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Commonly Encountered Ailments in Working Bullocks in Western Maharashtra, India

By Chittora R. K., Jadhav A. S., Upreti N. C. & Manilal V.

Abstract- Aim: The aim of present study was to determine the common diseases encountered by Animal Rahat teams in working bullocks in Western Maharashtra, India and also emphasize on diseases of higher prevalence encountered in more numbers during hard working season viz. sugarcane crushing season. This is based on analysis of Animal Rahat 'Streatment data of five years which is from April, 2015 to March, 2020. Animal Rahat, an animal welfare organization provides free treatment services to working bullocks in 180 villages and 26 sugar factories of Western Maharashtra i.e. in Solapur, Sangli, Satara and Kolhapur districts. Every year's thousands of animals are being treated for various ailments and these treatment data's are recorded in specified treatment register and on monthly basis these treatment data's are converted to soft and analysed.

Keywords: digestive disorders, lameness, ophthalmological disorders, western maharashtra, working bullocks, wounds, yoke gall.

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Commonly Encountered Ailments in Working Bullocks in Western Maharashtra, India

Chittora R. K. ^α, Jadhav A. S. ^σ, Upreti N. C. ^ρ & Manilal V. ^ω

Abstract- Aim: The aim of present study was to determine the common diseases encountered by Animal Rahat teams in working bullocks in Western Maharashtra, India and also emphasize on diseases of higher prevalence encountered in more numbers during hard working season viz. sugarcane crushing season. This is based on analysis of Animal Rahat 'streatment data of five years which is from April, 2015 to March, 2020. Animal Rahat, an animal welfare organization provides free treatment services to working bullocks in 180 villages and 26 sugar factories of Western Maharashtra i.e. in Solapur, Sangli, Satara and Kolhapur districts. Every year's thousands of animals are being treated for various ailments and these treatment data's are recorded in specified treatment register and on monthly basis these treatment data's are converted to soft and analysed. Treatment data of five years i.e. from April 2015 to March 2020 were collated and analysed. Analysis of data revealed that prevalence of lameness is highest in working bullocks which is 32-36 % of total affected animals which are reported every year and number of animals affected with lameness increases during the sugar cane crushing season (November to April/May) every year. Other ailments are; 25-28 % wound cases, 17-23 % digestive disorders, 5-7 % ophthalmological disorders, 4-7 % yoke gall cases and 2-5% respiratory disorders, different type of swelling and pyrexia of unknown origin (PUO) cases out of total affected animals reported. Working bullocks suffer with many diseases, most commonly with musculoskeletal problems which also increases during hard working season. Over work, over load, inadequate & inappropriate feeding, ignorance, unawareness, use of sharp nails to prevent bullocks from balancing their loads and greediness are the main cause of ailments in working bullocks.

Keywords: digestive disorders, lameness, ophthalmological disorders, western maharashtra, working bullocks, wounds, yoke gall.

1. INTRODUCTION

Working animals means draught purpose animals, used their muscles power for livelihood of human beings. They play very important role in lives of their owners [13]. They are used as working in agriculture; transport of agriculture product & by product, goods, hauling of passenger's in rural area, hauling of people in tourist industries,

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transportation of bricks in brick kiln industries, sand mining etc. Working animals are mainly cattle & buffalo (bullock or oxen), horses, mules, donkeys, camels [8]. Cattle and buffalo are the species predominantly used in agriculture operations to pull agricultural implements [8]. Draught animals play a dominant role in Indian rural economy. At present draught animals are being used to plough around 100 million hectares of farm land in India. Although an increasing mechanization is replacing the animal power in the villages, reducing the total draught animal power, yet India has to depend on animal energy for many years to come for agricultural operations and transport of farm produce [5].

Draught animals suffer in a variety of ways throughout their working life. Animals are often goaded by beating, to make them carry loads beyond their capacity or work for longer hours. Sick and injured animals are put to work. The state of health of draught animals is poor, as they are not fed adequately to replenish the energy required for work. Implements, carts and other devices may be attached to animals by ill-fitting harnesses, thus causing unnecessary pain; neck injuries often lead to callosity and/or cancer [8].

