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Analysis of Factors Influencing farmers Adoption of Improved Rabbit Production Technologies: a Case of Nyamira County, Kenya

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Abstract: *The study established farmer, social and institutional characteristics influencing the adoption of rabbit production technologies, the level of awareness and extent of adoption of rabbit production technologies and finally to determine the profitability of rabbit production in Nyamira County, Kenya. A total of 154 small scale rabbit farmers were chosen using a multistage sampling to cover Nyamira County. Data was collected using a semi structured questionnaire administered by trained research assistant and analysis done using descriptive statistics, gross margin and multiple regression analyses. Result showed that awareness of improved rabbit production technologies among rabbit farmers was high (76.6 percent) and 60 percent of the respondents adopted the new production technologies. A low adoption rate of 42.9 percent was reported. Housing technologies (37 percent) and disease control technologies (62 percent) were the most adopted technologies by farmers. On the other hand, majority of the farmers (75 percent) adopted low levels of feed supplementation. Major constraints included; unskilled personnel, limited farmers involvement and lack of adequate communication between farmers and extension officers. Multiple regressions showed that age of farmers, level of education, experience and level of awareness were the main determinants of adoption. In a descending order, dairy, rabbit, bean, tea and maize enterprises are profitable enterprises for the farmers. Because rabbit farming is profitable in the face of improved rabbit production technologies, farmers are advised to adopt all the recommended technologies because it is profitable. In particular, new housing technologies, feed supplementation, disease control technologies and breeding technologies are highly recommended for rabbit farmers.*

Key Terms: *Gross margin, Improved rabbit production, technologyNet margin Profitability, Small scale farmer*

I. Background Information

Introduction

Globally, more than 857 million rabbits estimated at 1.1 million tons of meat are produced annually. Major rabbit producers include: France, Italy, Spain in Europe and China in Asia.Europe and Asia accounts for 76% and 14%respectively of the total rabbit meat produced in the world (United Poultry Concerns, 2004). The nature of rabbit industry in most European countries iscommercialized, with rabbits under intensive farming conditions using specialized sheds. However, there still exist significant levels of traditional production methods in Spain.

In sub-Saharan Africa, it is believed that rabbits were first introduced by early European colonists and or European and American missionaries over 100 years ago (Lukefahr and Cheeke, 1991; Lukefahr, 2000). In most instances, small family rabbitries of four or less does and overdependence on local resources for housing, feeding and healthcare are the norm. As a result, the local meat production has not kept pace with the population growth. Statistics indicates that on average, 10g of animal protein is consumed per day compared to 35g recommended daily intake. As a consequence, Africa imports 30 to 40 tons of fresh airfreighted rabbit meat from Europe to meet its increasing demands(FAO, 1986).

Nevertheless, rabbit farming has several benefits; they have excellent reproductive potential all year round, faster growth rate, low grain and high roughage diets utilization and therefore can be produced from locally available forages and feed materials common in the tropics. Adukuand Olukosi (1990) noted that rabbits are highly adaptable animals, easy to manage with high growth rate, prolificacy and fecundity levels. In addition, the rabbits can also be kept for fur and as pets. Rabbit enterprise has excellent return to investment with high quality meat products. Moreover, they can be used in laboratory experiments and with high soil enriching manure. Also, rabbit meat is cheap in terms of production compared to beef, chicken and frozen fish.

In addition, it does not require refrigeration as it is supplied in pieces suitable for family needs or small parties thus saves household power cost (Ajala, 1989); (Aduku and Olukosi, 1990).

Statement of the problem

Nyamira County has a total population of 598,252 (urban 83,756; rural 514,496) people who mainly depend on agriculture (Bananas, dairy farming, Tea) for a livelihood. Approximately 46.6%of its population is classified as poor small scale famers.Due to cultural traditions of land sub-division, the land holding has reduced to below 1.5 acres. As a result of these pressures, households have discarded agricultural activities requiring large tracks of land. More than 278,789 households live on less than a dollar day. Farmers therefore require farm enterprises that not only increase their household incomes but also require less resource inputs. Rabbit farming is one such enterprise that if adopted have the potential of lifting households out of poverty and to food security arena.

Numerous efforts aimed at promoting rabbit industry are currently being implemented by the Government of Kenya and other development partners. However, challenges regarding rabbit farming still exist. Past studies (Schiere,2004; Sejian, 2012; Hunguet al., 2013) have shown that rabbit producers are faced with high rates of rabbit deaths, low incomes from rabbit sales, in-breeding as a result of poor breeding management, predators, pests and diseases, feeds unavailability and limited access to technical information about rabbit farming. It is hypothesized in this study that these challenges affect the adoption of rabbit production, increasing household income and promoting agricultural development.

Specific objectives

Specific objectives of thisstudy were to:

i. To determine the level of awareness ofimprovedrabbitproduction technologies by small scale farmers in Nyamira County
ii. To determine the extent of adoption of improved rabbit technologies by small scale farmers in Nyamira County
iii. To determine factors affecting the level of adoption of rabbit production technologies by small scale farmers in Nyamira County

Research questions

The research question for the study involves the following:

i. What is the level of awareness ofimproved rabbit production technologies by small scale farmers in NyamiraCounty?
ii. What is the extent of adoption of improved rabbit production technologies in Nyamira County?
iii. What are the factors that affect the level of adoption of rabbit production technologies by small scale farmers in NyamiraCounty?

Justification of the study

Despite the potential of rabbit farming in increasing household income and nutrition, its productivity is still low. This is due to low adoption of improved rabbit production technologies among farming households. In this regard, the study investigated farmers' level of awareness and factors influencing uptake of the improved rabbit production technologies. Understanding the farmers' level of awareness and the constraints affecting the adoption of the rabbit production technologies will help inform existing policies related to rabbit farming in order to increase adoption rate and hence improved household income and nutrition.

Scope of the study

The study area was limited to Nyamira County of Kenya. The cross sectional data collected during the March- August 2014 period was used as it was considered adequate for analyzing changes in rabbit production technologies in Kenya and particularly Nyamira County. Questionnaire was used to collect primary data and SPSS computer software was used in analysis. The study also concentrated only on household factors influencing improved rabbit production technologies thus excluding any other factor not within this category.

Limitations of the Study

The findings of this study were only applicable only to Rabbit producers in Nyamira County. Therefore, its application was only to be generalized to a limited extent to other livestock farmers in Nyamira County.

