

Public-Private Partnerships and Agriculture: A Review of Sorghum Production in Meru County, Kenya

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Abstract

Despite being a major source of income and the basis of economic development, agriculture still faces many challenges that have led to low yields. Inadequate access to extension services, low funding, and lack of markets, among others, explain the yield gaps in many developing countries. It is for this that many countries are resulting in Public-Private Partnership in trying to boost agricultural production. This study sought to establish the effect of public-private partnerships on sorghum production in Meru County. The study sought to achieve four objectives: to establish the role of farmer groups, farmer training, private markets, and provision of farming inputs for sorghum production. A descriptive research design was adopted for the study. A randomly selected sample of 134 farmers and seven key informants from PPP actors were engaged during the study. The study findings indicated that the majority of the participants had received farming training, inputs, and credit/financial support through the public-private partnership. The study also showed that there were new markets because of the public-private partnerships. The participants indicated that the farming training, inputs, and availability of markets led to an increase in sorghum production. The findings further showed that farmer training had the greatest effect on sorghum production, followed by private markets, followed by farmer groups, and lastly provision of farming inputs. The study concluded that, through public-private partnerships, small-holder farmers improved their sorghum production. The study recommended the need for the development of a framework that would encourage the formation and implementation of more public-private partnerships in the agriculture sector.

Keywords: *Public-private partnerships, Sorghum production, Farmer training. Private markets, Farmer groups, Provision of farming inputs*

1.0 Introduction

The importance of Public-Private Partnerships (PPPs) in diverse economic processes cannot be understated. In agriculture, PPP is seen as a panacea for perennial food insecurity in Africa. Sorghum is ranked fifth in the world's most important cereals after barley. Sorghum is considered a food and industrial crop. Globally, the US is estimated to produce 8.6 million metric tons of sorghum. Other countries include India, Mexico, China, Argentina, and Brazil (Onono, 2018). In Africa, Nigeria has been ranked second globally in the production of sorghum. Other countries that produce sorghum in Africa include Ethiopia, Sudan, Niger, Cameroon, and Mali (Shahbandeh, 2020).

In Kenya, sorghum is grown mostly in ASAL areas. Due to climate change, the government is focusing more on drought-tolerant crops. Sorghum is utilized as human food industrial crop and animal feed (Onono, 2018). There is a growing demand for sorghum in the brewing industry to replace barley. The largest group of producers in Kenya are smallholder farmers who have minimal access to production inputs (Kavoi et al., 2013). It is to this effect that a public-private partnership was adopted to improve sorghum productivity by bridging the gaps between the potential investors and the producers. The PPP model is comprised of the Kenya Agricultural Research Institute (KARI), EABL, the Ministry of Agriculture (MOA), Provincial Administration, and Smart Logistics.

In the agriculture sector, the provision of services has traditionally been done by the government. Studies show that the private sector underinvested in agriculture because they considered it unprofitable (D'Alessandro, Caballero; Lichte; Simpkin, 2015). However, the increase in food demand led to the need to have an increased food supply. This could not be easily achieved because of the various challenges the agriculture sector was facing. Studies show that the need for massive investment led to the adoption of public-private partnerships. Previous studies show that there is a growing acknowledgment of PPP value in this sector. The studies further reveal that PPPs in this sector are collaborative and most of them are between the government and private companies.

Studies reviewed indicate that PPPs have mostly been used to provide extension services in the sector (Ndwiga, 2017). A study by Kavoi (2013) highlighted how Gadam sorghum public-private partnerships were conceptualized and implemented, how outputs were generated, and the outcomes and lessons drawn for policy, practice, and research. Despite the implementation of PPPs in the sector, very few studies have been conducted to assess their effects. Most of the studies reviewed have focused on the legal aspect of PPPs, factors influencing their implementation, and a few aspects such as the provision of extension services. The current study assessed the effect of PPPs on sorghum production.

1.1 Statement of the Problem

Agriculture is well studied. There are many studies on profitability, productivity, and the environment. As a new area of study, public-private partnerships are increasingly attracting scholars from different areas of the economy, and agriculture is no different. This study aimed to contribute to this growing body of knowledge. Specifically, the contribution of this study is to find out what effects PPPs have had on this sector.

