

**Araştırma Makalesi**  
(Research Article)

Ege Üniv. Ziraat Fak. Derg.,2020, 57 (3):343-350  
DOI: [10.20289/zfdergi.567756](https://doi.org/10.20289/zfdergi.567756)

Felix Odemero ACHOJA<sup>1a\*</sup>

Ezekiel UKWAMA<sup>1b</sup>

<sup>1</sup>Department of Agricultural Economics and Extension, Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria.

<sup>1a</sup>Orcid No:0000-0002-9705-4923

<sup>1b</sup>Orcid No:0000-0002-2220-179x

\*sorumlu yazar: [achojafelix@gmail.com](mailto:achojafelix@gmail.com)

**Keywords:**

Smart Strategies, Productivity

Enhancement, West African Dwarf Goat,

Production Systems

**Anahtar Sözcükler:**

Akıllı Stratejiler, Verimlilik Artırma, Batı

Afrika Cüce Keçisi, Üretim Sistemleri

**Adoption of Smart Strategies for Enhancing Productivity and Income of West African Dwarf (WAD) Goat Farmers in Southern Nigeria**

Güney Nijerya'da ki Batı Afrika Cüce (WAD) Keçi Üreticilerinin Verimliliğini ve Gelirini Artırmak için Akıllı Stratejilerin Benimsenmesi

**Alınış** (Received): 20.05.2019

**Kabul Tarihi** (Accepted): 20.01.2020

**ABSTRACT**

**Objective:** In this study the adoption of SMART (specific, measurable, realistic and time-bound) strategies for enhancing productivity and income of West African Dwarf (WAD) goat farmers was investigated in Southern Nigeria.

**Materials and Methods:** In April, 2019, structured questionnaire and observation were instrumental to the collection of primary data from 94 WAD goat farmers that were purposively selected using snowball sampling technique. Descriptive and inferential statistical tools were employed in data analysis.

**Results:** The result of study shows that their productivity enhancement adoption index is 50%. The study revealed that about 52% of the total variation in value of WAD goat is accounted for by breed of initial stock, number of kids per doe, number of matured goat consumed, and age of kidding. Further result shows that SMART strategies adopted such as extension training received, breed of initial stock, number of goat stocked, extension agent and production infrastructures used, have a positive and significant relationship with the productivity. It was revealed that the mean net farm income of non-adopters of SMART strategies was ₦10,552 per goat and a net farm income of adopters was ₦15,184 per goat. Test of hypothesis indicated that there is significant difference in the income of goat farmers that did not adopt SMART strategies and goat farmers that adopted SMART strategies in WAD goat production. The result also showed that the major constraints to the adoption of SMART strategies by WAD goat farmers were inadequate genetically improved breed for cross breeding, inadequate capital and poor management system.

**Conclusion:** We concluded that adopting the identified SMART strategies will significantly improve WAD farmers' productivity and income. The provision of improved breeding stocks and improvement in management system will address the serious constraints faced by WAD goat farmers.

**ÖZ**

**Amaç:** Bu çalışmada Güney Nijerya'da Güney Afrika Cüce (WAD) keçi üreticilerin verimliliğini ve gelirini artırmak için SMART (spesifik, ölçülebilir, gerçekçi ve zamana bağlı) stratejilerinin benimsenmesi araştırılmıştır.

**Materyal ve Yöntem:** Nisan 2019'da yapılandırılmış anket ve gözlem, kartopu örnekleme tekniği kullanılarak bilerek seçilen 94 WAD keçi çiftçisinden birincil verilerin toplanmasında etkili olmuştur. Veri analizinde tanımlayıcı ve çıkarımsal istatistiksel araçlar kullanılmıştır.