Conceptual framework

A conceptual framework is a theorized model classifying concepts and their relationships in a given study (Mugenda and Mugenda (2003). The framework provides a summary of the preferred approach, outlines

relationships and desired effects between dependent and independent variables. In this study, independent variable includes whether a household adopt an improved rabbit technology or not while the dependent variables includes the factors responsible for the adoption of improved technologies which can be grouped into innovation, farmer or institutional related factors (Figure 1).

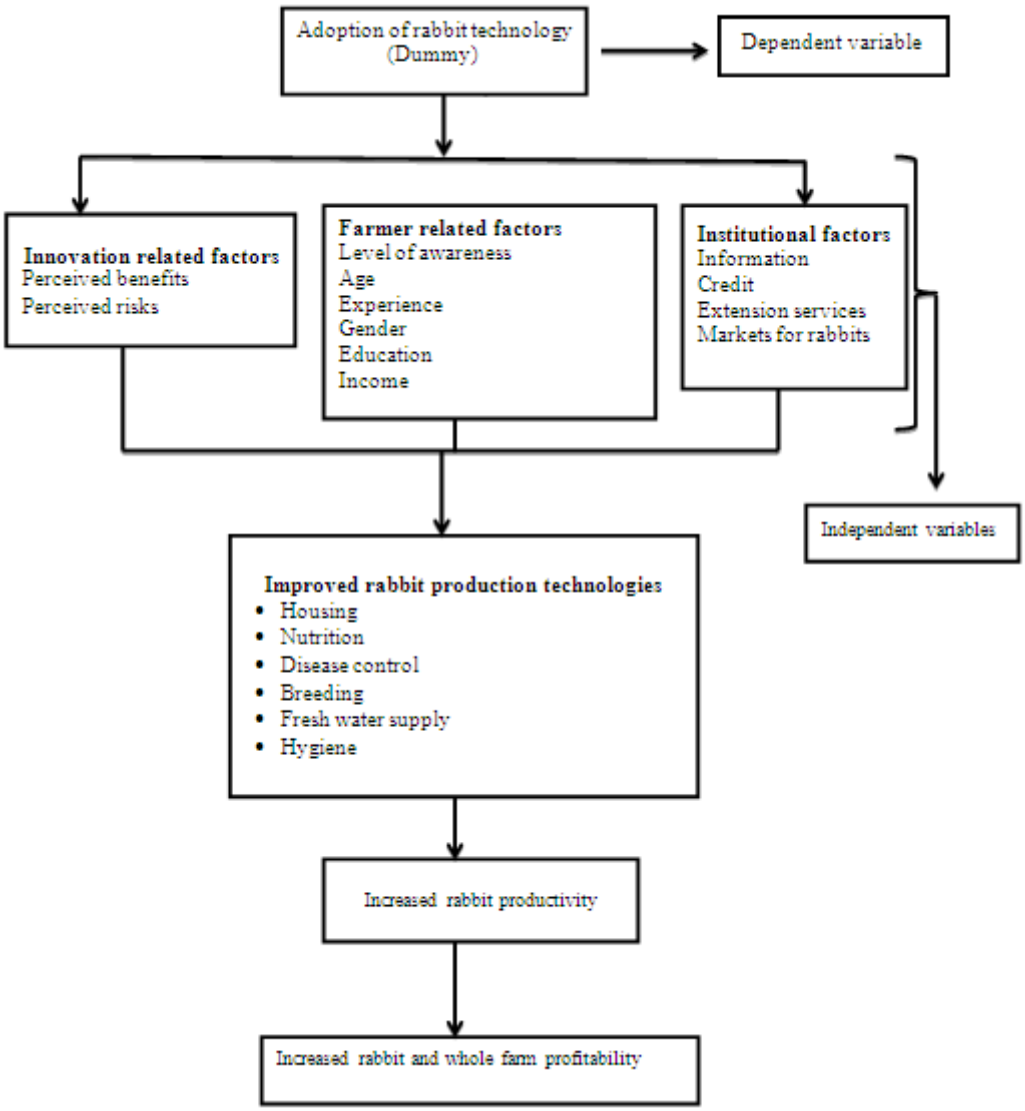

Figure 1: Conceptual framework

Source: Researcher, 2014

II. Literature Review

Introduction

In this section, literature review on rabbit farming is discussed global, African and Kenyan contexts. Importance and challenges facing rabbit farming is discussed. In addition, theoretical and conceptual frameworks are covered.

History and the importance of rabbits

Globally, more than a half of the rabbits reside in North America, islands in Japan, Africa, South East Asia, South Western Europe and Sumatra (Lukefahr, 2000). In South America, for instance, the history of rabbits' dates back to the great American interchange periods with Tapeti rabbit species. Hares, on the other hand, are a common animal in the Eurasia regions. Currently, rabbits and rodents are assumed to share common lineage under class Gliresand convergent evolution.They have long ears, wide field of vision (can see almost 360 degrees) using small blind spot at the nose bridge and are mostly active at dawn and dusk as an adaptation for oncoming predators especially the badgers, dogs, cats, red foxes and Iberian lynxes. In threatening occasions, rabbits freeze and warn other burrow members through ground thumping of hind legs, hop away in zig-zag motion and if caught deliver powerful kicks using its strong hind legs (Lebaset al., 1997).

Rabbit rearing as an agribusiness

In Africa, rabbit rearing is considered an excellent agribusiness activity amongst the youth. It contributes to self-employment and income generation through the sale of live rabbits and its related products. This might be related to its low capital investment, limited space requirement and faster multiplication and the ability to use fibrous feed-stuffs unsuitable for human beings. As a result, there has been increased awareness on the importance of rabbit production in Africa as a means of alleviating animal protein shortages, generation of income, particularly in areas with high human population and limited agricultural land (Gichoya, 2013). Rabbit farming has several advantages in the farm household.

Rabbit production in Kenya

Rabbits are characterized by small body size, short gestation period, high reproductive potential, rapid growth rate, genetic diversity, their ability to utilize forages and disease tolerance (Mailafiaet al., 2010; Begensel, 2008). Rabbits require small amounts of feed and use inexpensive, easierto construct housing (Cheeke, 1986). Furthermore, rabbits do not compete with humans for grains as strongly as chickens (Price and Regier, 1982; van Dijk, 2003; Moreki, 2007). In the opinion of Schiere (2004), rabbit farming exposes children to learning to tend for and appreciate animals. Additionally, rabbits can relief stress and tension when they are watched jumping and vibrating noses or by touching their smooth furs (Ramodisa, 2007). Unlike bigger animals such as cattle, rabbits can be tended by women, children or men as they do not need force to be restrained (Schiere, 2004).