In western part of Maharashtra (Solapur, Sangli, Satara, Kolhapur, Pune districts) working bullocks (especially Khillari breed) are of 455-500 kg body weight. Powerful, excellent, medium-paced draught animals [5] are used for agriculture work like ploughing, sowing, transportation of agriculture products & by products at villages and used for transportation of sugarcane from agriculture field to sugar mills during sugarcane crushing season. Large number of bullocks are used for transportation of sugarcane in the district of Solapur, Satara, Sangli and Kolhapur. This season is generally from November to April/May (6-7 months' period) every year. In village's bullocks mostly depend on sorghum straws (Kadbi) and at sugar mills, completely depend on sugarcane tops. Generally, no other feed materials are offered to bullocks other than kadbi and sugarcane tops which is inadequate in terms of balanced ration. However, Draught and Pack Animal Rules, 1965 [14] is in place and guidelines which protect them from hard work, over work etc. but animal owners, users violate such rules & regulation and put animals to hard work. Over loading, over working, work under scorching sun, carrying load on rough roads & undulated terrain, use of inappropriate equipment's, inadequate feed, dirty water etc. put these working

bullocks to suffer with many ailments viz. lameness (musculoskeletal problems), yoke gall, digestive disorders, ophthalmological disorders, respiratory tract infection etc. Lameness and yoke gall are directly related with carrying heavy load on uneven roads, undulated terrain & use of inappropriate equipment's; digestive disturbances directly related to feeding of inappropriate food and dirty water along with hard work. Bullock owners ignore at initial stages of problem, eventually leading to the worse condition such as chronic yoke gall, shoulder dislocation, weakness etc. Most of the ophthalmological problems are related to ignorance and unawareness of animal owners as they never clean the eyes of their animals while animals work in dusty environment, accidentally hitting of the eye with whip (this is quite common practice for a bullock owner to have the whip in their hands to control the bullocks). The aim of present study is to determine commonly encountered diseases by Animal Rahat teams in working bullock in Western Maharashtra and also emphasise that diseases of higher prevalence are encountered more in hard working season viz. sugarcane crushing season.

II. METHODOLOGY

Animal Rahat, an animal welfare organisation provides free treatment services to working bullocks and other needy animals in area of Solapur, Satara and Sangli & Kolhapur districts of Maharashtra. These services are available to 180 villages and 26 sugar factories of all four Animal Rahat intervention districts. On an average the population of bullocks is, 50 bullocks per village and at Sugar factories it varies from 500 to 1600 bullocks per factory in a season.

Animal Rahat records all cases in their specified treatment register and these data's are being converted to soft and analysed on monthly and yearly basis. For present study, treatment data of last five years i.e. from April 2015 to March 2020 are collated and analysed. Distribution of diseases are analysed against total number of affected animals encountered every year and over the period of five years. These data are also analysed on monthly basis to find out, which month has the higher prevalence of the affected animals are encountered.

III. RESULTS AND DISCUSSION

Among working animals, bovid experiences considerable suffering as they work for approx. 200 days in a year as are being predominantly used in agriculture operations [8] and during non-working days they do not get adequate feed in terms of quantity and quality, eventually die due to under or malnourishment and diseases [13]. Over work can also be significant with seasonal activities and that is why more number of lameness cases were reported during sugarcane

crushing seasons in western Maharashtra. India is a country where certain animal species are worshipped, the situation of draught animals is unsatisfactory. However, bullocks may still not be treated well [8]. The castrated male cattle over three year of age are used as draught animals –classified as 'animals for work'. Un-castrated bulls and buffaloes are also used for draught purpose. In most part of the country only male bovine is used for draught purposes [5].

Lameness is one of the most common welfare issues in cattle with significant impact on working strength and longevity [4]. Every year 32-36 percent of affected animals are reported with lameness against total cases reported which is highest among all ailments. Lameness includes all the animals who exhibit limping and most of them are encountered with involvement of joints (shoulder dislocation, capped knee, capped elbow, arthritis etc.), involvement of muscle, ligament & tendons (blunt traumatic injuries, cutting of ligaments, tendon, stiffness of muscles etc.) and bones (simple, compound fracture).