Agriculture is among the key areas of the economic pillar in Kenya's vision 2030. Sorghum production is important because it is both a food and an industrial crop. However, the production of sorghum in Kenya has stagnated for years. This is because the biggest group of producers are small-holder farmers who face challenges such as inadequate access to inputs, and low demand for sorghum, among others, leading to the adoption of PPPs to aid in enhancing production (Kavoi et al., 2013). The rationale behind the adoption of PPPs is based on the assertion that PPPs have the potential to fill the production gap by introducing private sector technology and innovation. It is therefore essential to examine the effects of PPPs in this sector.

Past studies have concentrated on the factors influencing the implementation of PPPs and their role in the agriculture sector. The findings of the studies indicated that long-term commitment, having clear objectives, and competitive selection of partners, among others, are crucial in the implementation of PPPs for agricultural novation (Moreddu, 2016). Mbugua (2015) found out that technical support, education level, and community support influenced the implementation

of the PPP project. The study also revealed that PPPs enhanced the mutual sharing of benefits, risks, and costs between the public and private sectors.

Ndwiga (2017) conducted a study on the provision of agricultural services through public-private partnerships. The study showed that most farmers under PPPs practiced good farming practices such as improvement of soil fertility, use of certified seeds, weed control, pest control, and disease control. The study found that lowering the production costs of the least efficient farmer could result in enormous benefits in terms of poverty reduction. The studies do not show the effect PPPs have on the agriculture sector. The inconsistency of these conclusions suggests that more research is required to assess the impact of PPPs, which would serve as the foundation for recommending their use to improve agricultural production. To fill the existing knowledge gap, this study sought to establish the effect of public-private partnerships on sorghum production. The study is also a follow-up to Nwangwu (2019), who recommended the use of PPPs in opening markets.

1.2 Objectives of the Study

- i. To assess the effect of farmer training on sorghum production.
- ii. to examine the effect of private markets on sorghum production.
- iii. To establish the role of farmer groups in sorghum production.
- iv. To evaluate the effect of the provision of farming inputs on sorghum production.

2.0 Literature Review

The paper was anchored on the allocative efficiency theory. The theory of allocative measures how production inputs can be used by an enterprise optimally and in the right combination to realize maximum profits (Farrell, 1957). Allocative efficiency is where the operation of a farm uses the lowest cost combination of production inputs. This theory can also be defined as “technically efficient production,” where the total cost of producing output is achieved using an optimal factor of production. Thus, the extra revenue generated from the utilization of an extra unit of a resource is required to be equal to its unit cost to enable a farm to maximize profit in circumstances where competitive markets are perfect. The relevance of this theory to this study is that most sorghum producers are small-holder farmers who need to allocate resources for profit maximization. The assumptions of this theory state that farmers need to choose low-cost inputs in their best combination to produce maximum output. It also assumes producers, being price takers, has perfect market information and inputs are of the same quality across the market. This study aimed to determine how PPPs have affected sorghum production.

Globally, Moreddu (2016) examined public-private partnerships for agriculture innovation. The study aimed at identifying good practices and actions by the governments in facilitating and implementing PPPs for agricultural innovation. The study findings indicate that long-term commitment, having clear objectives, and competitive selection of partners, among others, are crucial in the implementation of PPPs for agricultural innovation. The study further reveals that incentives to innovate were affected by regulations and policies. In the Netherlands, a range of policy instruments facilitated the greenhouse as a source of energy for the PPP project. They included subsidies for investment, tax reduction, and loan guarantees. The study focused on factors that influence the implementation of PPPs in agricultural innovation. The current study focused on PPPs’ effects on sorghum production.

In Africa, Akinwale (2016) undertook a study to compare the yields of rice between farmers participating and those not participating in PPP projects in Ogun and Benue states in Nigeria. A quasi-experimental approach was used for the study. A sample of 170 participating farmers

and 65 non-participating farmers was used for the study. Data collection was done using a structured questionnaire. A Chow test was carried out to test the relationship between the study variables. The study found out that the yields of rice were high in participating farmers as compared to farmers not participating in PPPs. The study showed that participating farmers had greater access to extension services compared to farmers not participating. The study further reveals that the policy environment was crucial in the implementation of PPPs because it informed the provision of credit and the provision of infrastructure. The study showed that fertilizers and seed quantity helped the yields of both participating and non-participating farmers. However, the study does not justify the difference in yields between the participating farmers and those not participating. This study used a quasi-experimental design, whereas this study used a descriptive research design. Akinwale (2016) conducted a Chow test to analyze the data. The current study used descriptive analysis.

