Research on World Agricultural Economy | Volume 05 | Issue 01 | March 2024

Research on World Agricultural Economy

https://journals.nasspublishing.com/index.php/rwae

RESEARCH ARTICLE

The Impact of Agricultural Extension Services on Farm Output: A Worldwide Viewpoint

Stavros Kalogiannidis*, Dimitrios Syndoukas

Department of Business Administration, University of Western Macedonia, Kozani, 50150, Greece

Abstract: In order to increase farm productivity and sustainability on a worldwide scale, agricultural extension services are essential in bridging the gap between research and actual farming. This study examined agricultural extension services and their effects on farm productivity. Data were collected using a questionnaire from 382 professional farmers. The results show that agricultural workshops and training positively affect farm productivity, access to government demonstration farms positively influences farm productivity, and media-based agricultural programs have a positive effect on farm productivity. Workshops and training in agriculture may have a very favorable impact on farm output. It's important to remember that the success of agricultural workshops and training might vary depending on a number of variables, including the training's quality, the information's applicability to local circumstances, the farmers' readiness to embrace new techniques, and the post-training assistance offered. In order to increase and facilitate access to knowledge, suitable production methods, and better inputs, the findings highlight the need to strengthen farmers' organizations and last-mile agricultural input providers. Farmers must have access to knowledge about marketing and other support services that are essential for agricultural growth in order to enhance global development in order to achieve greater farm productivity.

Keywords: Agricultural extension services; Farm productivity; Agricultural workshops and training; Media agricultural programs

1. Introduction

1.1 Background to the Study

Agricultural extension may be used to improve customers' decision-making, management, and problem-solving abilities. This method of getting specialised knowledge from public policy or research down to the farm level is frequently employed all around the world [1]. According to Bitzer [2], the majority of industrialised countries have established a system of consulting

*Corresponding Author:
Stavros Kalogiannidis,
Department of Business Administration, University of Western Macedonia, Kozani, 50150, Greece;
Email: aff00056@uowm.gr

Received: 10 December 2023; **Received in revised form:** 13 March 2024; **Accepted:** 15 March 2024; **Published:** 31 March 2024

Citation: Kalogiannidis, S., Syndoukas, D., 2024. The impact of agricultural extension services on farm output: A worldwide viewpoint. *Research on World Agricultural Economy*. 5(1), 96–114. https://doi.org/10.36956/rwae.v5i1.999

DOI: https://doi.org/10.36956/rwae.v5i1.999

services for owners and managers of rural property, which is mostly funded by general taxes and offered by public institutions. However, when evaluated as a whole, it is possible to see that these organisations' overarching objective is to enhance the individual and collective performance of farmers and the agricultural industry. The private sector has since added to this kind of government extension service [3,4]. To feed a rising global population, the agricultural industry must balance greater productivity with a decrease in negative environmental externalities, such as climate change. In these situations, extension services are crucial because they may exert pressure on the larger agricultural and rural sectors to alter how people behave now. However, there is a financial issue that comes along with this commitment as global economies navigate the recent turbulent macroeconomic cycles and there is a renewed emphasis on "value for money" policies. Examining the effects of present services may assist in ensuring that future extension programmes are targeted, effective, and efficient. Studies show that contacts with extension services positively influence farmers' decisions to adopt new technology and their levels of profitability [4–7]. For instance, Lee [5] argued that farmers who take part in extension activities are more likely to alter their practices to boost long-term profitability. In a similar vein, found that participatory extension positively impacted technology adoption and profitability. Kaini [8], who also looked at prior impact studies, stressed that findings should be interpreted with care owing to econometric challenges even though positive outcomes are often reported.

There is conflicting empirical data from earlier research on the impact of extension services on agricultural output globally. There aren't many thorough analyses of the effects of extension services in developing nations, and the available information is inconsistent [3,9,10]. Although an extension plan increased the economic returns for wheat by 15% in India, Bitzer [2] found that it had little effect on wheat production there and had no effect on fruit yields there. On the magnitude of returns on extension investments, there is often little agreement [11–13].

Most studies on how agricultural extension affects output and other outcomes use the premise that extension services are solely provided by extension workers [4,14,15]. Dummy variables have been utilized to track the number of visits delivered by an extension agent or if a farmer has received a visit from an extension worker to track extended contact. The idea that extension agents are the only individuals who can provide information about agricultural extension is suggested by the usage of an extension contact variable [16]. The statement suggests that the existing data on the effects of extension does not take into consideration the knowledge sharing that occurs between farmers and other agricultural information providers, such as radio, television, internet, telephone, magazines, bulletins, radio, farmer-to-farmer communications, radio, newspapers, and agriculture shows and exhibits [17–19]. As a result, the expected coefficient on the extension factor is biased lower, as other studies have shown [20]. The majority of farmers indeed benefit from extensions without ever having a direct conversation with staff members. By defining extended access to agriculture to include agriculture advisory/extension services from several sources and analyzing their impact on farm production, our research bridges that gap.

1.2 Purpose of the Study

The study focused on assessing agricultural extension services and their effects on farm productivity based on a global perspective.

1.3 Objectives of the Study

i) To examine the effect of agricultural workshops and training on farm productivity.

ii) To determine the effect of access to government demonstration farms on farm productivity.

iii) To examine the effect media-based agricultural programs on farm productivity.

1.4 Research Questions

i) What is the effect of agricultural workshops and training on farm productivity?

ii) What is the effect of access to government demonstration farms on farm productivity?

iii) What is the effect of media-based agricultural programs on farm productivity?

1.5 Development of Research Hypotheses

According to Gulati [21], there is a strong correlation between technical advancement and postsecondary education. Research, innovation expansion, and subsequently agricultural output all need skilled agricultural labor. A strong educational system that includes both general education classes and more specific occupational training might be considered the fundamental necessity for mass agricultural output [22,23]. Studies on the effectiveness of training for farmers have shown that only training programs that have been carefully revised and created to address specific farm needs can increase productivity in farms [24–26]. Based on this, it was hypothesized that:

H1: Agricultural workshops and training positively affect farm productivity.

Benefits from demonstration plots include the opportunity to interact with scientists, extension agents, and other development and research stakeholders as well as witness the technologies and their benefits when designed, developed, and implemented appropriately [27]. The beneficiaries are further supported in their decisions to use the demonstration technology by the chance to have significant doubts cleared up and concerns answered [28]. Most studies highlight the different benefits of demonstration plots for family income and investments. According to Gollin [29], an extension program based on demonstration plots raised family income and investment in a statistically significant way. According to similar findings, farmers who took part in demonstration plots and training programs saw a highly statistically significant increase in farm revenue [22]. Based on this, it was hypothesized that:

H2: Access to government demonstration farms positively influences farm productivity

Reports have also revealed that the types and degrees to which mass media are used to mobilize people for development have a significant role in the success of agricultural development programs in the majority of developing nations [30]. The growth of agriculture might be accelerated with efficient use of the media, as is also understood by planners in developing nations [31]. Gulati et al. [21] claim that mass media are communication channels that may quickly and easily expose a huge number of individuals to the same information. Technologies used in mass media include those that transmit information to consumers as voice, sound and moving visuals, or in the form of paper [2,12]. Because information can be sent across a large region at a quick and affordable rate through mass media, extension service organizations employ it. The media serves as a good source of early information for farmers and a reliable method for communicating production information on recent developments and catastrophes which greatly influences the levels of farm yields [24]. Based on this, it was hypothesized that:

H3: Media-based agricultural programs have a positive effect on farm productivity

1.6 Justification and Significance

There is little quantitative data to back up extension services' capacity to boost productivity. The paucity of data is, at least in part, a result of the inherent difficulties in quantifying changes and attributing them to extension. This research tackles the methodological issues, notably endogeneity and unobserved heterogeneity, which have weakened prior studies relating to agricultural extension and farm production. The findings of this study will be significant from a policy standpoint for at least two reasons. The advantages of policy measures targeted at enabling farmers to become more productive via extension services are first made clear to policymakers by precisely assessing the productivity impacts of agricultural extension contact. Second, the research sheds light on the relative weights that different agricultural inputs that affect farm production are assigned.