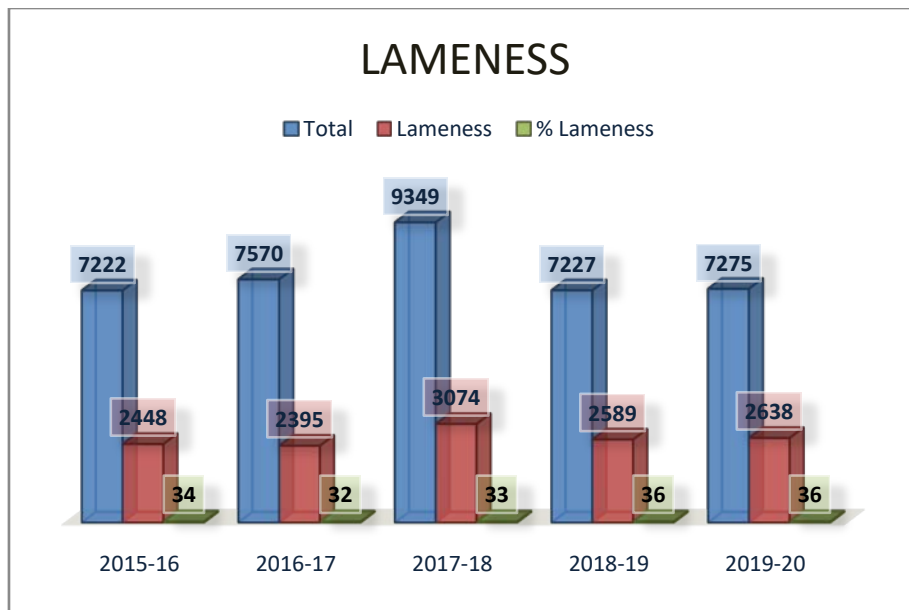


Fig. 1: Lame animals against total number of ailing animals reported in each year

Over stretching of animal's physical activity above their physiological capacity result into muscle fatigue.[6] Sugarcane crushing season generally from November to April/ May every year and peak of

sugarcane crushing season is December to January which shows highest number of lameness cases every year regardless of number of bullocks.

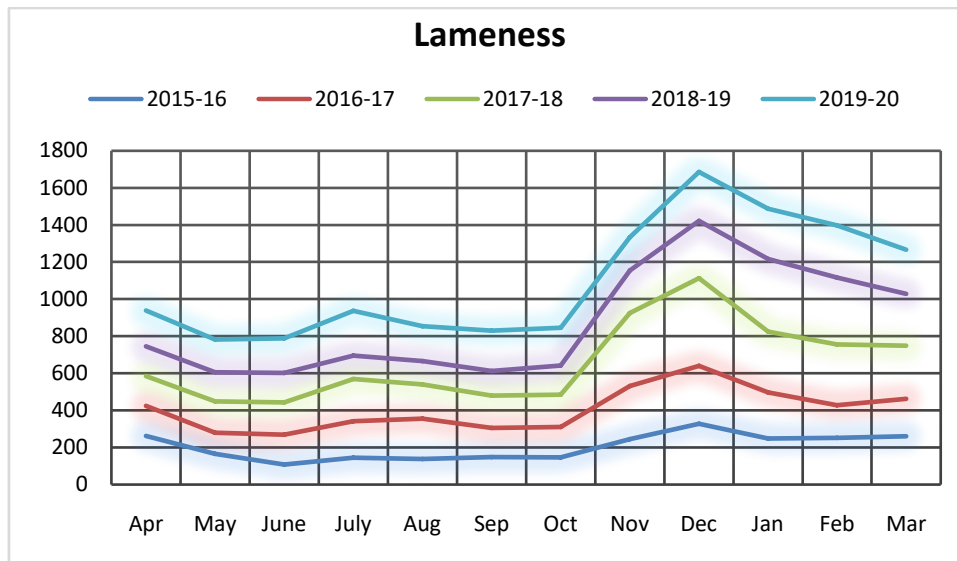


Fig. 2: Lame animals depicted month wise in each year

Lameness is the clinical manifestation of a range of painful locomotor conditions which have serious consequences for animal welfare, productivity, longevity and simultaneously prevention & treatment of lameness receive insufficient attention by animal owners [3].

Wounds cases are the second most prevalent issue in working bullocks. Every year 25-28 percent of ailing animals are reported with wounds, which is second highest among all the reported ailments.