**Bulgular:** Çalışmanın sonucu, verimlilik artırma benimseme endeksinin% 50 olduğunu göstermektedir. Çalışma, WAD keçi değerindeki toplam varyasyonun yaklaşık% 52'sinin başlangıçtaki hayvan cinsi, her bir keçi başına düşen oğlak sayısı, tüketilen olgunlaşmış keçi sayısı ve oğlaklama yaşına göre hesaplandığını ortaya koymuştur. Diğer sonuçlar, alınan yayım eğitimi, ilk stok cinsi, stoklanan keçi sayısı, yayım uzmanı ve kullanılan üretim altyapıları gibi SMART stratejilerinin verimlilikle pozitif ve önemli bir ilişkiye sahip olduğunu göstermektedir. SMART stratejilerinin benimsenmeyenlerin ortalama net çiftlik geliri keçi başına 10.552₦ ve benimseyenlerin net çiftlik geliri keçi başına 15.184₦ olduğu ortaya çıkmıştır. Hipotez testi, SMART stratejileri benimsemeyen keçi çiftçilerinin ve WAD keçi üretiminde SMART stratejileri benimseyen keçi üreticilerinin gelirlerinde önemli bir fark olduğunu göstermiştir. Sonuç ayrıca, WAD keçi çiftçileri tarafından SMART stratejilerinin benimsenmesinin önündeki başlıca kısıtlamaların, çapraz üreme için genetik olarak geliştirilmiş cins, yetersiz sermaye ve yetersiz yönetim sistemi olduğunu göstermiştir.

**Sonuç:** Belirlenen SMART stratejilerinin önemli verimlilik artırıcıları olduğu ve verimliliklerini ve net çiftlik gelirlerini artırmak için tüm keçi üreticileri tarafından benimsenmesi gerektiği sonucuna varılmıştır.

## INTRODUCTION

The global livestock sector including goat, has been undergoing revolution as a result of increase in demand for food of animal origin. This revolution has led to livestock production intensification through technological innovation and structural changes. Globally, livestock contributes about 40% of total value of agricultural output. World goat production was estimated to be 79 million with more than 77% from developing countries. In Turkey, Goat meat consumption rate varies between 1.8 % and 27.6 % according to regions ([Koşum, et. al. 2019](#)).

In 2012 Nigeria had about 34 million goats, (4% of the current world population) ([Albert and Okidhim, 2012](#)). The sector supports livelihoods and food security of about one billion people. Goat and other livestock sub-sectors, currently employ 1.3 billion people in the world accounting for 40% of agricultural GDP. It presently

contributes 15% total food energy and 25% of food protein ([Adu, 2015](#)).

Aina, (2012) opined that goat has special attributes that make it particularly important in rural economy compared to other domestic ruminants. These attributes include: (i) ability to graze and utilized a wide range of poor quality forages and browses, (ii) well adapted to almost all ecological zones in Nigeria, particularly the West African Dwarf (WAD), (iii) cheapest in term of feed requirement compared with cattle and other domestic animals, (iv) easiest to manage, (v) no religious taboo prohibits its consumption, (vi) highly efficient in milk production, (vii) resistance to most diseases affecting most farm animals etc. The West African Dwarf is the predominant breed of west and central Africa and is found mainly in the region, south of latitude 14°N which is humid and highly encourages proliferation of tsetse flies ([Amaefule and Okoye, 2010](#)).



**Figure 1.** West African Dwarf Goat

**Şekil 1.** Batı Afrika Cüce Keçisi

The West African Dwarf is small bodied, compact breed short legs and 'blocky' body, very hardy ([Omoruyi et al. 1998](#)). This breed exhibits various of colors including; all white, black, brown or spotted black or brown on a white coat. Goats are particularly valuable livestock species in developing countries because of their ability to utilize many types of forages and tolerate unfavourable climates.

FAOSTAT (2013) estimated that the global production of goat meat is more than 5 million tonnes, representing an increase of 36% in 2000. Most of this meat is produced in Asia and Africa, which together account for 93.6% of the world's goat production and 94.5% of meat production. Bangladesh, China,

India and Pakistan are the leading goat meat and milk production. FAOSTAT (2011) cited in Rodica, et al.,(2013) revealed that worldwide raising goat has been generally increasing, both in terms of the stock and the production level, and there were over 875.5 million heads of goats, over 530 million in Asia representing 61.6% of the total, followed by African with over 276 million heads holding a share of 31.6% of the global livestock.