2. Literature Review

2.1 Extension Services in Agriculture

One of the most effective ways to combat rural poverty and food insecurity has been via programs for increasing agricultural productivity [32]. This is because it may assist farmers solve issues, enhance adult learning in rural regions, transfer technology, and directly involve farmers in the creation of the agricultural information and understanding system [30]. Extension is referred to as "systems that should facilitate farmers' access to information, knowledge, and technologies; facilitate their interaction with partners in research, education, agricultural enterprises, and other relevant institutions; and assist them in developing their own technical, organizational, and management skills and practices" [33]. This concept views an extension as a crucial tool for enhancing the productivity and efficacy of agriculture, its related activities, and other economic activities in order to meet the needs of the people. As a result, it is regarded as a tool for promoting laws that would increase the security and caliber of agricultural products [23]. Since the primary goal of agricultural extension is to improve farmers' knowledge of rural development, it has developed a reputation as a crucial component of technology transfer. A crucial component of enabling development is agricultural extension because of its significant role in efforts to enhance agriculture and rural regions [34].

Extension, according to Kosim [24], serves as a resource for knowledge on new technology for agricultural communities, which, when accepted, may raise output, incomes, and living standards. Farm families are informed about innovations by extension service providers, who also catalyze to hasten adoption rates, manage change, and work to stop certain system actors from stopping the diffusion process. Extension agents reach out to farmers by demonstrating technology, but they focus a lot on early adopters since those who lag will eventually learn from those who do [12]. Farmers' issues are highlighted for further research and policy direction via extension programmes [5,11].

Lampach [16] argued that extension services go beyond the transfer of technology to general community improvement through the development of social and human resources, abilities and expertise for production and processing, facilitating access to markets and trade, organizing farmers and producer groups, and collaborating with farmers toward sustainable natural resource management. Extension services often provide remedies when market failures, such as inadequate financing availability and uncompetitive market arrangements, deter farmers from producing [3,9].

The supply of extension services can become increasingly complicated and information-intensive as a result of the policies of economic liberalization, decentralization, and transformation of agriculture with a concentration on smallholder commercialization and export orientation [17,24]. To sustainably increase productivity, encourage diversification into high-value products, shift toward value addition, and improve smallholder competitiveness in both domestic and international markets, agricultural extension should provide services that can meet specific needs in a variety of agroecological and socioeconomic contexts [8,25].

2.2 Agricultural Workshops and Training on Farm Productivity

Agriculture production is influenced by many factors, including education [12]. According to Tambi [34], education has a considerable influence on agricultural output. Farmers who have completed years of basic education are more likely to accept and use new agricultural technologies. Agricultural education results in both cognitive (the dissemination of specialized knowledge and the development of general skills and proficiencies) and non-cognitive (attitudes, beliefs, and habits) changes [18,35,36]. Farmers who are proficient in reading, writing, and mathematics are better able to gather knowledge, comprehend it, and determine the proper input amounts for their farms [5]. Additionally, it encourages farmers to be more open to taking a chance, implementing innovations, setting aside money for investments, and overall embracing productive techniques [37].

Furthermore, Wonde [23] demonstrates how education improves the effectiveness of on-the-job learning for farmers. Additionally, it was noted that several success stories support earlier results about the effectiveness of non-formal education, focusing on a learning-discovery strategy and bridging any knowledge gaps in farmers' beliefs [5]. If the whole agricultural community is to be worried by a process of change, Samsudin [25] reinforces the notion that farmers without education may survive innovation and technological development in agriculture. This means that farmers without formal education need extra attention from extension staff. Tambi [34] contends that education does not impact the method by which production takes place, but rather influences how well a farmer converts inputs into output. The conclusion from all of these is that agricultural training is a significant factor in determining agricultural productivity and sustainability around the globe [3].

According to Jelliffe et al [37], the market for agricultural products is evolving and farmers are facing new possibilities, such as the rise in demand for higher-value goods, the adoption of sophisticated agricultural equipment, and the release of new varieties of seeds. Farmers must be well-versed in the market environment and production system in order to enhance revenues and improve living conditions [11,38]. The capacity development of farmers who actively participate in training is more useful than the provision of financial help in terms of increasing productivity and income, according to Khalid and Sherzad [39], who used the example of small farmers in Bangladesh.

According to Okafor and Malizu [22], the development and training of extension employees may help the local economy and industrialization. Through the purchase of producer commodities like fertilizers, insecticides, and consumer goods, domestic demand for industrial goods is boosted. It implies that agriculture makes it possible for regional industry to expand [14]. According to OECD [14], personnel development is a major factor in the advancement of agriculture. For instance, in Nigeria, training extension employees has continued to be a crucial part of the agricultural industry. Currently, it makes up about 40 percent of the GDP, and 70 percent of those in active employment work in agriculture [18].

2.3 Access to Government Demonstration Farms on Farm Productivity

A crucial component of agricultural extension programs has been demonstration plots, and subsequently farmer field schools [8,30,40]. When properly planned, developed, and executed, demonstration plots provide beneficiaries the chance to, among other things, witness the technologies and their advantages and to connect with scientists, extension personnel, and other development and research players [27]. The beneficiaries are also allowed to have important questions clarified and uncertainties removed, which further supports their choices to implement the demonstration technology [28].

The majority of research's findings point to various advantages of demonstration plots for investments and family income. Gollin [29] concludes that a demonstration plot-based extension program increased family income and investment in a statistically significant way. Similar results were obtained [22], which showed that farmers who participated in training programs and demonstration plots had a highly statistically significant boost in farm revenue. Contrarily, whereas adoption choices were connected to training programs with demonstration plots, the influence was constrained by financial limitations [26,41]. Very few studies have specifically examined the degree to which demonstration plots, either alone or in conjunction with another initiative, influenced farmers' choices regarding the acquisition and use of inputs related to the demonstration technology [20].

Government demonstration farms provide a platform for farmers to learn from experts, agronomists, and researchers who are well-versed in modern farming techniques. Farmers can attend workshops, seminars, and training sessions to gather insights into efficient crop management, pest control, irrigation, soil health, and more [14]. Research shows that demonstration farms often incorporate the latest agricultural technologies, machinery, and equipment [42]. Farmers can observe and even test these technologies, helping them make informed decisions about which tools to incorporate into their own operations to increase efficiency. Government demonstration farms usually implement best practices for sustainable farming, soil conservation, water management, and biodiversity. Farmers can adopt these practices on their own farms to enhance productivity while minimizing negative environmental impacts [2,27].

2.4 Media Based Agricultural Programs

The effective dissemination of new agricultural research results and technology to rural farmers continues to be a viable method for boosting agricultural output [17,43]. According to Samsudin [25], production knowledge that normally circulates through the media may include information on how to apply fertilizers, insecticides, and fungicides to crops, as well as new techniques for crop cultivation and soil conservation. It may also include information on how to harvest and store crops. There are also new technologies for animal husbandry, processing, and selling a range of agricultural products, which farmers may adapt and employ [24]. These developments or innovations should reach farmers and/or their homes through effective extension and mass media channels [11,18,44].

The media is gradually becoming a real tool for changing agriculture. The print media, television, and radio are the main media platforms with the most to offer in terms of the agricultural environment. When compared to other developing nations, the evidence available demonstrates that Greece has a well-developed and robust broadcasting system. The immense promise of these media for farmers in agriculture has not yet been completely realized, however, due to a variety of factors, including the high cost of transmission and the lack of an appropriate framework for integrating the media into the agenda for agricultural growth. The media system, however, is heavily centralized and concentrated in metropolitan areas [45,46]. As a result, very little of the necessary information reaches the rural areas, where the majority of the population resides and where the real farming is done [4].

Media outlets may convey important knowledge about current agricultural methods, best practices, weather predictions, pest control approaches, and market trends. This information enables farmers to make wise choices that increase crop yields and overall production [21]. According to studies, media programs may instruct farmers in new skills and procedures by providing step-by-step instructions and visual examples [6,47]. This may include techniques for effective irrigation, soil management, crop rotation, and equipment utilization. Farmers that use these abilities may get better results and make the most of their resources. The houses of farmers may be visited by agricultural specialists, scientists, and researchers thanks to media programs. With this access to professional guidance, farmers may more easily solve issues, comprehend complicated ideas, and get tailored solutions based on their unique situation [27].

Smallholder farmers have difficulties at every stage of the agricultural process, from crop planning and input acquisition through harvest, processing, and product sales. Insufficient knowledge is a major cause of many of these difficulties [10]. For instance, financial illiteracy and the inability to give the information required by financial institutions for credit analysis and loan assessment may make it more difficult for smallholder farmers to acquire better credit facilities. In order to build stronger and more direct connections with consumers, smallholder farmers would benefit from having access to information about the weather and climate, as well as knowledge of planting methods and inputs that are specific to a given plot [44]. With real-time and accurate data available to smallholder farmers at every step of the agricultural cycle, frontier technologies may play a part in reducing these information asymmetries.