Wounds include, any breach in skin and injuries to horns of bullocks. These wound cases ranges from minor (abrasions, scratches, cracks etc.) wounds due to continuous touching of bullocks with carts or blunts objects, or any type of trauma etc. to major(deep wound, cutting of muscles, ligaments, tendon etc.) wound due to cutting by sharp objects, falling down of animal on ground while carrying load etc. Horn injuries involves crack on horn, horn fracture, horn avulsion etc.[12].

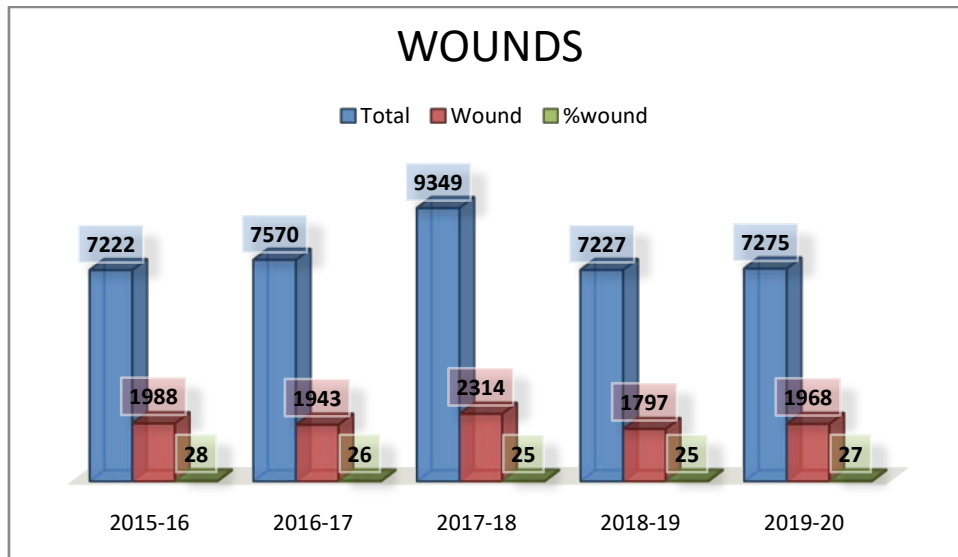


Fig. 3: Number of animals affected with wounds against total number of ailing animals in each year

Digestive system related disorders are the third most prevalent health issues of the working bullocks in study area. Every year 17-23 percent of ailing animals are reported with digestive system related disorders, which is third highest among all the reported ailments. These involve simple indigestion, enteritis, tympany or bloat, acidic indigestion, colic and traumatic reticuloperitonitis (TRP) etc. Simple indigestion, enteritis, tympany, acidic indigestion, colic is caused by sudden change in feed generally and offering water in dirty water troughs [11] etc. All of this is caused due to ignorance of animal

owners towards their bullocks and unawareness amongst bullock owners. In study area, working bullocks mostly depend on dry fodder, sorghum straw (*kadbi*) which do not fulfil their nutritional requirements. During sugarcane crushing season, bullock mainly depend on sugarcane tops and along with a little quantity of oil cakes. Continuous feeding of sugarcane tops which contain high oxalate [9] make animals prone to diseases like oxalate poisoning and calcium deficiency [7].