The population of goats in sub-Saharan Africa (SSA) is estimated at 147 million. The arid and semi-arid zone together hold the majority (64%) of the goat population ([Aina, 2012](#)). NBS, (2011), Adeleye, et al.,( 2016) estimated that there are 65.65 million goats of different

breeds in Nigeria being kept by 305,762 farmers giving a national average herd size of 5 goats. The major goat breeds in the country include Red Sokoto, Kano Brown and West African Dwarf (WAD). Amongst the goat population in Nigeria, 39.2% are WAD, 30.4% are Red Sokoto and 24.5% are Kano Brown. Other goats' breeds are about 5.9% of the goats in the country. In terms of distribution of goats by states Katsina State has 7.7%, Jigawa (7.5%), Zanfara (6.8%) and Benue (5.5%). About 2.5% of the national population of goat is found in Kaduna State. Aina, (2012) highlighted that Nigeria is ranked 6<sup>th</sup> among the top ten goat inventors and 4<sup>th</sup> top 10 goats meat producers in the world, but not top 10 goats meat importers and top 10 goat meat exporters.

These records show that Nigeria consumes all her goat meat produced. With great potential, Nigeria has to increase goat meat products. Nigeria has plan to increase goat meat production for domestic consumption and exports in the nearest future. According to Aziz (2010), the importance of West African Dwarf (WAD) goat is underestimated and its extent of contribution to the livelihood of the poor is inadequately understood. They are often neglected in comparison with cattle and sheep. The consumption of goat meat enjoys wide acceptability among social groups in Nigeria (Ribeiro and Ribeiro 2010; Haenlein, 2004). Daily consumption of goat meat by the ever increasing population of households is on the increase in Nigeria.

Increasing production can play an important role in meeting these demands, thus calls for farmer to scale up goat productivity by shifting from subsistence production to commercial production. It is assumed that adoption of SMART enhancement strategies can scale up goat productivity and income of producers of WAD goat in Southern Nigeria.

SMART strategies for productivity enhancement in goat production systems include: Education/Extension service; Hoof trimming; Detection and isolation of sick animals; Veterinary service; Routine vaccination; Housing; Feeding (tittering, concentrate, browse); Mineral supplementation and cross breeding (exotic and local breeds) (Devendra, 2018).

Therefore, to enhance the potential of goat rearing as a strategy for alleviating poverty in rural communities, concerted effort should be made by the government and other agencies to raise awareness on recommended practices (SMART strategies) in goat production through radio and extension advisory services, low credit facilities in form of young goats, high quality feed materials and drugs. SMART strategies

are specific, measurable, attainable, reliable and testable. Goat farmers must adopt the recommended practices that are SMART compliant in order to enhance productivity and better living standard (Adeleye et al. 2016).

If the constraints to goat productivity are identified and addressed, it could translate to progress in goat sub sector of livestock industry. As it stands, there is very limited empirical information on the financial performance. Generating empirical information on the productivity of WAD goat could broaden the understanding of potential investors for well-informed investment decision. For goat production to keep pace with the increasing demand, there is need for goat farmers to apply productivity enhancement strategies in the production system. Goat productivity enhancement strategies can be applied only if they are known to the farmers. As it stands, there is lack of empirical information on productivity enhancement strategies among goat farmers in the study area.

Several studies have been carried out on feasibility, profitability, genetic and impact of goat production. Notable studies include those of Zailani, et al. (2016) and Tesfaye (2004), but there is need for study on productivity enhancement strategies in goat production systems.

Therefore, this study contributed towards policy making to promote the productivity of West African Dwarf goat. It will help to reduce the protein deficiency experienced in Nigeria, serve as a guide to young graduates who wants to engage in goat production having known the profitability of the enterprise, and help those who are already in the enterprise to reawaken some of the lost skills. Hence this study was conducted and the objective of the study was to investigate SMART strategies for enhancing the productivity and income of West African Dwarf (WAD) goat in Southern Nigeria.