The planning step (crop selection, input acquisition, and soil preparation) is crucial for the entire value of smallholder farmers' agricultural production. Smallholder farmers make decisions on what, when, where, and which plants to grow at this stage, taking into account the needs for available space, sunlight, water, and other elements [48].

Planting, observing, and harvesting are all parts of the production process, which makes use of resources including soil, water, and energy. To conserve money and natural resources, it is intended to make it possible for smallholder farmers to participate in specialized production at a greater level of productivity. When deciding how to employ resources, smallholder farmers must consider the long term in order to make adequate income to support themselves. Additionally, they need to understand how to modify their production techniques following any potential trends in meteorological circumstances [49].

The step of processing and selling is crucial for farmer earnings because it links rural agricultural produce to urban and international customers. Smallholder farmers are better equipped to take advantage of new market possibilities and sell their agricultural goods to an increasingly urban customer base when they can integrate output into fully developed agricultural value chains. Additionally, it promotes spending to increase agricultural output [48].

2.5 Farm Productivity

According to Gollin [29], productivity is typically defined as a ratio of a volume measure of output to a volume measure of input use. Productivity, at its most basic level, quantifies how much is produced by a target group, whether it is a nation, industry, sector, farm, or almost any other target group, given a certain set of resources and inputs. Any geographic scale allows for the measurement of productivity for a single unit (farm, commodity), a collection of farms, or both. Micro-based measurements are necessary, for instance, if the goal is to compare agricultural production. Macro measurements are necessary if it is necessary to assess national agriculture policy at the level of the nation [50]. The national economy may be compared using the same comparison that applies to the sector [5,33]. The measurement problems involved in obtaining the various indicators are the same, even though the ultimate objective may vary. Measuring farm-level productivity for a single commodity and input (for instance, labour productivity of maize farms) may only require the most fundamental data on output quantities and input use, whereas producing aggregated measures typically requires pricing outputs and inputs [22].

Zikhali [45] noted that as the quantity of work utilised per hectare grows due to either an increase in cultivated area or an increase in cropping frequency, there will likely be greater demand for farm labourers as agricultural productivity rises. The amount of additional work required mostly relies on the technology employed to boost production or the changes in output composition that occur [21]. A novel agricultural technology could increase worker productivity, decrease input consumption, increase yields, or, in the instance of a short-season maize variety, permit an increase in the size of the farmed area [51]. The first will likely lead to a rise in profit but not in output, and it may lead to a decrease in employment; the second will likely lead to an increase in output and employment but not necessarily in profits; and the third will likely boost labour compensation but maybe at the cost of employment, with an unknown impact on production [5]. The last option may increase production, employment, and profits, but it may also reduce yields. New technology may also cause a shift in the output's crop composition towards ones that need more or less labour [18,52].

Danso-Abbeam et al. [53] noted that how yields are measured and whether to estimate overall yields or individual yields are the primary concerns in any empirical research that looks at crop yield estimations. Many countries routinely use the crop cut and farmer recall methodologies to assess agricultural output. These methods for calculating estimated yields include surveying farmers to get their estimates of the total crop they collected and dividing that quantity by their estimates of the area of land they planted [51–53]. According to the research that is presently available, both crop-cut and farmer-estimate methodologies have inherent biases and issues when estimating the crop yields for home farms [38,54]. Numerous studies have shown that farmer memory production estimations were only marginally higher than crop-cutting yield estimates, which were 14% to 38% higher than whole plot reference harvests [55].

The estimations provided by farmers do not necessarily result in a larger total error than those created using the crop-cut method, however, empirical evidence is increasingly showing [21,53]. Even if the farmer estimating approach has its challenges, this is still the case. However, it has been shown that mixed cropping (or intercropping), which may make it impossible to establish the actual area used for different crops, makes it difficult to measure and comprehend data on significant individual crop yields in many developing countries' agricultural systems [8,49]. Two crops may share a plot for a brief period during the growing season or for the entire year, or they may do so at different times of the year. Examples include one crop occupying space within the plot that would otherwise be occupied by another, one crop being added between rows of another crop that has been planted at its normal density, and more [2].

3. Methodology

3.1 Research Design

To comprehend the role of agricultural extension services and how they affect farm production, the researcher used a cross-sectional survey approach. In order to gather data, a survey was created and sent through email. The survey included a variety of multiple-choice and Likert-scale items. Using this method, the researchers successfully combined the many tendencies that the data collection indicated. Sent to a sample of farmers who represented all of Europe, the survey was sent to farmers.

3.2 Study Area

The study was conducted in Greece, a country with diverse agricultural landscapes and production systems. The plains of Thessaly are characterized for their intensive crop production systems while the mountainous regions of Epirus and Macedonia are characterized by predominant livestock farming. The agricultural system of Greece is diverse, and both intensive and extensive farming exist, and a high percentage of the population is involved in agricultural activities. The replacement of Greece as the study area gives the opportunity to study the effect of agricultural extension services in a context which is characterized by varied agricultural practices and climatic conditions. This geographical reach also makes it possible to examine to what extent agricultural extension services can be designed to fit the specific farmer's needs in different agro-environments of the EU regionally.

3.3 Target Population

The focus of this survey was professional farmers in Greece, including those who are engaged in agricultural activities in various locations in the country. These include small-scale farmers who operate on family labor, medium-scale farmers who supplement family labor with others, and large-scale farmers whose operations occupy large areas. The objective of the study was to cover as wide a range of agricultural practices as possible, from traditional methods of farming to modern ones that use technologically advanced farming methods. The intended beneficiaries with a chosen category of farmers who engage in production and have a deeper interest in their productivity and sustainability were the farmers. These farmers are impacted by the extension services rendered to them by government and private entities. Thus, it is critical to consider their feedback to assess the effectiveness of the services.

3.4 Sample

A sample size of 382 farmers was selected for the study based on a study population of 150,000 accessible farmers. This was determined using the formula developed by Yamane [56] as below.

$$n = \frac{N}{1 + N(e)^2}$$

where n = sample size sought

N = population

e = level of significance

1 = constant

Using a 5% (0.05) level of significance,

Sample size

$$n = \frac{150{,}000}{1+150{,}000(0.0025)}$$

$$n = 382$$

All respondents managed to respond to the questionnaire hence 100 percent response rate was obtained.

3.5 Data Collection

The research employed a questionnaire with closed-ended questions as a technique for collecting data from the 382 professional farmers in Greece. The questions were created utilizing the nominal scale of the three study goals. The selected farmers received the survey questionnaire after the previous agreement. Dissemination was under the control of the researchers. Respondents also received the survey surveys by email at the same time. A week (by email) was given to participants to complete the survey once it was sent. After the time for participation had passed, the researcher gathered a raw data file from experts in the field of agriculture for data analysis.

3.6 Data Analysis

The data collected was analyzed by means of ordered logistic regression, a statistical tool adequately designed to statistically predict ordinal dependent variables, such as Likert scale responses, which were used to categorize farm productivity. The data had to be edited and coded as part of the quantitative data analysis procedure. The Statistical Package for Social Sciences (SPSS) 20.0 version was used to enter the data into the computer for analysis. Ordered logistic regression enabled the analysis of the influence of different dependent variables (e.g., agricultural training workshops and training, access to demonstration farms, media-based agricultural programs) as well as farm productivity level. The dependent variable in our analysis is farm productivity which has encapsulated ordered levels based on responses to the Likert scale questions. Independent variables were the agricultural workshops and training, the government's demonstration farms, media-based agricultural programs, and other control variables which included farmers' education level and use of agricultural machinery. These variables are hypothesized to affect farm productivity, and the ordered logistic regression model provides an idea about the extent and size of the impact. The ordered logistic regression model estimated the probabilities of the dependent variable being the representative of the categories, taking into account the predictors. By this, it answered the Likert-like data without assuming equal intervals of the categories. This was obtained via odds ratios calculated for each predictor, implying the expected change in odds of being in higher versus lower productivity categories for a one-unit increase in predictor. The coefficients from the ordered logistic regression were used as the log-odds ratios. The positive coefficient demonstrated that the higher odds of being in the more productive category would be displayed when the predictor variable is increased, while the negative coefficient showed otherwise. The significance of those coefficients was tested in order to ensure their reliability.