Feeding and nutrition

Rabbit need a good diet to stay healthy and productive. Although supplementation with concentrate or grain is sometimes necessary and will enhance growth rates, roadside grass, kitchen and garden wastes (especially leaves) can provide the main feed at almost no cost (Schiere, 2004). Products of the processing plants such as tomato pomace form feed resources for rabbits. Sayed and Abdel-azeem (2009) showed that dried tomato pomace can be utilized efficiently and safely in the rabbit diets up to level 20% without any adverse effect on the performance and carcass traits.

Measures of profitability

In estimating the level of profitability, different methods; gross margin analysis, partial budgeting analysis, cost effective analysis, cost utility analysis and cost-benefit analysis are commonly applied (seeZweifelet al., 2009;Dijkhuizen and Huirne, 1997).In using partial budget and cost benefit analysis (complete enterprise costing); all costs (fixed and variable) are captured thereby resulting in a net profit with all costs allocation. This method is considered simple and helps in identifying all costs of an enterprise. In addition, it enables calculation of costs per unit of a product produced on a farm. Firth and Lennertsson (1999) also noted that net profit values obtained through this method tends to ignore the interrelatedness nature of enterprises. This lessens its applicability in most farm enterprise evaluations. However, its critics have noted that this method is full of awkward assumptions which requires making of arbitrary decisions in allocating expenses between enterprises (Firth, 2002).

Empirical findings using gross margin analysis

Olagunju and Sanusi(2010) observedthat on average, the total cost N190.33kwhile the total revenue was N465.62k per head of rabbit. With these, they concluded that, rabbit farming had a gross margin of N357.20k and net return of N275.29k per head rabbit. A significant relationship was observed between total revenueof farmers, educational level, farm size, labour and cost of feed. The study also show that the elasticities of variables was 0.977 making rabbit farming to be considered as rational as it fell in stage II of production. They concluded that the backyard rabbit farming can be an excellent source of protein and cash income which might enable farmers' attainment of nutritional, self-sufficiency and economic development.

Constraints to adoption of improved technology

Ozor and Madukwe (2005) in Nigeria on obstacles to the adoption of improved rabbit technologies found thatadoption of improved rabbit technologies was positively influenced by age, education level and experience of the rabbit farmers. Nutrition, housing, management and economic constraints were the major challenges. They recommended for targeted extension service to enhance mass adoption of improved rabbit technologies.

Das (2012) on adoption behavior of rabbit production technology in India observed that rabbit technology adoption was positively influenced by farmers' education; income level and training received or support in built-in the technology. He recommended that before technology is transferred to farmers, training

and exposure to it through demonstrations are necessary. In addition, the cost of technology needs to be taken into consideration as less costly technologies tends to be easily adopted than expensive technologies.

Theoretical approaches to understanding agricultural technology adoption

Several approaches exist in explaining agricultural technology acceptance and adoption. These approaches possess divergent focus contexts. In fact, most of these approaches attempt to form theories to explain why or how innovations or technologies are adopted and the level of acceptance and adoption. Some of these approaches focus on individual households and or societal levels while others focus on implementation success at organization's levels. Examples approaches common in the literature includes; economic constraint models, multiple source models, technology transfer and innovation diffusion models.

Economic constraint model

This model assumes that a household act as a single production and consumption unit that maximizes utility subject to production function, time and income constraints. This model holds on assumption that there is only a single decision maker in a household and that there will be no conflict and inequality within a household as members are assumed to possess level utility function to that of a household head (Aikenset al., 1975). The household head will in return make decisions basing his decision on what is best for the whole family so that maximizing a household utility would result in similar result as those of individual functions.

Multiple source of innovation model

This model aims at understanding the various needs, resources of clients and views the users not only as adopters but also as active participants in the process of technology development and adoption. The emphasis of this model is that agricultural technologies are not only derived from agricultural research but from several sources like farmers, extension agents, development partners, private entrepreneurs and even research practitioners. In this model, the views of users of technology are seen as a key to the development and transfer of locally usable innovations. For example, farmers are not only seen as recipients but also as providers of inputs to technological success (Hardon-Baars, 1997).

Technology transfer approach/ Central source of innovation model

The main tenant in this model is the transfer of technological knowledge from research institution to producers. Innovations are assumed to be moving from a research organization, extension agents and lastly to producers. Therefore, it involves assigning clear cut roles to research partners (farmers, extension agents or research institutions). Under this model, research institutions are assumed to be the sole source of technology and are only mandated to conduct research, extension agents to transfer research findings to farmers, while farmers are assumed to be people with unending problems who are supposed to adopt the technology. This represents a linear process in which scientists develop technologies, extension agents, demonstrate the technology to farmers and farmers adopt it to solve their problems. This method assumes that farmers are inexperienced or not knowledgeable in solving problems (Leeuwis and van den Ban, 2004). As a result, it has failed in managing the diverse biophysical environments, multiple livelihood goals, rapid changes in local and global economies, expansive number of stakeholders in agricultural sector, drastic decline in resource investment for the formal research and development sector, and the impacts of agricultural production (Gonsalveset. al., 2005) common with most agricultural researches.

III. Research Methodology

Introduction

This section discusses the methodology used in the study, research design, location of the study, target population, sample size, sampling procedures, research instrument, reliability and validity of the study, methods of data analysis and presentation.

Research Design

A descriptive research design based on the use of qualitative and quantitative approaches for stated objectives was adopted in this study. According to Amin (2005), this design is used for profiling, defining, segmentation, estimating, predicting, and examining associative relationships.

The area of study

The study was conducted in Nyamira County, Kenya. NyamiraCounty is one of the six Countiesin Nyanza Province. It is bordered by Bomet County to the South East and Kisii County to the West, Kericho County to East and Homa-bay County to the North. The County is sub-divided into 5 administrative Sub-counties: Nyamira North, Borabu, MasabaNorth, Manga and Nyamira with a land area of 896 km² (Table 2).

The County lies between latitude 0º 30´ and 0º 45´ South and longitudes 34º 45´ and 35º 00´ East (GoK, 2005). In Nyamira County, an estimated 67% of the population is living in absolute poverty partly due to their small land sizes, decline in agricultural productivity, population growth and environmental degradation (GoK, 2005)

Target population

The target population for this study included all small scale rabbit farmers in Nyamira County. NyamiraCounty has a total 257 small scale rabbit farmers (GoK, 2012) as shown in Table 3.