## MATERIAL and METHOD

### The Study Area, Sampling Techniques / Sample Size and Methods of Data Collection

This study was carried out in southern Nigeria in 2019. The Area lies between longitude 6°6'N and Latitude 6°4'E, with an area of 510km<sup>2</sup> and a population of 118,540, comprising male (49%) and females (51%) of the population (NPC, 2006). The area is made up of difference communities namely: Ibusa, Okpanam, Oko-Okwo, Ugbolu, Akwukwu Igbo, Ebu/Ilah, Okwe. The occupation is mainly farming & fishing. The area is

richly endowed with fertile soil, suitable for the growth of various tropical crops and good fodders for domestic animals. Major crops grown by the inhabitants of the study area includes; maize, cassava, yam, groundnut vegetables etc. Goat, sheep, poultry, constitutes the major important livestock enterprises and fish farming.

Snowball sampling technique was adopted to purposively select 94 WAD goat farmers for the study. This was because of the lack of officially published list of the population of WAD goat farmers in the study area.

The use of primary data was employed in the study area through the use of structured questionnaire in April, 2019. The questionnaire consists questions relating to the respondents, socioeconomic status including age, sex, level of education, household size, marital status religion, among others, also cost and returns, productivity of goat production systems, productivity enhancement strategies and constrains affecting goat production systems was collected.

Measurements of socio-economic variables:

- Age: Respondents were asked to indicate their age in years.
- Gender: Gender was measured by normal value of male (1) and female (2).
- Marital Status: This was measured by nominal value of single (1), married (2), divorce (3) widow/widower (4).
- Education level: This was measured as number of years spent in formal education or the number of years equivalent to the certificate obtained in school as the actual number of years spent on formal education. Their responses were grouped into No formal education, primary education, secondary and tertiary education.
- Household size: The respondents were asked the number of persons in a household under the head of the farm family.
- Goat farming experience: Farmers was measured in years.
- Average Annual income of respondents was measured in Naira.

**Method of Data Analysis**

Descriptive and inferential statistics was used to analyze data.

Descriptive statistics such as frequency, percentage, mean was used to realized objective (i). Gross margin was used to achieved objective (ii)

iii) determine productivity enhancement adoption index (PEAI) was realized using PEAi formula

$$PEAI = \frac{\text{No of enhancement strategies adopted}}{\text{Total number of identified strategies}} \times 100$$

This was measured in number from the list of identified enhancement strategies provided from which respondents were asked to tick the ones they adopted. Regression analysis was used to achieved objective iv& v.

Objective vi: This was realized using four point Likert-type scale, ranked 4-1, categorized as follows

- 4 = Strongly Agree (SA)
- 3 = Agree (A)
- 2 = Disagree (S)
- 1 = Strongly Disagree (SD)

**Model Specification**

Multiple Regression Analysis

The implicit form of the multiple regression model take the form of  $y = f(x_1, x_2, x_3, x_4, \dots, x_n) + e \dots \dots (1)$

The functional form will be estimated using ordinary least square mode. The explicit form is  $y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + e \dots \dots \dots (2)$

**Determinants of adoption of Productivity Enhancement Strategies among Goat Farmers**

$$Y = f(x_1, x_2, x_3, x_4, \dots, x_n) + e \dots \dots \dots (1)$$

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + e \dots \dots \dots (2)$$

PEAI = Goat productivity enhancement index (% of enhancement strategies adopted)

$X_1, X_2, \dots, X_n$  = identified strategies

e = stochastic error term

$\beta_0$  = constant or intercept value

$\beta_1, \beta_2, \dots, \beta_n$  = Regression co-efficient of respective variables

$X_1$  = Age  $X_3$  = Farm Experience

$X_2$  = Education  $X_4$  = Production System

$X_6$  = Extension Agent  $X_5$  = Number of goats stocked

**Determinants of goat productivity**

Implicit form of the multiple regression model takes the form:  $Y = f(X_1, X_2, X_3, \dots, X_n) + e \dots \dots \dots (1)$

The explicit form of the linear takes the form

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e \quad (2)$$

Where Y = Goat productivity

$X_1$  = Number of Breeding Stock (male and female)

$X_2$  = Litter size (Number)

$X_3$  = Mortality (Number) i.e 1,2,3, .....