The ordered logistic regression model was mathematically represented as follows:

$$\text{Logit}[P(Y \leq j \mid X)] = \alpha_j - (\beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5)$$

where:

Y represents the ordered categorical dependent variable corresponding to farm productivity levels (with categories ranging, for example, from 1 to 5 based on the Likert scale).

j indexes the categories of Y, such that = 1, 2,..., −1 j = 1, 2,..., j−1 for j categories in total.

X_1, X_2, X_3, X_4, X_5, represent the independent variables: X_1 for agricultural workshops and training, X_2 for access to government demonstration farms, X_3 for media-based agricultural programs, X_4 for farmers' education, and X_5 for the use of agricultural machinery.

β_1, β_2, β_3, β_4, β_5, are the coefficients for the respective independent variables, indicating the strength and direction of their associations with the odds of achieving a certain level of farm productivity.

α_j are the threshold parameters (or cutpoints) specific to the transition between adjacent categories of Y. These parameters allow the model to account for the ordered nature of the dependent variable by defining the points along the latent variable scale at which the probability of moving from one category to the next changes.

$P(Y \leq j \mid X)$ is the cumulative probability that Y falls in category j or below, given the predictors X.

Interpretation

Coefficients (β): A positive coefficient (β_k>0)for an independent variable suggests that increases in this variable are associated with higher odds of the farm being in a higher productivity category, controlling for other factors. Conversely, a negative coefficient (β_k<0) indicates that increases in this variable are associated with lower odds of being in a higher productivity category.

Threshold Parameters (α): These parameters define the points along the continuum of the underlying latent variable (representing farm productivity) at which the probability of moving into a higher category of the observed ordinal outcome changes. Each threshold corresponds to the boundary between two adjacent categories of the dependent variable.

In the regression analysis, the categorical variables above were converted into dummy variables to allow for their inclusion in the model. For example X_1 had two dummy variables for X_1: dx11 = 1 if X_1 = 2 and 0 otherwise; dx12 = 1 if X_1 = 3 and 0 otherwise.

The decision rule, which states that if $p < 0.05$, the null hypothesis should be accepted, and if $p > 0.05$, the null hypothesis should be rejected, determines whether the null hypothesis should be accepted or rejected. The 5% level of significance (0.05) was used to assess the study's assumptions.

4. Results

4.1 Bio Data of Respondents

The majority of the participating farmers (55.8%) were male and only 44.2% were female. In regard to the age bracket, the majority (46.9%) were in the bracket of 36–45 years and only 2.4% were below 25 years. Most participating farmers (87.9%) were degree holders implying that most farmers were highly educated and hence had the ability to answer the questions on extension services in agriculture and farm productivity. The results also clearly show that most participants (44.2%) had experience of 5–15 years in the farming sector which is a good experience (Table 1).

Table 1. Personal information of respondents.

	Frequency	Percent
Gender		
Male	213	55.8
Female	169	44.2
Age bracket		
Below 25 years	9	2.4
25–35 years	125	32.7
36–45 years	179	46.9
Above 45 years	69	18.0
Education qualification		
Certificate	14	3.7
Diploma	32	8.4
Degree	336	87.9
Experience in the farming sector		
Below 5 years	78	20.4
5–15 years	169	44.2
Above 15 years	135	35.4
Total	**382**	**100**

Source: Primary data (2023).

4.2 Descriptive Results

The study examined the effect of agricultural workshops and training on farm productivity and the results are presented in Table 2.

The results in Table 2 show that most respondents (56.5%) agree that learning directly from successful farms by observing their practices is very essential. It was revealed by 69.3% of participants that webinars or structured online courses that participants can access remotely help farmers. Furthermore, 52.3% of respondents agreed that practical sessions conducted on farms to showcase techniques in real-world settings are very important. It was revealed by 39.7% of respondents that workshops emphasize sustainable farming practices that focus on soil health. Also, most respondents (47.3%) agreed that training programs can help farmers develop their skills and capabilities in various aspects of agriculture. It was revealed by 42.6% of respondents that workshops provide opportunities for farmers to interact with experts, researchers, and fellow farmers.

The study also examined the effect of access to government demonstration farms on farm productivity and the results are presented in Table 3.

From the results in Table 3, most respondents (48.7%) agreed that government demonstration farms often showcase modern and improved farming techniques. It was revealed by 39.5% of study participants that demonstration farms often introduce farmers to improved crop varieties that are more resistant to diseases. Most participants (57.1%) agreed that exposure to innovative farming techniques and technologies can inspire farmers to experiment with new ideas and approaches. Most respondents (59.4%) agreed that demonstration farms often bring together farmers, researchers, and agricultural experts. It was revealed by the majority of study participants (65.2%) that successful demonstration farms can influence government policies and programs related to agriculture. Finally,

Table 2. Results on the effect of agricultural workshops and training on farm productivity.

Statement	%	SD	D	NS	A	SA
Learning directly from successful farms by observing their practices is very essential.	%	4.7	4.2	1.7	56.5	33.0
Webinars or structured online courses that participants can access remotely help farmers.	%	7.3	6.7	7.5	69.3	9.2
Practical sessions conducted on farms to showcase techniques in real-world settings are very important.	%	6.8	4.6	7.0	52.3	19.3
Workshops emphasize sustainable farming practices that focus on soil health.	%	9.3	4.7	16.1	39.7	30.2
Training programs can help farmers develop their skills and capabilities in various aspects of agriculture.	%	8.0	6.2	27.8	47.3	10.7
Workshops provide opportunities for farmers to interact with experts, researchers, and fellow farmers.	%	6.1	5.3	12.7	42.6	32.4

Note: SD = Strongly disagree, D = Disagree, NS = Not sure, A = Agree, and SA = Strongly agree.

most participants (49.2%) agreed that government demonstration farms might provide farmers with access to resources such as improved seeds.

The study also identified the effect media based agricultural programs on farm productivity and the results are presented in Table 4 below:

Table 3. Results on access to government demonstration farms on farms.

Statement	%	SD	D	NS	A	SA
Government demonstration farms often showcase modern and improved farming techniques.	%	4.2	9.9	10.7	48.7	23.1
Demonstration farms often introduce farmers to improved crop varieties that are more resistant to diseases.	%	9.2	13.3	18.3	39.5	19.7
Exposure to innovative farming techniques and technologies can inspire farmers to experiment with new ideas and approaches.	%	8.1	12.7	10.8	57.1	11.3
Demonstration farms often bring together farmers, researchers, and agricultural experts.	%	3.0	10.9	12.5	59.4	14.3
Successful demonstration farms can influence government policies and programs related to agriculture.	%	6.5	9.4	13.7	65.2	1.6
Government demonstration farms might provide farmers with access to resources such as improved seeds.	%	9.0	10.1	8.0	49.2	20.3

Note: SD = Strongly disagree, D = Disagree, NS = Not sure, A = Agree, and SA = Strongly agree.

Table 4. Effect media-based agricultural programs on farm productivity.

Statement	%	SD	D	NS	A	SA
Media platforms like television, radio, podcasts, and online videos can disseminate valuable agricultural knowledge to farmers.	%	15.0	3.7	1.3	59.1	20.2
Media programs often showcase practical demonstrations of various agricultural practices.	%	17.0	5.0	7.0	65.3	5.7
Media programs can offer guidance on optimal planting times, and crop rotation strategies.	%	5.0	7.2	12.0	58.3	17.5
Many media platforms provide weather forecasts that are crucial for agricultural planning.	%	8.3	10.7	21.3	49.3	10.3
Media programs can play a crucial role in empowering women farmers by providing them with access to information.	%	3.3	19.5	18.7	35.2	23.3

Note: SD = Strongly disagree, D = Disagree, NS = Not sure, A = Agree, and SA = Strongly agree.

Most respondents (59.1%) agreed that media platforms like television, radio, podcasts, and online videos can disseminate valuable agricultural knowledge to farmers. It was revealed by 65.3% of study participants that media programs often showcase practical demonstrations of various agricultural practices. Furthermore, most participants (58.3%) agreed that media programs can offer guidance on optimal planting times and crop rotation strategies. Relatedly, most respondents (49.3%) agreed that many media platforms provide weather forecasts that are crucial for agricultural planning. Finally, most participants (35.2%) agreed that media programs can play a crucial role in empowering women farmers by providing them with access to information.