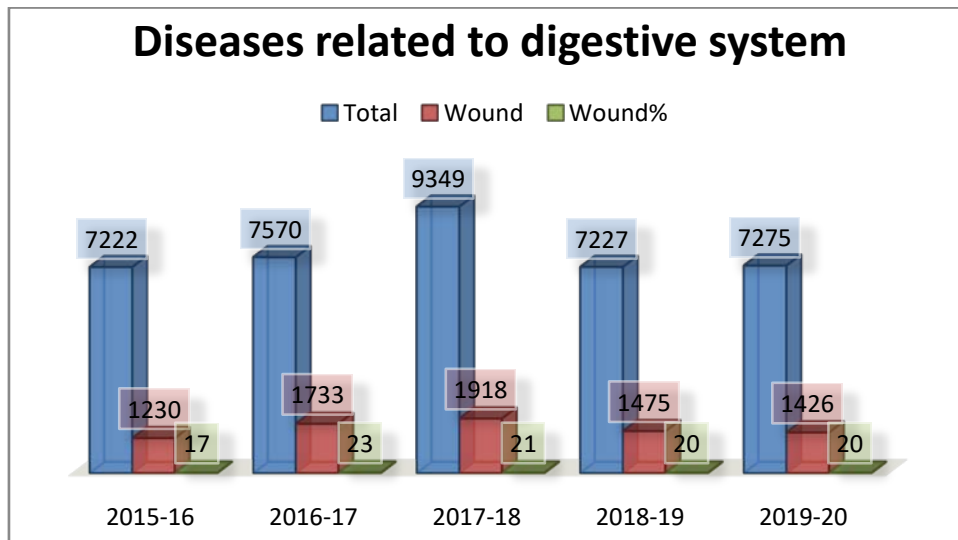


Fig. 4: Diseases related to digestive system against total cases in each year

Ophthalmological disorders are the fourth most prevalent health issues of working bullocks in study area. Every year 5-7 percent of ailing animals are reported with ophthalmological disorders, which is fourth highest amongst all the reported ailments. Ophthalmological disorders include corneal ulcers,

conjunctivitis, perforations, corneal opacity, squamous cell carcinoma etc. Corneal ulcers, conjunctivitis cases are mostly due to ignorance of animal owners, they never clean the eye of their animals even though the bullocks work in dusty environment on daily basis and other important cause is accidentally hitting the eye with

the whip, as animal owner use the whip to control the animals. Squamous cell carcinoma of eye is the another disorder of Khillari bullocks in the study area as squamous cell carcinoma is common cancer in cattle [1] due to direct exposure of actinic rays with high

temperature during working time in study area. Study on prevalence of eye diseases [2] reported more number of ophthalmological disorders in male animals as their involvement in field work is more common and hence they are vulnerable to trauma, accident, eye injury etc.

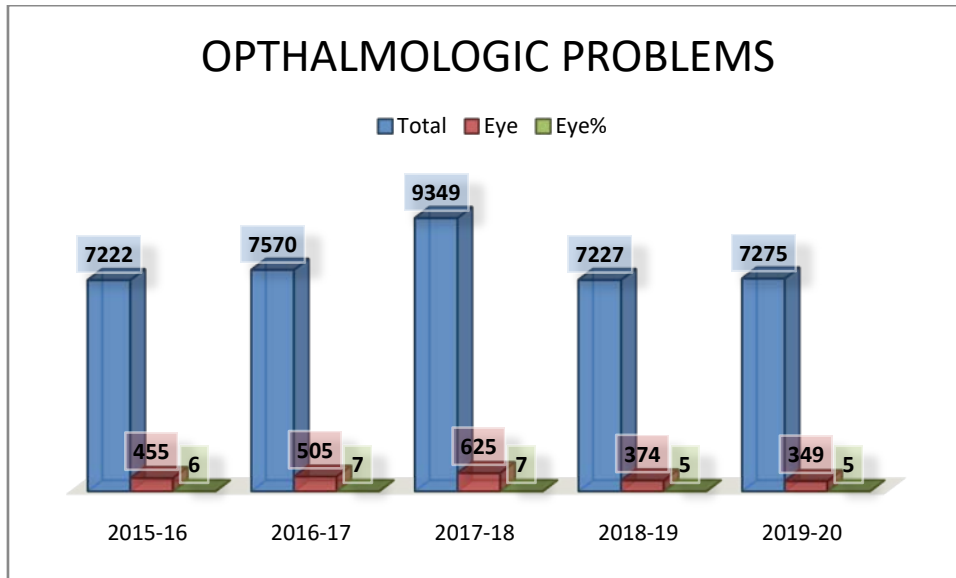


Fig. 5: Number of ophthalmological disorders against total number of ailments in each year

Yoke gall is the fifth most prevalent health issues in the working bullocks of study area. Every year 4-7 percent of ailing animals are reported with yoke gall, which is fifth highest amongst all the reported ailments. A yoke gall is a localized acute inflammation of the skin and subcutis on the neck of cattle due to constant friction caused by the yoke and most common abscesses observed in draught purpose bullocks and buffalo bulls. Rough, ill-fitting yokes [8] rough roads, extra heavy

loads [10] and jerk to neck muscles while carrying load are the main incriminating factor for yoke gall.

This is quite painful condition and at initial stages, animal owners do not provide rest to the animal, hence simple swelling converts into big size of painful abscesses and further gets converted into fibrous mass if not treated and not given rest to animals. Generally, bullock owners do not provide rest to animals at initial stage of this condition due to ignorance or greediness.

