Online ISSN : 2249-4626
Print ISSN : 0975-5896
DOI : 10.17406/GJSFR

Global Journal

of Science Frontier Research: D

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Highlights

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Discovering Thoughts, Inventing Future

VOLUME 18 ISSUE 5 VERSION 1.0

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Volume 18 Issue 20 was originally issued as D5

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

Volume 18 Issue 20
Originally issued as D5

Global Journal of Science Frontier Research: D
Agriculture & Veterinary

Volume 18 Issue 5 (Ver. 1.0)

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 18 Issue 5 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Investigating the Activities of Hungarian Vineyards in the Light of the Data from the Test Enterprise System 2005-2014

By Ildikó Ábel, Gábor Pintér & Nóra Hegedűsné Baranyai
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Abstract- The wine-growing area has decreased in Hungary, while the importance of individual estates has increased, and the importance of joint enterprises has declined. It is necessary to introduce modern technologies to increase competitiveness, but the deficiency of funds is a serious obstacle.

The aim of our analysis is to examine how the profitability of wine-growing estates has changed according to plant size and business form in the period of 2005-2014, after Hungary joined the EU. We also examined whether the profitability proportional to production value, total equity, own equity and labour has changed in the industry.

Our analyses were performed based on the FADN data of the Agricultural Research Institute.

The gross production value per hectare was the highest in all the enterprises in the sector in 2011. The operating expenses were the most significant in the same year, but the increase in expenses was lower than the production. Consequently, the stakeholders of the grape and wine industry could realize the second highest pre-tax profit in the period. However, 2013 was the most favourable year for pre-tax profits. Producers could achieve lower production with much lower expenses, therefore profitability ratios were the best in 2013.

Keywords: grape and wine production, profitability, tangible assets, gross investment, net investment, investment subsidies, net liabilities.

GJSFR-D Classification: FOR Code: 070199



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Investigating the Activities of Hungarian Vineyards in the Light of the Data from the Test Enterprise System 2005-2014

Ildikó Ábel [α], Gábor Pintér [σ] & Nóra Hegedűsné Baranyai [ρ]

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The income generated fluctuated for enterprises of different sizes. For large farms, 2007 was the most favourable year, but the same year was the worst for medium-sized enterprises. For small farms, 2013 can be considered the most successful, while they experienced the biggest loss in 2010. In the period examined, large and medium-sized wine-growers were profitable, but small farms had to book three years of losses.

Both vertical and horizontal integration is inevitable in the industry; accordingly it is necessary to coordinate vine-growing and viticulture, as well as the activities of grape growers and wineries.

Keywords: grape and wine production, profitability, tangible assets, gross investment, net investment, investment subsidies, net liabilities.

I. Introduction

Prior to 1989, 30 state farms and 50 farm cooperatives were involved in vine-growing and wine production. In 2000, almost three-quarters of the nearly 120,000 vine-growers farmed areas of less than 0.5 hectares and sold the grapes they produced. Since 2003, Hungary's total vineyard area has decreased by 15.1%. This decline has mainly occurred in areas growing white grape varieties, which have decreased by 18.6%, but the area planted with blue grapes has also decreased by 5.8% (Hill Communities National Council, 2016).

The control, unification and coordination of the sector is made difficult by the large number of sectoral actors (3,486 in 2005, 3,071 in 2013). In 2013, the use of vineyards was 18% for individual farms and 10% for economic enterprises (KSH, 2014). The average agricultural area used by individual farms is increasing, while there is a decrease in the area used by economic enterprises (Valkó, 2014). The fragmentation was also promoted by the subsidies for the restructuring and conversion of vineyards, amounting to HUF 6,312 million from EU funds in 2013, with HUF 4 million provided for removing vineyards. (Government of Hungary, Report B/3566 on the state of the agricultural economy in 2013)

On 22 June 2006, the European Commission published its position on the reform of community wine-growing. An EC Council Regulation (EC No 429/2008) was issued relating to grants for removing vines and to the 'national envelope' System. The support for the modernization of horticulture from the 1st axis of the NRDPH (National Rural Development Plan of Hungary) was HUF 78.6 million, and the aid for the modernization of horticultural plantations amounted to HUF 27.9 million (Judge - Nemes, 2014).

The state of the wine sector is shown by the fact that although in 2009 10% less wine was produced, the overcapacity of the sector was not resolved. Due to the unfavourable weather, in 2010 only half the amount of grapes was produced and the quality lagged behind the average. In the 2010-2014 period, production did not reach the previous level of 3 to 3.5 million hectolitres, but was 2 million hectolitres in unfavourable years, and 2.5 million hectolitres in favourable weather conditions (Hill Communities National Council, 2016).

In the second half of the 1990s, in the small farms, when examining the cost and income relationship for wine grapes, it was found that - when the owner's labour was calculated at the average hourly wage rate - practically no income was generated (Popp, 2004, Radóczné-Erdész, 2000). The profit-generating capacity

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of vine-growing can only be increased by improving quality and consequently by increasing prices. It can be said that the individual dominant positions which have formed at various levels of the wine-grape market may also have a significant effect on price evolution (Varga, 2007). In the improvement of the market position of vineyards and wine production, the support for plantation development and the establishment of cellar cooperatives had a vital role (Magda-Gergely, 2004, Radóczné, 2008).

Purchase prices almost doubled, but the increase in costs resulted in the majority of farmers making a loss. On the domestic market, foreign buyers appeared, also looking for grapes and musts, promising high prices and instant payment. 60% of the grape production of the wine region of Eger went to other domestic wine regions or abroad. Grapes and must were partly bought to improve the quality of the purchasers' own products. Some of these products appeared on domestic shelves with foreign labels. In 2010, 1,645 million hectolitres of wine were produced in Hungary, which is half of the average of a typical year.

Examining horticultural crops, between 2007 and 2011, wine grapes showed the least cost increase per hectare, at 5%. In 2010, the specific yields declined due to the extremely wet weather. The average yield of grape wines did not reach 5 tons/hectare in 2010, which is just over half that of 2008. In 2011, spring frost damage caused losses to the crop (7.28 t/ha). Looking at the average sales price for wine grapes, after falling in 2008 (64.2 HUF/kg) they increased significantly in 2011 (90.6 HUF/kg) but did not exceed the level of 2007 (92 HUF/kg) (Borbélyné et al., 2013). With regard to the 2007-2011 period, the sales price did not cover production costs on two occasions. In 2010, the sector's profitability was the lowest (-171 882 HUF/t). The cost of production increased by 7.6% between 2010 and 2011, but the cost decreased (4.88-7.28 t/ha) due to the increase in average production (Borbélyné et al., 2013).

The identification of quality with price is hampered by the vertical fragmentation of the market, i.e. the separation and fragmentation of the organization and ownership of vineyards and wineries. Raw material producers are in the most vulnerable position, while the farmers with greater security are those at a higher level on the product path. To move forward, i.e. to get to a higher processing level of the product, capital is essential. As a result of the reduction of state subsidies, producers may receive funding from EU tenders, but most of these are post-financing, and hence require the existence of a certain amount of equity (Erdészné et al., 2004).

In the case of family farms, they must realize the gross income to ensure the family's livelihood and to cover development. The cost of work is a function of realized gross income. Profitability and the total gross income must be kept in balance (Vági, 1996). To improve producer interests, Popp et al. (2010) proposes the introduction of income support replacements linked to established pre-conditions, rather than land-based and agri-finance subsidies.

Small and medium-sized food businesses and labour-intensive sectors with high added value play a prominent role in retaining rural population (Bíró-Nemes 2014). In their survival and effective operation, co-operatives have a great significance in that, by increasing the added value of the products, they can cover the entire product line. Cellar cooperatives facilitate integration and control, and simplify administration and the economical use of equipment. Producer co-operatives also represent a protection of interests, increase bargaining power and are also essential in obtaining the information needed to make business decisions (Lakner et al., 2007). Typically, farmers with less than one hectare of vineyards (primary producers) are very vulnerable, either to producers or to sales co-operatives, or in situations where there are no market integrators (Radóczné, 2002; Radóczné-Györe, 2006). Despite this, there is a decrease in the willingness to integrate; membership of producer groups declined significantly between 2006 (2653 producers) and 2012 (1288 producers) (Szabó-Barta, 2014). Small producers are inflexible, have little chance of their interests being defended and promoted, and sometimes they are vulnerable to the relative concentration of the food industry (Ferenczi, 1995; Baranyai-Takács, 2010). One of the alternative solutions to this problem could be the establishment of producer groups recognized by the EU, which are also able to exploit the benefits of co-operation and association, in order to solve the crisis of the low point of wine production. Producer groups may be able to carry out independent tasks under the current EU regulations, such as tendering, joint marketing, and market search (Barócsi et al., 2008). The current producers and professional organizations of the European Union have been established on a voluntary basis. They provide producers with a service enabling them to grow grapes of good quality to meet market needs (Popp, 2014).

The large number of players in the industry (3486 in 2005, 3071 in 2013) makes it difficult to control, consolidate, coordinate and regulate. In 2013, 18% of vineyards were used for individual farms, and 10% for enterprises (KSH, 2014).

The average agricultural area used by individual farms is increasing while there is a decrease in that used by economic organizations (Valkó, 2014). The fragmentation was also prompted by subsidies for the restructuring and conversion of vineyards, amounting to HUF 6312 million from EU funds in 2013, and HUF 4 million for support for removing vineyards (Government of Hungary, 2015).

On 22 June 2006, the European Commission published its position on the reform of Community wine-

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growing regimes. An EC Council Regulation (Council Regulation 2008) was issued on removal grants and the national envelope system. From the 1st axis of the NRDPH, the support for the modernization of horticulture was HUF 78.6 million, and the aid for modernization of the plantations was HUF 27.9 million (Bíró et al., 2014).

According to the latest processed 2016 statistics, a total of 41 798 farms were involved in wine production or winemaking, 85.9% only with grape production, 3.1%, only with wine making and 11.0% with both. Vineyards and wineries are divided, despite the fact that four-fifths of wine producers are involved in vine-growing. The division is important, even when we consider that it is often only formal (Hill Regions National Council, 2016).

On a yearly basis, a minimum of EUR 43 million is available to the sector. Wine-making investments and the restructuring of grape production were dominant in the distribution of subsidies (Hill Regions National Council, 2016).

Increasing the competitiveness of agriculture, including grape and wine production, requires the use of state-of-the-art technologies, which is hampered by the low cost of labour, black and grey employment and capital shortages (Harangi-Rákos - Szabó, 2012, Popp, 2014). We must also mention the need to increase employment, which can be achieved by developing highly labour intensive sectors (horticulture, plantation management) that create high added value (Bíró et al., 2014).

II. Aims - Hypothesis

During our research, we sought to find out whether the tangible assets, the investments and the subsidies of the vine-producing farms changed in the period after EU accession, and whether the profitability of their farms differed according to the size and form of the enterprise. We also were interested in how the value of net and gross investment, and profitability in terms of its proportionality to production, total capital, own equity and labour, have changed among those active in the sector.

Our hypothesis was that there are differences in the size of the tangible assets and the profitability in terms of size and corporate form, and that the differently sized grape-producing enterprises react differently to the economic effects caused by the weather.

III. Materials And Methods

During our investigations, we rely on the database maintained by the KSH (Hungarian Central Statistical Office) and the AKI (Hungarian Agricultural Research Institute) Test Enterprise System. The basis of the analysis is the average data provided by the test system. The database shows the data of a 2000 test enterprises which exceed the 4000 Euro Standard Production Value, representing more than 110,000 agricultural commodity producers. More than 3,000 vineyards are represented by 63 test plants.

The methodological background is provided by the tools of economic analysis. We assessed the asset balance between 2005 and 2014 on two levels: economy types (individual and social economy) and farm size expressed in hectares (small <5 ha, medium 5-15 ha, large >15 ha).

Investigations included tangible assets, current assets, depreciation, investment structure, gross and net investment value, investment subsidies and scrapping. Gross investment refers to the sum of money spent on increasing the holdings of fixed assets in a given year. Net investment is an increase in the portfolio of fixed assets, taking into account scrapping and depreciation (as decreasing factors) (Net investment = gross investment - scrapping - depreciation).

We also examined the changes in the profitability in terms of its proportionality to production, total capital, own equity and labour. The gross production value is the value of the outputs generated by the producer, the service provider and the related ancillary activities (sales revenue, capitalized own revenues, other revenues). The gross production value includes products and area-related subsidies. The return on profitability is the ratio of pre-tax profit to total production value. When calculating total return on profit, we add the paid interest to the pre-tax profit. In the case of own equity profitability, pre-tax profit is expressed as a percentage of own equity. For work profitability, the amount of pre-tax profit and personal income is adjusted to the individual annual workforce. The annual workforce is the unit of measurement of work performance, which is the annual working performance of a full-time employee working full-time, expressed in working hours (2200 hours per year). To aid comparability, the indicators are presented for 1 hectare of agricultural land.

During the study we applied a dynamic ratio for the quantification of the change and a distributional ratio for examining the structure.

IV. Results

When comparing the data of enterprises of different size and corporate form, it is important to consider the size of the farms in which they operate.

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Table 1: Average Agricultural Area per Holding (Hectares)

Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Enterprise	34.2	36.27	23.31	29.22	26.71	31.53	31.89	30.38	30.72	31.83
Medium-Sized Enterprise	8.09	7.77	8.37	8.59	8.88	9.52	9.1	9.16	9.15	8.83
Small Enterprise	3.26	3.34	3.58	3.64	3.65	3.58	3.5	3.53	3.48	3.45
All Enterprises	9.27	9.44	8.29	9.07	10.07	11.23	11.14	10.77	10.71	11.28
Individual Enterprises	6.95	6.91	7.36	6.99	8.19	8.85	9.05	8.46	8.89	9.44
Joint Enterprises	30.96	33.08	17.33	29.28	28.48	26.22	24.37	25.42	22.42	23.26

Source: Authors' own creation, based on Test Enterprise System data

For all enterprises, the average area per enterprise varied during the period under review, increasing by 21.7% in 2014 compared to 2005, with the lowest point in 2007 (Table 1). Small farms farmed an average of 3.2-3.6 ha. The average for medium-sized farms did not rise above 10 ha in any one year. The average size of the agricultural area used by the vine-growing individual farms ranged from 6.9 to 11.2 ha, i.e. the average farm size remained within the medium-sized category. The average area of joint enterprises showed significant volatility during the period under review, but it is clear that after a decline in 2007 in each year it exceeded 22 hectares. The significant downturn in 2007 is due to the decline in the area farmed by joint enterprises. The decline in area in large farms and joint enterprises in 2007 was obviously caused by the 37/2007 (V 11) FVM Decree, which included detailed conditions for granting subsidies for removing vineyards, which several farmers took advantage of.

One of the aims of this paper is to show the development of the tangible assets and the development of the investment activity. This category of equipment includes the machines, plant, equipment and vehicles which are necessary for the maintenance and cultivation of plantations, and for the harvesting and transportation of produce.

With regard to tangible assets per hectare, farms with a small farm size were in a better situation than medium-sized farms (except for the year 2007) (Table 2), because machines must also be purchased when a farm is small, when their utilization is not as favourable as for larger farms. During the period under review, medium-sized enterprises' tangible assets decreased by 8.6% compared to 2005. Their investments did not exceed the depreciation of tangible assets, so their machine fleet became older and became obsolete. The situation is not favourable for large-scale farmers either, as the value of the fixed assets per hectare only reached the 2005 level in the last three years, and this means that we can only talk about asset maintenance. Farmers with small areas reached a low point in 2007, after which the value of their tangible assets per hectare increased, and in the last three years they were of similar magnitude to farms with a large area. In 2014, none of the owners could increase the stock of tangible assets.

Table 2: Tangible Assets per Hectare of Agricultural Land (Thousand HUF)

Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Enterprise	5 049.0	5 010.5	3 721.8	4 138.9	3 553.3	4 421.7	5 392.4	5 078.1	5 094.7	4859.8
Medium-Sized Enterprise	2 356.5	2 330.9	2 246.3	2 108.7	2 277.4	2 184.9	2 003.6	2 076.8	2 153.6	2093.4
Small Enterprise	3 322.7	2 660.0	1 888.0	2 331.5	2 502.2	3 553.2	5 136.9	4 929.6	5 069.4	4957.0
All Enterprises	3 655.0	3 671.2	2 819.6	3 134.9	2 995.8	3 643.3	4 214.3	4 094.6	4 058.3	3852.1
Individual Enterprises	2 475.0	2 260.1	2 126.9	2 352.4	2 077.6	2 404.0	2 492.0	2 759.9	2 805.7	2652.5
Joint Enterprises	6 131.7	6 424.2	5 687.7	4 957.2	5 569.7	6 273.2	8 276.8	6 914.6	7 280.8	7011.2

Source: Authors' own creation, based on Test Enterprise System data

According to the form of wine producing enterprise, it can be concluded that the tangible assists per hectare of joint enterprises are more than double those of an individual farmer, averaging in excess of 6 million forints over 9 years. The reason for this is that joint enterprises have more favourable financing opportunities from both their own and outside sources.

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Table 3: Gross Investment per Hectare by Size of Enterprise, (Thousand HUF)

Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Enterprise	639.49	374.57	305.50	412.97	392.61	670.66	746.52	721.57	450.87	656.7
Medium-Sized Enterprise	95.32	167.82	186.57	219.31	186.18	218.35	157.53	100.09	293.15	164.3
Small Enterprise	22.12	43.09	35.10	206.50	233.19	334.74	2 519.80	267.68	336.14	151.38
All Enterprises	320.97	248.43	205.83	309.99	304.17	489.99	769.40	458.01	380.15	422.55
Individual Enterprises	149.42	118.25	117.13	216.31	121.45	196.20	550.17	206.01	249.61	219.4
Joint Enterprises	681.02	502.43	573.17	528.17	816.33	1 113.47	1 286.51	990.41	715.98	957.5

Source: Authors' own creation, based on Test Enterprise System data

Between 2005 and 2007, after the EU accession, the value of investment per hectare for small farms was significantly lower than in other enterprises, but since 2008 there has been a significant increase. As a result of the economic crisis of 2008-2009, the size of the investment per hectare did not decrease in these enterprises, and the value for 2011 was extremely high due to real estate investments. The stock of unfinished investments was also high due to semi-finished buildings and constructions. The upsurge phase of medium-sized farms in development is in the 2005-2010 period. Subsequently, while other farmers made the largest investment in the period under review, these farmers reduced their development. The 2008-2009 crisis had the most negative impact on individual farmers' investments.

Investment per hectare in the year following EU accession averaged over 20,000 HUF for all enterprises, but fell to below 5,000 by 2007 (Table 4), while in 2008 it increased by more than tenfold compared to the previous year.

Table 4: Investment Subsidies per Hectare (Thousand HUF)

Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Enterprise	35.79	6.6	8.63	46.89	52.45	91.51	174.41	279.79	125.89	165.24
Medium-Sized Enterprise	10.91	12.01	2.57	41.96	19.80	60.31	39.83	75.5	34.11	51.93
Small Enterprise	2.97	0	0	90.59	0	125.14	763.77	26.69	0	58.41
All Enterprises	20.60	7.58	4.68	54.63	33.95	87.29	202.70	178.44	76.84	112.35
Individual Enterprises	11.99	2.34	5.55	60.48	15.81	83.1	174.59	83.29	83.08	89.43
Joint Enterprises	38.67	17.8	1.08	41.01	84.8	96.19	269.02	379.47	60.78	172.71

Source: Authors' own creation, based on Test Enterprise System data

During the period under review, the investment subsidy was the highest in 2011, exceeding 200 000 forints per hectare on average for all farmers, while in 2013 it did not reach the 2010 average. The average for large farms fell from 35 790 in 2005 per hectare to 6 600 in 2006. In the following years, however, it grew year on year. These enterprises received the largest amount in 2012. The average amount of investment subsidy per hectare for medium-sized businesses also varied. The peak was reached in 2012. Small farms did not realize investment subsidies in 2006, 2007, 2009 and 2013. The investment subsidy per hectare in 2008, 2010 and 2011 far exceeded the subsidies for all other farmers. Based on this examination, it can be stated that this high amount was used for real estate investments, since they were able to use large amounts of real estate investment subsidies within the framework of the New Széchenyi Plan announced in 2011.