The study also established the different aspects of farm productivity and the results are presented in Figure 1 below:

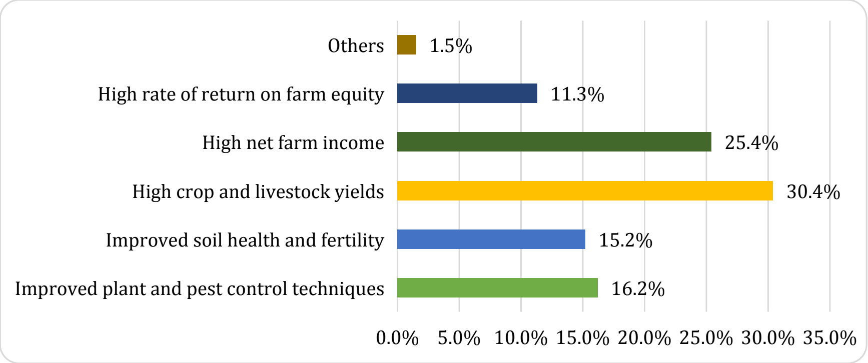

Figure 1. Aspects of farm productivity.

Source: Primary data (2023).

Results in Figure 1 show that farm productivity is mostly associated with High crop and livestock yields (30.4%) followed by High net farm income (25.4%), Improved plant and pest control techniques (16.2%), High rate of return on farm equity (11.3%) and the least number of participants (1.5%) mentioned other aspects of farm productivity.

The results in Table 5 provide an insightful breakdown of farm productivity among the 382 surveyed farmers.

Table 5. Farm productivity results.

Farm productivity categories	Frequency	Percentage
Low (Below $7,000)	82	21.5%
Moderate ($7,000–$12,000)	180	47.1%
High ($12,000–$18,000)	90	23.6%
Very high (Above $18,000)	30	7.9%
Total	382	100%

The results in Table 5 show that the majority of respondents (47.1%) fall within the moderate category, with farm productivity ranging from $7,000 to $12,000. This suggests that a substantial proportion of farmers in the sample achieve a moderate level of farm output in terms of income. These farmers likely demonstrate a balance between productivity and economic returns, indicative of a stable and sustainable farming approach. Following closely, 23.6% of respondents belong to the high farm productivity category, reporting incomes in the range of $12,000 to $18,000. This signifies a considerable portion of farmers who have attained a higher level of productivity, possibly through effective agricultural practices, access to resources, and successful implementation of extension services. Furthermore, 21.5% of respondents fall into the low farm productivity category, indicating incomes below $7,000. While this segment represents the smallest percentage, it is crucial to acknowledge the challenges and disparities that farmers in this category may face. Lastly, the very high farm productivity category, encompassing incomes above $18,000, is represented by 7.9% of respondents. This minority group showcases a notable achievement in farm productivity, potentially indicating advanced farming techniques, optimal resource utilization, or successful integration of extension services.

4.3 Regression Analysis

Table 6 shows the findings from an ordered logistic regression examining how several factors can influence farm productivity levels. Each column corresponds to a dependent variable respectively and describes how the independent variables affect the probability of an individual firmly falling into highly productive categories. The coefficients, standard errors, z-statistics, p-values, and confidence intervals play a very important role in understanding the link between these variables and farm efficiency.

The positive coefficient (0.1975) for workshops and training suggests that participation in these activities is associated with an increase in farm productivity levels. The coefficient indicates the change in the log odds of being in a higher productivity category for a one-unit increase in workshops and training, holding other variables constant. Although the p-value (0.081) is slightly above the conventional threshold of 0.05, it suggests a trend towards significance, indicating that workshops and training may positively influence farm productivity, warranting further investigation.

The coefficient of government demonstration farms indicates a positive impact, which indicates a beneficial effect of government demonstration farms on productivity, potentially through exposure to modern farming techniques and technologies.

Similar to workshops and training, media programs have a positive coefficient (0.1978), suggesting that exposure to agricultural information through media can also positively influence farm productivity. The marginal p-value (0.082) indicates a potentially positive relationship, suggesting that media as a tool for disseminating agricultural knowledge and practices may enhance productivity levels, though further research is needed for stronger conclusions.

Table 6. Regression coefficients and statistical significance.

Variable	Coefficient	Standard error	z-statistic	P-value	95% confidence interval
Workshops and training	0.1975	0.113	1.743	0.081	–0.025 to 0.420
Government demonstration farms	0.0815	0.112	0.728	0.001	–0.301 to 0.138
Media programs	0.1978	0.114	1.737	0.082	–0.025 to 0.421
Farmers education	0.0995	0.065	1.541	0.023	–0.226 to 0.027
Agricultural machine use	0.1106	0.184	–0.600	0.009	–0.472 to 0.251
Thresholds (1/2, 2/3, 3/4, 4/5)	Coefficients vary	-	-	-	-

The coefficient of Farmers' Education (0.0995) with a p-value (0.023) suggests a statistically significant positive relationship between farmers' education levels and farm productivity. This result implies that higher education levels among farmers are associated with improvements in farm productivity, possibly due to better management practices, improved decision-making, and greater efficiency in adopting new technologies.

The coefficient for agricultural machine use (0.1106) indicates a relationship with farm productivity, but the interpretation requires correction. Typically, a positive coefficient would suggest that the use of agricultural machinery is associated with higher productivity levels, reflecting the benefits of mechanization in reducing labor and increasing efficiency. However, the significance and direction of this relationship should be accurately reflected based on the actual table values and analysis.

Thresholds for Productivity Levels indicate the model's capability to differentiate between various productivity levels, with coefficients for thresholds providing insights into the transitions between categories. However, specific coefficients and interpretations would require accurate data to provide meaningful insights.

Table 7 presents the coefficients for the thresholds between different levels of farm productivity as determined in the ordered logistic regression analysis. These thresholds are essentially cut-off points that separate the ordered categories of the dependent variable, which in this case, are the different levels of farm productivity on a Likert scale.

The coefficient for the 1/2 threshold is −1.4786, with a statistically significant p-value of 0.001. This significant negative coefficient indicates a clear demarcation between the lowest productivity level (1) and the next higher level (2). The negative value suggests that as the predictors increase, the likelihood of a farm being in the lowest productivity category (level 1) compared to higher categories decreases. The significance of this threshold implies a strong differentiation between the lowest levels of productivity and those slightly above it.

The coefficient for the 2/3 threshold is 0.1273, but with a p-value of 0.234, indicating that this coefficient is not statistically significant. This suggests that the model does not find a statistically significant difference between productivity levels 2 and 3. In practical terms, it means that the transition from level 2 to level 3 productivity, as influenced by the independent variables in the model, is not as clearly defined or significant as other thresholds.

The coefficient for the 3/4 threshold is 0.0366 with a p-value of 0.694, which is also not statistically significant. Similar to the 2/3 threshold, this indicates that the difference between productivity levels 3 and 4, as determined by the predictors in the model, does not have a significant demarcation. Farms moving from level 3 to 4 productivity do not exhibit a statistically significant change based on the model's independent variables.

The coefficient for the 4/5 threshold is 0.3702 with a highly significant p-value of 0.000. This indicates a significant differentiation between the productivity levels 4 and 5. The positive coefficient suggests that as the predictors increase, the likelihood of a farm being categorized in the highest productivity level (5) compared to lower levels increases significantly. This threshold is particularly important because it signifies a substantial increase in the likelihood of achieving the highest productivity level, highlighting the impact of the independent variables on moving farms into the top productivity category.

The results in Table 8 show a positive standardized coefficient for agricultural workshops and training (Beta = 0.211, p = 0.002) suggesting a positive association with farm productivity. This implies that farms participating in agricultural workshops and training tend to have higher levels of productivity. The statistical significance of this coefficient strengthens the confidence in this relationship. This therefore meant that Agricultural workshops and training positively affect farm productivity, and this led to the acceptance of hypothesis one (H1). This means that Agricultural workshops and training positively affect farm productivity. For the categorical variable X_1, represented by dummy

Table 7. Thresholds for productivity levels.

Threshold	Coefficient	Standard error	z-statistic	P-value	95% confidence interval
1/2	−1.4786	0.463	−3.197	0.001	−2.385 to −0.572
2/3	0.1273	0.107	1.190	0.234	−0.082 to 0.337
3/4	0.0366	0.093	0.393	0.694	−0.146 to 0.219
4/5	0.3702	0.093	3.964	0.000	0.187 to 0.553

variables dx11 and dx12, the coefficients (Beta) are 0.045 and 0.077, respectively. These values indicate the additional impact on farm productivity when moving from the reference category (X_1 = 1) to X_1 = 2 and X_1 = 3. While dx11 is not statistically significant (p = 0.310), dx12 approaches significance (p = 0.078). This suggests that the effect of x1 on farm productivity may depend on the specific level.

