.2 | 3589.4 |
| Total Variable costs | | 31760.5 | 99503.6 |
| Gross margin | | 7092.8 | 91523.9 |

*Table 6: Average Annual Gross Margin for Indigenous Chicken*

From the results, farmers directly felt the positive effect of the chicken production interventions after a short period of only three years. The total annual revenue from eggs (tray) rose from Ksh15583.3 before intervention to Ksh133588.7 after intervention (a 757% increase). The quantity of eggs sold in trays increased from 54.4 to 193.7, while those sold in pieces increased from 482 to 969. The number of hens sold increased from 17 to 29, while that of cocks sold doubled from 15 to 30. All the variable cost components increased during the intervention period. Broilers Mash witnessed the biggest increase in cost by 217.6% from Ksh 1358.9 before intervention to Ksh 2956.5. Despite a rise in the total variable cost by 213%, the average annual gross margin rose from Ksh.7092 to Ksh 91523, representing an 1190% increase. These findings correspond well with those of Muchadeyi *et al.* (2005), in a study on the village chicken flock dynamics and the contribution of chickens to household livelihoods in a smallholder farming area in Zimbabwe.

3.1.5. County Indigenous Chicken and Eggs Aggregation Centre

Officials from all the four (4) model villages elected nine persons from amongst their officials to form an apex organization to manage their post-project period affairs. The county of Meru donated a facility at Ng'onyi to serve as its

operational headquarters and marketing centre. The new apex organization was meant to serve all the indigenous chicken farmers in the county. Apex organization leaders were expected to coordinate the supply of desired chickens from various administrative wards in the county in a scheduled manner. This idea of a scheduled supply of improved indigenous chicken to a central physical centre has attracted other countries. Many of them have sent their officials and farmers to come to learn about the model village approach and centralized marketing by small-scale producers.

*3.2. Potato Value Chain*

Potato (*Solanum tuberosum* L.) is the most important non-cereal crop in the world (Struik & Wiersema, 1999). In Kenya, potato is the second most important food crop after maize and is highly commercialized across its value chain. Potato production in Meru County is lower than existing potential despite its high demand.

3.2.1. Potato Farmers Training

Training was carried out in clusters of about 50 members after the 200 members per model village were divided into four. The training curriculum consisted of 20 different areas, covering 12 technical and 8 non-technical sections. The technical areas included types of clean potato seed varieties, sources, land preparation, fertilizer use, irrigation, potato disease control, harvesting, sorting and grading. The training was in both theory and farm demonstrations. They were taught non-potato production areas such as group leadership, book-keeping, group dynamics, general aspects of farming as a business and marketing. The training sessions were set at 172 but exceeded 200 because many sections were repeated, especially for demonstrations at the farm level. Table 7 presents the general areas of training over the project period. Other training needs arose over the project period and were incorporated.

| Year | Targeted Number | Number of Trainings Held | Remarks |
|---|---|---|---|
| 2020 | 102 Technical | 81 | Emergence of COVID-19 affected farmer gatherings |
| | 48 Non-technical | 60 | |
| 2021 | 72 Technical | 78 | Some sessions were covered by new collaborators, such as agrochemical suppliers. |
| | 36 Non-technical | 42 | Cooperative officers were incorporated into the group of trainers to ensure post-project sustainability |
| 2022 | 88 Technical | 88 | |
| | 32 Non-technical | 40 | |

*Table 7: Number of Training Held to the Irish Potato Farmers*

3.2.2. Sourcing and Supply of Clean Seed Potatoes

A total of 47.8 tonnes of assorted clean seed potatoes were budgeted, but 51 tonnes were procured and supplied to the farmers. Table 8 presents the quantities supplied over the project period.

| Year | Quantity Targeted (Kg) | Quantity (Kg) Procured | Remarks |
|---|---|---|---|
| 2020 | 10000 | 10000 | There was, however, a great challenge of clean seed potato supply, leading to a change of varieties procured and sourced. |
| 2021 | 17800 | 17800 | |
| 2022 | 20000 | 23200 | |