Based on the method of management, it can be seen that between 2005 and 2007 the amount of subsidy per hectare was very low in both types of economic activity. In the case of joint enterprises in 2007, this amount hardly exceeded 1 000 HUF per hectare. As a result of the 2008 crisis, private farms used significantly less investment support in 2009 than in the absence of their own resources, while in the case of joint enterprises there was no such shift.

In the case of investments, it is important to consider whether the amounts spent on investment are sufficient to replace the assets, and to maintain, renew, and expand the asset stock. If we start from the average of all farms, it can be concluded that during the period under review, the value of the investments was only 75,910 forints higher than the amount per hectare for scrapping and depreciation (Table 5). If we ignore the rate of inflation and the fact that the life expectancy of

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real estate is much longer than that of machinery, equipment and vehicles, and so its depreciation is significantly lower, this sum is still very low. In the sector in general, sufficient resources are not devoted to replenishing tangible assets, or obtaining state-of-the-art equipment, so the machine fleet becomes old and obsolete, resulting in a rise in refurbishment costs and lower competitiveness, all factors which affect the decline in profitability.

Table 5: Net Investment per Hectare (Thousand HUF)

Type	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Enterprise	18.80	-58.67	-123.90	-107.82	100.85	80.95	118.63	215.18	-23.44	140.98
Medium-Sized Enterprise	-95.45	-124.33	-42.48	48.19	-116.80	8.01	-22.29	-68.44	12.46	17.25
Small Enterprise	-171.32	-167.60	-97.26	89.08	106.15	132.94	1 139.43	-102.65	-250.56	-258.36
All Enterprises	-56.37	-99.28	-90.50	-18.38	36.34	67.22	198.81	79.23	-41.16	53.61
Individual Enterprises	-78.09	-110.29	-65.52	33.48	-21.82	8.97	177.28	-23.85	-18.48	52.75
Joint Enterprises	-10.78	-77.81	-193.96	-139.19	199.38	190.84	249.59	297.00	-99.53	55.86

Source: Authors' own creation, based on Test Enterprise System data

The net investment per hectare was negative in the first four years of the survey period, which means that the amount of investment did not even reach the value of depreciation and scrapping. Although a minimal increase in 2009 was achieved, and the highest value was reached in 2011 - which is likely to be due to the large amount of real estate investment by small farms - it again showed a downward trend, and again in 2013 was negative. We also see a similar trend for large area farmers, with the exception that the indicator was positive in the first year. In the nine years overall, the sector had a positive balance of 220 580 HUF/hectare. Medium-sized farms show the worst picture, the amount of investment per hectare totalling 401 130 forints on average over nine years, including scrapping and depreciation. For small farms, a total of 678 210 HUF is the positive balance of the indicator during the period examined, but this figure is disappointing as this was caused by the 2011 real estate investment, and if we ignore this, then the investment position of these farmers is no better than the medium sized farms. Examining the form of farm management, the average of individual farmers for the nine years overall was negative: -98 320 forints. In 2011, we see a higher value compared to the other years (the investment was nearly HUF 178 000 higher), probably also due to the real estate investment. With regard to the creation of resources, joint enterprises were in the best position, but in terms of the trend the increase from 2009 was broken in 2013, and the indicator also became negative for these farmers.

Table 6 shows the values of the profitability indicators for all vineyards.

Table 6: Profitability Indicators for Vine Growers (All Farms)

Type	Unit of Measurement	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Gross Production Value	1000 Ft/ha AL	1451.6	1744.2	1118.1	1231.7	961.9	1485.9	3508.3	2074.3	1744.9	1556.1
Personnel Expenses	1000 Ft/ha AL	250.5	272.8	186.3	228.9	208.5	284.2	395.1	327.5	333.2	328.7
Of which : Wage Costs	1000 Ft/ha AL	178.6	206.5	141.4	170.9	154.8	213.2	295.2	254.7	257.2	249.8
Other Personnel Payments	1000 Ft/ha AL	18.8	6.7	1.9	6.6	9.2	12.3	20.5	12.5	11.4	14.6
Total Agricultural Operating Costs	1000 Ft/ha AL	1277.1	1458.9	851.9	1025.7	902.3	1388.3	3145.0	1827.0	1311.4	1250.2
Pre-Tax Profit	1000 Ft/ha AL	92.4	267.4	277.9	206.0	49.9	85.1	300.4	230.9	407.5	292.7
Own Equity	1000 Ft/ha AL	3730.8	4066.1	2683.1	3845.9	3634.2	4465.5	5450.0	5449.4	5438.3	5381.4
Proportional Profitability	%	6.4	15.3	24.9	16.7	5.2	5.7	8.6	11.1	23.4	18.8
Profitability of Capital	%	3.0	5.3	7.5	4.9	1.6	2.0	5.2	4.0	6.5	4.9
Profitability of Own Equity	%	2.5	6.6	10.4	5.4	1.4	1.9	5.5	4.2	7.5	5.4
Work Profitability	1000 Ft/AUL	1078.4	1803.0	2153.6	1801.1	1229.2	1580.9	2301.8	2252.7	3206.1	2768.0

Source: AKI Test Enterprise System data

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With regard to gross production value, we saw a very high value in 2011. This year, early frosts caused serious damage, but rising prices compensated for this unfavourable effect. In terms of the trend, gross production fluctuated. During the first two years of the period there was an increase, and a further increase was recorded after a slight decline in 2007. The lowest value was recorded in 2009.

Viticulture is a labour-intensive sector, so it is very important to consider the development of personnel costs within the overall costs. The cost of wages per hectare also show great fluctuations in the 10 years under review. An outlying value can be seen in 2011, similarly to the gross production value. From 2010, the wage costs incurred increased significantly, one reason for which is the rise in the minimum wage.

Analysing the operating costs it can be stated that the 2011 value is also the highest. In 2007 and in 2009 it was possible to reduce operating costs, so we can observe a value below 1000 HUF per hectare. However, these years also show a low value for gross production.

For the pre-tax profit, the years 2005, 2009 and 2010 can be said to be unfavourable due to low returns and higher operating costs. In 2011, high production was associated with high costs, so this year cannot be said to be outstanding for pre-tax profit. On a per hectare basis, vine-growers enjoyed the highest pre-tax profit in 2013, thanks to the fact that production was lower than in 2012, and to cost-saving farming.

Favourable values of the proportional profitability - production ratio are linked to years when the gross production value was not outstanding. However, thanks to cost-effective management, in 2007 and 2013 the index rose to over 20. In 2005 and 2006 we see the lowest profitability, with the value of the indicator barely above 5, indicating that the after-tax profit is only 5% of the gross production value. The reason for this is the low production value in 2009 and the high operating costs associated with a moderate production value in 2010.

Regarding the trend of the profitability of capital and own equity, production tracks profitability in a proportional way.

Examining labour productivity in labour-intensive sectors is of the utmost importance. The highest earnings of the workforce were produced in 2013, at which time the pre-tax profit was highest, and the personal income tax paid was also significant.

We have investigated the variability of the profitability indicators of the vine-producing enterprises according to the type of farm operated (Table 7).

Table 7: Profitability Indicators for Individual Farmers and Joint Enterprises

Indicator	Unit of Measurement	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Individual Farms											
Gross Production Value	1000 Ft/ha AL	549.5	800.0	767.0	825.6	596.7	0.2	894.2	956.8	1138.8	940.2
Personnel Expenses	1000 Ft/ha AL	116.8	129.8	143.7	141.9	127.8	123.7	143.3	156.8	170.1	155.7
Of which: Wage Costs	1000 Ft/ha AL	96.3	107.7	112.3	113.1	100.2	66.9	113.5	124.4	135.8	124.5
Other Personnel Payments	1000 Ft/ha AL	0.3	0.0	0.3	0.1	1.6	90.2	1.2	0	0.3	0
Total Operating Costs	1000 Ft/ha AL	547.1	645.1	627.0	659.3	545.3	83.1	658.8	714.2	731.3	667.8
Pre-Tax Profit	1000 Ft/ha AL	-6.6	146.9	136.6	163.3	38.8	-35.7	217.2	234.0	399.4	266.3
Own Equity	1000 Ft/ha AL	2551.3	2357.4	2331.2	2693.2	2326.2	2784.9	2909.7	3375.9	3660.5	3566.7
Proportional Profitability	%	-1.2	18.4	17.8	19.8	6.5	-5.5	24.3	24.5	35.1	28.3
Profitability of Capital	%	-0.1	5.5	5.2	5.4	2.0	-0.6	7.2	6.5	10.0	7.1
Profitability of Own Equity	%	-0.3	6.2	5.9	6.1	1.7	-1.3	7.5	6.9	10.9	7.5
Work Profitability	1000 Ft/AUL	367.4	1037.1	1244.5	1283.8	834.6	510.3	1949.2	2093.0	3073.7	2349.1
Joint Enterprise											
Gross Production Value	1000 Ft/ha AL	3344.9	3 586.3	2572.1	2177.6	1985.4	3255.5	9674.3	4435.3	3304.1	3178.3
Personnel Expenses	1000 Ft/ha AL	531.0	551.9	362.6	431.7	434.9	567.4	989.2	688.4	753.0	784.2

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Of Which: Wage Costs	1000 Ft/ha AL	351.1	399.0	261.6	305.5	307.9	417.9	723.7	530.0	569.6	579.7
Other Personnel Payments	1000 Ft/ha AL	57.5	19.7	8.7	21.9	30.5	31.3	66.0	38.8	40.0	52.9
Total Operating Costs	1000 Ft/ha AL	2809.2	3046.6	1783.1	1879.0	1902.9	2909.3	9009.5	4178.1	2804.0	2783.6
Pre-Tax Profit	1000 Ft/ha AL	300.0	502.5	863.0	305.3	81.0	341.5	496.8	224.2	428.2	362.3
Equity	1000 Ft/ha AL	6206.3	7399.5	4140.2	6530.8	7300.7	8032.0	11442.3	9830.5	10012.1	10160.4
Proportional Profitability	%	9.0	14.0	33.6	14.0	4.1	10.5	5.1	5.1	13.0	11.4
Profitability of Capital	%	4.7	5.2	10.0	4.4	1.3	3.6	4.2	2.3	3.6	3.1
Profitability of Own Equity	%	4.8	6.8	20.9	4.7	1.1	4.3	4.3	2.3	4.3	3.6
Work Profitability	1000 Ft/AUL	2228.1	2996.8	6429.4	3053.9	2211.5	3013.3	2586.6	2429.7	3400.6	3394.1

AL = Agricultural Land, AUL = Annualised Unit of Labour

Source: AKI Test Enterprise System Data

In terms of gross production per hectare, jointly-owned enterprises far exceed individual farms. In the case of joint enterprises, the most favourable year was in 2011; in the case of individual farms it was 2013.

When examining expenditure on personnel, it should be said that for individual farms, using a family member to assist as an unpaid worker may distort the comparison. Moreover, farmers take their income out of the year-end result. Partly for the above-mentioned reasons, we can see a much lower wage cost for individual farms than for social farms. Other personnel-related payments are in a similar situation, since the opportunities offered by fringe benefits are usually not enjoyed by private entrepreneurs.

Operating costs show the same trend as personnel costs. Individual farms produce a lower level of gross production at considerably lower costs. This is due to the fact that joint enterprises are characterized by general costs.

Examining pre-tax profit, it can be said that joint enterprises were able to achieve positive results for the entire period under review, while for individual farms, 2005 was unprofitable. The production of joint enterprises is burdened with higher costs, but their revenues are much higher, so their profits exceed those of individual farms. Only one year (2012) was an exception to this rule.

With regard to the ratio between proportional profitability and production, individual farms are clearly in the most favourable position. An exception to this was a 3 year period (2005, 2007 and 2010) when the pre-tax profit was negative or very low.

Alongside the lower production and operating costs, proportionally favourable pre-tax profits could be achieved. In 2014 the production of individual farms was 30% of that of joint enterprises, while pre-tax profits reached 73.5% of those recorded by joint enterprises.

The profitability of total capital and own equity during the period under consideration was more favourable to joint enterprises, due to the higher pre-tax profit. Regarding the trend, the value of these two indicators follows the change in ratio between proportional profitability and production.

The labour productivity indicator is higher for joint enterprises, the reason for which is the higher value of personnel expenses and the pre-tax profits among these enterprises. Individual farmers take far less income out of their business and the work of unpaid family members also affects the value of the indicator.

During our research, we also examined how profitability changed with the size of the grape producers in the agricultural area (Table 8). The vast majority of large enterprises are joint enterprises, while small farms are individually-owned farms, and with medium-sized farms, joint enterprises are the most common form.

The gross production value per hectare of agricultural land is the highest in the case of large farms. Only one year (2006) was an exception, when the production of medium-sized farms exceeded the large farms. The performance of small farms in the last 4 years of the survey exceeded that of medium-sized farms (by 45% in 2014).

For large farms, the outstanding production value is coupled with high operating costs. In the case of small farms, in the last 4 years, not only the performance but also the operating costs incurred exceeded the similar values recorded in medium-sized enterprises. In 2014, production costs of medium-sized enterprises were on average 54% of those of large farms, while for small enterprises this figure was 107%. It can therefore be said that the production of small farms was accompanied by extremely high costs in the last year of the investigation.

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Large-scale farms also lead in terms of personnel expenditures. Here, it is also possible to pay employees higher fringe benefits. One of the factors of outstanding production costs in the small farms are personnel costs, which exceeded those of medium-sized enterprises between 2010 and 2014.

When examining pre-tax profit, it can be stated that for large enterprises 2007 was a good year (488.6 thousand HUF/ha), as was 2013 (429 thousand HUF/ha), while 2009 was unfavourable, with profits hardly exceeding HUF 40 thousand per hectare. During the period under review, the value of the indicator fluctuates significantly. For medium-sized farms, the lowest profits were recorded in 2005 (60.3 thousand HUF/ha), in 2007 (58.2 thousand HUF/ha) and in 2010 (77.1 thousand HUF/ha), but this was still higher than in large enterprises. The most successful years were 2006 and 2013.

The performance of medium-sized enterprises is different from large ones. 2006 was a remarkably good year, and then - with some minor fluctuations - the gross production value declined, with a slight upswing in 2013 and 2014. In 2011, when large enterprises produced high output, medium-sized enterprises registered average performance. Their personnel expenditures were considerably lower, and in 2014, were 37% of those of large enterprises. Other personnel payments - including sick leave and optional fringe benefits - were also considerably lower. A smaller operating size is also a reason for lower operating costs, since they have to employ fewer administrative staff than large enterprises. For pre-tax profits, the worst years for this type of enterprise were 2005, 2007, 2009 and 2010, when it did not even reach 80,000 HUF/ha. The most successful years, as in large enterprises, were 2006 and 2013. In 2006, 2009 and 2012, the pre-tax profits of medium-sized businesses exceeded that of large enterprises.

The proportional profitability of production is lower than in large enterprises, since the lower operating costs were unable to offset the low revenues. With respect to the labour profitability indicator, with the exception of 2006, they reported slightly lower values.

Table 8: Profitability indicators for grape producers, according to size of enterprise

Type	Unit of Measurement	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Large Enterprises (Area Above 15 Ha)											
Gross Production Value	1000 Ft/ha AL	2055.4	1860	1471.8	1622.1	1052.2	2002.9	5601.8	2892.7	2107.4	1895.8
Personnel Expenses	1000 Ft/ha AL	390.7	402.9	201.2	317.8	248.1	373.3	596.3	462.6	458.5	439.3
Of Which: Wage Costs	1000 Ft/ha AL	266.6	298.4	151.0	229.6	179.2	278.0	442.9	361.3	351.5	329.6
Other Personal Payments	1000 Ft/ha AL	39.6	11.6	3.1	12.0	13.2	16.5	32.7	19.7	17.9	23.8
Total Operating Costs	1000 Ft/ha AL	1725.0	1622.5	1010.2	1367.0	999.1	1816.6	5109.0	2664.4	1632.9	1488.6
Pre-Tax Profit	1000 Ft/ha AL	191.4	221.7	488.6	256.9	40.8	174.5	396.5	201.1	429.0	385.9
Equity	1000 Ft/ha AL	4990.7	5597.2	3020.9	5183.4	4337.0	5561.9	7360.9	6926.5	6916.0	6824.3
Proportional Profitability	%	9.3	11.9	33.2	15.8	3.9	8.7	7.1	6.9	20.4	20.4
Profitability Of Capital	%	4.0	3.7	9.6	4.7	1.3	3.0	5.1	2.9	5.5	5.2
Profitability Of Own Equity	%	3.8	4.0	16.2	5.0	0.9	3.1	5.4	2.9	6.2	5.7
Work Profitability	1000 Ft/AUL	1962.4	2127.0	4126.2	2764.3	1619.5	2491.4	2724.1	2446.5	3834.7	3961.3
Medium-Sized Farms (5 to 15 ha)											
Gross Production Value	1000 Ft/ha AL	1151.2	2023.3	786.9	961.9	947.3	834.4	973.3	934.7	1176.5	1071.4
Personnel Expenses	1000 Ft/ha AL	164.5	171.5	156.4	145.5	176.5	140.5	132.9	147.8	156.4	162.4
Of Which: Wage Costs	1000 Ft/ha AL	125.4	132.2	120.9	112.7	133.6	104.5	99.0	110.3	119.5	122.9
Other Personal Payments	1000 Ft/ha AL	3.8	3.0	1.5	2.7	7.0	9.0	8.0	5.3	5.3	5.4
Total Operating Costs	1000 Ft/ha AL	1042.6	1604.3	724.5	738.8	858.3	737.6	734.3	668.8	805.7	810.9
Pre-Tax Profit	1000 Ft/ha AL	60.3	392.7	58.2	217.3	79.1	77.6	228.6	264.9	366.8	256.7
Equity	1000 Ft/ha AL	2371.9	2386.1	2416.1	2372.4	2820.7	2468.6	2406.4	2970.0	3066.6	3118.2
Proportional Profitability	%	5.2	19.4	7.4	22.6	8.4	9.3	23.5	28.3	31.2	23.9
Profitability Of Capital	%	3.0	9.8	2.2	7.6	2.8	3.1	7.9	8.1	9.9	7.2
Profitability Of Own Equity	%	2.5	16.5	2.4	9.2	2.8	3.1	9.5	8.9	11.9	8.2

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Work Profitability	1000 Ft/AUL	827.8	2322.6	966.5	1729.7	1258.9	1167.7	2062.9	2230.2	2899.0	2175.0
Small Farms (Area Size Below 5 ha)											
Gross Production Value	1000 Ft/ha AL	485.3	703.9	916.9	732.5	697.2	788.7	1384.7	1547.4	1840.9	1549.4
Personnel Expenses	1000 Ft/ha AL	77.4	105.1	202.3	147.2	138.8	227.1	241.6	222.0	314.9	355.8
Of Which: Wage Costs	1000 Ft/ha AL	67.2	94.3	153.5	121.5	114.6	179.9	192.1	177.1	255.6	293.5
Other Personal Payments	1000 Ft/ha AL	0	0.1	0	0	0	2.9	2.1	1.4	2.3	0
Total Operating Costs	1000 Ft/ha AL	596.9	589.6	729.7	662.9	670.1	1033.7	1240.9	1269.8	1401.6	1592.7
Pre-Tax Profit	1000 Ft/ha AL	-120.2	110.2	192.3	73.6	26.4	-246.6	82.9	267.1	431.3	-49.7
Equity	1000 Ft/ha AL	4011.6	3266.4	2415.1	2929.4	2845.0	4223.5	5482.7	5455.6	5975.3	6068.8
Proportional Profitability	%	-24.8	15.7	21.0	10.1	3.8	-31.3	6.0	17.3	23.4	-3.2
Profitability Of Capital	%	-2.6	3.2	6.8	2.3	0.9	-5.2	2.2	4.4	6.4	-0.6
Profitability Of Own Equity	%	-3	3.4	8.0	2.5	0.9	-5.8	1.5	4.9	7.2	-0.8
Work Profitability	1000 Ft/AUL	-120.2	494.3	1197.0	615.5	522.9	-217.1	849.0	1640.1	2090.5	677.7

AL = Agricultural Land, AUL = Annualised Unit of Labour

Source: AKI Test Enterprise System data

Examining the gross production value of small farms it can be concluded that, with the exception of 5 years (2007, 2011-2014), they performed worse than medium-sized farms. Operating costs in the years 2007 and 2010-2014 were higher than those of medium-sized farms. As a result, their pre-tax profit was negative three times during the period under review. In 2014, the high gross production was associated with such high operating costs that small holdings had to report losses of 49.7 thousand forints.