Table 8. Regression of predictive Factors of farm productivity.

Predictive variables	Standardized coefficients (Beta)	Significance (p-value)
Constant	0.128	0.014
Agricultural workshops and training	0.211	0.002
dx11 (X_1 = 2)	0.045	0.310
dx12 (X_1 = 3)	0.077	0.078
Access to government demonstration farms	0.156	0.010
dx21 (X_2 = 2)	0.032	0.518
dx22 (X_2 = 3)	0.091	0.024
Media based agricultural programs	0.048	0.001
dx31 (X_3 = 2)	0.036	0.456
dx32 (X_3 = 3)	0.062	0.163

Concerning access to government demonstration farms, the positive Beta coefficient (0.156, p = 0.010) signifies a positive relationship with farm productivity. Farms with access to government demonstration farms tend to exhibit higher levels of productivity. Therefore, hypothesis two (H2) was accepted meaning that access to government demonstration farms positively influences farm productivity. The coefficients for dummy variables dx21 and dx22 associated with X_2 indicate the additional impact on farm productivity when transitioning from the reference category (X_2 = 1) to X_2 = 2 and X_2 = 3, respectively. Only dx22 is statistically significant (Beta = 0.091, p = 0.024), suggesting that the effect of X_2 may be more pronounced at the higher levels.

The values for media based agricultural programs (0.048, p = 0.001) are positive, indicating a positive statistically significant relationship with farm productivity. Therefore, hypothesis three (H3) was accepted meaning that media based agricultural programs have a positive effect on farm productivity. For X_3, represented by dummy variables dx31 and dx32, both coefficients are positive, but only dx32 is statistically significant (Beta = 0.062, p = 0.163). This is an indication that the impact of X_3 on farm productivity may be influenced by the specific level represented by dx32.

5. Discussion

The results show that; agricultural workshops and training positively affect farm productivity, access to government demonstration farms positively influences farm productivity, and that media based agricultural programs have a positive effect on farm productivity. Workshops and training in agriculture may have a very favorable impact on farm output. It's important to remember that the success of agricultural workshops and training might vary depending on many variables, including the training's quality, the information's applicability to local circumstances, the farmers' readiness to embrace new techniques, and the post-training assistance offered [24]. According to Sseguya et al. [57], agricultural extension may help consumers become better managers and problem solvers. It is common practice everywhere in the world to use this approach to transfer specialized information from the level of public policy or research to that of individual farms. The majority of industrialized nations have developed a system of consulting services for owners and managers of rural land, which is mostly supported by general taxes and provided by public institutions [38]. Nevertheless, when taken as a whole, it becomes evident that the primary objective of these organizations is to increase the agricultural sector's and farmers' individual and collective achievements. The private sector has since increased the availability of this type of government extension service [9]. The agricultural industry faces a variety of difficulties, including the need to strike a balance between increasing productivity to feed a rising world population and a decrease in negative environmental externalities, such as climate change [3,44]. Extension services are crucial in this situation because they might exert pressure on the larger agricultural and rural sectors to alter how people behave now. This devotion does, however, come with a financial problem as global economies negotiate the recent tumultuous macroeconomic cycles and there is a renewed focus on "value for money" measures. Examining the consequences of the current services might help to make future extension initiatives more focused, effective, and successful [3].

According to studies, farmers' choices to accept new technology and their levels of profitability are favorably influenced by their interactions with extension services [8,12,18]. For instance, according to Kaini [8], farmers who participate in extension programs are more likely to change their methods to increase long-term profitability. Similar results were obtained by Ghimire et al. [31], who discovered that participatory extension had a favorable influence on technology uptake and profitability. The latter idea is the main subject of this research, which looks at the connection between farm revenue and extension operations. According to more recent research by Blázquez et al. [47], participation in extension programs boosted consumer growth in Ethiopia by 7.1% and decreased headcount poverty by 9.8%. Several direct and indirect influences on agricultural production, including access to government demonstration farms, are possible. These outcomes may change depending on elements including the quality of the demonstration farms, the agricultural methods being promoted, and the degree of assistance given to nearby farmers [20]. Government demonstration farms often display cutting-edge and improved agricultural methods. As farmers embrace more productive and efficient agricultural techniques, there may be an increase in production as a result of this knowledge transfer [17,53]. Demonstration farms are often created to demonstrate best practices in several facets of agriculture, including crop selection, soil management, pest control, irrigation techniques, and more [1,37].

Local farmers who embrace these best practices are likely to see increased yields and higher-quality finished goods [12]. It's crucial to remember that the success of government demonstration farms might vary based on factors including accessibility, the quality of training and extension services, the openness of farmers to adopting new methods, and the agro-climatic conditions in the area [10,58]. It is essential to monitor and assess the effectiveness of such initiatives to make sure they are accomplishing their stated objectives of boosting agricultural output and enhancing livelihoods [17]. By giving farmers useful information, instruction, and assistance, media-based agricultural initiatives may significantly impact farm production. Farmers may have access to important agricultural information via media channels including television, radio, podcasts, and internet videos. This may contain details on cutting-edge agricultural practices, crop management, pest control, irrigation systems, soil health, and other topics [16,17,59]. When farmers have access to the most recent information, they may make better choices that will increase their yields. Media shows often include real-world examples of different farming techniques. Watching these demos may help farmers learn how to utilize new equipment and technology efficiently [21,45]. It's crucial to remember that the success of agricultural initiatives that use media also relies on a number of other elements, including local context, language obstacles, accessibility to media, and content quality. These initiatives should be well-thought-out, catered to the requirements of the intended audience, and supported by other extension services and regional agricultural organizations to have the greatest possible effect [24,26,60].

According to Mgendi et al. [61], an increase in productivity is only conceivable if there is a discrepancy between the current and prospective output. Research shows that extension services play a crucial role in the dissemination of knowledge to farmers, and economic development and growth now need capacity building and training [21]. According to Normile and Leetmaa [61], personal production is captured by individual efficiency and they further claim that innovation as a cultural practice brings new goods and advancements in the agriculture industry [35]. According to their results, advances in human capital have led to an approximately 30.0 percent rise in total factor productivity. The difference in farm structures between those who get extension services and those who do not is reflected in the impact of extension access on farm production. This implies that other significant identifying characteristics of the farmer may have a larger influence on the effect of extension services on farm production [29]. According to Ragasa et al. [12], farmers may profit in various ways from extension services, which is relevant to this. For example, a risk-averse farmer would gain more than one who is less risk-averse, since the latter is less likely to accept new technology.

Extension is to make it easier for farmers to identify, evaluate, and make decisions regarding profitable and sustainable farming [62]. Links to knowledge and research are important because they provide a means of developing, producing, and disseminating a research agenda that is pertinent to improving farmer practice [12,18]. On the other hand, Wickramasinghe [10] claims that one of the factors affecting the global sustainability and productivity of the agricultural sector is the effectiveness and quality of extension services. Observations show a mismatch between agricultural performance and information available from studies conducted in developing countries. This has been attributed to both poor extension service delivery and a lack of interaction between extension employees and knowledge providers [21,63,64]. The transfer of knowledge and cutting-edge technologies to farming communities has also been shown to be hampered by a lack of communication among extension service providers, particularly among the ministries of agriculture and higher education and other relevant ministries, research institutions, NGOs, and farmers. The knowledge that is given would be of higher quality and farmers would be encouraged to use new technologies, which would increase agricultural production and improve the lives of rural poor people [30, 34, 59, 65].

6. Conclusions

The study illustrates the significant role of agricultural extension services as a panacea globally for improving farm productivity. Policymakers must capitalize on that to scale up agricultural growth and thus play a key role in the fight against poverty and overall development. The study reveals that extension services had a less notable albeit positive impact on agricultural outputs after controlling the unseen choices than the studies that indicated a dominant effect of extension access on farm-level results. ICT and low literacy rates in the developing world, farmers often depend on extension service which provides information about farming techniques, fertilization, plant protection, marketing, livestock and crop management, climate change, and so on. In particular, this work shows the positive resources of the workshop and the training, access to government demonstration farms and the media-based agricultural programs on farm productivity. The results demonstrate the significance of training workshops in farm output, but the outcome could differ, for example, due to issues like learning quality, practical applicability of the information in local settings, farmers' readiness for changes, and follow-up support. The accessibility of government demonstration farms, which are discussed in the study, is a very important tool for farmers who want to enhance the productivity of their farm by learning new technologies and advanced farming practices first-hand. This confirms the advice for governments to help farmers obtain these resources and shows the function of public extension and advisory services as a major support for farmers who can't afford private services. From the standpoint of the policy, the study put forward additional investment in the agricultural extension services sector, for instance, increasing the number of people working there, financial resources, and logistics to deliver these services worldwide. Such investments would, therefore, not only increase the agricultural productivity and farm incomes but also significantly add to the family income. The study further proposes the advocacy for agricultural loans' accessibility and the creation of farmer groups, such as associations of farmers, to realize the full potential of the agricultural extension service delivery.