$X_4$  = Household consumption (Number)

$X_5$  = Age of breeding stock measured in years

### Cost and Returns Analysis

Gross margin was used for the Measurement of Return.

$$GM = TR - TVC \quad (\text{Achoja and Akporhwarho, 2016}) \quad (3)$$

TR = Total Revenue (Naira)

TVC = Total variable costs (Naira).

Fixed cost is relatively small in WAD Goat production system and no loan was borrowed by farmers. As a result, depreciation of fixed cost items and interest on loans were considered negligible in the Gross margin (income) formula.

## RESULTS and DISCUSSION

The essence of gross margin is to determine the cost of inputs and revenue generated in goat production systems. The purpose was to identify the net profit (Gross margin), the nature of return on investment.

Table 1 showed that total cost of production of goat in the study area was ₦105,517 where farming labor is solely used. While total revenue was ₦257,357 and ₦21,058 as lost revenue from goat stolen/dead which may be attributed to diseases. The analysis showed that goat producers earned ₦151,840 per 10 matured goats sold as net profit and net profit per goat was ₦25,180. The mean output of semi-intensive and extensive production systems was 12.00 and 8.00 and unit price of goat was ₦15,184. The returns of semi-intensive and extensive production systems are ₦182,208 and ₦121,472 respectively. This showed that, goat farmers that adopted smart strategies of production was the highest return. The net ratio on investment of an average goat producer is 1.44.

This could be the reason why households engaged in small-scale goat production because of the economic importance. The present study is in line with Tesfaye (2004) who reported that cash income is the most important incentive in goat farming.

**Table1.** Cost and Returns of Goat Production  
*Çizelge1. Keçi Üretiminin Masraf ve geliri*

Cost	Average Amount (₦)
<b>1 Variable cost</b>	
a. Feed	3,874
b. Medication/veterinary service	7,173
c. Transportation	1,145
d. Goat purchased	32,141
Total	44,334
<b>2 Fixed cost</b>	
a. Housing	53,682
b. Tools	7,501
Total	61,183
<b>Total cost (TC) = TVC + TFC</b>	105,517
<b>3 Revenue</b>	
Goat sold	193,574
Goat consumed	48,826
Goat given out	14,957
Lost Revenue from death goat	21,059
Total Revenue TR	257,357
<b>4 Net farm income (NFI) (TR-TC)</b>	151,840
<b>5 Net Ratio on Investment (NFI/TC)</b>	1.44

From the result, it shows that 50% of the respondents adopted the enhancement strategies of goat productivity. This implies that the mean percentage of adoption is still low and it is expected that if the percentage of adoption increase it will lead to high productivity of goat in the study area.

### Determinants of Productivity of WAD goat

The results in Table 3 showed that  $R^2$  for the estimated average productivity function in the study area was 0.520. This implies that 52% explained the variation in goat productivity is due to the joint effect of independent variables specified in the model while the rest 48% unexplained variation in goat productivity may be due to other variables of interest not specified in the model but are present in the error term. The results also show that out of the five (5) variables identified four were significant.

**Mortality:** The results showed that, mortality is negative and significance at 1%. This implies that increase in goat mortality will decrease goat productivity, (but if proper management of animal husbandry is practiced and productivity enhancement strategies are fully adopted, it is believed to reduce mortality rate in the study area and which also affect goat fecundity and litter size of the flock.

**Table 2.** Productivity enhancement adoption index (PEAI) of goat production**Çizelge 2.** Keçi üretiminde verimlilik artışı benimsenme endeksi (PEAI)

PEAI	Frequency	Percentage (%)
None	18	19.11
1-19%	15	15.96
21-39%	15	15.96
41-59%	22	23.40
61-79%	12	12.17
81-99%	7	7.45
100%	5	5.32
Total	94	100.00

**Table 3.** Determinants of productivity of WAD goat**Çizelge 3.** WAD keçisinin verimlilik belirleyicileri

	Coefficient	t	Sig.
(Constant)		-1.038	0.302
Initial stock	0.345	4.531**	0.000
Number of kids per doe	0.147	1.960*	0.053
Number of mortality	-0.344	-4.033**	0.000
Goat consumed	0.279	3.284**	0.001
Age of kidding	0.121	1.580	0.111

$R^2 = 0.52$ ,  $R^2(\text{adjusted}) = 0.49$ ,  $F = 19.096$ , \* = Significance at 5%, \*\* = Significance at 1%.