Looking at the change in their own production inventories, it can be said that there was continuous growth for the period 2005-2009. In 2010, in the case of joint enterprises, this trend remained more or less the same. In the case of small farms, in 2010-2011 significant sales of previously accumulated self-produced inventories were made, while this process was characteristic of joint enterprises in 2012. This shows that small farms can tolerate an unfavourable period for only a short period of time, while larger farms and joint enterprises have sufficient resources to operate for longer periods.

V. Conclusion And Recommendation

During our investigations, it was found that the number and size of the farmers in the grape growing sector decreased during the period under review. The structure of the sector changed only slightly between 2005 and 2014. Vine growers operating with a larger area are in a much better position as regards assets and investment than small farms. Examining the form of farming, we can see that the average position and assets of the joint enterprises are better than those of the individual farmers.

The various groups in the industry are, on average, on a fairly low level, both in terms of assets and investment. The special feature of the industry is that it takes a long time for removed plantations to be replaced by replanting productive vineyards. As a result, up to that point the operation incurs only costs and expenditures, which must be funded. This is why - among other things - economic, agricultural, credit and subsidy systems play a very important role in the life of the sector.

Examining all the vine-growing enterprises, we can say that the gross production fluctuated. Between 2005 and 2010, growth and decrease followed each other regularly, followed by a decline after 2011. Because of the labour intensive nature of the sector, personnel expenditures accounted for 19-26% of all operating costs. Between 2009 and 2011, an increase in own equity was observable, which weakened slightly from 2012, but its rate barely rose above 1%. Overall, the sector was characterized by profitable management during the period under review.

In terms of the form of the enterprises, the picture is more nuanced. Individual farms were forced to record losses in 2005 and 2010. Within the operating costs, the proportion of personnel expenses remained within narrow limits (17-23%), partly due to the work of unpaid family members. Between 2009 and 2013, own equity increased significantly, before decreasing slightly in 2014 (2.5%). Gross production was higher in joint enterprises; in 2005 it was 6 times, and in 2011 it was 10.8 times greater than that of individual farms. The proportion of personnel costs within the total cost varied between 18 and 26%. In terms of the company form, there was also a significant difference in the production cost per hectare: costs in joint enterprises exceeded those in individual farms, being 2.8 times higher in 2007, 13.7 times higher in 2011, and 35 times higher in 2010.

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It can be stated, therefore, that large-scale enterprises and joint enterprises generate higher production per hectare at higher costs.

In general, stockpiling is characteristic of grape growing. Apart from raw material producers, we can see an increase in the stock of finished goods in the worst weather years. Smaller sized and individual farms find it more difficult to handle financing in years of unfavourable weather, so they have to sell their stocks at these times.

Acknowledgement

The publication is supported by the EFOP-3.6.3-VEKOP-16-2017-00008 project. The project is co-financed by the European Union and the European Social Fund."

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 18 Issue 5 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Growth Performance, Haematology and Blood Serum Chemistry of Weaner Rabbits Fed Parboiled-Sundried False Yam (*Icacina Tricantha*) Meal at Varying Replacement Level for Maize

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Abstract- A seven-week feeding trial was conducted at the Rabbitary Unit of the Teaching and Research Farm, Ambrose Alli University, Ekpoma to evaluate the growth performance, hematology and serum biochemistry of 15 unsexed weaner rabbits fed varying levels of Parboiled sundried false yam (*Icacina tricantha*) meal. Five treatments were formulated with diet one containing 100% maize as control, while in diet two, three, four and five parboiled sundried false yam meal replaced the percentage proportion of maize in diet one at 25, 50, 75 and 100% inclusion level respectively. Each rabbit was randomly assigned to the five treatment diets in a complete randomized designed (CRD) each treatment group contained three replicates with one rabbits each. Performance characteristics revealed that final live weight and weekly feed intake were significantly ($P<0.05$) influenced with the highest value (2.01kg/rabbit and 398g/rabbit) recorded from rabbits fed 25% PSFYM. Weekly weight gain was also significantly ($P<0.05$) influenced with the highest (194.67g/rabbit) from those fed 25% PSFYM. Feed conversion was lowest (1.36) from rabbits fed 25% PSFYM while lowest mortality rate of (3.34%) was recorded from rabbits fed 25% PSFYM. All the hematological indices assayed in this study showed a significant ($P<0.05$) variation among rabbits fed the treatment diets with highest values recorded among those fed 75% PSFYM.

Keywords: *broiler chicken, growth performance haematology, serum, parboiled-sundried false yam.*

GJSFR-D Classification: *FOR Code: 070799*



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Keywords: broiler chicken, growth performance haematology, serum, parboiled-sundried false yam.

I. Introduction

In a developing country like Nigeria, there is an inadequate supply of animal protein sources. An average Nigerian consumes only about 8.6g of animal protein per day as against 53.3g by the inhabitants of developed countries (Ojo, 2003). This shortcoming is majorly due to low productivity of livestock products. Inadequate supply of feeds, nutritionally unbalanced rations, adulterated ingredients or stale feeds are some of the factors responsible for low productivity of livestock in tropics (Ogundipe *et al.,* 2003) and when it comes to livestock management nutrition is perhaps the most important consideration. Apart from nutrition, livestock industry contributes significantly to family income (Ogundipe and Sanni, 2002). Livestock production especially the production of rabbits offers the greatest scope for increasing the quality and quantity of protein intake in Nigeria because of the short generation interval and prolificacy. Rabbit production is regarded as a means of sustainable livelihood and a way of achieving a certain level of economic independence. Rabbits are good sources of meat that is tasty, of good quality and similar to poultry meat with few or no religions taboo attached to its consumption. They grow rapidly because they are efficient at converting feed, forage and vegetative materials into meat besides their high productivity. Therefore the major interest of the farmer is to reduce feed cost, which usually accounts for 60 to 70% of the total cost of production (Ogundipe, *et al;* 2003). Research efforts are now geared towards evaluating alternative feed ingredients for poultry and other livestock like rabbits. Investigations has being carried out for the use of other alternative energy sources (Agunbiade *et al,* 2004 and Ajaja, 2005). Okosun and Eguaoje, (2017) recently reported the inclusion of 66.6% cassava grit and 5% supplementation of moringa leaf meal as substitute for maize in cockerel diet. This study tend to look at an unconventional feed ingredient such as false yam (*Icacina tricantha*), a small perennial shrub that is drought resistant. The plant produces erect leaf shoots from a large underground fleshly tuber. It belongs to the family of *Icacinaceae.* It is indigenous to West and Central Africa. False yam is seldom cultivated; however, it is reported from Senegal to be propagated by pieces of tuber, before the wet season. No pest and diseases have been reported (Kay, 1987). People truly enjoy the fruit as well as the seed, which represent a permanent, reliable and very tasty fruit. The tubers which resemble large turnips or beet root is such a great source of emergency moisture and feed energy to the plant that it can survive at least four years without rain. Thus, as long as false yam is around, food is always available for people (NRCNAP,

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2008). There is dearth of information on the use of *Icacina tricantha* as a basal diet in rabbit ration. This study is therefore embarked upon to evaluate the growth performance, haematology and blood serum biochemistry of weaner rabbits fed varying levels of parboiled-sundried false yam (*Icacina tricantha*) meal basal diet.

II. Materials and Methods

a) Location and Duration of the Study

The experiment was carried out in the Department of Animal Science, Livestock Section (Rabbitary Unit) of the Teaching and Research Farm, Ambrose Alli University, Ekpoma for the period of seven weeks.

b) Sourcing and Processing of Raw Materials

Fresh tubers of *Icacina trichantha* was collected from Uzebba in Owan West Local Government Area of Edo State, Ambrose Alli University Ekpoma Main campus in Esan West Local government area of Edo State and Otobaye community in Orhionwon Local Government Area of Edo State, Nigeria. The tubers were washed, chopped into small pieces and processed parboiling and then sundried (PBSD). For the parboiled-sun dried sample of *Icacina tricantha* after slicing, it was boiled for about 15-20mins and subsequently dried in the sun. All the chopped, processed tubers were then milled into a fine powder to pass through a 2mm mesh sieve until ready to use.



Fig. 1: Root, Stem and Leaves of *Icacina Tricantha.*



Fig. 2: Root Tuber of *Icacina Tricantha.*

c) Chemical Analysis of the Processed Raw Materials

The proximate composition was determined using the method described by AOAC (1990). The crude protein was determined by the Kjeldahl method. The energy value was determined using an Adiabatic Oxygen Bomb calorimeters (12149 Adiabatic calorimeter, PARR instrument Co. Illinois USA.

Table 1: Proximate Composition of Parboiled Sundried False Yam and Maize

Parameters	PSFYM	Maize
Dry Matter	7.61	6.20
Crude Protein	5.38	8.90
Crude Fiber	1.32	1.38
Ether Extract	2.63	4.47
Crude Ash	2.26	1.49
Nfe	80.80	77.56
Carbohydrate	88.39	82.62

**estimated*

d) Design and Management of Experimental Animals

A total of 15 mixed bred rabbits of same average weight were purchased from the Teaching and Research farm Benson Idahosa University, Benin city and the Animal House unit of College of Medicine, Ambrose Alli University Ekpoma, Edo State, for the experiment. The rabbits were kept and housed under a standard temperature (25°C), relative humidity (45%-55%), dark/light cycle (12 hours), and were fed with the commercial diet supplemented with Elephant grass harvested at least 24 hours previously for 4 weeks acclimatization period. The experimental animal had free access to clean water *ad libitum.* The 15 unsexed rabbits were randomly allotted in a completely randomized design (CRD) to five dietary treatments with treatment one being the control i.e. (100% maize) while treatment 2, 3, 4 and 5 were formulated to have a replacement level of maize with parboiled Sun dried (*Icacina tricantha*) meal at 25, 50, 75 and 100% . All treatments were replicated three times. All the diets (1 to 5) were formulated to be isonitrogenous (16%) and isocaloric (2680 ME Kcal/kg) as reflected in Tables 2.

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Table 2: Gross Composition of Experimental Rabbit Diets

	Inclusion Levels of PBSFYM (%)				
	0	25	50	75	100
	Diets				
Ingredients	1	2	3	4	5
Maize	56.12	42.09	28.06	14.03	0.00
PBSFYM	0.00	14.03	28.06	42.09	56.12
Soya Bean Meal	15.96	16.38	16.76	17.02	18.02
Wheat Offal	20.00	20.00	20.00	20.00	20.00
Bone Meal	2.00	2.00	2.00	2.00	2.00
Limestone	5.28	4.86	4.44	4.22	4.22
Salt	0.34	0.34	0.34	0.34	0.34
Premix	0.30	0.30	0.30	0.30	0.30
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis					
Crude Protein	16.00	16.00	16.00	16.00	16.00
Crude Fibre	3.28	3.81	3.79	3.78	3.77
Ether Extract	3.25	3.02	2.79	2.56	2.88
Calcium	2.00	1.88	1.75	1.62	1.70
Ash	3.82	3.81	3.79	3.78	3.77
ME (Kcal / Kg)	2599	2620	2642	2663	2673

PBSFY: Parboiled Sundried False Yam Meal.

e) Performance Study

During the feeding trial, daily feed consumption and weight changes will be recorded where weight gain, feed conversion ratio and protein efficiency ratio will be estimated. Daily feed intake will be determined by subtracting the weight of left-over of feed from the initial weight of feed supplied.

i.e. Feed intake = Feed given - Left over of feed

Weekly weight gain will be determined as the difference between the weight at the beginning of the week and the weight at the end of each week.

Feed conversion ratio will be estimated as the ratio of the feed intake to that of the weight gain .

$$\text{i.e.} \quad \text{Feed conversion ratio} = \frac{\text{Feed intake (g)}}{\text{Weight gain (g)}}$$

Protein efficiency ratio (PER) will be determined as the ratio consumed to weight gain.

$$\text{i.e.} \quad \text{PER} = \frac{\text{Weight gain (g)}}{\text{Protein consumed (g)}}$$

f) Hematology and Serum Biochemical Study

At the 7th week of the feeding trial, two sets of fresh blood samples were collected via neck slit from one (1) rabbit selected from each of the replicates into 2 bottles per rabbit, one of the bottles contains ethylene di-amine tetra-acetic acid (EDTA) to prevent clothing, while the other bottle was without EDTA for the serum biochemistry study. The haematological parameters determined are packed cell volume (PCV), haemoglobin (Hb), red blood cell (RBC), white blood cell (WBC), platelets, neutrophils, monocytes and eosinophil; while mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC), were calculated according to Jain (1986). Serum biochemistry parameters such as total protein, albumin and serum glucose were determined by the method of Hyduke (1975) while globulin values were estimated by the subtraction of albumin value from serum protein value (Dacie and Lewis, 1991).

g) Statistical Analysis

All the data collected were subjected to analysis of variance (ANOVA) and differences between means and treatments were determined using Duncan's multiple range test (DMRT) at 5 percent level of probability. All statistical procedures were according to (Steel and Torrie, 1990) with the aid of SPSS package.

III. Results

a) Performance Characteristics

The performance characteristics of weaned rabbits as influenced by the dietary treatments are shown in (Table 3). The dietary treatments significantly ($P<0.05$) influenced the average final live weight, average weekly feed intake, average weekly weight gain and feed conversion ratio. Average final live weight was significantly higher among rabbits placed on 25% Parboiled Sundried False Yam Meal (PSFYM) with a mean value of 2.01kg/rabbit, followed by the comparable mean value of 1.92kg/rabbit in those fed the control diet while lowest mean value of 1.57kg/rabbit was from those on 100% PSFYM replacement of maize. Average weekly feed intake was highest ($P<0.05$) among rabbits fed the control diet with an average value of 398.33g/rabbits, followed by comparable value of

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269.33g/rabbit in those fed 25% PSFYM while least mean value of 173.00g/rabbit was obtained from those fed 100% PSFYM. Average weekly weight gain was significantly ($P<0.05$) highest in rabbits maintained on 25% PSFYM with a mean value of 194.67g/rabbit, followed by (177.33g/rabbit) in those placed on diets three while the lowest mean value of 76.33g/rabbit was recorded among those placed on 100% PSFYM. Feed conversion ratio was also significantly ($P<0.05$) highest among birds fed 100% parboiled sundried false yam meal with a mean value of 2.27, similar to 2.17 in control, followed by similar values of 1.62 in rabbits placed on diet four while best FCR value of 1.36 was recorded among rabbits maintained on 25% PSFYM. Mortality rate was highest (10.00%) among rabbits fed 100% PSFYM, followed by (6.67 and 6.67%) among rabbits placed on 50 and 75% PSFYM, (3.34%) in those fed 25% PSFYM while no mortality was recorded among rabbits fed the control diets.

Table 3: Performance Study Weaner Rabbits as Affected by the Dietary Treatments.

	Inclusion Levels of PSFYM (%)					
	0	25	50	75	100	
	Diets					
Parameters	1	2	3	4	5	SEM±
Ave. Initial Weight (kg/b)	0.79	1.00	1.00	1.17	1.00	0.06
Ave. Final Live Weight (kg/b)	1.92^{a}	2.01^{a}	1.74^{b}	1.71^{b}	1.57^{c}	0.13
Ave.Weekly Feed Intake (g/b)	398.33^{a}	269.33^{ab}	216.33^{b}	205.00^{b}	173.00^{c}	16.21
Ave. Weekly Weight Gain (g/b)	174.00^{b}	194.67^{a}	177.33^{b}	106.33^{bc}	76.33^{c}	2.33
Feed Conversion Ratio	2.17^{ab}	1.36^{c}	1.46^{b}	1.62^{b}	2.17^{a}	0.11
Mortality (%)	0.00	3.34	6.67	6.67	10.00	

abc : Means in the same row with varying super script differ significantly ($P<0.05$).

SEM ± : Standard Error of Mean; PSFYM. Parboiled Pundried False Yam Meal.

b) Hematological Indices

Hematological traits of rabbits as influenced by the dietary treatments are depicted in (Table 4). All the hematological parameters assayed in this study were significantly ($P<0.05$) influenced by the treatment diets. Hemoglobin was highest among rabbits fed 25% parboiled sundried false yam meal PSFYM with a mean value of 10.73g/dL, followed by similar values of 10.66 and 10.59 among those placed on the control diet and 75% PSFYM and least value of 8.48 g/dL was recorded in rabbits fed 100% PSFYM based diet. Packed cell volume was however, highest with a mean value of 31.34% in rabbits placed on 75% PSFYM, followed by 29.22% in those placed on the control diet, and lowest value of 25.35% was recorded in rabbits fed 100% PSFYM. Red blood cell values were significantly ($P<0.05$) highest among rabbits placed on 75% PSFYM with a mean value of 5.30%, followed by 8.07% in those fed 25% PSFYM while least mean value was recorded in rabbits fed 50% PSFYM. The mean value obtained for mean corpuscular volume (MCV) was significantly highest ($P<0.05$) among those fed the control with mean value of 65.67fl, followed by similar values of 62.42 and 61.41fl in rabbits fed 50 and 100% PSFYM, while least mean value 54.05fl was recorded among those placed on 25% PSFYM. The mean values for mean corpuscular hemoglobin (MCH) were highest ($22.44x10^{9}/_{L}$) in control, followed by $20.80x10^{9}/_{L}$ among rabbits fed 50% while lowest mean value of $20.22x10^{9}/_{L}$ was obtained in those placed on 100% PSFYM. Rabbits maintained on 25% PSFYM had significantly ($P<0.05$) highest mean value of 38.25pg, followed by 34.45pg in rabbits fed 75% PSFYM while the least mean value of 33.07pg was recorded among those placed on 50% PSFYM for mean corpuscular Hemoglobin concentration (MCHC). Red disc width and platelet values were significantly ($P<0.05$) highest with mean values of 17.82% and $252.12mm^{3}$ in rabbits placed on 75% PSFYM, followed by 20.54% and $203.18mm^{3}$ among those fed 25% PSFYM. For RDW, the lowest value of 17.04% was recorded among rabbits fed 100% PSFYM and $189.08mm^{3}$ in those placed on 50% PSFYM. The average numerical value recorded for mean platelet volume was significantly ($P<0.05$) higher in rabbits fed 100% PSFYM with the mean value of 8.03, followed by 5.16 in those fed 50% PSFYM while the least mean value of 4.28 was recorded in those fed 25% PSFYM. Plate disc width (PDW) and white blood cell (WBC) values were significantly ($P<0.05$) highest with the mean values of 8.33 and 95.11 x $10^{3}/_{mm}$ in rabbits placed on 75% PSFYM, followed by 6.49 and 66.25 x $10^{3}/_{mm}$ among those fed 25% PSFYM. For PDW, the lowest value of 5.69 was recorded among rabbits fed 0% PSFYM and 12.41 in those placed on 100% PSFYM for WBC. The average values of neutrophil in rabbits placed on treatment diet three had the highest value of 60.26fl while the lowest mean value of 29.72fl was recorded in those placed on diet five. Lymphocytes values were also significantly ($P<0.05$) highest in those fed diet four with and average of 45.86%, followed by similar values of 33.92 and 34.26% in those fed diets two and four while lowest mean value of 25.76% was recorded in those fed diet three.