Sample size

In estimating the recommended sample size, Krejcie and Morgan (1970)formula was adopted. A totalof 218 small scale rabbit farmers were sampled and interviewed. However, after data cleaning, only 154 questionnaires were available for data analysis. The 154 rabbit farmers are distributed in the four sub-counties as shown in table 3.

$$\text{Sample size(n)} = \frac{x^2 NP(1-P)}{d^2(N-1) + x^2 P(1-P)}$$

where;

x^2 - table value of Chi-square each d.f. =1 for desired confidence level such that: 0.1=2.71, 0.05 = 3.84, 0.01 = 6.64 and 0.001 = 10.83 (in this case 0.05 = 3.84 was used)

N - Population size (in this case 257 rabbit farmers)

P - Population proportion (assumed to be 0.5)

d - Degree of accuracy (expressed as a proportion)

The above values are substituted to the above equation to get the sample size as follows:

$$n = \frac{(3.84)^2 257 * 0.5(1-0.5)}{(0.05)^2(257-1) + (3.84)^2 0.5(1-0,5)} = 218$$

Sampling procedure

In this study, NyamiraCounty was purposivelydue to increasing interest in rabbit farming among farmers. The County is also characterized bynumerous farmers with small land sizes estimated at below 1.5 acres.The County consists of five Sub-Counties(Manga, NyamiraNorth, Nyamira, Borabu and MasabaNorth) out of which four Sub-Counties (Manga, Nyamira North, Borabu and Masaba North) were purposively selected due to existence of high number of rabbit farmers. A total of 257 rabbit farmers operate within the four Sub-Counties. Within each Sub-County, the rabbit farmers were selected using simple random sampling procedure. A total sample of 154 rabbit farmers were selected for this study. The sample distribution within each Sub-County is shown in Table 1.

Research Instrument

In this study, astructured questionnaire was usedin collectionof primary data. This approach enabled collection of diverse data necessary for this study.

Validity of the instrument

To verify the validity of our questions, a Content Valid Index (CVI) was used. CVI is a scale developed by rating relevant items in the instrument by checking for their clarity, meaningfulness in line with all objectives stated and dividing by the total number of items in the instrument (Wyndet al., 2003). After the computation,a 56 percent value was obtained after and thus was deemed valid for this research.

$$\text{CVI} = \frac{\text{Relevant items}}{\text{Total number of items in the instrument}}$$

Reliability of the Study

In achieving the recommended reliability index, a pilot study was done inKisii County (Gucha district) to detect any major challenge likely to result from the research instrument application. A total number of 24 respondents were used in pre-testing the study instrument.Thereafter, unclear questions in the study instruments were corrected. Irrelevant ones were dropped and new ones introduced in order to capture data as expected.

Data and Data Collection

Before the start of data collection, a permission to undertake research was sought from the Faculty of Agriculture and Natural Resource Management, Kisii University and Nyamira County Agricultural Office. Rabbit producers were requested to respond to the questionnaire willingly with assistance of trained enumerators. Primary data collected include: the level of awareness of improved rabbit technologies, income and expenditures on rabbit farming, household, institutional and technology characteristics influencing adoption of improved rabbit production technologies. This instrument was administered using trained enumerators

Data Analysis and presentation

This data was analyzed using SPSS computer software and results in form offrequencies and percentageswere presented using tables, pie-charts and bar graphs.

IV. Results And Discussion

Introduction

This chapter presents the results and discussion of the study of rabbit production technologies in Nyamira County, Kenya. This section discusses the household characteristics of the respondents, factors affecting the level and extent of adopting rabbit production technologies, farmers' level of awareness of improved rabbit technologies, conclusions and suggestions for further research.

Household characteristics of rabbit farmers

The age composition of rabbit farmers showed that majority (83 percent) are in the age bracket of below 40 years. The average age of rabbit producers was 35.5 years. This might be true because rabbit farming is usually taken up by younger farmers. However, less that 4 percent of rabbit farmers fall above 60 years (Table 4). This might be attributed to the unwillingness of older persons to adopt improved technologies for fear of failure and negative consequences. Therefore, provision of agricultural extension programmes should be directed young and older farmers. This might be through group trainings in farmer field schools and formation of young farmers clubs at primary and secondary schools to act as vehicles to disseminate technology.

Nature of Rabbit business in Nyamira County

Farmers were asked to indicate whether they keep rabbit on sole proprietorship or within a group or as company contracted farmers. Findings are presented below (Figure 3).

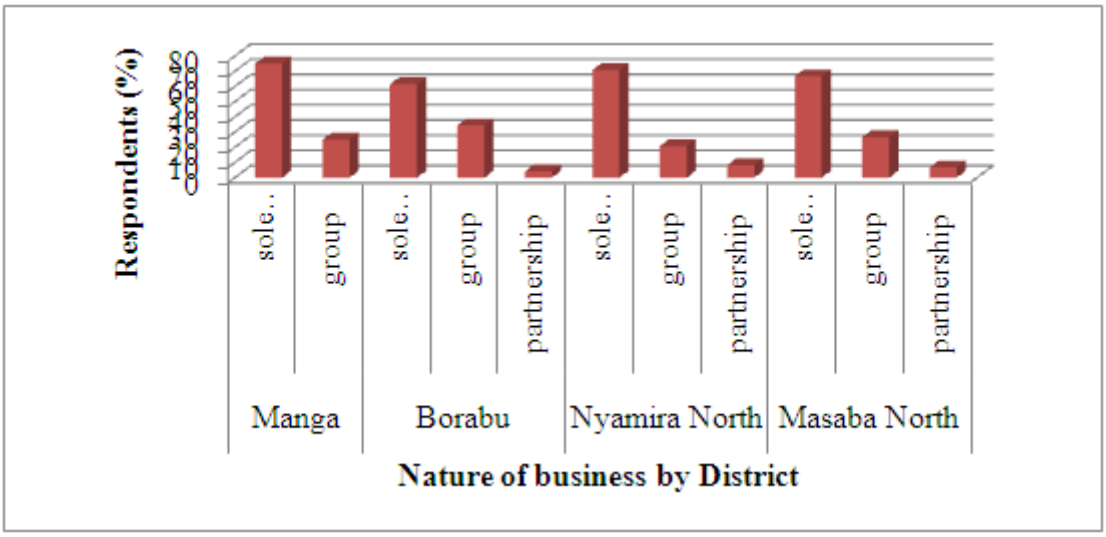

Figure 2: Nature of rabbit business in Nyamira County

The findings (Figure 3) show that, rabbit farming in Nyamira County is majorly on sole proprietorship with existence of group and partnership approaches. Specifically, Manga had the highest levels of rabbit farming as a sole proprietorship (70 percent), Nyamira North (68 percent), Masaba North (65 percent) while Borabu had the least (60 percent) proportion of rabbit farmers operating as sole proprietor. In general, rabbit farming in Nyamira County is a sole proprietorship and therefore, more extension servicesare necessary to promotecollective action (partnerships, companies and groups) in rabbit farming. It is also important to note that farmer groups among rabbit producres is beginning to increase in all the four districts of NyamiraCounty (Figure 3). In addition, more research trainings are necessary in group dynamics, contract management, group marketing and affordable lending approaches.