**Initial Stock:** This showed that, initial stock is one of the major determinants influencing goat productivity which is positive and significant at 1%. It implies that, increase in initial stocking capacity has the tendency to increase productivity of goat in terms of number of kids produced per doe. A prolific West African Dwarf (WAD) goat produces an average of two kids per doe during kidding and sometimes produces twice a year, as revealed by some of the respondents in the study area. This may be due to genetic improvement of the WAD.

Assuming such breeds are stocked, it will increase goat productivity in terms of kids produced.

**No of kids per doe:** The results showed that, number of kids per doe is positive and significant at 5%, implying that, an increase in number of kids per doe brings a corresponding increase in productivity of goat in a yearly average.

### Hypothesis Testing

Ho: There is no significant difference in the income of farmers that did not adopt smart strategies and goat farmers that adopted smart strategies in goat production.

**Table 4.** Statistical difference between mean income of goat farmers with adoption and without adoption of identified smart strategies**Çizelge 4.** Belirlenen akıllı stratejilerin benimsenmesi ve benimsenmemesiyle ortalama keçi geliri arasındaki anlamlı farkın testi

Variable	Mean	Std. Deviation	t	P-value
Farmers that adopted smart strategies	182,136	3.961	7.48	0.000
Farmers that did not adopt smart strategies	121,424	1.351		

Significant at 1%

From the result in Table 4, the null hypothesis is thereby rejected and alternate hypothesis accepted, implying that there is significant difference in the income of goat farmers that did not adopt smart strategies and goat farmers that adopted smart enhancement strategies of goat production.

The Table 5 shows the result of regressions analysis on determinant of productivity enhancement adoption index (PEAI). The  $R^2$  for the PEA function in the area was 0.709. Implying that about 70.9% of the total variation in the value of PEA is accounted for by the predictive variables included in the model while the other 29.1% are variables not captured in the model. T-statistics was used to test the significance of the parameter coefficients. The t-test showed that four out of the PEA determinants were significant. The factors are education, number of goats stocks, extension agents and production system.

Education variable appears to have a positive and significant ( $p < 0.05$ ) with goat productivity enhancement in the model. This implies that level of education attained by the farmers will increase the level of adoption of the strategies. A literate goat farmer is more likely to adopt a technology than an illiterate farmer. Education is a boost of human capital that can contribute towards adoption decision. This finding is in support of the earlier report of Dev and Hossain (1996) that education has a positive effect on technology adoption agricultural output. Goat farm's productivity given a bundle of resources depends to a large extent on the knowledge stock of the goat farmer. Education increases the information acquisition ability and adjustment ability of the farmer, it provides awareness on real world possibilities and rational decision making. Therefore, level of educational attainment will enable farmers willingness to adopt modern technologies for goat production.

**Table 5.** Determinants of Productivity Enhancement strategy Adoption Index (PEAI)**Çizelge 5.** Verimlilik Artırma stratejisinin Kabul Edilme Endeksi (PEAI) Belirleyicileri

	Std. Coefficient	t	Sig.
	Beta		
<b>(Constant)</b>		-1.627	0.107
Age	0.018	0.257	0.803
Education	0.138	2.102*	0.038
Farm experience	-0.010	-.137	0.892
No. of goats stock	0.387	4.649**	0.000
Extension agent	0.267	3.748**	0.000
Production system	0.333	4.555**	0.000

R<sup>2</sup> = 0.709, Adjusted R<sup>2</sup> = 0.689, F = 35.3, 45% is the mean percentage of PEAII

\* Significant at 5%, \*\* significant at 1%.