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Table 4: Hemotological Indices of Weaner Rabbits Fed the Treatment Diets

	Inclusion Levels of PSFYM (%)					
	0	25	50	75	100	
	Diets					
Parameters	1	2	3	4	5	SEM±
Haemoglobin (g/dl)	10.66^{a}	10.73^{a}	9.70^{b}	10.59^{a}	8.48^{c}	0.27
Packed Cell Volume (%)	29.22^{a}	27.59^{b}	27.42^{ab}	31.34^{ab}	25.35	0.75
Red Blood Cell (x 10^{9}/L)	4.91^{bc}	5.22^{b}	3.75^{d}	5.30^{a}	4.16^{c}	1.00
MCV (fl)	65.67^{a}	54.05^{d}	62.64^{b}	57.44^{bc}	61.41^{b}	1.05
MCH (x10^{9}/L)	22.44^{a}	20.54^{b}	20.80^{b}	20.35^{b}	20.22^{c}	1.02
MCHC(Pg)	32.62^{c}	38.25^{a}	33.07^{d}	34.45^{b}	32.66^{c}	1.00
Red Disc Width (%)	14.79^{b}	14.79^{b}	14.63^{b}	17.82^{a}	17.04^{c}	1.12
Platelet (x$10^{3}/_{mm^{3}}$)	195.00^{c}	203.18^{b}	189.08^{c}	252.12^{a}	60.06^{d}	1.32
Mean Platelet Volume	4.48^{c}	4.28^{d}	5.16^{b}	4.88^{bc}	8.03^{a}	1.00
Platelet Dist. Width	5.96^{c}	6.49^{b}	6.53^{b}	8.33^{a}	5.85^{d}	1.08
White Blood Cell (x$10^{3}/_{mm^{3}}$)	82.19^{ab}	66.25^{b}	63.33^{b}	95.11^{a}	12.41^{c}	2.30
Neutrophil (%)	47.18^{b}	46.34^{b}	60.26^{a}	45.16^{bc}	29.72^{c}	3.12
Lymphocyte (%)	32.85^{bc}	33.92^{b}	25.76^{c}	34.26^{b}	45.86^{a}	2.46

abcd : Means in the same row with varying super script differ significantly (P<0.05)

SEM±: Standard Error of Mean; PSFYM. Parboiled Sundried False Yam Meal.

c) Serum Biochemical Indices

Table 4. shows the serum biochemical indices of weaner rabbits as influenced by the treatment diets. The result revealed that total protein, albumin, globulin, urea and Creatinine of the weaner rabbits were significantly (P<0.05) affected by the treatment diets. Total protein values were significantly (P<0.05) highest in rabbits maintained on 100% PSFYM with a mean value of 6.28g/dl, followed by those placed on 75% PSFYM with a mean value (6.22g/dl), and statistically similar values of (5.33, 5.75 and 5.53g/dl) were recorded for rabbits placed on diet one, two and three respectively. Albumin was significantly (P<0.05) affected by the test diets with highest value of 3.90g/dl in rabbits fed 100% PSFYM, followed by similar values of 3.83g/dl in those fed 25% PSFYM while the lowest value of 3.59 was recorded in diet four. Serum globulin values were also significantly (P<0.05) highest among rabbits fed 75% PSFYM with a mean value of 2.63g/dl, followed by 2.38g/dl in those raised on 100% PSFYM, while the least values (1.79g/dl) was recorded in rabbits placed on diets three. Urea showed a significant (P<0.05) variation among rabbits fed dietary treatments with the highest value of 36.05g/dl among rabbits fed the control diet, followed by 29.12g/dl in those placed on 100% PSFYM while the lowest mean value of 19.28g/dl was observed from those placed on 50% PSFYM. Creatinine values in rabbits were significantly higher in those placed on diet three with a mean value of 1.18g/dl, followed by equal values of 1.08 and 1.08g/dl recorded among rabbits fed the control diet and 75% PSFYM, followed by 1.02g/dl in diet four and least 0.92g/dl in diet two.

Table 5: Serum Biochemical Indices of Weaner Rabbits as affected by the Dietary Treatments.

	Inclusion Levels of PSFYM (%)					
	0	25	50	75	100	
	Diets					
Parameters	1	2	3	4	5	SEM±
Total Protein (g/dl)	5.63^{c}	5.75^{c}	5.53^{c}	6.22^{b}	6.28^{a}	0.08
Albumin (g/dl)	3.71^{b}	3.83^{a}	3.74^{b}	3.59^{c}	3.90^{a}	0.06
Globulin (g/dl)	1.92^{c}	1.87^{c}	1.79^{c}	2.63^{a}	2.38^{b}	0.16
Urea (mg/dl)	36.05^{a}	23.18^{c}	119.28^{d}	28.91^{b}	29.12^{b}	0.84
Creatinine (mg/dl)	1.08^{b}	0.92^{d}	1.18^{a}	1.08^{b}	1.02^{c}	0.08

abc: Means in the same row with varying super script differ significantly (P<0.05)

SEM±: Standard Error of Mean; PSFYM. Parboiled Sundried False Yam Meal.

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IV. Discussions

a) Performance Characteristics

The significant ($P<0.05$) increase in the weekly weight gain and the consequent higher final live weight recorded in rabbits fed 25% Parboiled sundried false yam meal (PSFYM) may be adduced to the nutrient availability and density which eventually translated to the improvement in growth rate of the weaner rabbits. It also goes to showed parboiled sundried false yam meal at 25% level of inclusion was efficiently utilized by the rabbits. This lend support from the report of Ansar *et al.,* (2012) who reported a significant ($P<0.05$) variation in the weight gain and final live weight of weaner rabbits fed false yam leaves. Daily feed intake differ significantly ($P<0.05$) with highest mean value recorded in control statistically similar to those on 25% PSFYM and this could be ascribed to the high level of Palatability and Metabolizable energy in the diet as rabbits are known to satisfy their energy requirement (Atteh, 2004) and *Icacina tricantha* (False yam) as reported by Sunday *et al.,*(2016) is known to contain a very high level of carbohydrate. The trend in the feed conversion ratio showed significant ($P<0.05$) variation among rabbits fed the dietary treatments with highest value observed in birds fed 100% PSFYM similar to the control diet and the values increased as the inclusion of the basal diet increases. This observation is in Tandem with that of Nworgu *et al.,* (2000) and Oduguwa *et al.,* (2004). This finding also takes credence from the report of Ansar *et al.,* (2012) who earlier observed a significant variation in the feed to gain ratio value of weaner rabbits fed false yam leaf meal. However, the higher mortality rate recorded among rabbits fed 100% Icacina is traceable to the fact that the high inclusion would have aided the intake of more of the anti-nutrients present in false yam probably not completely eliminated by the processing method employed in this study. which would have hampered the health status of the animal and eventually led to their death. Sunday *et al.,* (2016) in their research on the proximate analysis and mineral element composition of false yam (*Icacina tricantha*) tuber and oyster mushroom (*Pleurotus ostreatus*) reported that false yam contain anti nutrients like phytic acid, tannin, cyanide and oxalate, so if consumed in high quantity could be detrimental to the health of the animal and could lead to death.

b) Haematological Indices

Blood is important and reliable medium for assessing the physiological and health status of individual animals (Oduye, 1976; Egbe-Nwiyi *et al.,* 2000). According to James (2004), the life of all flesh is the blood and it is useful for atonement for human soul. Blood is useful for assessing the health status, clinical evaluation for survey of physiological/pathological conditions and diagnostic and prognostic evaluation of various types of diseases in animals (Singh *et al.,* 2002; Obasoyo *et al.,* 2005; Alade *et al.,* 2005; Amel *et al.,* 2006). The significant higher and similarities in the haemoglobin values of the rabbits placed on control diet, 25 and 75% parboiled-sundried false yam meal is an indicator for effective oxygen transport and the distribution of metalloprotein in the body of the experimental animal (Sidell and Kristin, 2006). The significant variation observed for Packed cell volume (PCV) with highest value recorded among rabbits fed 75% implies that the rabbits on these diets were on better nutrition and had low susceptibility to infections compared to rabbits on other dietary treatments. This is in consonance with the findings of Ayo *et al*., (1996). The higher red blood cell value recorded among rabbits placed on 75% parboiled-sundried false yam meal in this study could be related to the nutritional adequacy and safety of the test diet which agrees with the report of (Olabamiji, *et al.,* 2007). The significantly highest mean value recorded for mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration among rabbits placed on the control diets could be due to the higher haemoglobin values and this showed the animals on this diets were not susceptible to microcytic anaemia (Choladda, 2012; Wikipedia, 2013). This implies that these rabbits also have the ability to withstand adverse weather condition. This lend support from Mitruka and Rawnsley, 1977 who reported that MCV and MCHC are important traits which determines the cell size of the red blood cell (Erythrocyte) and thus an important factor in determining the ability of the birds to withstand Oxygen starvation for a long time. The significant variation observed in the values of platelet and platelet dist. Width with highest value recorded in rabbits fed 75% Parboiled sundried false yam meal could be due to the increased in the level of anti bodies in the animal which in turn boost the ability of the animal to resist microbial infection and fight against foreign bodies. The values recorded fell between the normal range reported by Mitruka and Rawnsley (1977); Maxwell *et al.,* 1990). The significant highest value of white blood cell count recorded among rabbits fed 75% Parboiled sundried false yam meal which also fell within the normal range as reported by The Merck's Veterinary Manual, 1998 suggested adequate defense against infectious agents (Kaneko, 1989). This is probably due to adequate protein in the diets. It has been stressed by Mitruka and Rawnsley, (1977) also that higher lymphocyte and white blood cell are associated with the ability of the animal to perform well under a very stressful condition. On this fact is where higher lymphocyte obtained in rabbits fed 100% PSFYM found its support. The least values of neutrophil recorded in diet 4 and 5 showed that the anti nutrients present in parboiled sundried false yam meal did not affect the blood quality of the rabbits. The values for all the parameters falls with the recommended range

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established by Maxwell, *et al.,* (1990), (Mitruka and Rawnsley, 1977; Mohammed *et al.,* 2008).

c) Serum Biochemical Indices

The use of chemical indices as a pointer or indicator to conditions that cannot be readily noticed by performance indices cannot be over emphasized. However, the highest serum protein was recorded in birds on 100% PSFYM, followed by 75% PSFYM. This implies that the dietary treatments contains quality protein . Although Agbede and Aletor (2003) have reported that total serum total protein syntheses were not affected by sources of dietary protein (quality of protein). However, similar evidence of positive linear correlation between dietary protein quality and quantity has been reported (Tewe, 1985; Eggum, 1989). Significantly highest globulin value with highest value recorded in rabbits fed 75% PSFYM indicated that the rabbits placed on this diets has the ability to fight infections and globulin as we know carries essential metals through the bloodstream to the various parts of the body and helps the body to fight infections Agboola *et al.,* (2013). Elevated globulin levels are often pronounced in birds with serious infections because of abnormally increased production of antibodies. In this study, the globulin value of rabbits on 75% PSFYM performs the best which is an indication that the test diet did not precipitate any severe effects on the health status of the birds. According to Deldar (1994), albumin is the most abundant protein in blood plasma. The significantly ($P<0.05$) highest albumin value in 100% PSFYM similar those on 25% PSFYM showed a synergetic effect of the protein quality of the test ingredients. The ratio of albumin to globulin can also help to determine whether certain disorders are occurring. This result is in line with the report of raphael et al., (2017) who reported a significant variation in the albumin value of broilers fed frog meal as replacement for fish meal. Serum urea is known to be a function of the protein quality ingested by the animal, energy deficiency and disease condition which impair protein utilization. When diet is deficient in essential amino acid, the amino acid present will be deaminated resulting to an increase in urea excretion (Ranyhon, 2001). In this present study the least serum urea value in rabbits fed 50% PSFYM is a pointer to effective protein utilization compare to other treatment diets. The creatinine levels in the study showed that there was significant difference ($P<0.05$) and all the values fell within the normal physiological values (Merck's Manual, 1998). This negates with the results of Ahamefule *et al.* (2006) who had no significant difference ($P>0.05$) as well as having values fell within normal physiologic values but was supported by the report of Raphael *et al.,* (2017) who observed a significant difference in the creatinine value of broiler chickens fed sundried Irish potato peel meal. This suggests that there was no wasting or catabolism of muscle tissues and that the animals were not surviving at the expense of the body reserve Ahamefule *et al.,* (2006). This indicated that dietary proteins were well utilized by the rabbits and the residual HCN in the treated PSFYM did not interfere with the nutrient utilization (Olafadehan, 2011).

V. Conclusion

It is concluded therefore from this study that parboiled sundried false yam meal is a valuable replacement for maize up to 25% for optimum growth performance while 75% replacement can be tolerated in rabbit diets without adverse effects on the blood metabolites.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 18 Issue 5 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Occupation of Sambisa Forest and Boko Haram Insurgency in Northeastern Nigeria as Security Threat and Challenges to Sustainable Forest Management

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Abstract- Since 2013 when the Boko Haram insurgents found a safe haven in the Sambisa forest from where they launch their attacks on the Nigerian state, neither Nigeria nor the forest has known any peace ever since. Although the socio-economic, socio-political and socio-cultural consequences of Boko Haram insurgency have been highlighted by many writers and researchers, nothing is yet known regarding its consequences on the Sambisa forest itself. With experiences from other parts of the globe, this paper highlights the factors linking forests with conflict. The first fact emerging from the research is that Nigeria is not the only country where conflicts have been linked with forests rather it is a common and worldwide phenomena, as countries experiencing violent conflict in their forests account for about 40 percent of the world's tropical forests. Among factors linking forests with conflicts include their remoteness, seclusion, inaccessibility and richness and hence the ability to provide refuge, funds and food for combatants. Among the negative consequences of such conflicts on forest is the likelihood of its destruction and or occupation by the state forces in an effort to prevent insurgent groups from continuing using it as a hideout to carry out their criminal activities. This happens to be the fate of the Sambisa forest today.

GJSFR-D Classification: *FOR Code: 070501*

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Occupation of Sambisa Forest and Boko Haram Insurgency in Northeastern Nigeria as Security Threat and Challenges to Sustainable Forest Management

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Abstract- Since 2013 when the Boko Haram insurgents found a safe haven in the Sambisa forest from where they launch their attacks on the Nigerian state, neither Nigeria nor the forest has known any peace ever since. Although the socio-economic, socio-political and socio-cultural consequences of Boko Haram insurgency have been highlighted by many writers and researchers, nothing is yet known regarding its consequences on the Sambisa forest itself. With experiences from other parts of the globe, this paper highlights the factors linking forests with conflict. The first fact emerging from the research is that Nigeria is not the only country where conflicts have been linked with forests rather it is a common and worldwide phenomena, as countries experiencing violent conflict in their forests account for about 40 percent of the world's tropical forests. Among factors linking forests with conflicts include their remoteness, seclusion, inaccessibility and richness and hence the ability to provide refuge, funds and food for combatants. Among the negative consequences of such conflicts on forest is the likelihood of its destruction and or occupation by the state forces in an effort to prevent insurgent groups from continuing using it as a hideout to carry out their criminal activities. This happens to be the fate of the Sambisa forest today. Based on its location, wide expanse and abundant content of wood and non-wood resources, it was not surprising that the insurgents found its confines very alluring hence its occupation. With the recapture of the Sambisa forest by the Nigerian military, she decided to be holding her *Small Arms Championship* and other sporting events in the forest as a way of keeping it permanently safe from insurgents. The implication of this development is that the forest has lost its reserve status.

I. Introduction

Nigeria is today bedeviled by many security challenges. From the South-south geo-political zone comes the militancy challenge, from the North-east is the issue of Boko Haram insurgency while the North-central, South-east and South-south is being ravaged by the herdsmen - farmer conflicts. Kidnapping and cultism though originally concentrated within the South-south and South-east geopolitical zones is now widespread all over the country. More often than not, most of the criminal elements involved in these nefarious activities find refuge inside forests from where they usually carry out their criminal activities and or hide their loots. The kidnappers for instance often hide their human cargos inside thick forests from where they demand for ransom from the government, oil companies or victim's families. The Niger Delta militants find refuge in the creeks and swamp forests within the Niger Delta region. In the Northeast region of the country, the Boko Haram insurgents who since 2009 have waged a relentless war against the Nigerian state and have been involved in series of killings and maiming of innocent lives as well as the destruction of property worth billions of naira has found safe haven within the confines of the Sambisa forest. Since 5th February, 2013 when the insurgent group found a safe haven in this forest, it has known no peace ever since. It remained the stronghold of the insurgents from where they launched their attacks on civilian and other targets and they always ran back to its safe refuge to escape capture. Not only did the insurgents establish their head-quarters inside the forest, but they also established various camps within its confines. All their captives including over 200 Chibok school girls they took away from their school in Chibok in Bornu State are believed to be kept in their hideouts within the Sambisa forest.

Although the socio-political, socio-economic and socio-cultural consequences of these security problems have been widely reported by many writers and is therefore in the public domain, their environmental consequences however has only received cursory attention. Outside the wide coverage Sambisa forest occupation by the Boko Haram insurgents has received in the mass media, the consequences of such occupation on Sambisa forest itself has never been given any serious consideration. Sambisa forest occupation by the Boko Haram insurgents and indeed the use of forests in general as hide outs for criminal elements in the society is throwing up a new challenge for sustainable forest management in Nigeria. The question that begs for answer is "how has the existence of forests aided

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Global Journal of Science Frontier Research (D) Volume XVIII Issue V Version I Year 2018
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criminality in our land and how has such criminal activities affected sustainable forest management in the country. Answers to such questions will no doubt help authorities concerned with forest management to device new means of confronting such a new menace. Therefore, using Sambisa forest and its occupation by the Boko Haran insurgents as a case study, the present paper looks at the impacts security challenges have or will have on sustainable forest resources management in the country. The ultimate aim of the study being to raise the consciousness of government, policy makers and natural resource managers particularly forest managers to this new menace with a view to finding a way out before it becomes a major obstacle to sustainable forest management in the country.