Nwangwu (2019) evaluated the PPPs' impact on Nigeria's agricultural sector. The study focused on sustainable land use systems, the provision of services, infrastructure, and structured market development. The study showed service provision helped enhance the agriculture sector's competitiveness. Under infrastructure, the study showed that PPPs were instrumental in the construction of grain silos to help solve the challenge of post-harvest losses in Nigeria. The study recommended the use of PPPs to open markets as compared to traditional market boards. The current study examined the effect of private markets on sorghum production. In East Africa, PPPs were used to improve the productivity of sugar cane in Tanzania (FAO, 2013). The report indicated that the PPP project focused on the use of new technology, research, and development. The report reveals that these factors led to an increase in sugarcane yields from 30 tonnes per ha to 55 tonnes per ha.

In Kenya, Mbugua (2015) conducted a study to establish the factors that influenced the implementation of PPPs in the agriculture sector. The study adopted a survey research design. Emphasis was given to primary data obtained through questionnaires from youth in Murang'a County practicing greenhouse farming under Amiran and YEDF. Data analysis was done through descriptive statistics. The study found that community support, education level, and technical support influenced the implementation of the PPP project. The study also revealed that PPPs enhanced the mutual sharing of benefits, risks, and costs between the public and private sectors (Mbugua, 2015). From the study, it is evident that PPPs encourage commercial farming supported by technology. The study recommended that the government needed to promote transparency in the different phases of PPPs through legislative action. However, the study findings do not justify the effect of technical support and financing provided through the PPP project. This study focused on factors influencing the implementation of PPPs in the agricultural sector. The current study concentrated on the effect of PPPs on sorghum production.

Ndwiga (2017) analyzed the provision of agricultural services through a public-private partnership. The study showed that most farmers under PPPs utilized good farming practices such as soil fertility improvement, use of certified seeds, weed control, pest, and disease control in their production. The findings of the study also show that the use of extension services provided by private sectors was not a replacement for public extension services. According to the study, lowering the production costs of the least efficient farmer could result in enormous benefits in terms of poverty reduction. It is evident from the study that the PPP model was efficient in promoting the adoption and improvement of modern agricultural practices. The study suggests that the improved yields in tomatoes were because of the increased adoption of technology and modern agricultural practices. However, the study does not justify which

technologies contributed to improved yields, and there is no empirical evidence to back up the claim. The current study sought to assess technologies' effects on sorghum production.

Kavoi et al. (2013) did a study on the production and marketing of Gadam sorghum in Eastern Kenya through a public-private partnership. The study focused on the conceptualization, implementation, and outcomes of the PPPs. The findings of the study showed that an enabling environment was crucial for the adoption of new technology. The study further recommended encouraging sustainability of PPP initiatives to avoid experiences that discourage farmers. The current study focused on the effects of PPPs on sorghum production.

3.0 Methodology

A descriptive research design was adopted for the study. A randomly selected sample of 134 farmers and seven key informants from PPP actors were engaged during the study. The privacy of participants was guaranteed. Data was collected using a questionnaire and analyzed using descriptive and inferential statistics. The data was presented using tables and frequencies.

4.0 Results and Discussion

4.1 Farmers Training

The study sought to assess the effect of farmer training on sorghum production. The assessment was based on the number of respondents who had received farming training, who conducted the training, the type of training received, and whether the farming training had any effect on sorghum yields.

Table 1: Farming training

Trained	Frequency	Percentage
Yes	116	86.6%
No	18	13.4%
Total	134	100%

In Table 1, the respondents indicated whether they had received any farming training because of the public-private partnership. The findings showed that 86.6 percent of the respondents with a frequency of 116 had received farming training, while 13.4 percent with a frequency of 18 had not received any training. The findings reveal that most of the respondents, 86.6%, had received farming training. This implied that most of the in the study area had been trained in sorghum production. The findings further imply that farming training is crucial in sorghum production. The findings resonated with the Omoro (2013) findings, who found that there were better farming practices that farmers could benefit from if they received farming training.