The study revealed that the number of goats stocked has positive and significant ( $p < 0.01$ ) relationship with the farm productivity over time. This implies that increase in number of goats stocked, especially the number of ewes in the stock tends to increase goat productivity faster. This finding corroborates Akporhwarho (2019) who specified that the ratio of matured male to matured female goat (Buck: Doe) should be 1:10 in the tropics. Where this is violated, possibility of successful mating is often problematic during ovulation period.

Extension agents shows positive and significant ( $p < 0.01$ ) relationship with the adoption of productivity enhancement strategies in goat production systems. This implies that regular contact of goat farmers with extension agents will increase the likelihood of adoption of the strategies thereby improving goat output. The frequency of contact of extension agent with goat farmers determines to a large extent, the effectiveness of monitoring and evaluation of technology transfer. This result is in agreement with Dev & Hossain, (1996) who had earlier emphasized the centrality of the positive contribution of extension agents to increased technology adoption and its sustainable utilization.

Production management system shows a positive and significant relationship with productivity enhancement ( $p < 0.01$ ). This implies that type of production system being practiced influences the adoption of the strategies (feeding, housing, veterinary service, hoof trimming, routine vaccination, detection and isolation of sick animals (goat), mineral supplementation and extension agent). This finding agrees with Okagbare, et. al. (2014) who argued that proper supplementary feeding regime, housing and engagement of veterinary service are important in increasing goat output in the tropics.

**Table 6.** Constraints of WAD Goat Production System**Çizelge 6.** WAD Keçi Üretim Sisteminin Kısıtları

Factors	Total	Mean	Remarks
Shortage or high cost of feed	6.76	1.69	Unserious
Disease	13.72	3.43	Serious
Genetically less productive breed	12.84	3.21	Serious
High predators	9.84	2.46	Unserious
Market fluctuation	14.04	3.51	Serious
Inadequate capital	14.6	3.65	Serious
Cost of medicine	9.36	2.34	Unserious
Poor management system	13.76	3.44	Serious
Harsh weather	10.12	2.53	Unserious

\* Mean value above 3.00 indicates serious constraints.

## CONCLUSION

The adoption of productivity and income enhancement strategies by West African Dwarf goat farmers was main thrust of this study and following conclusions were drawn:

West African Dwarf goat farmers that raised stocks with the identified smart strategies for enhancement of productivity in Nigeria have increased income.

Adopting the identified SMART strategies will significantly improve WAD farmers' productivity and income. The provision of genetically improved breeding stocks by the government and supply of improved knowledge of goat management systems by extension officers will address the serious constraints faced by WAD goat farmers.

Furthermore, formation of goat farmers' cooperative societies and subsequent access of WAD Goat farmers

to cooperative loan facilities and periodic workshops and conferences are important steps to improve farmers' adoption of productivity enhancement strategies in West African Dwarf goat production

systems. Productivity and income enhancement strategies of West African Dwarf goat production systems are therefore important drivers of the growth and development of the goat sub-sector in Nigeria.