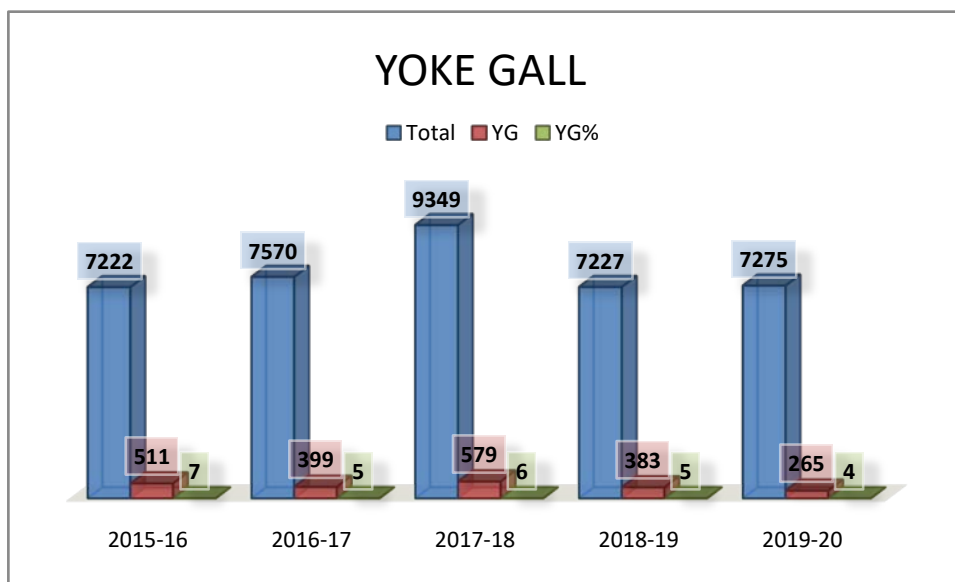


Fig. 6: Number of animals affected with yoke gall against total number of ailing animals in each year

Overloading, jerk while carrying heavy load on rough road & undulated terrain, over working (no rest), use of ill fitted equipment (rough surface of wooden yoke) etc. are the main cause of yoke gall and these situations are encountered mostly during sugar cane

crushing season which is generally from November to March- April every year. More number of cases yoke gall during these months from November to April are indicates that bullocks suffer most during sugar cane crushing season.

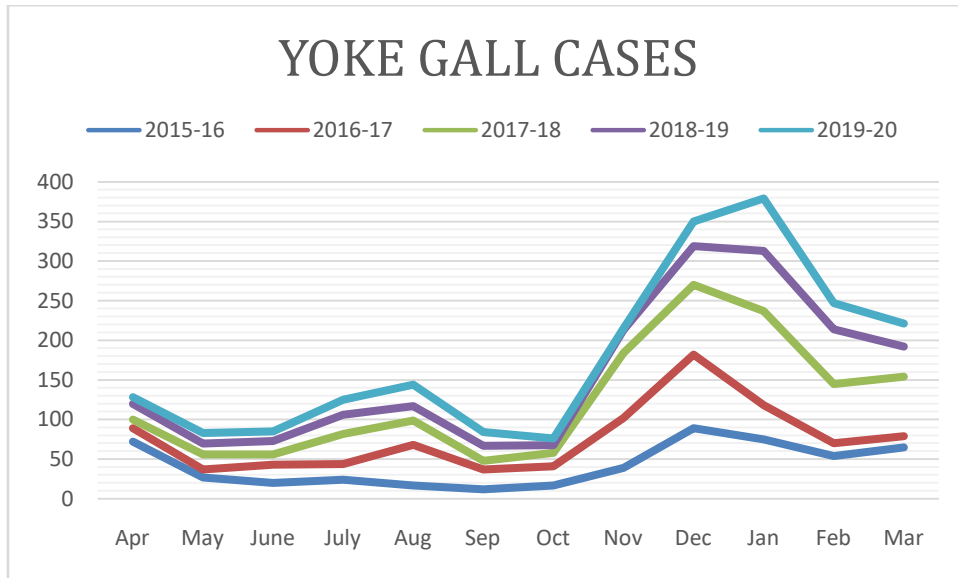


Fig. 7: Number of animals affected with yoke gall depicted month wise in each year

Other disorders include swellings, pyrexia of unknown origin (PUO) and respiratory disorders which are 2-5 percent of the reported ailing animals against total number of reported ailments each year. Swelling includes abscesses, hematomas, hernia etc. PUO might

be due to viral and protozoal infections. Respiratory disorder mostly includes upper respiratory tract of animals with seldom involvement of lower respiratory tract in working bullocks.