Table 2: Who conducted the training

Trainer	Frequency	Percentage
Agriculture officers	78	58.2%
Extension officers from the private sector	38	28.4%
Others	0	0.00%
Not trained.	18	13.4%
Total	134	100%

In Table 2, the respondents were asked to indicate who conducted the farming training. The findings reveal that 58.2%, with a frequency of 78, were trained by agricultural officers from the Ministry of Agriculture; 28.4%, with a frequency of 38, were trained by extension officers from the private sector; 13.4%, with a frequency of 18, were not trained at all; and none of the

respondents received training from other actors, like fellow farmers. The study findings show that among the respondents who received farming training, the majority were trained by agricultural officers. The study findings imply that the agricultural officers did most of the farming training in the study area. The findings differed from the findings of Omoro (2013), who found out that sorghum farmers in the Nyando district had not received any farming training.

Table 3: Type of Training Received

Training received	Frequency	Percentage
Use of hybrid seeds	46	34.3%
Pest control	16	11.9%
Weed management	28	21%
Harvesting methods	26	19.4%
Not trained	18	13.4%
Total	134	100%

In Table 3, the farmers were requested to highlight the type of farming training received. The study shows that 34.3% with a frequency of 46 received training on the use of hybrid seeds, 11.9% with a frequency of 16 were trained on how to control pests, 21% with a frequency of 28 received training on weed management, and 19.4% with a frequency of 26 were trained on harvesting methods, while 13.4% with a frequency of 18 were not trained.

The findings show that majority of those who were trained received training on the use of hybrid seeds, while the least received training on pest control. The study findings imply that most of the sorghum farmers in the study area were able to utilize new, improved sorghum varieties. The findings further revealed that pests were not rampant in the study area. The findings of the study showed similarities with the findings of Mangeni (2019), whose findings showed that public-private partnerships focused on training on the responsible use of inputs and pesticides.

Table 4: Utilization of the training

The training utilized	Frequency	Percentage
Yes	116	86.6%
No	0	0.0%
Not trained	18	13.4%
Total	134	100%

The farmers were asked to indicate whether they had utilized the training they had received. The study findings depict that 13.4 % with a frequency of 18 had not been trained as shown in table 4, 86.6 % with a frequency of 116 had utilized the training they received. None of the trained respondents failed to utilize the training. The findings imply that the training received by the sorghum farmers was crucial for sorghum production thus the farmers were able to utilize all the training they received. Omoro (2013) recommended the need to have KARI sensitize small-scale farmers on sorghum production best practices starting with land preparation, seed selection, planting time, weeding, harvesting, and post-harvest handling. The findings of the study have demonstrated that training is necessary for sorghum production.

Table 5: Has the training increased sorghum yields

Increased yields	Frequency	Percentage
Yes	109	81.4%

No	7	5.2%
Not trained	18	13.4%
Total	134	100%

The respondents were asked whether the training led to an increase in sorghum yields. The findings show that 81.4% with a frequency of 109 agreed that the training helped increase sorghum yields, 5.2% with a frequency of 7 disagreed that the training helped increase the sorghum yields while 13.4% with a frequency of 18 had not been trained at all as depicted in table 5. A study by Omoro (2013) showed lack of training was one of the factors that led to low sorghum yields in the Nyando district because farmers were unable to utilize better farming methods and relied on traditional farming practices. The findings show that most of the respondents at 81.4% agreed that the training they received led to an increase in sorghum yields. This implies that farmer training helps farmers adopt best farming practices that lead to improved sorghum production.

4.2 Farmer Groups

Public-Private Partnerships use a farmer group approach in agriculture. The study aimed to establish the roles played by farmer groups in sorghum production. The study aimed to establish the reasons farmers joined groups, whether the farmer groups were actively involved in the implementation of the public-private partnership projects, what the roles of the farmer groups were, whether the farmers accessed credit or financial assistance through the groups and whether farmers sold their produce through the groups and how easy it was to sell their products through their respective farmer groups.

Table 6: Reason for joining farmer groups

Reason	Frequency	Percentage
To access agricultural services	38	28.4%
To increase crop production	36	26.9%
To access financial support	57	42.5%
Others	3	2.2%
Total	134	100%

In Table 6, the respondents indicated the reason they joined farmer's groups. The findings reveal that 28.4% with a frequency of 38 joined to access agricultural services, 26.9% with a frequency of 36 joined to increase crop production, 42.5% with a frequency of 57 joined to access financial support, and 2.2% with a frequency of 3 had their reasons for joining the farmer groups. The findings showed that most of the sorghum farmers joined the farmer groups to access financial support, whereas the least number of farmers had their reasons for joining the farmer groups. The findings imply that most of the sorghum farmers in the study area relied on the farmer groups to have access to financial support. These findings showed similarities to the findings of Mangeni (2019), who reported that farmer groups provided structures for the provision of credits to farmers.