We will start the discussion by examining the driving factors that link forests with conflicts, as well as look at how armed conflicts in other parts of the world have impacted on forest resources and how forest itself has impacted on past conflicts.

II. Forests and Conflicts

Within the last 30 years, many countries have witnessed several armed conflicts that have taken place in forested regions. Among these countries include Angola, Bangladesh, Bosnia and Herzegovina, Cambodia, Central African Republic, Colombia, the Congo, Côte d'Ivoire, the Democratic Republic of the Congo, Guatemala, India, Indonesia, Liberia, Mexico, Mozambique, Myanmar, Nepal, Nicaragua, Pakistan, Peru, the Philippines, Rwanda, Senegal, Sierra Leone and the Solomon Islands (FAO, 2005). As CIFOR (2003), has noted, countries experiencing violent conflict in their forests account for about 40 percent of the world's tropical forests and over half of all tropical forests outside Brazil. In many of these countries, insurgents used forested regions to hide from government troops. In Sierra Leone, for example, forests enabled the Revolutionary United Front to regroup, recruit, and indoctrinate child soldiers (USAID, 2005).

Many factorslink forests with conflicts, central being the very important role forests play at different levels of the society. Forests (and the land beneath them) are critical to local livelihoods, especially to the most vulnerable: women and the rural poor. According to the World Bank, forests contribute to the livelihoods of most of the world's poorest 1.2 billion people (Schroeder-Wildberg and Carius, 2003). Forests also play valuable roles to national and global economies, providing important function to the national and international markets not only for timber and other forest products but also for global public goods such as biodiversity (useful for ecosystem function and for genetic material) and carbon. These multiple and often competing constituencies frequently make forests the center of struggles over control of access, use, and benefit streams (Harwell, 2010).

On the other hand, a number of studies on armed conflicts point to the fact that areas within countries that are most likely to experience armed conflicts tend to be those with characteristics that provide the means or motives for war. Such areas include secluded places where insurgents can hide and exploit valuable natural resources to finance military activities. In addition, such areas also tend to be remote and inaccessible and are capable of providing refuge, funds and food for combatants (FAO, 2005). It is not surprising therefore that several research findings dealing with conflicts show that many violent conflicts often occur in forested regions particularly in poor countries. Apart from being often located in secluded, remote and inaccessible areas, forests often have valuable timber, petroleum, land, ivory, diamonds, gold and other minerals, the demand for which can lead to competition and hence conflicts. Timber for instance is in great demand in today's global markets. The Organization for Economic Cooperation and Development (OECD) estimates forest-product trade at more than $150 billion per year. While demand fuels competition for control and exploitation of timber, its accessibility, ease of transportation, myriad uses, and other qualities also make it attractive as a conflict commodity (USAID, 2005). Because a conflict's duration depends partly on the financial viability of armed groups, timber as a conflict commodity often heightens or prolongs existing crises. This is because it is often possible for combatants to quickly accumulate a significant amount of capital for war from conflict timber (Price, 2003). For example, estimated revenues from the trade of conflict timber in Liberia, Cambodia, and Burma exceeded US$100 million per year (Renner, 2002). In Angola, Colombia, Cambodia and Sudan, such pillaging of forest resources allowed violent conflicts that were initially driven by grievances or secessionist and ideological struggles to continue (Renner, 2002). Forests can also be a major factor in the perpetuation of conflict and instability. They may, for example, be the location for rebel militia bases or provide shelter and a protected pathway for movement for rebels, which may prolong conflicts, and drive the government into accommodations with loggers in order to drive insurgencies out (Harwell, 2010; OECD, 2005).

Another very important driving factor linking forests and conflicts is the tendency of central governments to view forested regions as peripheral places containing few people and being of little political importance or economic value. More often than not, the only interest governments have on such regions is to extract timber or minerals. As a result, forested regions have traditionally been poorly integrated into national political processes and only receive few public services. Many violent outbreaks of conflicts in such regions are

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therefore the result of such long-standing government neglect or a weak and ineffective presence of central authorities. This is because, such situations leave room for political activists or insurgents and other groups to fill the void (FAO, 2005). This is the lot of many Spanish-speaking agricultural frontier areas in tropical Latin America who have witnessed widespread social violence, including the Chapare in Bolivia, southeast Pará in Brazil, the Petén in Guatemala, the Peruvian Amazon and regions of Colombia. In several cases also, governments have often taken insurgents for granted or only made perfunctory efforts to control them as long as they remained in remote forested regions, believing that sustained military campaigns in areas of little strategic importance are too costly. It was however under such situation as this, that insurgent group in countries such as Colombia, Nepal and the Philippines were able gradually to build up military capacity (FAO, 2005). Conflicts also occur when governments decide unilaterally to protect forests from logging or other uses by relocating forest dwellers outside park boundaries or by restricting access rights of traditional users. Some Conflicts that have arisen in Africa, Asia and Latin America are due to loss of such traditional forest access and rights (USAID, 2005).

III. The Impact Of Armed Conflicts On Forests

According to McNeely (2003), while conflict is almost always devastating for people, it has both negative and positive effects on forests. Impact on forests can vary greatly depending on prevailing circumstances of the conflict and change over the course of the conflict. However, significant influences of conflicts on forests are exerted by the strategic role of forests as shelter or as obstructions to access to territory by combatants, the tide of displacement of civilians toward or away from forests, and the reliance on forests for fuel, timber, and protein during the crisis or wartime. In the absence of any other economic and livelihood alternatives, forests serve as very important sources of emergency subsistence and revenue to both combatants and vulnerable civilians. This makes forests a field of either competition or collaboration—and therefore a significant variable in conflict resolution or further exacerbation (Harwell, 2010).

Conflicts can adversely affect forests under the following conditions. For many civilians especially those who do not flee conflict to organized camps either due to illness, tradition or lack of information, forests usually serve as critical place of refuge and subsistence. In a like manner, forests can also play a role in providing either shelter or blocking access to strategic territory for combatants. Serving as a very important place of refuge for insurgents or separatist forces in particular, forests are often seen as sites that need to be destroyed by states interested in the neutralization of this source of refuge (Harwell, 2010). Hence, intentional clearing or destruction of forests is a warfare tactic often used to deprive enemies of cover (Taylor, 2004). Armies often burn or clear forested areas to enable them spot the enemy more readily (Hart and Mwinyihali, 2001; SAMFU, 2002). Under this situation, forests might be napalmed, defoliated, logged, or simply become the site of heavy militarized presence, especially along borders or areas of key strategic value (Harwell, 2010). During the Vietnam wars the U.S. Operation Ranch Hand sprayed defoliant on some 6 million acres, and by so doing destroying both forests and crops, and creating persistent dioxin pollution problem that would have long-lasting health effects (Biggs, 2005; Buckingham, 1982).Studies of the impacts of the defoliants estimated that 10% of trees sprayed were not only defoliated but killed by one application of Agent Orange, with a particularly strong effect on sensitive and ecologically important mangrove forests along the Mekong Delta (Orians and Pfeiffer, 1970; Westing, 1971). Similarly, the Indonesian military repeatedly bombed and napalmed forested areas in East Timor where independence guerillas took shelter, with devastating impacts to the environment (Commission for Reception, Truth and Reconciliation in East Timor, 2005).In Darfur, Sudan, trees were deliberately destroyed by militia in an attempt to sever community ties and reduce possibilities for resettlement in the area (UNEP, 2007).

In conflict situation as well, State or donor-supported forest protection and conservation efforts are suspended or impeded; illegal logging and hunting can proceed unchecked, especially where governmental and regulatory authorities are absent or ineffective (USAID, 2005). In the Democratic Republic of the Congo for example, a series of civil wars in the 1990s created a power vacuum and broke down conventional forest management regimes, fostering illegal logging and other resource conflicts (Renner, 2002). Loggers and farmers also often take advantage of roads built for military purposes to exploit resources that run through forested areas. Military power is often strengthened by conflicts, making it difficult for civilian authorities to render army personnel accountable for their actions (FAO, 2005). Some governments have even encouraged their forces to engage in economic activities such as logging rather than fund operations from the central budget. In countries where the military is involved in logging or is closely associated with private logging companies, or where the government allows private forestry companies to establish their own militia for protection purposes, it becomes much more difficult to enforce forestry and conservation laws (Carle, 1998).

To make the situation worse, post-conflict, weakened political institutions may lack the authority, ability, funding, or urgency to restart derailed conservation efforts (USAID, 2005). Governments on

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their own part may promise former combatants land, training and credit but be unable to keep or sustain these commitments over time (Plumptre, 2003). Such category of people often move into new areas to hunt, fish, collect fuelwood and cut trees to build houses and by so doing can rapidly deplete local resources (FAO, 2005). As well, forest concessions may be granted to appease former foes or reward supporters. For example, when a corrupt administration came to power in Liberia after years of civil war, it authorized a few companies to harvest timber in many parts of the country without adequate regulation, and authorized them to recruit private militias to protect their operations. In exchange, the firms provided the government with timber used as barter for weapons (Thomson and Kanaan, 2003).

On the other hand, the return of peace after conflicts also enables forest exploitation, since the goals of national reconstruction and development require timber, and the need to obtain foreign currency reduces political will to embark on sustainable forest management (Oglethorpe 2002; Halle et al., 2002). As well, following a war, governments and international aid agencies are often too preoccupied with other concerns to focus on longer-term issues such as forest management or conservation. They are rather under tremendous pressure to restore the economy, and logging is often the only option in many low-income countries. Harvesting activities therefore frequently expand much more rapidly than the public sector's capacity to regulate them, as was the case in Cambodia (FAO, 2005). After the recent war in the Democratic Republic of the Congo, the government allocated concessions for over one-third of its forest area, without due attention to silvicultural safeguards in contractual agreements (Taylor, 2004).

Sometimes also, forests are cleared for settlement and rehabilitation for ex-combatants (Kaimowitz 2003). For instance, post-war governments in Colombia, Guatemala and Nicaragua relied on forested areas to settle demobilized soldiers and displaced people, as those were the only large areas of sparsely populated lands (Kaimowitz, 2002). In addition, conflicts often lead to the displacement of large populations from their homes into neighbouring regions and countries and forests provide a place of refuge for such new entrants. Such refugees and internally displaced people, whether housed in formal refugee camps or fending for themselves, experience a radical and life-threatening loss or disruption of livelihood, shelter, social networks, and saved assets. Under such precarious situations, short-term survival becomes a priority over long-term investments or sustainable practices. The demand for construction materials and fuelwood for hundreds of thousands if not millions of people concentrated over short periods of time in small areas are devastating to the local environment and vegetation regeneration capacity (UNHCR, 1998, 2005). Likewise, the sale of fuelwood to meet this boom in demand is often one of the only income generating opportunities available in refugee and IDP camps (Harwell, 2005).As a result, the increased burden on forests in the receiving areas to supply food, shelter and fuel can be overwhelming, and this primary needs usually override goals of sustainable resource management (Taylor, 2004). In 1994, for example, almost 2 million refugees fled the genocide in Rwanda into the Congolese forests where they consumed 1 000 tonnes of fuelwood daily, thus denuding large forest areas (Renner, 2002). A similar situation occurred with the influx of Afghan refugees in border areas of Pakistan (Taylor, 2004).

In addition to civilians pushed to subsistence crisis during the conflict, both state or non-state combatants are often camped in remote sites without provisions and rely on what they can hunt and loot from civilians. The proliferation of weapons in and near the forest makes hunting by combatants very efficient. As well, hunting by civilians increases due to displacement to the forest (or nearby refugee camps where there are insufficient food rations), and the loss of other livelihoods such as farming and livestock due to looting. In Tanzania for example, TRAFFIC (2007), has documented how numerous protected areas rich in wildlife were heavily impacted by the influx of some 800,000 refugees in the mid-1990s. In Mozambique, Gorongosa National Park and Morromeu Reserve reportedly suffered massive declines in large mammal populations from hunting by combatants stationed in the area for long periods of time (Hatton et al, 2001).Surveys in 1994 (two years after the end of the war) showed that in Gorogosa, there was decline in elephant population to some 100 individuals from some 3000 prior to the conflict. Populations of buffalo (some 14,000), hippo (some 4800), and wildebeest (some 5500) were virtually wiped out while only 129 waterbuck remained of a previous count of 3500 (Cumming et al, 1994).

IV. The Sambisa Forest

The Sambisa forest is located at the northeastern tip of the west Sudanian Savanna and the southern boundary of the Sahel Savanna about 60 km south east of Maiduguri, Bornu State capital (Bodunrin, 2014a). It occupies parts of the states of Borno, Yobe, Gombe, and Bauchi along the corridor Darazo, Jigawa, and some parts of Kano State in the far north (Bodunrin, 2014a & b). It is administered by the Local government areas of Askira/Uba in the south, by Damboa in the southwest, and by Konduga and Jere in the west (Bodunrin, 2014a).The forest got its name from a village called Sambisa which is on the border with Gwoza in the East. The Gwoza hills with heights of about 1,300 meters above sea level provides scenery and is made up of

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mountains known as Mandara Mountains (Bodunrin, 2014b). These Mountains form a natural barrier between Nigeria and Republic of the Cameroun, starting from Pulka. They overlook the game reserves by meandering towards Mubi and beyond in Adamawa State. They equally have a connection with the Mambilla Mountain which is also home to the Gashaka Game Reserve at its foot, which is also a corridor connected to the Sambisa Game Reserve. The forest is drained by seasonal streams into the Yedseram and the Ngadda Rivers (Mbaya and Malgwi, 2010; Omondi P. et al, 2006). During the colonial period, the Sambisa game reserve was said to have covered an area of 2,258 km^2 in the eastern part of the forest (Olugbade, 2014), but today the area of the reserve has been greatly reduced and now measures approximately 518km^2.

By 1963, Sambisa forest comprised of a combination of two native authority forests known as northern and southern Sambisa Forest Reserve, and was gazetted in 1974 by the North-eastern region and inherited by Borno State (Olugbade, 2014). It was Muhammed Buba Marwa who as military administrator of Borno State that commissioned the Sambisa forest as a Game Reserve. While commissioning the Game Reserve, Marwa stated that the primary objectives of its establishment was to identify and harness the numerous untapped wild flora and fauna of the forest and their natural environment and to use them to contribute to the overall socio-economic development of the state. He further stated that the Game Reserve was established to promote tourism, conservation, and scientific research, as well as to perpetuate the species' diversity and genetic potentials of nature's flora and fauna (Olugbade, 2014). In 1991, the Borno State government incorporated the reserve as the national park of the Lake Chad Basin.

Sambisa Game Reserve has often been referred to as one of the best endowed habitat in the Northern Guinea/Sudan Savannah zone. The dominant vegetation in the Reserve is Sudan–Guinea Savanna but, as a result of human activities, areas of the reserve have taken on a more Sahelian aspect. Dominant tree species include *Detariummacrocarpum, Ficus spp., Vitexdoniana, Anogeissusleiocarpus, Balanitesaegyptiaca, Prosopisafricana, Acacia spp., Piliostigmathonningii, Combretum spp., Adansoniadigitata, Diospyrosmespiliformis, Tamarindusindicaand Terminalia spp.* As reported by Bird Life International (2015), about 62 species of birds have been recorded in the Sambisa Game Reserve including the Guinea fowl, Francolin, Village weaver, Abysinian ground hornbill, Arabian bustard, Savile's bustard, African collared dove,black scrub-robin and the Sudan golden sparrow. The forest was also thought to be the last remaining site of the ostrich in Nigeria. Approximately 17 species of mammals were reported in the Game Reserve in 2010 (Mbaya and Malgwi, 2010), including, baboon, patas monkey, tantalus monkey, Grimm's duiker,red-fronted gazelle, African bush elephant, roan entelope, hartebeest, and African leopard.The forest also served as a dry season home-range for over 509 Elephants that are permanently situated in the southern part of Borno State. The unique combination of Guinea and Sudan vegetation made Sambisa Game Reserve a tourism attraction.

V. Sambisa Forest Occupation By The Boko Haram Insurgents

The Boko Haram insurgents captured and took hold of Sambisa Forest Reserve in 2013. Prior to the capture and occupation of the reserve, the Boko Haram insurgents were using a place called *Bulabulin Ganaram* within Maiduguri, Borno State capital as their stronghold and main base to launch their attacks on civilian targets. But, very early in 2013, the Nigerian military and volunteer youth group popularly called *Civilian Joint Task Force*(JTF) uprooted them from that base forcing them to disperse initially only to congregate later in the Sambisa forest. Finding the forest as a safe refuge for themselves, the insurgents decided to take control of it and subsequently launched an attack on the base station inside the forest on February 5, 2013 killing two rangers in the process thus forcing other staff to flee (Olugbade, 2014). Sambisa forest subsequently fell into the hands of the insurgents who then turned it into their fortress and used it as their main base to launch attacks on civilian targets. Prior to the occupation of the Sambisa forest, there existed so many routes, both official and unofficial that led into the Sambisa Game Reserve. While there were three official routes, there existed more than 10 unofficial routes, leading to the three local governments of Konduga, Bama and Gwoza that border the place and Maiduguri, and through Damboa to Gujba in Yobe State. There was also an unofficial route that leads through Izge village to Madagali in Adamawa state. But, the most dangerous of the routes to the reserve was said to be the one that passed through Buladiauma due to the thickness of its vegetation which made it extremely difficult to be easily spotted aerially (Olugbade, 2014).

In order to take full control of Sambisa forest, the insurgents began a tactical attack and takeover of all the routes leading to the forest and by so doing made it difficult for any other force to penetrate them. All the surrounding villages to the reserve were also attacked and taken over. Malari closest to Maiduguri from the reserve was the first to be attacked followed by Konduga, a big town next on the route to Sambisa from Maiduguri. In a like manner, all the other villages that surrounded the Sambisa forest were attached one after the other and taken over after the inhabitants have fled. The insurgents thereafter made the forest *"impregnable"* to the military and from there they began to launch most

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of their attacks. The terrorists were believed to live in a protected enclave, within the reserve known as Barguma waterhole while their headquarters was said to be located at Kagum Zairo waterholes, said to be the heart of the Reserve (Olugbade, 2014).

VI. Military Operation To Stamp Out Boko Haram Insurgents From The Sambisa Forest

The Boko Haram insurgents having found a comfortable home in the Sambisa forest intensified their attacks on innocent citizens. They indulged in the acts of killing, arson, bombing and shooting targeting important national events and public institutions like markets, churches, mosques, schools, police stations and government, private and public owned facilities with a kind of guerilla warfare tactics. In 2014 alone, the group killed an estimated 10,000 people. In addition to such killing raids, the group regularly organized mass kidnappings. One of such kidnapping incidence that drew the attention of the international community was the kidnap of 276 school girls from Chibok Government Secondary School, Borno State in April 14, 2014. Towards the end of that year, the group began to seize territory aggressively, declaring northeastern part of the country to be a caliphate under their control. By the end of 2014, Boko Haram controlled 14 districts, an area that was roughly the size of Belgium (Ardo, 2015; Ewokor, 2015). They became the most dangerous insurgent group that Nigerians ever had.

It therefore became pertinent that a drastic action needed to be taken in order to contain the rampaging group hence the military expedition. The Nigerian army began their military operation to retake a swath of territory in the Northeast seized by the terror group by late January, 2015. An agreement to provide 7,500 African Union Troops from Chad, Cameroon, Benin and Niger for the operation was tentatively reached on 7th February, 2015. Starting early in the same month, the Nigerian and Chadian warplanes aided by the ground troops and the French military which provided reconnaissance flights forced Boko Haram forces to abandon about a dozen towns and villages they had earlier occupied including Monguno, Bama and Gwoza (*Al Jazeera AFP, 2015)*. By April 2015, the Nigerian military was reported to have retaken most of the areas previously controlled by Boko Haram, with the exception of the Sambisa forest (Corones, 2015).