Experience in rabbit farming

Producers were asked to indicate the number of years they have been practicing rabbit farming as a business. Result from study are presented in the Figure 4 below.

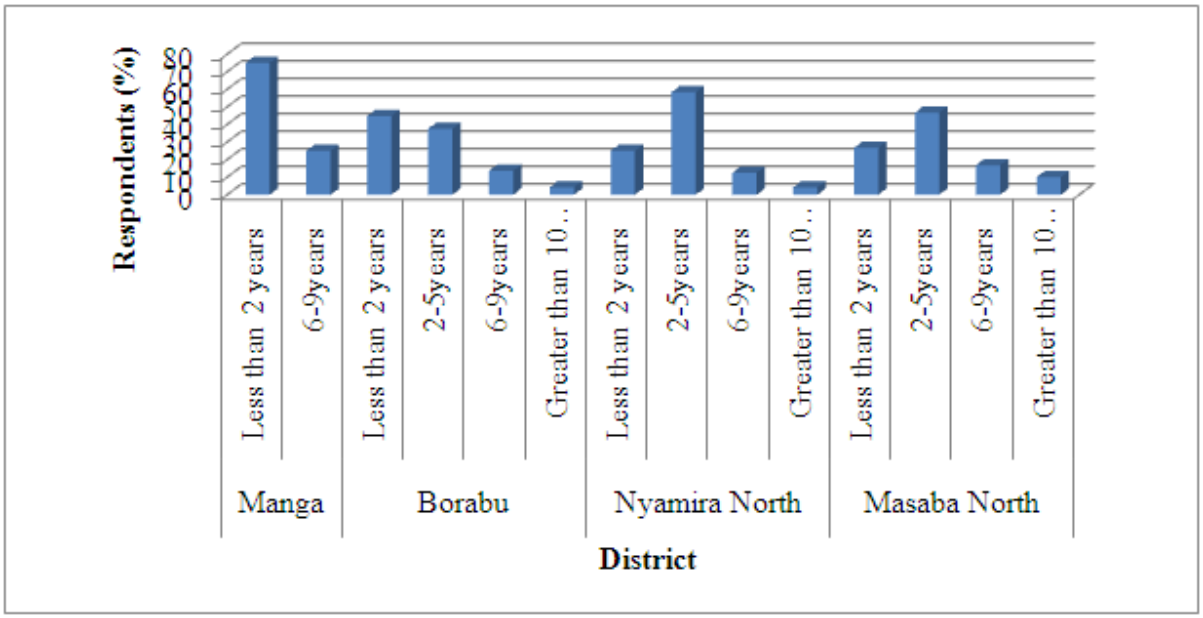

Figure 3: Farmers experience with new rabbit technologies

Figure 4 shows that, most rabbit farmers in Nyamira North and MasabaNorth districts had morethan 2 years of experience in using the improved rabbit technologies compared to Manga and Borabu. In Manga, 70 percent of producers had less than 2 years of experience (Figure 4). From our discussion with extension agents working in the area, it might be true as rabbit farming in the area was just introduced in 2010. Therefore, farmers were still considering whether to adopt or not to. However, NyamiraNorth and MasabaNorth are the only districts where rabbit farmers have used the new technologies for many years at 55 and 45 percent respectively. In these districts, there are many development partners who are currently promoting new rabbit farming technologies and thus farmers are used to these new technologies. This gives a clear picture that farmers might be willing to change their rabbit rearing technologies if they get correct information and they be given more time to consult. Therefore, these districts can act as idea exchange forums for other farmers and extension agent who want to improve their knowledge concerning rabbit farming.

Awareness of improved rabbit technologies

The respondents were asked to indicate their level of awareness of improved rabbit technologies. The result is shown in Figure 5 below.

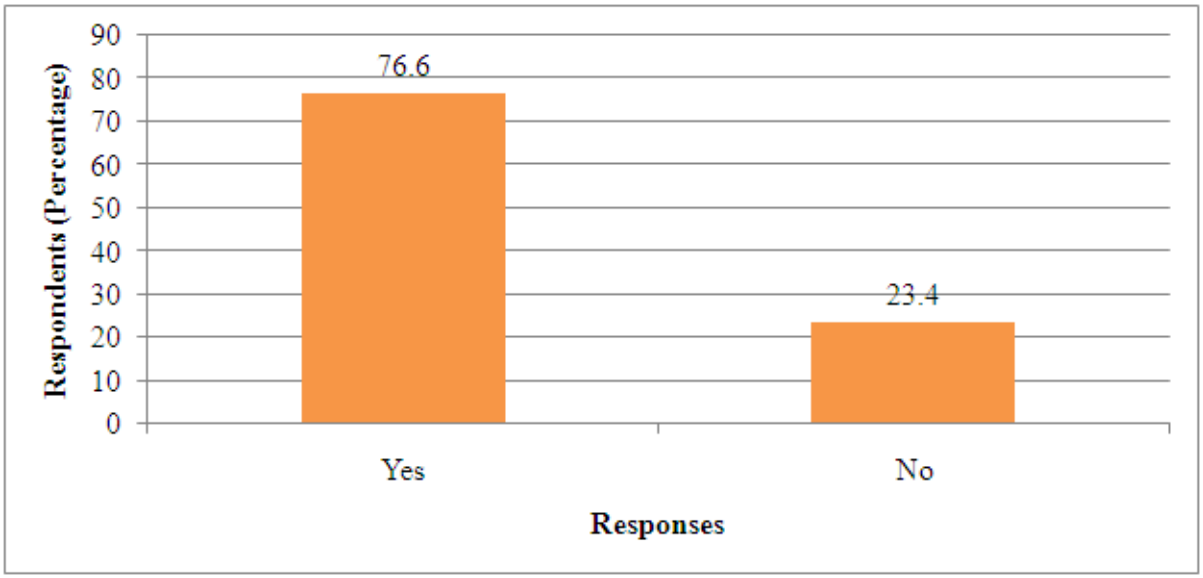

Figure 4: Respondents level of awareness of improved rabbit technologies

From the result, it was noted that most respondents (77 percent) were aware of improved rabbit technologies (Figure 5). The high level of awareness might be attributed to the excellent publicity undertaken by Ministry of Agriculture- Extension department. In addition, it might be attributed to the limited number of respondents who keep rabbit, thus making target extension easier than in large number of population.