Table 7: Sale of Produce through Farmer groups

Sale through Farmer groups	Frequency	Percentage
Yes	84	62.7%
No	50	37.3%
Total	134	100%

In Table 7, the farmers responded to the question as to whether they sold their sorghum produce through their respective farmer groups. The study showed that 62.7%, with a frequency of 84, sold their produce through the farmer groups, while 37.3%, with a frequency of 50, did not sell their products through the farmer groups. The findings show that most sorghum farmers sold their products through the group. These findings imply that farmer groups assisted the sorghum farmers in selling their produce.

Table 8: Did Farmer groups make it easy to sell the produce

Sale of produce	Frequency	Percentage
Yes	79	59%
No	5	3.7%
No Response	50	37.3%
Total	134	100%

In Table 8, the respondents were asked whether the farmer groups made it easier for them to sell their produce. The results showed that 59%, with a frequency of 79, agreed that the farmer groups made it easier for them to sell their produce. 3.7%, with a frequency of 5, felt that the farmer groups did not make it easy for them to sell their produce, while 37.3% did not respond since they were not selling their products through the farmer groups. The study's findings imply that most of the sorghum farmers felt that the farmer groups made it easy for them to sell their produce. The findings resonate with the results of Kavoi et al. (2013), whose study indicated that farmer groups formed a central collection of the sorghum grain.

Table 9: Access to credit/financial support

Access to Credit/ Financial support	Frequency	Percentage
Yes	104	77.6%
No	30	22.4%
Total	134	100%

In Table 9, the respondents were asked to indicate whether they had accessed credit or financial support through the farmer groups. The results showed that 77.6%, with a frequency of 104, had received credit or financial support through the farmer group, while 22.4%, with a frequency of 30, had not received credit or financial support. The results showed that most of the sorghum farmers had received credit or financial support through the farmers' groups. The study findings showed similarities with the findings of Mangeni (2019), which indicated that farmer groups provided structures for the provision of credits.

Table 10: Farmer group's involvement in the implementation of PPPs

Farmer group involvement	Frequency	Percentage
Yes	109	81.3%
No	25	18.7%
Total	134	100%

In Table 10, the respondents were asked to state whether their groups were actively involved in the implementation of the public-private partnership. The study findings showed that 81.3%, with a frequency of 109, indicated that their group was actively involved in the implementation of the public-private partnership, while 18.7%, with a frequency of 25, indicated that their groups were not actively involved in the implementation of the PPP. The findings imply that farmer groups are an integral component in the implementation of PPPs. The findings had similarities with the findings of Mangeni (2019), which showed that farmer groups were used by public-private partnerships because they provided structures for project activities such as training and the provision of inputs and credits.

Table 11: Role of farmer groups in the implementation of the PPPs

Farmer group roles	Frequency	Percentage
Training	41	30.6%
Formation of Production cells	25	18.7%
Delivery of sorghum produce	43	32%
Others	0	0.00%
No response	25	18.7%
Total	134	100%

In Table 11, the respondents indicated the role played by the farmer groups in the implementation of the public-private partnerships. The results of the study showed that 30.6%, with a frequency of 41, provided a structure for farming training, 18.7%, with a frequency of 25, formed production cells, 32%, with a frequency of 43, were involved in the delivery of the sorghum produce, while 18.7%, with a frequency of 25, had not responded because they felt that the farmer groups were not actively involved in the implementation of the PPPs. The findings imply that most of the farmer groups were involved in the delivery of sorghum produce. These findings differ from the findings of Kavoi (2013), whose findings indicated that most of the farmer groups formed production cells.

4.3 Provision of Farming Inputs

The study aimed to evaluate the effect of the provision of farming inputs on sorghum production. The study looked at the number of farmers who had received farming inputs, the type of farming inputs they received, the level of access to farming inputs, and the effect farming inputs had on sorghum production.