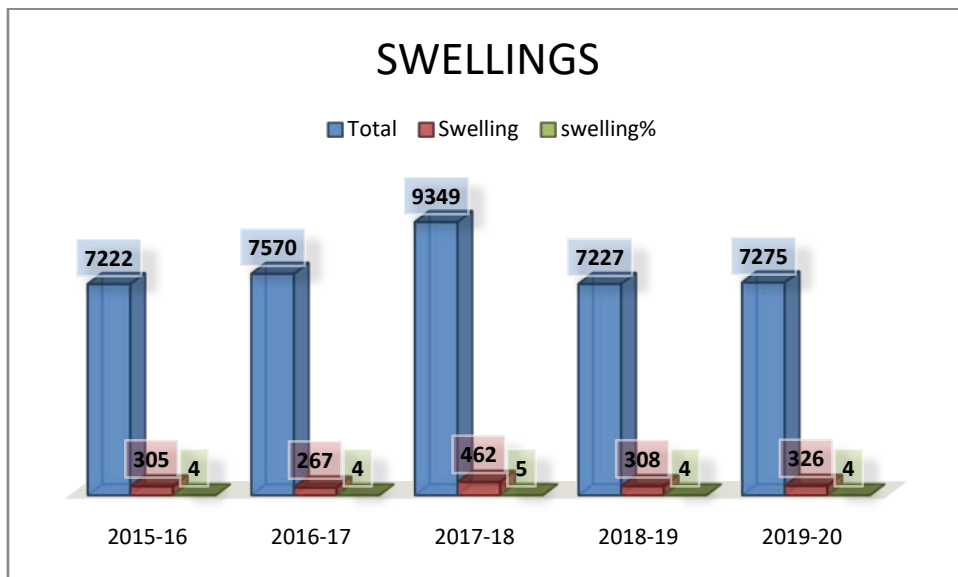


Fig. 8: Number of animals affected with swelling against total number of ailing animals in each year

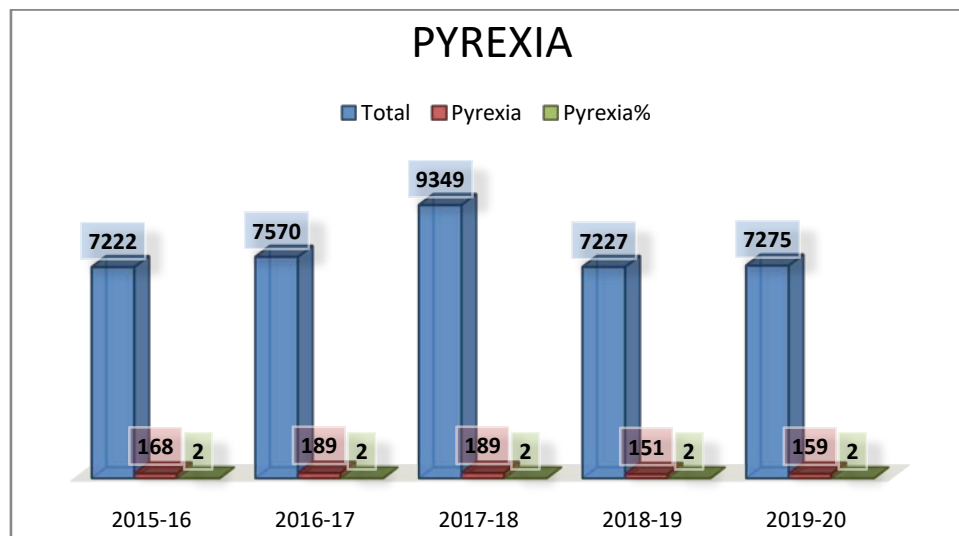


Fig. 9: Number of animals affected with PUO against total number of ailing animals in each year