A positive relationship between the efficacy of agricultural workshops, training, and farm productivity is clear. Governments with the support of agricultural organizations should be investing more in the development of practical training and workshops that will be provided to farmers. Such projects should respond to the specific local agricultural challenges and opportunities of the area and provide training that is applicable and useful. Developing partnerships with agricultural research organizations to keep training content new with the latest innovations and practices is vital as well.

The positive impact of demonstration farms owned by the government on farm productivity shows that the government need to intensify efforts in establishing more of these farms in different agro-ecological regions. These farms should be a learning tool for farmers, demonstrating new agricultural methods, conservation procedures, advanced crop varieties, and simplified farm operations. As such, there need to be efforts put in place to ensure that the practice farms are not only close to the farmer communities but also accessible to all other communities including the remote and marginalized ones.

With the noticeable impact of media-based agricultural programs on yield production, governments and NGOs must come together with media stations to air informative programs on how to farm. These programs can cover quite a broad scope of issues, including crop management, pest control, market access, and climate-smart agriculture. Ensuring that local dialects and cultures are integrated into these programs would make them more effective. Added to this, social media, websites, and mobile apps among other platforms have to be utilized to reach the younger farmers and those in remote areas.

Author Contributions

Conceptualization, S.K., and D.S.; methodology, S.K.; software, D.S.; validation, S.K.; formal analysis, D.S.; investigation, S.K.; data curation, D.S.; writing—original draft preparation, S.K.; writing—review and editing, S.K. and D.S.; supervision, S.K. All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Data Availability

The primary data used in this study is available and can be availed by the author upon request.

Conflict of Interest

The author disclosed no conflict of interest.

References

[1] Lampach, N., Nguyen-Van, P., Nguyen-Anh, T., 2021. The role of agricultural extension programs on crop farming technical efficiency. Preprint. DOI: https://doi.org/10.21203/rs.3.rs-891170/v1

[2] Bitzer, V., 2016. Incentives for enhanced performance of agricultural extension systems. Kit Sustainable Economic Development & Gender. 6, 1–8.

[3] Irz, X., Lin, L., Thirtle, C., et al., 2001. Agricultural productivity growth and poverty alleviation. Development Policy Review. 19(4), 449–466. DOI: https://doi.org/10.1111/1467-7679.00144

[4] Tivy, J., 2020. Agricultural productivity. Agricultural ecology. Routledge: London. pp. 98–122.

[5] Lee, Y., An, D., Kim, T., 2020. The effects of agricultural extension service on crop production, revenue, and profit: Evidence from Mbale district in Uganda. Korean Agricultural Economics Association. 61(3), 161–179. (in Korean). DOI: https://doi.org/10.24997/kjae.2020.61.3.161

[6] Sebaggala, R., Matovu, F., 2020. Effects of agricultural extension services on farm productivity in Uganda. African Economic Research Consortium—AERC: Nairobi.

[7] Kalogiannidis, S., Kalfas, D., Giannarakis, G., et al., 2023. Integration of water resources management strategies in land use planning towards environmental conservation. Sustainability. 15(21), 15242. DOI: http://dx.doi.org/10.3390/su152115242

[8] Kaini, M., 2020. Role of agriculture in ensuring food security. International Journal of Humanities and Applied Social Science. DOI: https://doi.org/10.33642/ijhass.v5n1p1

[9] Giller, K.E., Delaune, T., Silva, J.V., et al., 2021. The future of farming: Who will produce our food? Food Security. 13, 1073–1099. DOI: https://doi.org/10.1007/s12571-021-01184-6

[10] Wickramasinghe, G.A.U., 2018. Fostering productivity in the rural and agricultural sector for inclusive growth in Asia and the Pacific. Asia-Pacific Development Journal. 24(2), 1–22. DOI: https://doi.org/10.18356/f85ba82d-en

[11] Evenson, R.E., Mwabu, G., 2001. The effect of agricultural extension on farm yields in Kenya. African Development Review. 13(1), 1–23. DOI: https://doi.org/10.1111/1467-8268.00028

[12] Ragasa, C., Mazunda, J., 2018. The impact of agricultural extension services in the context of a heavily subsidized input system: The case of Malawi. World Development. 105, 25–47. DOI: https://doi.org/10.1016/j.worlddev.2017.12.004

[13] Kalogiannidis, S., Chatzitheodoridis, F., Kalfas, D., et al., 2023. Socio-psychological, economic and environmental effects of forest fires. Fire. 6(7), 280. DOI: https://doi.org/10.3390/fire6070280

[14] OECD, 2021. Agriculture policy (Dimension 14). Competitiveness in South East Europe 2021. OECD: Paris. DOI: https://doi.org/10.1787/9b8c3a5d-en

[15] Kalogiannidis, S., Papadopoulou, C.I., Loizou, E., et al., 2023. Risk, vulnerability, and resilience in agriculture and their impact on sustainable rural economy development: A case study of Greece. Agriculture. 13(6), 1222. DOI: https://doi.org/10.3390/agriculture13061222

[16] Lampach, N., Phu, N.V., The, N.T., 2021. The effect of agricultural extension programs on technical efficiency of crop farms in low and middle-income countries. DOI: https://doi.org/10.2139/ssrn.3208034

[17] Ahmad, S., Jamal, M., Ikramullah, A., et al., 2007. Role of extension services on the farm productivity of District Swat (a case study of two villages). Sarhad Journal of Agriculture. 23(4), 1265–1271.

[18] Boix-Fayos, C., de Vente, J., 2023. Challenges and potential pathways towards sustainable agriculture within the European Green Deal. Agricultural Systems. 207, 103634. DOI: https://doi.org/10.1016/j.agsy.2023.103634

[19] Chatzitheodoridis, F., Melfou, K., Kontogeorgos, A., et al., 2023. Exploring key aspects of an integrated sustainable urban development strategy in Greece: The case of Thessaloniki City. Smart Cities. 6(1), 19–39. DOI: http://dx.doi.org/10.3390/smartcities6010002