Table 12: Provision of farming inputs

Received farming inputs	Frequency	Percentage
Yes	81	60.4%
No	53	39.6%
Total	134	100%

In Table 12, the respondents were asked to indicate whether they had received any farming inputs through the public-private partnership. The study findings showed that 60.4% with a frequency of 81 had received farming inputs, while 39.6% with a frequency of 53 had not received any farming inputs. The findings revealed that most of the sorghum farmers had received farming inputs because of the public-private partnerships. A study by Onono (2018) found that most sorghum producers were small-holder farmers who had limited access to farming inputs such as seeds, fertilizers, and pesticides. The findings of this study imply that public-private partnerships enable farmers to access farming inputs.

Table 13: Type of farming inputs received

Farming inputs	Frequency	Percentage
Hybrid seeds	60	44.8%
Fertilizers	19	14.1%
Pesticides	2	1.5%
Others	0	0.0%
Not received	53	39.6%
Total	134	100%

In Table 13, the respondents indicated the type of farming inputs they had received. The findings showed that 44.8% with a frequency of 60 had received hybrid seeds, 14.1% with a frequency of 19 had received fertilizers, 1.5% with a frequency of 2 had received pesticides, and 39.6% with a frequency of 53 had not received any farming inputs. The results showed that most of the sorghum farmers in the study area had received hybrid seeds, while the least received pesticides. This implies that pests were not a major problem in the study area.

Table 14: Access to farming inputs

Access of inputs	Frequency	Percentage
Yes	84	62.7%
No	50	37.3%
Total	134	100%

In Table 14, the respondents were asked to state whether it had been easy to access farming inputs on a timely basis. 62.7%, with a frequency of 84, stated that it was easy to access farming inputs on a timely basis, while 37.3%, with a frequency of 50, felt it was not easy to access farming inputs on a timely basis. The study findings revealed that most of the respondents accessed farming inputs easily and timely. The findings implied that sorghum farmers accessed farming inputs easily and timely. The findings further implied that with the existence of public-private partnerships, farmers were able to access farming inputs easily and timely. The study findings differed from the findings of Onono (2018), who found that small-holder sorghum farmers had limited access to farming inputs such as seeds, fertilizers, and pesticides.

Table 15:1 Sorghum yields

Improved yields	Frequency	Percentage
Yes	104	77.6%
No	30	22.4%
Total	134	100%

In Table 15, respondents were asked to indicate whether the provision of farming inputs improved sorghum production. The findings showed that 77.6%, with a frequency of 104, agreed that the provision of farming inputs led to improved sorghum production, while 22.4%, with a frequency of 30, were not in agreement that the provision of inputs led to improved sorghum production. The findings showed that sorghum production improved in the study area because of the provision of sorghum. The study's findings implied that the provision of farming inputs led to improved sorghum production. The study findings showed similarities with the

findings of Akinwale (2016), who concluded that certified seeds and fertilizers aided the improvement of rice yields in Nigeria.

4.4 Private Markets

The study sought to examine the effect of private markets on sorghum production. The study sought to establish whether sorghum farmers had access to market information, where they sold their produce, the mode of payment, and whether the availability of private markets led to an increase in sorghum production.

Table 16: Access to market information

Market information	Frequency	Percentage
Yes	107	79.9%
No	27	20.1%
Total	134	100%

In Table 16, the respondents were asked whether they had access to market information. At 79.9%, with a frequency of 107, they had access to market information, whereas at 20.1%, with a frequency of 27, they had no access to market information. The findings showed that most sorghum farmers had access to market information. This implies that most of the small-holder sorghum farmers knew possible places they could sell their sorghum products.

Table 17: New markets

New markets	Frequency	Percentage
Yes	82	61.2%
No	52	38.8%
Total	134	100%

In Table 17, the respondents were asked whether there were new markets because of the public-private partnership. 61.2%, with a frequency of 82, stated that there were new markets, whereas 38.8%, with a frequency of 52, stated that there were no new markets. The findings show that most of the respondents stated that there were new markets because of public-private partnerships. The findings implied that public-private partnerships led to the opening of new markets. A study by Nwangwu (2019) recommended the use of public-private partnerships (PPPs) to open new markets. The findings of this study showed that PPPs led to the creation of new markets for sorghum products.