The push into the Sambisa forest by the Nigerian army commenced on April 22, 2014, but they were forced to retreat after encountering landmines and booby traps that killed three vigilantes working with the military. The army began a fresh push into Sambisa forest by 27th April and consequently started destroying Boko Haram camps and freeing a large number of women and children held as hostages by the terrorist group. For instance, no fewer than 17 Boko Haram camps in the Sambisa forest were overrun by the Nigerian military between 28th April, 2015 and very early in 2016 in which more than 1,500 persons predominantly women were freed (Searcey*, 2016;* Enyiangho, 2017). The overwhelming success recorded by the Nigerian military against the group made the President, Mohammadu Buhari to declare on 24 December 2015, that Boko Haram had been ousted from their last stronghold in the Sambisa forest, effectively reducing Boko Haram to an insurgent force (BBC News, 24 December, 2016*)*.

In order to ensure that the Boko Haram insurgents do not have control of the Sambisa forest any longer, the Nigerian army came up with a plan to be holding her annual *Small Arms Championship* in the Sambisa forest effective from 2017. The first of such championships was held between 27th and 31st March, 2017. The President, Mohammadu Buhari, while declaring open the championship noted that "holding the championship in the forest was an affirmation of the Federal Government's resolve to stamp out all activities and operations of the Boko Haram insurgency from our territory". He further noted that the championship was a showcase of the clear effect and degradation of the Boko Haram terrorist group with the destruction of Camp Zairo in the heart of the famous Sambisa forest. Speaking on the same vain, Lt.-Gen. Tukur Buratai, the Chief of Army Staff noted that the championship was held in the heart of the Sambisa forest as part of Nigerian Army's plans to effectively dominate all hostile territories in the north east. And as part of the ways to control the forest, Buratai directed that the army should henceforth be holding exercises, including final exercises of passing out of cadets from the Nigerian Defence Academy (NDA) and other trainings in the forest. He noted that the army had also established a shooting range in the forest known as "*Lt.-Col. Abu Ali Shooting Range"* while it also set up "*Forward Operation Base*" all in a bid to dominate and make Sambisa forest safe. This according to him is to ensure that all entry and exit points to the forest are adequately controlled to prevent re-infiltration by the terrorists and other criminal minded elements. He further noted that for the forest to be accessible to all and not be dreaded again after the fall of the terrorists, the army had embarked on a limited removal of mines from Sambisa forest. He solicited the assistance of the United Nations (UN), relevant non-governmental organizations and development partners as such project requires much resources and effort that the country alone might not be able to finance Eniangho (2017).

But as reported by the United Nations High Commission for Refugees (UNHCR) however, and confirmed by the Nigerian Airforce, members of a faction of Boko Haram were said to be regrouping, re-arming and returning to the Sambisa forest area. The

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United Nations further claimed that at least three local government areas in Borno State are still under the control of the Boko Haram fighters. It insisted that some locations in Borno state, including the three local government areas, remained inaccessible as a result of the threat posed by the Boko Haram sect. A report by the United Nations' Office for the Coordination of Humanitarian Activities (OCHA) warned that Boko Haram attacks that slowed down due to the rainy season might increase in the coming months (Daily Post, July 28, 2017). All these gave an indication that the elimination of Boko Haram insurgents from their Sambisa forest strong hold is not yet a done deal.

The Nigerian Airforce therefore in an effort to ensure complete elimination of the terrorist group from the Sambisa forest carried out air surveillances as well as several bombardments of Boko Haram positions in the forest. As disclosed by the Air Component Commander of Operation Lafiya Dole, the military operation in the North-East, Air Commodore Tajudeen Yusuf, Airforce fighter jets and attack helicopters, had bombed the terrorists' hideouts 108 times between April and July, 2017. Making the disclosure while briefing newsmen in Yola, Adamawa State, Air Commodore Yusuf said that the air interdiction missions were carried out with the ultimate aim of neutralizing the Boko Haram terrorist targets within the Sambisa forest (Daily Post, 28, July, 2017).

VII. The Consequences Of Sambisa Forest Occupation By The Boko Haram Insurgents And Subsequent Military Expedition To Reclaim The Forest

No information as yet exists of any deliberate attempt to assess the effects of Sambisa forest occupation by the Boko Haram insurgents and the subsequent military expedition to root out the terrorist group from the forest on the forest resources itself and there may never be at list for some time in the future due to the incomplete dislodgement of the group and the presence of land mines in the forest. It is obvious however that most of the negative consequences of armed conflicts on forests as earlier highlighted are already playing out in the case of Sambisa forest occupation. For one, since it's take-over by the insurgent group, the game reserve has been under no kind of any management. Whereas the insurgents on the one hand have maintained their physical presence in Sambisa forest since 2013, a period of five years, the Nigerian army on the other hand has also maintained their physical presence in the forest since 2015, a period of three years. These two opposing forces no doubt must have done an incalculable harm to the forest.

With the insurgents making Sambisa forest their main strong hold and with several of their camps located within the forest where they are living with members of their families as well as many of their hostages being kept inside the forest, there is no doubt that a large swath of the forest must have been denuded to create space for their living quarters, to farm and to provide wood for fuel and other non-wood forest products. As well, a large percentage of the wildlife within the game reserve must have been hunted for meat either by the insurgents themselves or by the military forces operating in the Sambisa forest. Those that may have escaped their capture might have been killed by the large swaths of landmines the insurgents have buried all over the forest as well as by the series of bombings that have taken place there by the Nigerian Airforce in her bid to route the Boko Haram out from the forest.

The decision of the Nigerian army to be holding some of her sporting activities and other trainings in the Sambisa forest means that yet a large expanse of the forest is going to be cleared to create enough space for these activities. It is also becoming clearer that the army is going to maintain her physical presence in the Sambisa forest for a long time to come since their primary objective is to ensure that Boko Haram or any other insurgent group cannot at any point in the future find a safe haven in the forest again. This therefore is going to adversely affect the management of the Sambisa forest as a game reserve.

At the moment, there are over two million internally displaced persons (IDPs) in Northeastern Nigeria resulting from the Boko haram insurgency and many of these people are living in the "Internally Displaced Persons" (IDP) camps. Building camps to accommodate this large number of refugees means that very large expanses of forest lands elsewhere other than the Sambisa forest have been cleared thus adding to the ongoing onslaught on the forest resources in the northeastern parts of the country. And these IDPs themselves left with no other means of survival must have also done an incalculable harm on surrounding forests within their vicinities.

VIII. Conclusion

From the fore going exposition, it's obvious that the on-going war in the Northeastern parts of the country by the Boko Haram insurgents is not just a war on the socio-political, socio-economic and socio-cultural life of the people but also an environmental war. Since the start of the war, Sambisa forest has never been the same and it's obvious that the forest will never remain the same again even if Boko Haram insurgents are completely rooted out from the forest. There is therefore a call for action by the government and forest resource

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managers to forestall similar incursions by other insurgent groups in other forest reserves in the country.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 18 Issue 5 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Study on the Prevalence of Ixodid Ticks of Domestic Ruminants in Three Selected Districts of Wolaita Zone, Southern Ethiopia

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Abstract- A cross-sectional study was conducted from November 2010 to April 2011 with the objective of identifying the major ixodid tick species of domestic ruminants, estimating their prevalence and investigating their associated risk factors in SodoZuria, Damot Gale and Humbo districts of Wolaita zone, Southern Ethiopia. A total of 384 ruminants comprising 138 cattle, 130 sheep and 116 goats were examined in the study areas. An overall prevalence of tick infestation in the three study districts was 89.1% in cattle, 70 % in sheep and 32.8% in goats. The difference in the prevalence of tick infestation between the three species of ruminants was statistically significant ($P<0.05$). There was a significant ($P<0.05$) variation was observed in Damot Gale (95%) and lowest in Humbo (79%); however, such variation was not observed in sheep and goats ($P>0.05$). In the present study, tick infestation was not associated with sex of the animal ($P>0.05$) except for goats in which the prevalence was significantly ($p<0.05$) higher in males than females. Similarly, the infestation was not significantly ($P>0.05$) associated with the age of animals. In this study, six species of ixodid ticks which belong to three genera were identified in all the three ruminants. These are *Amblyomma variegatum, Amblyomma gemma, Amblyomma lepidium, Amblyomma cohaerence, Rhipicephalu evertsi evertsi* and *Boopphilu decoloratus*.

Keywords: *prevalence, tick infestation, wolaita, ethiopia.*

GJSFR-D Classification: *FOR Code: 070199*



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Study on the Prevalence of Ixodid Ticks of Domestic Ruminants in Three Selected Districts of Wolaita Zone, Southern Ethiopia

Mesfin Mekonnen Moliso [α], Tewodros Sadado Samago [σ] & Yemisrach Yonas Alaro [ρ]

Abstract- A cross-sectional study was conducted from November 2010 to April 2011 with the objective of identifying the major ixodid tick species of domestic ruminants, estimating their prevalence and investigating their associated risk factors in SodoZuria, Damot Gale and Humbo districts of Wolaita zone, Southern Ethiopia. A total of 384 ruminants comprising 138 cattle, 130 sheep and 116 goats were examined in the study areas. An overall prevalence of tick infestation in the three study districts was 89.1% in cattle, 70 % in sheep and 32.8% in goats. The difference in the prevalence of tick infestation between the three species of ruminants was statistically significant ($P<0.05$). There was a significant ($P<0.05$) variation was observed in Damot Gale (95%) and lowest in Humbo (79%); however, such variation was not observed in sheep and goats ($P>0.05$). In the present study, tick infestation was not associated with sex of the animal ($P>0.05$) except for goats in which the prevalence was significantly ($p<0.05$) higher in males than females. Similarly, the infestation was not significantly ($P>0.05$) associated with the age of animals. In this study, six species of ixodid ticks which belong to three genera were identified in all the three ruminants. These are *Amblyomma variegatum, Amblyomma gemma, Amblyomma lepidium, Amblyomma cohaerence, Rhipicephalu evertsi evertsi* and *Boopphilu decoloratus*. The most prevalent tick species in cattle was *Boopphilus decoloratus* while in sheep and goats, *Rhipicephalus evertsi evertsi* was the dominant tick species. From the total 252 animals infested with different tick species, 89.7% ruminants were found to be infested with a single tick species while 10.3% ruminants were infested with two or three different tick species. In conclusion, this study has demonstrated that ticks are highly prevalent in domestic animals in the study areas and particularly cattle are more prone to tick infestation. Therefore, due attention should be given to control and prevent of ticks, since they could inflict huge economic losses by damaging hides and skins and transmitting tick-borne diseases to domestic animals.

Keywords: prevalence, tick infestation, wolaita, ethiopia.

I. Introduction

In Ethiopia the livestock subsector contributes 16% of the total GDP and over 30% of the agricultural GDP (1997). With an estimated 47.57% cattle, 26.12 million sheep, 21.71 million goats, 1.01 million camels and 7.73 million equines, the country has Africa's largest livestock population (CSA, 2008). However, the contribution from this huge livestock resource of the national income is disproportionately small due to several factors. Diseases of various etiological origins are among the numerous factors responsible for poor production and productivity. Parasitic diseases are a global problem and considered as a major obstacle in the health and product performance of livestock. Ticks are very significant and harmful blood sucking external parasite of mammals, birds and reptiles throughout the world (Rajput*et.al*, 2006).

In Ethiopia, tick and tick borne diseases cause considerable losses to the livestock economy ranking third among the prevalently parasitic diseases after trypanosomes and endo parasites. Ticks are directly or indirectly involved in substantial financial losses to livestock industry of Ethiopia which accounts for 75% the animal exports (Pegram *et al*., 1981). Tick bites can be directly debilitating to domestic animals causing mechanical damage, irritation, inflammation and hypersensitivity and, when present in large numbers, feeding may cause anemia and reduced productivity. The salivary secretion of some tick species may cause anemia and paralysis; however, more importantly when they attach and feed they are capable of transmitting a number of pathogenic viral, bacterial, rickettsial and protozoal diseases to livestock (Minjaw and Mclead, 2003; Drummond, 1983). Hence, ticks are one of the most significant groups of arthropod pests of veterinary interest (Wall and Shearer, 2001; Walker *et al*., 2003). Moreover, ticks also predispose to secondary attacks from other parasites (Abera *et al*., 2010).

In Ethiopia, ticks are common in all agro-ecological zones (Pegram *et.al*, 1981) and the major genera reported belong to *Amblyomma, Boopphilus, Haemaphysalis, Hyalomma* and *Rhipicepalus* (Pegram *et.al*, 1981; de Costoro, 1994). Moreover, it was also reported that different species of ticks comprising of *Rhipicephalus evertsi evertsi, Rhipicephalus muhsamae, Rhipicephalus practextatus, Rhipicephalus bergeoni, Rhipicephalus lunulatus, Haemaphysalis leachileachi, Haemaphysalis aciculifer, Haemaphysalis parmata, Ambloyma lepidum, Ambloyma variegatum, A. cohacrens, A. gemma, Hyalomma truncatum, Hyalomma marginatum rufipes, Argaspersicus* and *Ixodes rasus*

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occur in western Ethiopia (Abera *et al*., 2010; de Costoro, 1994; G/Michael, 1993).

The objective of the present study were to identify the main ixodid tick species infesting domestic ruminants and to estimate the prevalence of ixodid tick infestation in bovine, ovine and caprine species in selected districts of Wolaita Zone, Southern Ethiopia.

II. Materials and Methods

a) Study Area

The study was carried out in three districts of Wolaita zone, namely Sodo Zuria, Humbo and Damot Gale. Wolaita zone is in Southern Nations, Nationalities and People's Regional state at 390 km far from Addis Ababa. Geographically, Wolaita Sodo, the capital of Wolaita zone, is located at 6.4°-7.2°N latitude and 37.4°-38.2° E longitudes. The total land area covers 438,370 hectares, out of which 51.7% is cultivated and, 6.4% cultivable, 11.9% is grazing land 30% is others. The annual mean temperature ranges from 17.5-25.5°c and the area receives an average annual rainfall of 900-1400 mm. The rainfall pattern is bimodal, that is heavy rain from June to mid October and short rain from March to April. The area is characterized by tropical sub-humid climate and ever green forest type of vegetation. The main occupation of the rural population is mixed farming practice where by crop and livestock are managed hand in hand and together. The livestock populations of Wolaita zone were estimated to be 658,886 cattle, 59,233 sheep, 40,543 goats, 1,987 equines and 39,643 poultry. Livestock populations occupy a significant place in the farm economy. The most common crops that grown in the area are: wheat, inset, maize, barley and root crops. With the regard to the altitudes of the three districts, Damot Gale is a highland with an altitude about 2700 meters above sea level (*m.a.s.l*), Sodo Zuria is a midland area that has got an altitude of 2016-2261 meters above sea level (m.a.s.l) and Humbo is a lowland area with an altitude of 1480 *m.a.s.l.* (WZFED and CSA, 2003).

b) Study Population

The study population constitutes of those indigenous breeds of cattle, sheep, and goats, kept under the traditional management system. The animals depend on the grazing for their feed source with little supplementation of crop residues. All age groups and both sexes of animals were included in the study.

c) Study Design and Sampling Strategy

A cross-sectional study was employed to address the objective of this work. The sample size was determined following the formula described by Thrusfield (2005) for simple random sampling technique. Accordingly, considering the expected prevalence of 50% and 5% absolute precision and 95% confidence interval, a total 384 ruminants comprising of 138 cattle, 130 sheep and 116 goats were selected from the three study areas. The study animals were selected systematically at watering points and grazing areas.

d) Tick Collection and Identification

The animals selected for tick collection were properly restrained. The feeding adult ticks were collected from different body parts of animals including dewlap, brisket, back side, udder, vulva, an genital, foot and thigh. Tick samples were collected by hand picking method after examining the body parts of the animal for the presence of a tick (Alekaw, 2000). The collected ticks were preserved in universal bottles containing 70% ethyl alcohol as a preservative for each species of animals. Petri dishes, forceps, filter papers and stereo microscope were used for identification.

The ticks collected from different species of animals were placed in to a Petri dish and the adult ticks were spread on filter paper to absorb excess preservatives then, subsequently identified to genus and species level using standard stereo microscope based on tick identification keys adapted from Walker *et al*., (2003) and Hoogstraal (1956) and available in Sodo Regional Laboratory.

III. Data Management and Analysis

The data collected from the three species of ruminants were coded and entered into computer Microsoft excel spreadsheet. All statistical analysis was performed on STATA 9 software. The prevalence of tick infestation was computed as the number of animals infested divided by the number of animals examined multiplied by 100%. The association between the prevalence of tick infestation and the assumed risk factors such as species of animal, district, sex, and age was tested by Chi-square (X^2)statistic. P-value <0.05 was considered for significance at 95% level of confidence.

IV. Results

a) The Prevalence of Tick Infestation

Of the total 384 ruminants examined, 252 (65%) animals were found to be infested with one or more tick species. There was a significant difference ($P<0.001$) in the prevalence of tick infestation between the different animal species. The highest prevalence was observed in bovine (89.1%) and the lowest in caprine (32.8%) (Table 1).

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Table 1: The Overall Prevalence of Tick Infestation in Bovine, Ovine and Caprine Species

Animal Species	No. of Animals Examined	No. of Animals Infested	Prevalence (%)	χ^2	P -Value
Bovine	138	123	89.1		
Ovine	130	91	70		
Caprine	116	38	32.8	89.89	0.001
Total	384	252	65.5		

When the overall prevalence of tick infestation was analyzed on the study basis, a statistically significant difference ($P<0.05$) was seen between the different study area. The overall prevalence was the highest (71.8%) in Damot Gale district and the lowest (57%) was observed in Humbo district. However, this difference was attributed only due to the differences in tick infestation of bovine species and the differences within infestation of ovine and caprine species across the three study areas was not significant ($P>0.05$) (Table 2).

Table 2: The Prevalence of Tick Infestation in Animals Examined based on Study Areas

Species of Animals	Study Districts						X^2	P-Value
	Sodo Zuria		Damot Gale		Humbo			
	No.	Prevalence (%)	No.	Prevalence (%)	No.	Prevalence (%)		
Bovine	50	92	44	95	44	79	6.47	0.039
Ovine	46	65	58	72.4	26	73	0.82	
Caprine	36	36.1	29	34	29	29	0.53	
Overall	132	67	131	71.8	121	57	6.3	0.042

The overall prevalence of tick infestation observed in males and females were 63% and 67%, respectively. Although the prevalence was slightly higher in females, the difference was not statistically significant ($P>0.05$) except for caprine species in which significantly ($P<0.05$) highland prevalence was observed in males than females (Table 3).

Table 3: Prevalence of Tick Infestation in Animals Examined based on Sex

Species of Animals	No. Examined		No. Infested		Prevalence (%)		Difference Between Sex	
	M	F	M	F	M	F	X^2	P-value
Bovine	56	82	49	74	87.5	90.2	0.25	
Ovine	64	66	42	48	65.6	72.7	0.77	
Caprine	67	49	27	11	40.2	22.4	4.08	0.043
Total	187	197	118	133	63.1	67.5	0.82	

b) The Tick Species Identified

Three different genera of ticks were identified in the study area: *Amblyomma, Rhipicephalus and Boophilus.* Of these three genera, six species were identified *in* bovine, ovine and caprine. The most prevalent tick species in bovine was *Boophilus decoloratus* (53.7%) while in ovine and caprine, *Rhipicephalus evertsi evertsi* was the most dominant tick species identified with a proportion of 42.9% and 32.25%, respectively. *Amblyomma gemma* was the least prevalent species in bovine while *Amblyomma lepidium*in ovine and caprine (Table 4).