*Table 8: Quantities of Procured Clean Seed Potatoes*

The following are the results (Tables 9 and 10) of a study carried out on the performance of Irish potato seed in the two model villages over the months of March and April 2021.

| Activity | Target | Achieved | % Change |
|---|---|---|---|
| Weight of total tubers | 8 711 | 16711 | 192 |

*Table 9: Summary of Achievements Made by Irish Potato Farmers*

| Parameter | Project Farmer Practice | Other Farmer Practice |
|---|---|---|
| Weight of total tubers (Kg/Acre) | 16 711 | 8711 |
| Weight of Ware sized tubers (Kg/Acre) | 6 400 | 3 556 |
| Weight of seed-sized tubers (Kg/Acre) | 9 067 | 3 556 |

*Table 10: Yield in Kg per Acre: Project (KOPIA) Vs Normal Farmers' Practice (Katheri and Murungurune)*

The project farmers attained results that were three times higher than those not covered by the project. Low yields realized by farmers not under the project were mainly influenced by poor farmer practices in the use of seed, fertilizers, pesticides and crop rotation. This was compounded by farmers' perceptions of input quantities applied, frequencies and farmers' access to agricultural extension information on potatoes, which heavily relied on family members and neighbouring farmers (Kwambai *et al.,* 2023).

In a study carried out in October 2021, twenty (20) model villages (project beneficiaries) and 10 non-member farmers from each of the 2 Irish Potato model villages were randomly sampled. The main objective of the study was to assess the change in household incomes over the covered project period. The results were as indicated in table 11.

| Year | | Weight (Kg/Acre) | Net Income (Ksh) | Net Income Ratio |
|---|---|---|---|---|
| 2020 | Model village (A) | 6,528 | 82,956 | 51 |
| | Non-member (B) | 4,564 | 43,836 | 55 |
| 2021 | Model village (A) | 8,765 | 145,545 | 66 |
| | Non-member (B) | 4,859 | 54,690 | 62 |
| Change from year 2020 to 2021 | Model village (A) | 34.3% | 75.4% | 29.4% |
| | Non-member (B) | 6.5% | 24.8% | 12.7% |

*Table 11: The Weight, Net Income and Net Income Ratio among the Project and Non-Project Farmers over the 2020-2021 Project Period*
*Note: A = Average of the 40 Farmers from 2 Model Village Groups*
*B = Average of the 20 Farmers from 2 Non-Member Farmers*

This 75.4% increase in household incomes in the second year of implementation surpassed the project target of 30 % in the technical cooperation project (TCP) document. It was, however, noted that the Potato price rose marginally by 0.8% from average Ksh. 25.0 in year 2020 to Ksh.25.2 in 2021

Another study was carried out on the impact of the project (KOPIA) in Meru County between August and November 2022. It indicated that the potato gross margins increased by 76.9 % during the project intervention period. The farm gate prices also increased by 28.57%. Table 12 provides the comparison of annual gross margins for potatoes per person before and after project intervention.

| Item | Before Intervention | After Intervention |
|---|---|---|
| Quantity produced (Kg) | 1394.5 | 2120.5 |
| Price (Ks/Kg) | 33.6 | 43.2 |
| Total revenue (Ksh) | 46855.2 | 91605.6 |
| Total Variable costs (Ksh) | 37288.7 | 74678.2 |
| Gross Margin | 9566.5 | 16927.4 |

*Table 12: Average Annual Gross Margin for Potatoes per Season (In Ksh) before and after KOPIA Project Intervention*

After the intervention, the gross margin recorded an increase from Ksh 9 566.5 to 16927.4, which translates to a 77% increase in income for farmers.

The average total seasonal production increased from 1,394.5 Kg (3984.3 Kg/ha) to 2,120.5 Kg (6236.8 Kg/ha). The revenue received from potatoes per season increased from Ksh.46855.2. to Ksh.91605.6 per season. The increase in revenue was a result of the increase in the quantity produced and the price per Kg.