Table 18: Sale of produce

Sale of produce	Frequency	Percentage
Private companies	47	35.1%
Local retailers	54	40.3%
Millers	33	24.6%
Others	0	0.00%
Total	134	100%

In Table 18, the respondents were asked where they sold their produce. 35.1%, with a frequency of 47, sold their produce to private companies, 40.3%, with a frequency of 54, sold their produce to local retailers, and 24.6%, with a frequency of 33, sold their produce to millers. The findings revealed that the majority of the respondents sold their produce to local retailers. This implied that sorghum farmers had not yet embraced emerging markets brought about by the existence of public-private partnerships. The findings differ from the findings of Loriente (2015), who indicated that PPPs allowed the private sector to benefit from the supply chain through engaging small-holder farmers in new markets, which allowed farmers to benefit from linkages to secure markets. The current study findings showed that the sorghum farmers had developed trust with the local retailers and still preferred to sell their produce to them.

Table 19: Mode of payment

Mode of Payment	Frequency	Percentage
Through the bank	34	25.4%
Mobile money	15	11.2%
Cash	80	59.7%
Others	5	3.7%
Total	134	100%

In Table 19, the respondents were asked to indicate how they were being paid. 25.4% with a frequency of 34 were paid through the bank, 11.2% with a frequency of 15 were paid through mobile money, 59.7% with a frequency of 80 received cash, while 3.7% with a frequency of 5 received other forms of payment like exchange with other products like maize and beans. The findings showed that most of the respondents received cash, while the least preferred other modes of payment. The findings imply that most of the small-holder farmers delivered their products and were paid immediately.

Table 20: Effect of markets on Sorghum production

Markets effect	Frequency	Percentage
Yes	115	85.8%
No	19	14.2%
Total	134	100%

In Table 20, the farmers were asked to state whether the availability of markets led to an increase in sorghum production. 85.8% with a frequency of 115 indicated that the availability of markets led to an increase in their produce, while 14.2% with a frequency of 19 indicated that the availability of markets did not lead to an increase in their production. The findings reveal that most farmers have a high production of sorghum. The findings imply that the availability of markets motivated the sorghum farmers to produce more.

Table 21: Sorghum production

Level of production	Frequency	Percent
high level of production	96	71.6
low level of production	38	28.4
Total	134	100.0

In Table 21, respondents indicated the level of sorghum production because of the public-private partnership. 71.6%, with a frequency of 96, indicated that the level of production was high, while 28.4%, with a frequency of 38, indicated that the level of production was low. The findings implied that public-private partnerships led to a high level of sorghum production.

4.5 Regression Analysis

A regression analysis was conducted to establish the effect of the independent variables on the dependent variable. The independent variables are farmer training, provision of farming inputs, the role of farmer groups, and private markets. The dependent variable is sorghum production.

Table 22: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.859a	0.738	0.708	0.261

Table 22 indicates a model that was used to establish how well the model equation fits the data. The R square was found to be 0.738, which implies that 73% of the variations in the effect of public-private partnerships on sorghum production in Meru County are explained by changes in farmer training, provision of farming inputs, the role of farmer groups, and private markets.

Table 23: ANOVA Test

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.719	4	1.680	24.692	<.001 ^b
	Residual	2.381	35	.068		
	Total	9.100	39			

Table 23 shows a probability value of 0.001, which indicates that the regression relationship was significant in determining how farmer training, the provision of farming inputs, the role of farmer groups, and private markets affected sorghum production in Meru County.

Table 24: Regression coefficients of determination

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.015	0.055		0.28	0.781
	Farming Training	0.468	0.174	0.409	2.695	0.011
	Provision of Farming Inputs	0.05	0.188	0.038	0.268	0.791
	Role of farmer groups	0.129	0.129	0.124	1.005	0.322
	Private Markets	0.431	0.114	0.447	3.771	<.001

a. Dependent Variable: Sorghum Production

Table 24 shows that there is a positive relationship between sorghum production (dependent variable) and the PPP strategies, which include farmer training, the provision of farming inputs, the role of farmer groups, and private markets (independent variable).

The estimated model was as follows;

$$\text{Sorghum production} = 0.015 + 0.468 (\text{Farmer training}) + 0.050 (\text{Provision of farming inputs}) + 0.129 (\text{Role of farmer groups}) + 0.431 (\text{Private markets}).$$

A unit change in farmer training would lead to a 0.468 change in sorghum production; a unit change in the provision of farming inputs would lead to a 0.050 change in sorghum production; a unit change in the role of farmer groups would lead to a 0.129 change in sorghum production; and a unit change in private markets would lead to a 0.431 change in sorghum production, holding all factors constant. This implies that among other factors, farmer training, the provision of farming inputs, the role of farmer groups, and private markets all contribute to sorghum production. The study showed that farmer training had the greatest effect on sorghum production, followed by private markets. The provision of farming inputs had the least effect.