Extent of adoption of improved rabbit technologies

Rabbit farmers were further asked to rank their level of adoption depending on the number of years they have used improved rabbit production technologies. The extent of adoption was divided into three categories to allow for easier analysis and discussion. The result is presented in figure 6 below.

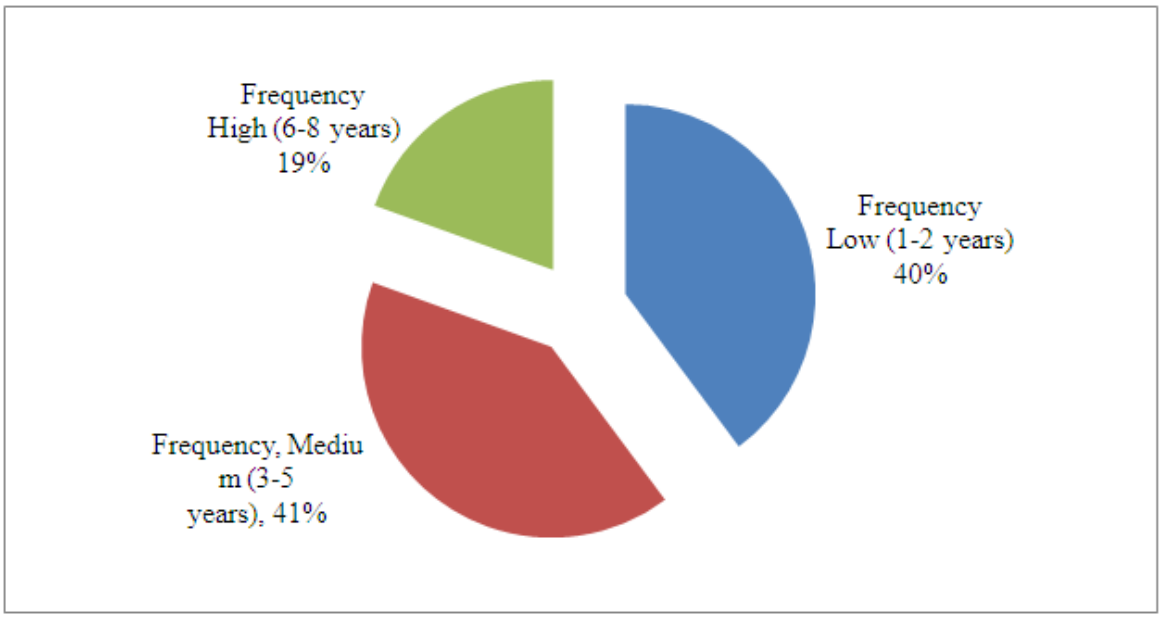

Figure 5: Extent of adoption of rabbit technologies

Result from figure 6 indicates that, majority (41 percent) of small scale rabbit farmers were medium adopters (3-5 years), 40 percent as low adopters (1-2 years) while only 19 percent were high adopters (6-8 years) of rabbit technologies. From this result, it is clear that the level of improved rabbit technology adoption in Nyamira County varied from medium to low levels. This means that although there is potential of improved income in adoption of improved rabbit technologies, rabbit farmers might not get these returns accruing to them because of low rate of adoption.In addition, it might be related to the low knowledge due to the low levels of education in the area. This might have deterred most rabbit farmers from accessing the available extension information packages on improved rabbit production technologies.

Adoption profile of improved rabbit technologies

Farmers were asked to rank their level of adoption of the improved rabbit technologies being promoted in Nyamira County in terms of low/high. Results are presented in Table 5.

Table 1: Overall level of adoption of rabbit technologies in Nyamira County

Specific technology	**N**	**Level of Adoption[1] (%)**
Pathology and hygiene technology	79	51.3
Housing	57	37.01
Disease control	96	62.3
Feed supplementation	38	24.67
Fresh water supply	61	39.61
Reproduction and production technology (Breeding)	66	42.86
Overall level of technology adoption		**42.9**

[1]A farmer's level of adoption was measured by calculating an adoption index as; (respondent's total score (N)/total possible score (154))*100 (Das, 2012); N represent the number of people who reported to have adopted the giventechnology; Note: Low adoption (below 50 percent; high adoption (50 percent upwards)

Rabbits cannot tolerate extreme temperatures (low and or high). Therefore, a good housing system for rabbits was assumed to be necessary in protecting rabbitsfrom hostile weather conditions and predators. As a result high levels of adoption were expected if farmers were to reap the benefits of new rabbit farming technologies. However, result in Table 5 indicates that,only 37 percentof our respondents adopted this practice.Similar observations of low adoption levels werea common scene amongst small scale farmers operating in developing countries. For instance, Rahman (2007) observed lowpercentage levels of adoption amongst pig farmers with respect tohousing practices. Nevertheless, Onuekwus and Kezie, (2007) observed highpercentage level of adoption of rabbit housing technologies amongst Nigerian rabbit farmers.

Feeding rabbits can either be cheap or expensive depending on the feed source and type. Morekiet al., (2011) attribute high prevalence of nutritional deficiencies in rabbits' to poor quality diets. Although rabbit feeds are sometimes freely available like roadside grasses and wastes from kitchen or garden, grain or concentrate supplementation is sometimes necessary to enhance growth rates (Schiere, 2004). He cautions producers feeding rabbits on garden wastes to keenly look for pesticide or herbicide residues. On feed supplementation, respondents indicated the lowest level of adoption at less than 25 percent. This was considered as normal as feed supplementation requires training but in the study area, most rabbit farmers had low levels of education as shown in Table 5.