## REFERENCES

- Achoja, FO and Akporhwarho, PO. 2016., Profitability and Constraints in the Marketing of Poultry Birds in Delta Central Agricultural Zone of Delta State, Nigeria, *J Agric. and Food Sc.* 14 (1): 16 – 23.
- Adeye, O, Alli-Balogun JK, Afemo OG, Bako S. 2016. Effects of Goat Production on the Livelihood of Women in Igabu, Chikun and Kajuru Local Government Areas, Kaduna State. *Asian J Agric Ext, Econs and Soc.* 11(1): 1-8.
- Adu IF. 2015. Investing in the Livestock Sub-section and its Value chain: Impact on Nigeria's Economy beyond Oil-Keynote addressed of the Proceedings of the 49<sup>th</sup> Annual Conference of the Agricultural Society of Nigeria "Delta 2015" held in Delta State University, Asaba Campus from 9<sup>th</sup> -13<sup>th</sup> November, 2015. Pg 1-6.
- Aina, ABJ. 2012. Goat (*Capra hircus*): A misunderstood Animal. Federal University of Agriculture Abeokuta of the 35<sup>th</sup> series of inaugural Lecture on Wednesday 28<sup>th</sup> March, 2012.
- Albert CO, Okidhim AI. 2012. Profitability and challenges of goat production in Etche Local Government Area of Rivers State, Nigeria. Proceedings of international agricultural conferences "ANSUIAC 2012", 6 – 9<sup>th</sup> May. Anambra State University, Igbariam Campus, Awka, Anambra State.
- Akporhwarho, PO. 2019. Goat production in the tropics. (Unpublished lecture note) Department of Animal science, Delta state university, Abraka, Nigeria.
- Amaefule FO, Okoye LE. 2010. Seasonal variation in the hematological and biochemical profile of red Sokoto and West Africa dwarf bucks in humid environment. *Nig. Agric. J.* 41(2): 67-72.
- Aziz AM. 2010. Present Status of the World Goat Populations and their Productivity. *Lohmann Information*, 45(2): 42-52.
- Dev, UK, Hossain, M. 1996. Effect of education on technology adoption and aggregate crop output in Bangladesh, *Bangladesh J. Agric. Econs.* 19, (1,2): 1-15
- Devendra C. 2018. Small Ruminants in Asia; Contribution to Food Security, poverty alleviation and opportunities for productivity enhancement. Schematic scholar <https://pdfs.semanticscholar.org/7cbd3>.
- FAOSTAT 2011. <http://faostat.org>. Accessed 5th March, 2019.
- FAOSTAT 2013. <http://faostat.org>. Accessed 5th March, 2019.
- Haenlein, GFW. 2004. Goat Milk in Human Nutrition. *Small Ruminant Research*, 51: 155-163. Retrieved from <http://dx.doi.org/10.1016/j.Smallrumres.2003.08.010>
- Koşum, N., Taşkın, T., Engindeniz, S., Kandemir, Ç. 2019. Goat Meat Production and Evaluation of its Sustainability in Turkey. *Ege Üniv. Ziraat Fak. Derg.*, 56 (3):395-407, DOI: 10.20289/zfdergi.520488.
- Muyatwa, L. 2007. Analysis of economic contribution of meat goat production to small holder livelihoods in Gwembe district, Zambia 2012 – 2013, (Unpublished Msc dissertation) Department of Agricultural Economics, University of Egerton, Kenya.
- NBS 2011. National Bureau of Statistics/Federal Ministry of Agriculture and Rural Development. Collaborative Survey on National Agricultural Sample Survey.
- NPC 2006. National Population Commission.
- Okagbare OG, Godstime U, Moemeka MA. 2014. The Optimum Feeding Level of *Gmelina arborea* leaves Supplemented with *Pennisetum purpureum* to West African Dwarf (WAD) Goats. *Abah Bioflux*, 6(2):134-139. <http://www.abah.bioflux.com.ro> Accessed 5th March, 2019.
- Omoruyi SA, Orhue UX, Akerobo AA, Aghimien CI. 1998. Prescribed agric science for senior secondary schools. Revised edition. Idodo Umeh Publishers Ltd.
- Ribeiro, CA, Ribeiro, SDA. 2010. Specialty Products Made from Goat Milk, *Small Ruminant Research*, 89 (2 - 3), 225-233. doi:10.1016/j.smallrumres.2009.12.048
- Rodica C, Ion C, Carmen NG. 2013. Worldwide Trends and Orientation of Raising Goats. online at <http://mpira.ub.uni-muenchen.de/53460> Accessed 5th March, 2019.
- Tesfaye, AT. 2004. Genetic Characterization of Indigenous Goat Population of Ethiopia Using Microsatellite DNA Markers. Doctor of Philosophy in Animal Genetics & Breeding. National Dairy Research Institute (Deemed University) Karnal (Haryana), India.
- Zailani SA, Madu HK, Abubakar N, Omar NA. 2016. Feasibility for Sustainable and Profitable Local Goats Production in Nig. *J Livestock Sc.* (7): 126-132.