4.6 Role and contributions of key PPP Actors in sorghum production

The study aimed to establish the various roles played by the PPP actors, how they contributed to sorghum production, their effect on production practices, and their effect on farmers' income. The study targeted EABL, the Ministry of Agriculture, the National Government Administration, KARI, banks, and buyers. The study findings showed that the national government administrators mobilized farmers for training and sensitized them on sorghum production for the improvement of their livelihoods. This led to the adoption of effective farming methods, which led to increased production.

The study showed that EABL, as the major consumer of sorghum, guaranteed a market for sorghum produced. The study revealed that EABL also helped build market capacity for farmer groups. The study revealed that Tuuti Giaki, Ithundio, Kanthoya, and Mwariama groups were able to sell their produce directly to EABL. The study further revealed that EABL also ensured that farmers had access to market information, especially the current prices. EABL also stated that sorghum production had increased exponentially over the years. The study also revealed that farmers' income had increased over the years.

The study also showed that over 30 agents and local traders worked with the farmers, and their major role was bulking and buying from the farmers. The study also found that agents like Quinam also trained farmers in the harvesting and storage of sorghum produce. The study showed that this led to an increase in production, which in turn contributed to an increase in farmers' income.

The study found that KARI provided sorghum seeds. The study showed that they first introduced KARI mtama 1 and later the Sira variety, which is more productive. Kari also sensitized the farmers on the adoption of new, more productive sorghum varieties. The findings revealed that farmers in the study area planted the Sira variety. This contrasted with the findings of Kavoi (2013), whose study showed that public-private partnerships focused on Gadam sorghum production and marketing in the Mwigwani District.

The Ministry of Agriculture, through the agriculture officers, conducted farming training. The study showed that they were instrumental in setting up demonstration fields to educate the farmers. The agriculture officers also visited the farmers on their farms to monitor their farming activities and guide them in areas that required improvement. The study also showed that agriculture officers assisted in the distribution of sorghum seeds to farmers. The findings show similarities with the findings of Kavoi (2013), who found that the Ministry of Agriculture was involved in the acquisition and distribution of Gadam sorghum seeds through public-private partnerships.

5.0 Conclusion

Based on the findings, this study concludes that public-private partnerships (PPP) are important in assisting small-holder sorghum farmers to gain access to farming training. This is evident

from the findings where both the agriculture officers from the Ministry of Agriculture and extension officers trained most of the small-holder sorghum farmers in the study area. The study further concludes that farming training is necessary for the improvement of sorghum production. The respondents stated that they utilized the training, which led to an increase in sorghum production.

The study also concludes that farmer groups assisted small-holder farmers to access credit and financial assistance. The study further concludes that most of the farmers sold their sorghum produce through farmer groups. This gave them bargaining power and made it easy for them to deliver their produce to the market.

The study further concludes that through public-private partnerships, small-holder farmers were able to access farming inputs easily and on time. The respondents indicated that most of them had received farming inputs through the PPP, which led to improved sorghum production. The study further concludes that most of the farmers had received sorghum seeds.

The study concludes that public-private partnerships led to the introduction of new markets in the area. It further concludes that despite the introduction of new markets, farmers still preferred to sell their products through local traders. The study also concludes that the availability of markets encouraged the sorghum farmers to produce more. Through public-private partnerships, small-holder farmers can improve their production because PPPs enable farmers to benefit from farming training, the provision of inputs, access to credit facilities, and new markets. This led to an increase in farmers' incomes. This means that public-private partnerships are instrumental in addressing the challenges that small-holder farmers face, and their utilization would lead to the revitalization of the agriculture sector.

6.0 Recommendations

The study recommends the inclusion of local traders in the public-private partnerships to ensure that small-holder farmers are not taken advantage of in terms of market prices. The study also recommends the need to build small-holder farmers' capacity in terms of market access, since the study findings showed that farmers still relied on local traders to sell their produce, yet there were new markets from which they could have benefited directly. The study further recommends the development of a framework that would encourage the formation and implementation of more PPPs in the agriculture sector.

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