Table 4: Ixodid Tick Species Identified in Bovine, Ovine and Caprine Expressed as Proportion in Relation to the Number of Animals Infested with in each Species

Ticks Species	Animal Species							
	Bovine (n=123)		Ovine (n=91)		Caprine (n=38)		Overall (n=252)	
	No.	Proportion	No.	Proportion	No.	Proportion	No.	Proportion
A. variegatum	20	16.3	18	19.8	9	23.7	47	18.7
A. gemma	2	1.6	7	7.7	4	10.5	13	5.15
A. lepidium	8	6.5	5	5.5	3	7.9	16	6.34
A. cohaerence	24	19.5	10	11	3	7.9	37	14.7
R. evertsievertsi	13	10.6	39	42.9	13	34.2	65	25.8
B. decoloratus	66	53.7	23	25.3	12	31.6	101	40

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Out of total 252 animals infested with ticks, 89.7%, 9.9%and 0.4% were found to be affected with a single, two and three different tick species respectively. On animal species basis, 91.9% bovine, 87.91% ovine and 86.84% caprine were infested with a single tick species while 8.1% bovine, 12.1% ovine and 10.52% caprine were infested with two tick species. Only 2.6% caprine were observed to be infested with three tick species (Table 5).

Table 5: The Number and Proportion of Animals Infested with One or More Tick Species

No. of Tick Species	Animal Species							
	Overall (n=252)		Bovine (n=123)		Ovine (n=91)		Caprine (n=38)	
	No.	Proportion	No.	Proportion	No.	Proportion	No.	Proportion
Animals Infested with a Single Tick Spp.	226	89.7	113	91.9	80	87.91	33	86.84
Animals Infested with Two Tick Spp.	25	9.9	10	8.1	11	12	4	10.52
Animals Infested with Three Tick Spp.	1	0.4					1	26

V. Discussion

The problem of ticks in domestic ruminants of the study area seems to be very important as they are widely distributed. Poor management and poor level of awareness for cattle, sheep and goats owners regarding the effect of ticks are believed to have contributed to widespread occurrence of infestation. Considering these conditions, the present study was undertaken to identify the tick species found in Wolaita zone and to estimate their level of infestation in domestic ruminants. Higher proportion of the animals (65.6%) examined in the study area were infested with one or more species of ticks. There was a significant ($P<0.001$) difference in the prevalence tick species among the three animal species. The highest prevalence was observed in cattle (89.1%) and the lowest in goats (32.8%). The present finding is relatively lower than that of previous study (Abera *et al*., 2010) where 97.8% cattle, 89.9% sheep and 94.4% goats were reported to be infested in Bedelle district, Western Ethiopia. The prevalence of tick infestation observed in sheep and goats is also lower than previous report by Abunna *et al*., (2009) who reported 89.9% and 87.5% in sheep and goats, respectively in Meisso district, Eastern Ethiopia. However, the present finding is considerable higher than that of Arega (2010) who reported the prevalence of 59.6% in cattle, 37.7% in sheep and 48% in goats in and around Kombolcha. Such difference in prevalence may arise from differences in agro-climate, management and health care provided to the animals in the study areas.

Tick is the most prevalent ecto-parasite in Ethiopia (Pegram *et al*., 1981). In addition to the current study, the occurrence and importance of ticks in and around Wolaita area has also been reported by different scholars (Shiferaw and Abebe, 2005; Naser, 1985; G/Michael, 1993; Yacob *et al*., 2008).

The observation of a significant difference in the prevalence of tick infestation between the different animal species is in agreement with the findings of Abera *et al*., (2010); however, contrary to the present study, the highest prevalence was reported in goats. On the other hand, the current study contradicts with that of Abunna *et al*., (2009) who reported insignificant variation in tick infestation between sheep and goats.

The present study revealed a significant difference in the prevalence of tick infestation in cattle between the three districts ($P<0.05$). This variation in prevalence might be the result of altitudinal differences between the areas. The highest prevalence in cattle (95%) was observed in Damot Gale which is a highland area while the lowest (79%) in Humbo district which is a lowland. It is stated that tick activity is influenced by rainfall, altitude, and atmospheric relative humidity (Pegram *et al*., 1981). However, such differences were not observed in sheep and goats ($P>0.05$). This result contradicts that of Arega (2010) who reported absence of variation in tick infestation in cattle and goats between different agro-ecologies.

In this study, the prevalence of tick infestation was significantly ($P>0.05$) higher in male (40.2%) than female goats (22.4%). However, the association between tick infestation and sex was not significant in cattle and sheep ($P>0.05$), although it tended to be higher in females than males. A previous work by Abunna *et al*., (2009) has reported a significance difference between male and females in both sheep and goats but a higher prevalence was observed in females than males. Similar to the present study, another previous study by Abera *et al*., (2010) did not find a significant difference between male and female animals across all the three ruminant species.

Six species of tick were identified in the domestic ruminants in the present study. *Boophilus decoloratus* was the most prevalent in cattle and the second most dominant in sheep and goats. *Rhipicephalus evertsi evertsi* was the dominant species in sheep and goats. The distribution and abundance of tick species infesting domestic animals in Ethiopia vary from area to area. Various studies in Ethiopia have

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reported that *Amblyomma variegatum* is the most abundant tick in cattle (Morel, 1980; Pegram *et al*., 1981; Tessema *et al*., 2010). However, similar to the present study, *B. decoloratus* was reported to be the most abundant tick species in cattle in previous studies conducted in Wolaita (G/Michael, 1993; Shiferaw and Abebe, 2005). It is a one-host tick and a vector of an important tick-borne disease, babesiosis. All the tick species identified in cattle, sheep and goats belong to three genera: Boophilus, Rhipicephalus and Amblyomma. The same genera of ticks have also been reported in cattle, sheep and goats in Bedelle district (Abera *et al*., 2010) and Wolaita (Yacob *et al*., 1981). Contrary to the current finding, Abunna *et al*., (2009) have reported that *R. evertsi evertsi* was the most abundant species in sheep and goats. However, in agreement with the present study, Abera *et al.*, (2010) have reported that *R. evertsievertsi* was the dominant species in sheep.

VI. Conclusion and Recommendations

The present has shown that ticks are very important ectoparasites in domestic ruminants affecting the majority of animals examined in the study area. A higher proportion of animals (32-89%) examined in the study areas were infested in one or more species of ticks. Moreover, six species of that belong to three genera were identified in all the three animal species. Among the tick species identified in the study areas *Boophilus decoloratus, Rhipicephalus evertsi evertsi* and *Amblyomma variegatum* were the most prevalent. The observation such a high level of infestation and a wide variety of species clearly shows that ticks are threats for livestock production in the study areas because it is a well established fact that ticks cause great economic losses to livestock and adversely affect livestock host in several ways and parasitize a wide range of vertebrate hosts and transmit widely variety of pathogenic agents than any other groups of arthropods. On the other hand, the present study reminds that much more remains to be done to control ticks in the study area.

The present study has also demonstrated that cattle are more prone to tick infestation than sheep and goats and special attention should be given to cattle when tick control schemes are planned. Furthermore, it was observed that prevalence of tick infestation in cattle is dependent on altitude that is, the highest level of infestation was observed in animals from highland whereas, lowest in animals from lowland district.

Therefore in line with the aforementioned facts, the following measures are recommended that might help to reduce the high level of tick infestation in the study areas:

- First and foremost it is important to educate farmers on the problems of ticks, and the different control methods, which can be available in the areas.
- Application of acaricide aimed at reduction of tick population based on information about their prevalence on different agro-ecological zones should be encouraged.
- Special attention should also be given in awareness that there is high probability of the occurrence of tick-borne diseases in the study areas and supplement of basic drugs should be supplied.
- Further study is required to generate a complete data set on the epidemiology of tick infestation in the study areas and also to collect data on the occurrence of tick-borne diseases.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 18 Issue 5 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Genotype X Environment Interaction and Yield Stability in Improved Rice Varieties (*Oryza Sativa L.*) Tested Over Different Locations in Western Oromia, Ethiopia

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Abstract- Eleven rice genotypes were evaluated at 6 environments in Western Ethiopia during 2015 and 2016 main cropping season. The objective of the study was to determine the magnitude of genotype x environment interaction and performance stability in the rice genotypes. The study was conducted using a randomized complete design with 3 replications. Genotype x environment interaction and yield stability were estimated using the additive main effects and multiplicative interaction and site regression genotype plus genotype x environment interaction bi plot pooled analysis of variance for grain yield showed significant ($P<0.01$) to significant ($P<0.05$) differences among genotypes, environment, genotype x environment interaction effects. This indicates that genotypes differentially respond to the change in test environments or the test environments differentially discriminated the genotypes or both. Environment accounted for 69.39%, of the total yield variation, genotype for 8.50% and genotype x environment for 3.90%, indicating the need for spatial and temporal replication of the trials. Regression and AMMI analysis were employed in order to determine the stability of genotypes. The two models regression analysis and AMMI revealed similar result in that Adet and Hidassie were stable and widely adapted genotypes.

Keywords: *rice, genotype x environment interaction, stability parameters, yield.*

GJSFR-D Classification: *FOR Code: 079999*



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Genotype X Environment Interaction and Yield Stability in Improved Rice Varieties (*Oryza Sativa L.)* Tested Over Different Locations in Western Oromia, Ethiopia

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Abstract- Eleven rice genotypes were evaluated at 6 environments in Western Ethiopia during 2015 and 2016 main cropping season. The objective of the study was to determine the magnitude of genotype x environment interaction and performance stability in the rice genotypes. The study was conducted using a randomized complete design with 3 replications. Genotype x environment interaction and yield stability were estimated using the additive main effects and multiplicative interaction and site regression genotype plus genotype x environment interaction bi plot pooled analysis of variance for grain yield showed significant ($P<0.01$) to significant ($P<0.05$) differences among genotypes, environment, genotype x environment interaction effects. This indicates that genotypes differentially respond to the change in test environments or the test environments differentially discriminated the genotypes or both. Environment accounted for 69.39%, of the total yield variation, genotype for 8.50% and genotype x environment for 3.90%, indicating the need for spatial and temporal replication of the trials. Regression and AMMI analysis were employed in order to determine the stability of genotypes. The two models regression analysis and AMMI revealed similar result in that Adet and Hidassie were stable and widely adapted genotypes. Adet and Hidassie varieties were the most stable and high yielding genotype and was therefore recommended for commercial production in the western Ethiopia upland rice growing areas.

Keywords: rice, genotype X environment interaction, stability parameters, yield.

I. Introduction

More than half of the world's population depends on rice for its major daily source of food energy and protein and thus the importance of rice in relation to food security and socio-economic stability is self-evident (FAO, 2003). Rice is the fastest growing source of food in Africa. During the past three decades rice grain has seen a steady increase in consumption and demand given its important place in the strategic food security planning policies of many African countries (Norman and Otoo, 2003; Africa Rice Center, 2007; Forum for Agricultural Research in Africa, 2009). Rice is proven to be one of the potential strategic commodity crops that can assure food security and poverty reduction in Ethiopia (Seyum and Gebrekidan, 2005; Gebrekidan and Seyoum, 2006; Zenna *et al*., 2008). Moreover, rice could also be considered as one of the best and cheapest alternative technology available to small-scale farmers for improving productivity of grain yields in flooded and swampy environments through efficient utilization of land and water (Gebrekidan and Seyoum, 2006).

The recent surge in demand triggered by soaring import price, consumer preference in urban areas, population growth and rapid urbanization forced the country to expand small-scale and commercial rice production in various agro-ecologies (Zenna *et al*., 2008). As a result of which, rice production is escalating rapidly from year to year (Gebrekidan and Seyoum, 2006; Aredo *et al*., 2008; Zenna *et al*., 2008). Nevertheless, the challenges facing the successful development of the rice sector are huge and includes: lack of adequate rice milling facilities, lack of improved varieties and recommended crop management practices for different rice ecosystems, and biotic and a biotic stresses; low agricultural inputs (fertilizer, improved rice varieties seed, agro-chemicals etc), poor mechanization and lack of adequate human resource in the value chain (MoARD, 2010).

Western Oromiya is one of the potential areas where rice is recently introduced and being produced mainly in rain fed upland ecology. However, improved rice varieties and development out puts are very limited in the area to satisfy the growing demand of large and small-scale farmers for improved rice varieties. Grain yield depends on genotype, environment and management practices and their interaction with each other (Messina *et al*., 2009). Under the same management conditions, variation in grain yield is principally explained by the effects of genotype and environment (Dingkuhn *et al*., 2006). So information of genotype × environment interaction leads to successful evaluation of stable genotype, which could be used for general cultivation.

The level of performance of any character is a result of the genotype (G) of the cultivar, the environment in which it is grown (E), and the interaction

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between G and E (GEI). Interaction between these two explanatory variables gives insight for identifying genotype suitable for specific environments. The environmental effect is typically a large contributor to total variation (Blanche *et al*., 2009). Moreover, G x E interactions greatly affect the phenotype of a variety, so the stability analysis is required to characterize the performance of varieties in different environments, to help plant breeders in selecting desirable varieties. Mosavi (2013) observed significant yield differences among rice genotypes, environment and genotype by environment interaction. Therefore, the major objective of present study was to evaluate and select high yielding improved rice varieties for upland ecology of western Oromiya.

II. Materials and Methods

Eleven rice (*Oryza sativa* L.) varieties including standard check (*Chewaqa)* were tested at Bako, Chewaqa, Uke and Guttin for three cropping seasons (2015-2016). Genotypes were planted in a completely randomized block design with three replications in which each plot comprises of six rows having 5 m length. The spacing between rows was 20 cm and the seed was drilled in rows. A 100/100 kg P2O5 and urea per hectare (ha-1) fertilizer was used. Urea was split appliad half at planting and half at panicale initiation. Management practices were done according to the recommendations for the particular crop and/or location. The middle 4 rows were harvested and the grain yield was adjusted to 14% seed moisture content before data processing for analysis. Grain yield analysis was carried out using regression (Eberhart and Russell, 1966) and AMMI models in Agrobase software (Agrobase, 2000). The linear model proposed by Eberhart and Russell (1966) is:

$$Y_{ij} = \mu_i + b_i I_j + S^2 d_{ij}$$

where Yij is the mean performance of the ith variety (I = 1, 2, 3…, n) in the jth environment; is the S^2d_{ij} mean of the i^{th} variety over all the environments; bi is the regression coefficient which measures the response of i^{th} variety to varying environments; S^2d_{ij} is the deviation from regression of ith variety in the j^{th} environment and Ij is the environmental index of the j^{th} environment. Similarly, the AMMI model (Gauch and Zobel, 1996) is:

$$Y_{ge} = \mu + \alpha_g + \beta_e + \sum_{n=1}^{N} \lambda n \gamma_{gn} \delta_{en} + \rho_{ge}$$

where Y_{ger} is the observed yield of genotype g in environment e for replication r; Additive parameters:μ is the grand mean; α_g the deviation of genotype g from the grand mean and β_e is the deviation of environment e; the multiplicative parameters:λ_n is the singular value for interaction principal component axis (IPCA) n,Y_{gn} is the genotype eigenvector for axis n, and δ_{en} is the environment eigenvector; ρ_{ge} PCA residuals (noise portion) and ε_{ger} is error term.

Table 1: Characteristics of Rice Varieties Tested

No.	Variety Name	Year of Release	Rain Fall (mm)	Ecosystem	Days to Maturity	Yield (ton ha^{-1})	
						On-Farm	On-Station
1	Adet	2014	800-1400	Upland	112-120	2.4	4.2
2	NERICA 13	2014	650-800	Upland	104	3.3	3.8
3	Getachew	2007	800-1400	Upland	97-125	2.1	3.0
4	Andassa	2007	800-1400	Upland	111-135	2.5	3.8
5	Chewaqa	2013	800-1200	Upland	160	3.3	4.2
6	Hidassie	2012	800-1400	Upland	100-130	2.2-3.2	3.0-4.2
7	Tana	2007	800-1400	Upland	109-135	2.4	4.4
8	NERICA-2	2007	Intermitte Irrigation	Irrigated upland	80-90	3.5	5.5
9	NERICA-4	2006	800-1400	Upland	110	3.0	4.8
10	Tana	2007	800-1400	Upland	109-135	2.4	4.4
11	SUPERICA-1	2006	800-1400	Upland	115	2.3	5.1

III. Results and Discussion

a) Combined Analysis of Variance

Table 1 presents the combined analysis of variance. Genotype (G), environment (E) and genotype × environment interaction (GEI) were highly significant ($P<0.001$) for grain yield (Table 1). The factors explained showed that rice grain yield was affected by genotype (69.39%), environment (8.50%) and their interaction (3.90%). In general, a wide genetic diversity for maximum traits existed in the rice materials used in

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this study and this may be due to their diverse origins. The effects of G and E as shown in their highly significant mean square (MS) for maximum traits reflected genotypic differences towards adaptation to different environments. Thus the highly significant G × E effects suggest that the genotypes may be selected for adaptation to specific environments. This is in harmony with the findings of Aina *et al*., (2009) and XuFei-fei *et al.,* (2014) in G × E interaction effects of cassava genotypes. The significant genotype × environment interaction effects demonstrated that genotypes responded differently to the variation in environmental conditions of locations. This is indicative of the necessity of testing rice varieties at multiple locations. This also attests to the difficulties encountered by breeders in selecting new varieties for release. The large sum of squares for genotypes indicated that the genotypes were diverse, with large differences among genotypic means causing most of the variation in grain yield, which is harmony with the findings of Misra *et al.* (2009) and Fentie *et al.,* (2013) in rice production.

b) Regression Analysis Based on Eberhart and Russell Model

Mean square due to genotypes and interaction of genotype x environment (linear) were found to be highly significant ($P < 0.01$ (Table 2). The significance of genotypes x environments (linear) showed there is differences in yield performance among the genotypes under different environments. In line with the findings of this study, Chaudhary *et al.* (1994) reported highly significant for genotypes and Genotype x environment (Linear) in field pea.

The mean performance, regression coefficient (b_i) and squared deviation (s^2d_i) from the regression values are presented in Table 3. According to Ebrehart and Russell (1996) genotypes with high mean yield and regression coefficient (b_i) equal to unity and deviation from regression (s^2d_i) approach to zero. The genotypes *Adet and Hidassiei* have mean yields higher than the average, (b_i) did not differ significantly from unity and (s^2d_i) approaching zero. This implied that these genotypes were stable and widely adapted.