3.2.3. Borrowing of Model Village Extension Model by Other Agricultural Programs in Both Meru and Other Counties

The observable success of the Korean village extension model led the county leadership to direct all the other programs supporting Indigenous chicken production to align with the new approach. Joint leadership and general management by value chain-specific small-scale farmers can motivate members to generate other additional projects, such as the sale of borehole water and its use in coming up with commercial tree nurseries. The farmers get opportunities to learn and undertake other economic activities such as making and use of energy-saving Jikos. Many counties, such as Embu, Trans Nzoia and Isiolo, visited Meru County to learn about the village extension model. The salient areas of the village model include the focus of resources on a specific value chain, the formation of a countywide value chain farmers' apex organization and the scheduling of production and marketing.

**4. Conclusions and Recommendations**

The objective of improving the performance of both the Indigenous chicken and Irish potato value chains in Meru County was achieved. The challenges faced by the farmers were addressed through various approaches. Indigenous chicken farmers benefited in many ways. Facilities for training were constructed and equipped. Egg incubators and Hatchers were provided. They were intensively trained through theory and demonstrations (352 sessions). A total of 73,

837 day-old improved indigenous chicks were supplied. 41,600 day-old chicks were procured from KALRO, while 32,237 were locally hatched. A motorcycle to assist farmer movement was provided to each of the model villages. Farmers felt the positive effect of chicken production-focused interventions after only three years. The total annual revenue from eggs per tray rose from Ksh. 15583.3 before intervention to Ksh. 133588.7 after intervention (a 757% increase). The quantity of eggs sold in trays increased from 54.4 to 193.7, while those sold in pieces increased from 482 to 969. The number of hens sold increased from 17 to 29, while that of cocks sold doubled from 15 to 30. However, all the variable cost components increased during the intervention period. Broilers Mash witnessed the biggest increase in cost by 217.6% from Ksh 1358.9 before intervention to Ksh 2956.5. Despite a rise in the total variable cost by 213%, the average annual gross margin rose from Ksh.7092 to Ksh 91523, representing an 1190% increase.

*4.1. Potato Farmers*

Each model village had a training hall and a potato storage unit constructed and equipped. Farmers were trained in various technical and non-technical areas to ensure performance improvement. They were taught in non-potato production areas such as group leadership, book-keeping, group dynamics, general aspects of farming as a business and marketing. A total of 51 tonnes of assorted clean-seed potatoes were supplied. One study after one year of project implementation showed that farmers found an increase of 192% in the weight (Kg/acre) of total tubers. Production rose from 8711 to 16711 Kg. A second study after two years showed a 75.4% increase in household incomes, surpassing the project target of 30 % in the technical cooperation project (TCP) document. A study on the impact of the project was carried out at the end of the official project period, indicating that the potato gross margins increased by 76.9 %. The farm gate prices also increased by 28.57%. After the intervention, the gross margin recorded an increase from Ksh. 9 566.5 to 16927.4, translating to a 77% increase in income for farmers. The average total seasonal production increased from 1,394.5 Kg to 2,120.5 Kg. The revenue received from potatoes per season increased from Ksh.46855.2. to Ksh.91605.6 per season. The increase in revenue was a result of the increase in the quantity produced and the price per kg. The observable success of the Korean village extension model led the county leadership to direct all the other programs supporting Indigenous chicken production to align with the new approach. Many counties, such as Embu, Trans Nzoia and Isiolo, visited Meru County to learn about the village extension model. The focus of resources on a specific value chain, the formation of a countywide value chain farmers' apex organization and the scheduling of production and marketing remain a key area of the village model approach. It is recommended that policy-makers consider this village model approach in all agricultural-based value chains. Improving the value chain apex bodies to savings and cooperative organizations and constant government supervision could improve the performance of the agricultural sector.

## 5. Acknowledgement

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