Sources of information on improved rabbit technologies

Table 2: Sources of information for improved rabbit technologies in Nyamira County

Source of information	Frequency	Percent
Media	50	36.2
Ministry of Agriculture	37	26.8
Non-governmental organization	13	9.4
Via other farmers	38	27.5
Total	**138**	**100**

Farmers were asked to indicate their main sources of information from the list provided in the questionnaire. Result on information sources on improved rabbit technologies demonstrated a consistent pattern as shown in Table 6. As expected, Ministry of Agriculture, farmer to farmer and media were the major sources of improved rabbit information at 26.8, 27.5 and 36.2 percent respectively.

Overreliance on media as a source of information can be attributed to the existence of numerous local radio channels.In addition, it might be linked to the several programs being promoted by development partners like KerumondRabbit Kingdom, a company charged with creating awareness among rabbit farmerson the potential of rabbit farming and building of a strong network in rabbit breeding within Nyamira Country.

Farmer-to-farmer sources were considered more important, compared to official sources like Ministry of Agriculture, media and presence of development partners, amongst small scale rabbit farmers. Similar observations of over reliance on other farmers as source of adoption information were also noted in Son (2007). The study also noted that, experienced farmers or those who have been in rabbit production for a long time were willing to share their experiences with new farmers.

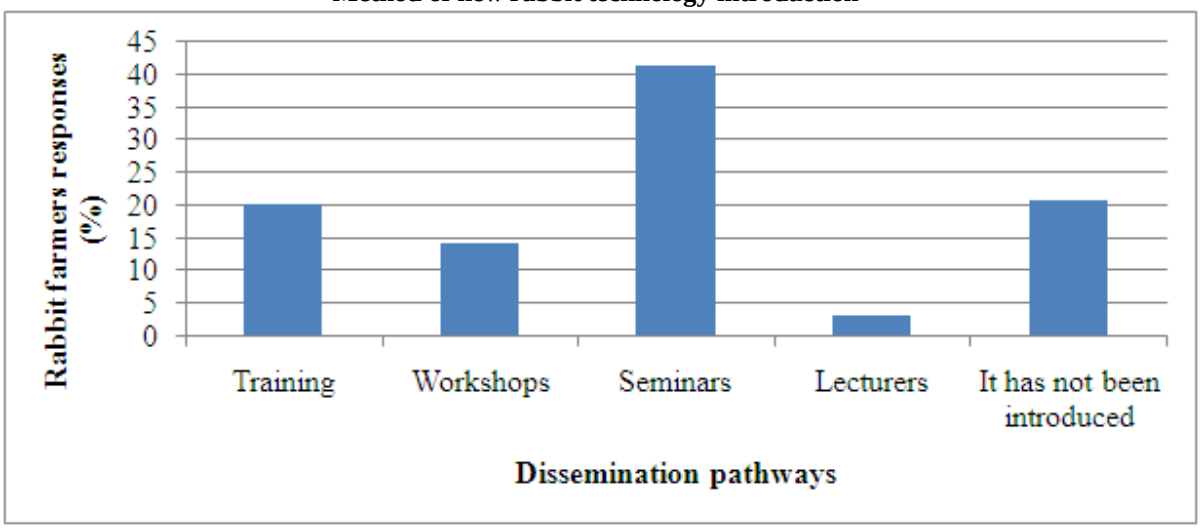

Figure 6: Dissemination pathways of new rabbit technologies

New technologies aimed at improving farmers livelihoods like new rabbit farming can be introduced using different dissemination pathways as shown in Figure 7. In Nyamira County, seminars were the most common method at 42 percent while lectures were the least at 3 percent. Seminars are parts or modules meant to improve a user's skill. Although this was the commonest means of information dissemination in Nyamira County, it is not clear whether there is improvement in the welfare of farmers as a result of its use. There is potential for further research on its effect or farmers perception on its use. Workshops on the other hand, are for promoting users understanding of vital points through actual experiment. In Nyamira County, only 15 percent of the responses accepted that workshops were used in promoting rabbit technologies.

Constraints to adoption of improved rabbit technologies

Table 3: Constraints to the adoption of improved rabbit technologies

District	Constraints to new rabbit technology adoption	N	Percent
Manga	Limited involvement of rabbit farmers	1	25
	Lack of adequate communication	1	25
	Unskilled extension personnel	2	50
	Total	**4**	**100**
Borabu	Limited training of rabbit farmers	12	12.5
	Limited involvement of rabbit farmers	26	27.1
	Failure of the agriculture department	18	18.8
	Lack of adequate communication	13	13.5
	Unskilled extension personnel	27	28.1
	Total	**96**	**100**
Nyamira North	Limited training of rabbit farmers	5	20.8
	Limited involvement of rabbit farmers	3	12.5
	Failure of the agriculture department	2	8.3
	Lack of adequate communication	11	45.8
	Unskilled extension personnel	3	12.5
	Total	**24**	**100**
Masaba North	Limited training of rabbit farmers	3	10
	Limited involvement of rabbit farmers	10	33.3
	Failure of the agriculture department	3	10
	Lack of adequate communication	8	26.7
	Unskilled extension personnel	6	20
	Total	**30**	**100**

Information regarding specific constraints to the adoption of improved rabbit technologies is presented in Table 7. The results show that, an estimated 25 percent of rabbit farmers in Manga reported that they need to be included in the technological process for ownership and easier adoption exercises. Inclusion of farmers in technological process might be through seeking their opinion, ideas or involving farmer representatives in the actual discussion before project launch. Specifically, farmers in Masaba North and Borabu Districts reported higher levels of the need for their involvement at 33.3 and 27.1 percent respectively.It is only NyamiraNorth district where farmers reported lack of their involvement as the lowest,12.5 percent. This might be in line with the low levels of adoption of these technologies as reported by farmers earlier. These findings are common in most developing countries where extension approaches follow top-down approach with farmers being observed as takers of technology rather than technology developers.

Factors affecting the adoption of improved rabbit technologies: A multiple regression analysis

Table 4: Factors affecting the adoption of improved rabbit technologies in Nyamira County; A multiple regression analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	.851	.584		1.458	.147
Gender	-.284	.215	-.110	-1.322	.188
Age (years)	.030	.108	.025	.281	.007*
Level of education	.065	.081	.072	.806	.042**
Nature of rabbit business	-.202	.177	-.093	-1.141	.256
Experience in rabbit farming (years)	-.018	.128	-.012	-.144	.085***
Awareness level	.260	.254	.086	1.024	.000*

Dependent variable: Adoption of improved rabbit technologies; Adjusted R^2=0.412; F= 0.362; * =P<0.01;** = P<0.05; ***=P<0.1.