Table 2: ANOVA From Means Table (Eberhart-Russell Regression Model)

Source	df	SS	MS
Varieties	10	28.343	2.83**
Env.+ in Var. x Env.	55	180.693	3.28
Env. in Linear	1	115.656	
Var. x Env. (Linear)	10	33.272	3.32**
Pooled Deviation	44	31.765	0.722
Residual	132	24.543	0.186

Grand Mean = 4.055; R-squared = 0.8242; C.V. = 18.42%

Table 3: Stability Anaylsis in Rice Tested in Western Ethiopia during 2015-2016

Genotype	Regression Coefficient (b_i)	Squared Deviation from Regression (s^2d_i)	Grain Yield (tons ha-1)
Adet	1.1557**	0.5429	6.04
Kokit	0.1276	0.1786	3.59
Hidassies	1.6541**	0.7949	4.58
Nerica 13	1.3815**	0.4985	3.62
Superica 1	1.4781	0.2417	4.52
Nerica 2	1.2338*	0.3501	4.1
Getechew	0.9989	0.1523	3.88
Andassa	1.1494	0.0452	3.28
Nerica 4	0.861	0.2812	3.72
Tana	1.183*	0.4536	3.33
Chewaqa	0.0321*	2.3569	4.37
Mean			4.09

Own Data Source, 2017

c) Stability Analysis by AMMI Model

The mean grain yield value of 11 rice vareties averaged over six environments presented in Table 4, which showed that the varieties Adet and Hidassie had the highest 8.2 t ha-1 and 8.1 t ha-1 and lowest 4.58t ha-1 and 3.37 t ha-1 respectively. Different genotypes showed inconsistent performance across all the environments. The variety Adet (6.04) was the top performers, while variety Andassa 3.28 t ha-1 and Tana 3.33 t ha-1, were the poorest yielders.

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Table 4: Mean Grain Yield of Rice Across Years (2015/16-2016/17) and Locations (Uke, Chewaqa, Bako & Guttin).

Mean Grain Yield (ton ha-1)									
		2015/16			2016/17				
No.	Genotype	Uke	Chewaqa	Bako	Bako	Uke	Guttin	Meam	Rank
1	Adet	6.89	8.23	4.96	6.07	5.52	4.58	6.04	1
2	Kokit	3.50	3.22	4.00	4.31	3.85	2.66	3.59	8
3	Hidassies	6.61	8.10	3.37	1.14	4.55	3.69	4.58	2
4	Nerica 13	4.29	7.32	3.82	2.37	2.36	1.58	3.62	9
5	Superica 1	6.21	7.73	3.50	1.62	4.48	3.58	4.52	3
6	Nerica 2	5.30	7.31	3.63	2.04	3.61	2.74	4.10	5
7	Getechew	4.98	6.35	3.40	2.09	3.70	2.75	3.88	6
8	Andassa	4.67	5.57	2.68	1.18	3.24	2.31	3.28	11
9	Nerica 4	4.18	6.35	3.61	2.76	3.20	2.23	3.72	7
10	Tana	4.75	5.67	2.48	1.05	3.52	2.54	3.33	10
11	Chewaqa	3.59	4.98	5.69	6.07	3.45	2.42	4.37	4
	Mean	**5.00**	**6.44**	**3.74**	**2.79**	**3.77**	**2.82**	**4.09**	

Table 5: Genotype X Environment Interaction Explained

Source	df	MS	% Genotype X Environment Interaction Explained
Total	197		
Environments	5	69.393**	
Reps within Env.	12	1.146	
Genotype	10	8.503*	
Genotype x Env.	50	3.902**	
IPCA 1	14	10.245**	73.52
IPCA 2	12	1.901**	11.69
Residual	120	0.499	

d) AMMI Biplot Display

Among the varieties Adet and Hidassie were generally exhibited high yield with high main (additive) effects showing positive IPCA1 score, but variety Adet being the overall best. Hence, variety Adet was identified as specially adapted to the environments of Uke and Chewaqa and these two environments were considered as the wide range suitable environments for this variety.

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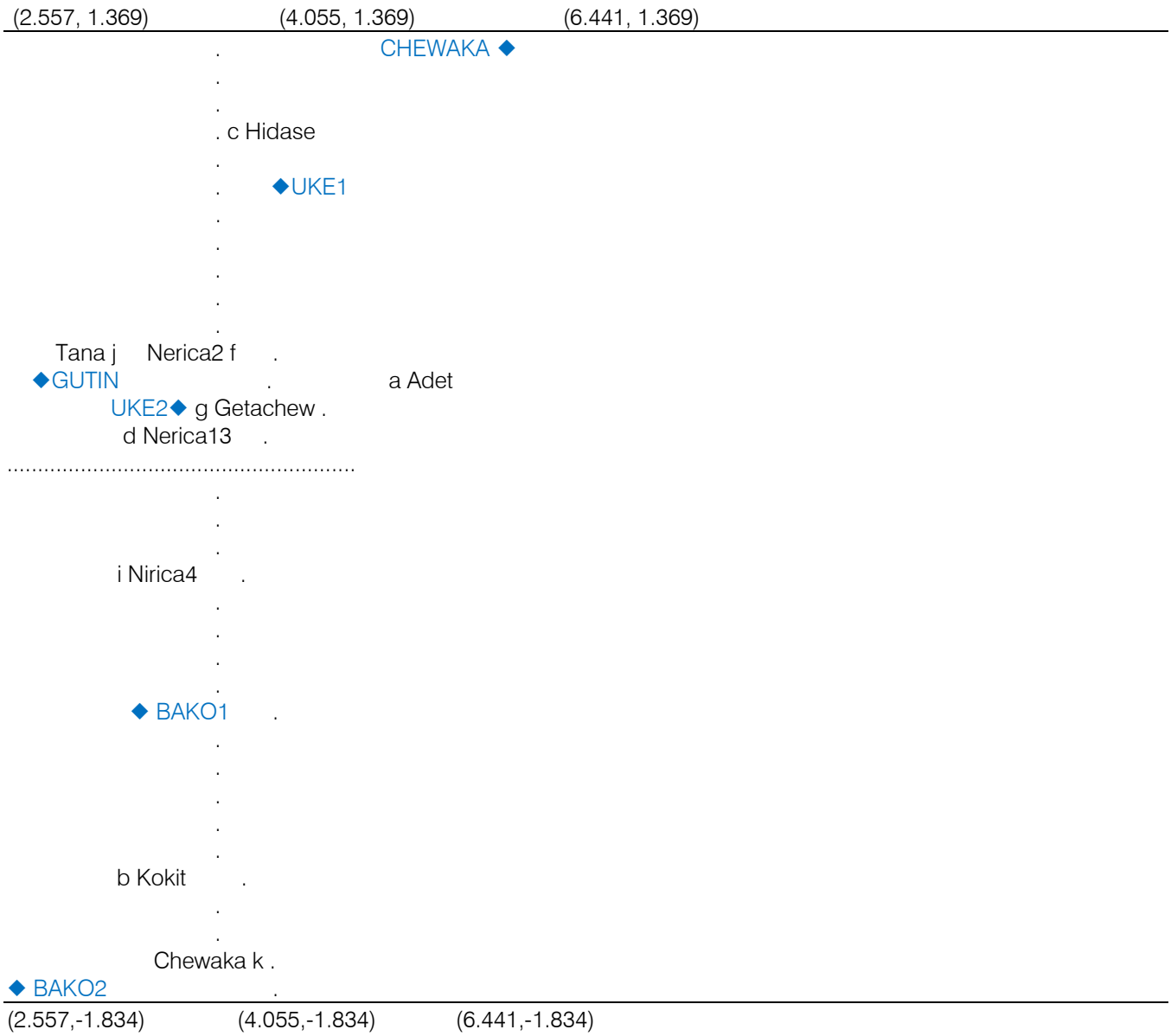


Fig. 1: AMMI Biplot for Grain Yield (t ha-1) of 11 Rice Genotypes (G) and Four Environments (E) using Genotypic and Environmental IPCA Scores.

IV. Conclussion

The present studies revealed that rice yield were liable to a significant fluctuation with changes in the growing environments, G x E interaction effect being almost eight times higher than that of genotype effect. This study also clearly demonstrated that the regression and AMMI analyses models were found to be effective for determining the magnitude and pattern of genotype x environment interaction effect in the rice genotypes. From the regression and AMMI analyses, therefore, *Adet and Hidassie varieties were* the most stable and high yielding genotype and as a result, these were recommended for commercial use for the western Ethiopia upland rice growing areas.

Acknowledgement

The corresponding Authors would like to thank Girma Mengistu and Dr. Dangachew Lule for their encouragement. The financial support provided by the Oromiya Institute of Agricultural Research (OARI) is also dully acknowledged. All Research and supportive Staff at Bako Research Centers are dully acknowledged for handling the experiment and facilitation.

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Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 18 Issue 5 Version 1.0 Year 2018
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Effect of between Plants Space on Seed Yield Potential of Cow Pea at Dilla Sub - Station, Southern Ethiopia

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Keywords: *biomass yield, seed yield, cowpea.*

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Effect of between Plants Space on Seed Yield Potential of Cow Pea at Dilla Sub - Station, Southern Ethiopia

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Abstract- The study was conducted in Dilla substation with objective of identifying optimum between plant space for optimum seed yield and quality seed. Planting one high yielding which is in seed multiplication status was used as experimental material. Four different between plant space(10 cm, 20cm, 30cm and 40cm with constant between row space(40cm) were used as experimental treatments in a randomized complete block design (RCBD) with four replications. Plot size was 3 x 2m with an inter-row spacing of 40cm and 1m between replication and plots. Dry matter herbage yield has shown significantly higher in between plant space of 20cm than other treatments (30 and 40 cm) at ($p<0.05$) which is in contrary to seed yield. Seed yield has showed statistically significant variation at 30cm than at 20 and 10 cm between plants spaces at ($p<0.05$). Hence, there will be two recommendation options for smallholder producers. To secure feed shortage and increased herbage production 20cm between plant space where as increased seed yield and further researches spacing under intercropping condition in different cereal crops should be conducted to fill the existing knowledge gap and thereby to utilize efficiently existing resources and plaster feed shortage gap.

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I. Introduction

Feed shortage both in quantity and quality remains the leading constraint to good animal performance in Ethiopia (Yayneshet et al 2009). Natural pasture and crop residues are the main feed sources. However, most of the feedstuffs obtained from natural pasture and crop residues have crude protein (CP) levels below 8% and neutral detergent fiber (NDF) of above 55% (Seyoum and Zinash 1995). Feedstuffs of such composition are insufficient to provide year round supply of adequate quantity and quality of nutrients beyond maintenance (Hindrichsen et al 2001). Various options have been advocated Cowpea is well adapted to the harsh growing conditions, including low soil fertility, high temperatures, and drought (Turk et al 1980). Cowpea can fix nitrogen to improve soil fertility and cropping system productivity. Additionally, farmers feed cowpea fodder to livestock to increase income, and collect the manure produced for use in their fields thereby reduces farmers' reliance on commercial fertilizers and sustains soil fertility (Odion et al 2007; Akinlade et al 2005). Previous studies with cow pea (Gwanzura et al 2012; Akinlade et al 2005; Ebro et al 2004; Alemayehu 1997) indicated this legume improves soil fertility and enhances the intake and utilization of poor quality roughage consequently improves livestock production and productivity. Another important feature of cowpea is also its ability to suppress weeds particularly Striga species (Dawit et al 2009) as possible solutions to this perennial problem. This includes feeding of treated and, untreated crop residues or integration of forage legumes into the feeding strategies. Legumes are the most important forage plants that substantially improve the feed available for livestock as they can provide the essential protein for animals, improving soil fertility, food crop production and household nutrition through a more reliable supply of milk and meat (Akinlade et al 2005; Alemayehu 1997).

In the Southern region demand for production of improved forage production is increasing due to decreasing trend of grazing land for livestock production and increased awareness of farmers on improved forage production by different stalk holders (unpublished AGP-II need assessment, 2016 report). However, supply of improved forage crop seed is below the demand, this is mainly due to lack of forage production enterprises, lack of forage seed production bylaw and there is no seed rate space that is recommended for seed production despite of presence of manual for forage herbage production. Hence, identifying optimum seed yield production space rather than herbage will encourage seed producers which in turn has significant importance in improving feed quality and soil fertility and productivity. Therefore, this experiment was conducted with the objective of identifying optimum between plant space for optimum seed yielding and quality seed of cowpea for lowlands of Southern Ethiopia.

II. Materials and Methodology

a) Site Description

Dilla substation is characterized by Orthic Luvisols soil, with an average annual rain fall and temperature of 1300 mm and 21^{0}C respectively. The average min and max temperature of the area are 13.10

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and 28.05 ^{0}c respectively. It has an altitude of 1572 masl, and located at latitude and longitude of 38^{0}18'30" E and 6^{0}24'30" N respectively.

b) Treatments and Data Collection

The between plant space, 10cm, 20cm, 30cm and 40cm, were used as experimental treatments in a plot size of 3 x 2m with an inter-row spacing of 40 and 1m between replication and plots. Two seeds were sown together at the onset of main rainy season around mid of July with extra seedling thinned 14 days after germination, leaving one plant per station. A 100 kg/ha Di-ammonium phosphate (DAP) fertilizer was applied right before sowing. All plots were weeded two times before flowering. Number of branches per plant was counted by taking five plants per plot randomly. Number of pods per plant was also counted by using five plants per plot. Plants were harvested at ground level and fresh biomass weighed immediately using a 0.1 g scale. Then, a sub-sample of 15-20% of the total weight was separated and put into a paper bag for dry matter herbage determination. The samples were oven dried at 105 0C for 24 hours in Hawassa Agricultural research center soil Laboratory. To determine grain yield, the pods were harvested from the rest rows at optimum physiological maturity by hand picking and threshed.

c) Statistical Analysis

The trial was laid out in a complete randomized block design with four replications and analyzed by analysis of variance using general linear model procedure of SPSS (version 20). Differences among means with $P<0.05$ were accepted as representing statistically significant differences. Tukey multiple comparisons was used to separate treatment means.

III. Result and Discussion

Maximum yield of a particular crop in a given environment can be obtained at row spacing where competition among the plants is minimum. This can be achieved with optimum spacing which not only utilize soil moisture and nutrients more effectively but also avoids excessive competition among the plants. However, beyond certain limit yield cannot be increased with decreasing/increasing row spacing. Hence, optimum row spacing induces the plant to achieve its potential yield.

a) Number of Branches

There was statistically significant difference in number of branches per plant between plant space of 30cm and 40 cm between rows which is in line with report conducted under irrigation by Armara *et.al,* 2017 they reported as there is increase in space there is increase number of branches per plant up to the optimum level at 40 X 20cm number of branches (18.42 plant-1). Our study indicated that there was no significant difference in number of branches per plant at 30 cm and 40 cm between plant spaces (table 2) this might be the indicative of optimum level of space for increase in number of branches per plant. Branches per plant higher in higher space between plants than lower space and positively correlated with seed yield. These results are in conformity with Angne et al. (1993), Yadav (2003) in cowpea.

Table 1: Effect of Between Plant Space on Number of Branch per Plant

Between Plant Space	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
10 cm	12.0	.4	10.7	13.3
20 cm	14.8	.4	13.2	16.2
30 cm	18.5	.4	17.5	19.4
40 cm	20.0	.4	17.7	22.2

b) Number of Pod per Plant

There was statistically significant difference in number of pods per plant between plant space of 30 cm and 40 cm between rows which is in line with report conducted under irrigation by Armara *et.al,* 2017 they reported as there is increase in space there is increase number of pods per plant up to the optimum level at 60 X 20 cm number of pods (32-36 plant-1). Our study indicated that there was no significant difference in number of branches per plant at 30 cm and 40 cm between plant spaces (Table 2) this might be the indicative of optimum level of space for increase in number of pods per plant. Pods per plant higher in higher space between plants than lower space and positively correlated with seed yield. These results are in conformity with Angne et al. (1993), Yadav (2003) in cowpea.

Table 2: Effect of Plant Space on Pod / Plant

Between Plant Space	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
10 cm	18.50b	.774	15.814	20.186
20 cm	19.00b	.774	16.314	21.686
30 cm	24.25a	.774	22.564	25.936
40 cm	26.50a	.774	23.814	28.186

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c) *Dry Matter Yields*

There was statistically significant difference in biomass yield of between plant space of 20cm and 40 cm between rows which is in contrary with report conducted under irrigation by Armara *et.al,* 2017 they reported as vegetative growth and number plant population increase there is increase there is increase with grain yield. The increase in grain yield and above ground biomass yield with 40 x 20cm row spacing was mainly due to significantly higher performance of all the growth and yield components compared 40 X 10 cm (table 3). These results are in conformity with Angne et al. (1993), Yadav (2003) in cowpea. As a result comparison in previous studies on cowpea which was conducted for herbage and seed yield on different genotypes, Ayana et al (2013) and Agza et.al (2012) reported dry matter herbage yield of different cowpea genotypes ranging between 2.78 t ha-1 and 7.67 t ha-1 and 2.33 t h^{-1} and 7.13 t h^{-1}, respectively. Ibrahim et al. (2006) obtained dry matter yields of over 4 t ha-1. The average herbage dry matter yields obtained in our study in the experimental period were in the range of those reported by (Ayana et al 2013; Ibrahim et al 2006) but quite lower than Rao and Shahid (2011) who found an average dry matter herbage yield of 18.1 t ha-1 for different cowpea genotypes.

Table 3: Effect of Between Plant Space on Dry Matter Yield t/ha

Between Plant Space	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
10 cm	4.28b	.06	4.1	4.5
20 cm	4.75a	.06	4.5	4.9
30 cm	4.45a	.06	4.2	4.6
40 cm	4.15b	.06	3.9	4.35

d) *Grain Yield*

There was significant difference in seed yield at ($p \leq 0.05$) in 30 cm between plant space and 40 cm b/n row space than at 10 and 20 cm b/n plant space. The increase in grain yield with 40 x 30cm row spacing was mainly due to significantly higher performance of all the growth and yield components compared to 40 x 20cm and 40 X 10 cm (table 4). These results are in conformity with Armara *et.al,* 2017, Angne et al. (1993), Yadav (2003) in cowpea. Cowpea grain yield ranged 3.71 quintal to 11.4 quintal ha-1 in Ethiopia Ayana et al (2013), our result is in this range (7.05 quintal to 8.12 quintal ha-1). Other studies reported far lower result than current study; 2 quintal to 4 quintal ha^{-1} in Uganda (Omongo et al 1997), and 2 quintal to 3 quintal ha-1 in Nigeria (Alghali 1992). But the range of grain yield recorded at different between plant space in this study far lower than report of Agza et al (2012) and Goenaga et al (2011) who found that grain yield of different cowpea genotypes varied between 17.2 t h-1 to 34.7 t ha-1 and 15.56 quintal ha-1 to 36.82 quintal ha,-1 respectively even though there is variation in genotype, this might be variation in genotypes and other environmental factors.

Table 4: Effect Between Plant Space on Seed Yield t/ha

Between Plant Space	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
10 cm	.705b	.021	.660	.750
20 cm	.758b	.021	.712	.783
30 cm	.812a	.021	.793	.858
40 cm	.805a	.021	.772	.833

IV. Conclusion

There was significant difference in seed yield at ($p \leq 0.05$) in 30 cm between plant and 40 cm between row space than at 10 and 20 cm between plant spaces. On the other hand relatively better DM yield was obtained in 20 cm between plants spaces than others between plant spaces. High biomass yield of crop residues was obtained minimum space between plant than higher between plant spaces. Pod per plant higher in higher space between plant than lower space and positively correlated with seed yield. So, in can be concluded for increased seed yield it is better to sow at 30 cm between plant spaces. On the other the other hand relatively better biomass yield of crop residues was obtained 20 cm space between plants.

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V. Recommendation

It can be recommended that those who need for herbage production; better to use 40 cm between row space and 20 cm between plants space where as those who need forage seed as business source should use 40 cm between row space and 30 cm between plant. For further investigation adaptation trail of more potential cowpea genotypes at different environments is across years and under irrigation condition is recommended.

Acknowledgement

The authors acknowledge the South Agriculture Research Institute (SARI) and Jinka Agriculture Research centre for their financing the activity for its implementation

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1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.



Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.



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Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



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Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals.

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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ISSN 9755896



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