[20] FAO and ITU, 2020. Status of digital agriculture in

18 countries of Europe and Central Asia. FAO and ITU: Geneva.
[21] Wesley, A., Faminow, M., 2014. Research and Development and Extension Services in Agriculture and Food Security [Internet]. Asian Development Bank. Manila, Philippines. Available from: https://www.adb.org/sites/default/files/publication/151701/ewp-425.pdf
[22] Okafor, G.O., Malizu, C.F., 2013. New media and sustainable agricultural development in Nigeria. New Media and Mass Communication. 20, 66–73.
[23] Wonde, K.M., Tsehay, A.S., Lemma, S.E., 2022. Training at farmers training centers and its impact on crop productivity and households' income in Ethiopia: A propensity score matching (PSM) analysis. Heliyon. 8(7), e09837.
DOI: https://doi.org/10.1016/j.heliyon.2022.e09837
[24] Kosim, M., Aji, J.M.M., Hapsari, T.D., 2021. The impact of agricultural extension on productivity of smallholder sugarcane farmers in East Java. IOP Conference Series: Earth and Environmental Science. 892(1), 012009.
DOI: https://doi.org/10.1088/1755-1315/892/1/012009
[25] Samsudin, M., & Bin, A. F. (2010). Agriculture Extension and Its Roles in Ensuring Food Safety, Quality and Productivity in Malaysia. Available from: https://www.nodai.ac.jp/cip/iss/english/9th_iss/fullpaper/1-2-1upm-Fikri.pdf
[26] Transforming Food Systems with Farmers: A Pathway for the EU [Internet]. World Economic Forum. Available from: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consulting/us-transforming-food-systems-farmers.pdf
[27] Mbise, M., 2016. The impact of extension services on agricultural production : A case of maize in Ludewa District of Njombe Region, Tanzania. Research Application Summary. 14(14), 105–111.
[28] Boosting Productivity in the Aftermath of COVID-19 [Internet]. International Monetary Fund. Available from: https://www.imf.org/external/np/g20/pdf/2021/061021.pdf
[29] Gollin, D., 2019. Farm size and productivity: Lessons from recent literature. IFAD Research Series. (34), 1-35.
[30] The Economic Lives of Smallholder Farmers [Internet]. Food and Agriculture Organization of the United Nation. Available from: https://www.fao.org/3/i5251e/i5251e.pdf
[31] Ghimire, R., Joshi, N., Ghimire, S., 2021. Agricultural extension services in Nepal: past, present, & future. bBook Innovations in Agricultural Extension published by Michigan State University.
[32] Impact Evaluation of the Farmer Training and Development Activity in Honduras [Internet]. NORC. Available from: https://www.oecd.org/countries/honduras/report-100512-evaluation-hon-farmer-training-and-development.pdf
[33] Productivity and Efficiency Measurement in Agriculture: Literature Review and Gaps Analysis [Internet]. FAO. Available from: https://www.fao.org/3/ca6428en/ca6428en.pdf
[34] Tambi, M.D., 2019. Agricultural training and its impact on food crop production in cameroon. Journal of Socioeconomics and Development. 2(1), 1-11.
DOI: https://doi.org/10.31328/jsed.v2i1.740
[35] Normile, M.A., Leetmaa, S.E., 2004. U.S.-EU Food and Agriculture Comparisons. Agriculture and Trade Report. WRS-04-04. Available from: https://www.ers.usda.gov/webdocs/outlooks/40408/30650_wrs0404_002.pdf?v=7245.3
[36] Papaevangelou, O., Syndoukas, D., Kalogiannidis, S., et al., 2023. Information technology and human resource management in educational institutions. Journal of System and Management Sciences. 13(2), 258–272.
DOI: https://doi.org/10.33168/JSMS.2023.0218
[37] Jelliffe, J., Gerval, A., Husby, M., et al., 2023. United Kingdom Agricultural Production and Trade Policy Post-Brexit. Available from: https://ageconsearch.umn.edu/record/333547
[38] Afin, R. Natural disasters, agricultural extension, and productivity: Empirical Evidence from Papua New Guinea. Available from: https://devpolicy.org/Events/2023/Workshop-on-Microeconomics-of-Development-in-the-Pacific_14-15Feb/Papers/7_Afin.pdf
[39] Agricultural Extension Manual for Extension Workers [Internet]. SAP & FAO. Available from: https://www.fao.org/3/ca5007en/ca5007en.pdf
[40] Kalfas, D., Kalogiannidis, S., Chatzitheodoridis, F., et al., 2023. Urbanization and land use planning for achieving the sustainable development goals (SDGs): A case study of Greece. Urban Science. 7(2), 43.
DOI: https://doi.org/10.3390/urbansci7020043
[41] World Bank, 2007. World development report 2008: Agriculture for development. The World Bank.

[42] Amone, W., 2014. Agricultural productivity and economic development in Uganda: An inclusive growth analysis [Ph.D. thesis]. Mbarara: Mbarara University of Science & Technology.
[43] Kalogiannidis, S., Kalfas, D., Chatzitheodoridis, F., et al., 2022. Role of crop-protection technologies in sustainable agricultural productivity and management. Land. 11(10), 1680.
DOI: https://doi.org/10.3390/land11101680
[44] World Bank, 2011. Growth and productivity in agriculture and agribusiness. World Bank: Washington, D.C.
DOI: https://doi.org/10.1596/978-0-8213-8606-4
[45] Zikhali, W., 2017. Impact of agricultural staff training and development on agricultural productivity: aA case of Bubi district, Zimbabwe. International Journal of Academic Research and Reflection. 5(3), 11-20.
[46] Kalogiannidis, S., 2021. Business trust and communication as predictors of business growth. WSEAS Transactions on Business and Economics. 18, 1512–1522.
DOI: https://doi.org/10.37394/23207.2021.18.138
[47] Cabrera Blázquez, F. J., Cappello, M., Talavera Milla, J., et al., 2022. Investing in European Works: The Obligations on VoD Providers. Strasbourg: European Audiovisual Observatory.
[48] Lemma, T., Sehai, E., Hoekstra, D., 2011. Status and capacity of farmer training centers (FTCs) in the improving productivity and market success (IPMS) pilot learning woredas (PLWs).
[49] Giller, K.E., Hijbeek, R., Andersson, J.A., et al., 2021. Regenerative agriculture: An agronomic perspective. Outlook on Agriculture. 50(1), 13–25.
DOI: https://doi.org/10.1177/0030727021998063
[50] Preparing for Future AKIS in Europe [Internet]. European Commission. Available from: https://agriculture.ec.europa.eu/document/download/576bd513-6809-4e28-b11c-057e2078ec5a_en?filename=report-preparing-for-future-akis-in-europe_en.pdf
[51] Ndaghu, A.A., Taru, V.B., 2013. Role of mass media in agricultural productivity in Adamawa State, Nigeria. Global Journal of Agricultural Sciences. 11(2), 111–116.
DOI: https://doi.org/10.4314/gjass.v11i2.7
[52] Kalogiannidis, S., Kontsas, S., Nikolaou, E.E., et al., 2023. The rationale of integrated planning and sustainable development strategies in the development of local government regional unit. Advances in empirical economic research. Springer: Cham.
DOI: https://doi.org/10.1007/978-3-031-22749-3_27
[53] Danso-Abbeam, G., Ehiakpor, D.S., Aidoo, R., 2018. Agricultural extension and its effects on farm productivity and income: Insight from Northern Ghana. Agriculture and Food Security. 7, 74.
DOI: https://doi.org/10.1186/s40066-018-0225-x
[54] Training Workshop on Agricultural Technology Transfter and Training [Internet]. Available from: https://www.apec.org/docs/default-source/Publications/2005/4/Training-Workshop-on-Agricultural-Technology-Transfer-and-Training-April-2005/05_atc_techtransfer.pdf
[55] Estimating Yield of Food Crops Grown by Smallholder Farmers [Internet]. International Food Policy Research Institute. Available from: https://core.ac.uk/download/pdf/6278813.pdf
[56] Yamane, T., 1973. Statistics: An introductory analysis. Harper & Row Ltd.: New York.
[57] Sseguya, H., Robinson, D.S., Mwango, H.R., et al., 2021. The impact of demonstration plots on improved agricultural input purchase in Tanzania: Implications for policy and practice. PLoS ONE. 16(1), e0243896.
DOI: https://doi.org/10.1371/journal.pone.0243896
[58] Concepts and Practices in Agricultural Extension in Developing Countries: A Source Book [Internet]. Available from: https://core.ac.uk/download/pdf/132630922.pdf
[59] Dwyer, J., Maredia, K., 2021. Overview & Importance of Agricultural Extension. A book chapter published in Innovations in Agricultural Extension,. 1-1..
[60] Kalogiannidis, S., Chatzitheodoridis, F., Papaevangelou, O., et al., 2023. Management information technology and quality service delivery in government institutions, WSEAS Transactions on Business and Economics. 20, 1074–1099.
DOI: https://doi.org/10.37394/23207.2023.20.97
[61] Mgendi, G., Mao, S., Qiao, F., 2021. Is a training program sufficient to improve the smallholder farmers' productivity in Africa? Empirical evidence from a Chinese agricultural technology demonstration center in Tanzania. Sustainability. 13(3), 1527.
DOI: https://doi.org/10.3390/su13031527
[62] Buehren, N., Goldstein, M., Molina, E., et al., 2017. The impact of strengthening agricultural extension services: evidence from Ethiopia. World

Bank Policy Research Working Paper, No. 8169.

[63] Berthe, A., 2015. Extension and Advisory Services Rural Extension Services for Agricultural Transformation [Internet]. Asian Development Bank—ADB: Mali. Available from: https://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Extension_and_Advisory_Services_Rural_Extension_Services_for_Agricultural_Transformation.pdf

[64] Cambodia Agriculture, Natural Resources, and Rural Development Sector Assessment, Strategy, and Road Map [Internet]. Asian Development Bank. Available from: https://www.adb.org/sites/default/files/publication/718806/cambodia-agriculture-rural-development-road-map.pdf

[65] Kalogiannidis, S., Chatzitheodoridis, F., 2023. Strategic communication and sustainable agricultural competitiveness: A Greek case study. International Journal of Sustainable Agricultural Management and Informatics. 9(4), 350–373. DOI: https://doi.org/10.1504/IJSAMI.2023.10056114