A multiple regression analysis was used in the analysis of the factorsaffecting the adoption of improved rabbit technologies in Nyamira County, Kenya. Result of the analysis is presented in table 8. Findings indicate that adoption of improved rabbit technologies was influenced by farmers' level of education (P≤ 0.042), rabbit farming experience level (P≤0.085), awareness of the existence of improved technology (P≤0.000) and the age of a farmer (P≤0.007) (Table 8). This means that an increase in farmers' educational level, age, level of awareness and experience have a positive effect on improved rabbit technology adoption.In summary, therefore, adoption of improved technology was a function of a farmer's age, level of education, awareness level and experience in rabbit farming.

Regression analysis result indicates a higher value of R2 (0.412). Thisindicates that about 41 percent of adoption of improved technologies is explained by independent variables. This therefore, implies that technologies adopted by farmers areinfluenced be farmers age, gender, level of education, nature of rabbit business, experience in rabbit farming and awareness level and use of improved technology. The β coefficients (the unstandardized coefficients) shown in Table 8 indicatesa mixture ofdirect/ an inverse movementof independent variables with technology adoption level. The final model of adoption can be summarized as below:

Adoption (Y)=0.851-0.284 (Gender)+0.030 (Age)+0.065(education)-0.202(Nature of business)-0.018(Experience)+0.260(awareness level).

Respondents' Age

Age of a respondent is important in determining whether a person adopts an improved technology or not. Most adoption theorists believe that there is anindirect relationship between a person's age and technology adoption level, in that, the younger a person is, the higher is his likelihood of adopting new technologies like improved rabbit technologies. This implies that younger persons are better educated, more aware of benefits of improved technology and are therefore more risk averse compared to older persons who are conservative, more skeptical, rigid and would like to keep to their traditional ways of doing business. From our study, it was observed that a farmer's age had a positive and significant effect on his adoption of improved rabbit technologies (P=0.007).This means that younger farmers have higher appetite for new ideas aimed at improving production and profitability of rabbit farming.

Farmer'sexperience

A farmers experience can either be inagricultural technology adoptionorin general farming. Studies have shown that a positive but insignificant relationship exists between agricultural technology adoption and rabbit technologyadoption and a negative and insignificantrelationship between general farming experience and technology adoption.For instance, as farmers gatherskills over time, they graduallyshift fromtraditional to improved agricultural technologies based on observed performanceand learning by doing basis (Federet al., 1985). From our regression result (Table 8), farmer's experience had anegative but significant effect on improved rabbit technologyadoption (P=0.085). This was consistent with our prior hypothesis that as farmers level of education increases, they would reject rabbit production as small scale farming for a higher and expensive enterprise. Instead, they would only locate most of their resources to maximize projects that are more urban based which requires more capital.

Respondents' level of awareness

Agriculturaltechnology transfer involves teaching, information acquisition, technology supply and servicefunctions. This makes awareness tobean indispensable and a preceding step towards improved technology adoption. Therefore, recipients of technology need to have technical knowledgeconcerning technology formulation and design. For instance, if farmers possess poor technical knowledge of a given technology, a negative adoption rate is witnessed.Empirical finding concerning rabbit farmers'level of awareness and use of improved technologies is presented in Table 8above. Our results indicates that farmers level of awareness and use was positive and significant at 1 percent (P=0.000) (Table 8). This implies that farmer's level of awareness influence adoption level of for improved rabbit technologies. As was expected, rabbit farmers who were aware ofimproved rabbittechnologies potential in improving their profits had a higher level of adoption. The level of awareness of improved rabbit technologies had a positive and significant coefficient of 0.260 (Table 8). The results suggest that increase in awareness of improved technologies increases with respondents' closenessto the change agents like other farmers withhigher level of awareness.

Rabbit profitability: Gross Margin Analysis

Gross Margin (GM) for a rabbit enterprise was determined as total revenue minus total variable costs. From table 9, several cost items incurred by rabbit farmers are presented plus their average market prices as

indicated by farmers. For benchmark purposes, GM for both livestock and crop enterprises common in Kenya (Maize, Beans, Tea, Onions, Dairy and poultry) were also obtained from secondary data.

On average, a single rabbit farmer earned a gross margin per rabbit of KES 2586 and a net return of KES 552.50 per annum. This might be considered good revenue because rabbits do not require a big space and also do not compete with human for food. In most cases, rabbits are feed on pellets during dry season and vegetable wastes from the market. Therefore, for a farmer with about 100 rabbits kept for sale, it is possible for him to get a net margin of 55,250. This money might be enough to pay school fees.

V. Conclusion And Recommendation

Conclusion

This study examined small holder farmers' adoption of improved rabbit technologies in Nyamira County, Kenya. Findings indicate that majority of rabbit farmers were in their active age bracket (below 40 years) thus making rabbit sub-sector to be a prime job creator, GDP growth and food security supporter.In addition, rabbit farming was a male dominated business with farmers possessing low levels of education. Majority of farmers sourced improved rabbit information from the media, via other farmers and through ministry of agriculture extension agents.

This study also found a higher level of awareness amongst small holder farmers onimproved rabbit production technologies in Nyamira County. However, overall adoption rate was estimated at 42.9 percent and therefore was considered low according to our scale. In particular, housing technologies and disease control technologies were the leastadopted technologies by rabbit farmers. Results from multiple regression shows that, improved rabbit technology adoption was influenced by farmer's age, level of education, experiencein rabbit farming and level of awareness.

Recommendations from the study

Thisstudy recommends that keen attention be given in addressing the challenges (for instance low of education and lack of access to information) facing rabbit production. This calls for effective linkages between the farming community and the extension staff personnel as most rabbit farmers were not well equipped with necessary knowledge for producing rabbits. Also, there is need for repackaging improved technologies in local languages to help reach more farmers with low levels of education. This might help improve the adoption rate ofimproved rabbittechnologies. All these initiatives should target primary school children via simple but innovative approaches like 4K clubs and inculcating rabbit farming in the syllabus for learners at primary and secondary schools. At community levels, promotion efforts should target male farmers because they are the major rabbit farmers in Nyamira County. To counteract adoption challenges, organizing rabbit shows, seminars and workshops should be given priority. This will helpin improvingfarmers knowledge, skills and expertise necessary inmaximizing rabbit output and income potential of small scale farmers in the study area.

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