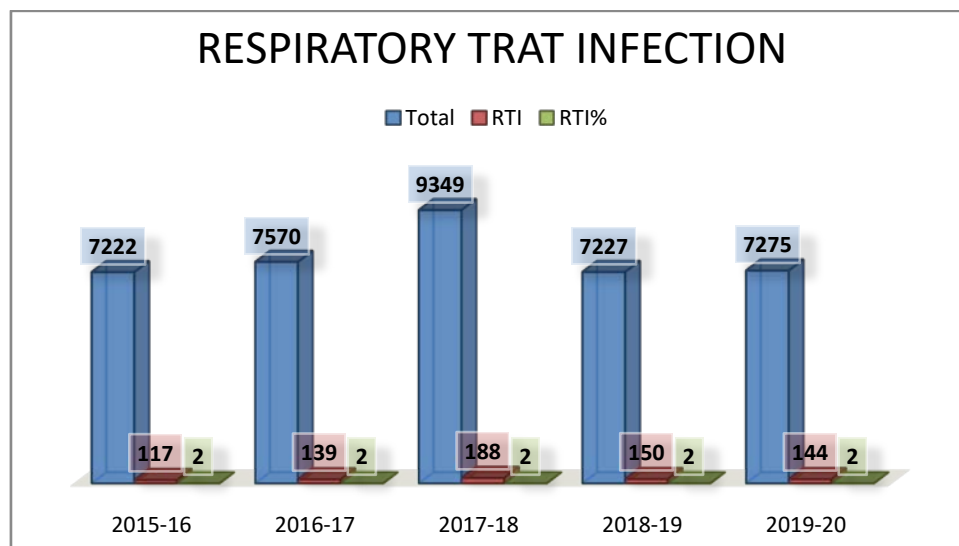


Fig. 10: Number of animals affected with ailment related to respiratory system against total number of ailing animals in each year

IV. CONCLUSION

Working bullocks suffer with many diseases, mostly with musculoskeletal problems which also increases during hard working season. Over work, over load, inadequate & inappropriate feed, ignorance, unawareness, use of sharp nails to prevent bullocks from balancing their loads and greediness are the main causes of ailments in working bullocks.

Conflict of Interest

No conflicts of interest have been declared.

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available all required resources including the treatment data of last five years.

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Reaction of Detached Fruits From Selected Cocoa Clones To Artificial Inoculation With *Phytophthora Palmivora*

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Keywords: *black pod rot, theobroma cacao, genetic resistance.*

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Reaccion a la Inoculacion Artificial Con *Phytophthora Palmivora* de Frutos Desprendidos de Clones de Cacao Seleccionados

Eleonora Rodriguez Polanco ^α, Martha Liliana Carrero G ^σ, Edinson Bayardo Parra A ^ρ
& Jose Dimas Segura A ^ω

Abstract- Black pod rot (BPR) caused by several species of the genus *Phytophthora*, is one of the most limiting diseases for the production of cocoa as it appears in all of the producing regions of the world and generates significant losses. The aim of this study was to establish the response to infection in six cocoa clones, EET8, IMC67, TSH565, PA46, ICS95, and CCN51, through the detached fruits inoculation test using five *P. palmivora* isolates from five producing regions. The incidence and severity of the disease in the detached pods were evaluated at six and ten days after inoculation (DAI). Clone CCN51 was classified as susceptible, and clones IMC67 and PA46 as moderately susceptible at six DAI. All the clones evaluated were categorized as susceptible at ten DAI. The HURV19 isolates of *P. palmivora* showed the highest aggressiveness compared to ANYA228, which was found to be the least aggressive.

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I. INTRODUCTION

In Colombia, there are about 175,000 hectares cultivated with cacao trees that produce 60,535 t of cocoa (Fedecacao, 2017). Losses caused by fungal diseases, especially by *Monilia* (*Moniliophthora roreri* (Cif.)), are higher than 40% (Rodriguez, 2006; Tirado et al., 2016). Furthermore, the black pod rot (BPR) of cacao (*Theobroma cacao* L.) caused by several species of *Phytophthora* is one of the most limiting diseases for the production of cocoa and is present in all the cacao-producing regions worldwide (Cilas & Despreaux, 2004). Different species of this oomycete have been reported to cause significant losses, e.g., *Phytophthora capsici* Leonian, can cause yield losses of up to 10%, *Phytophthora palmivora* Butler, can be responsible for up to 30% of the losses (Tahi et al., 2006b), mean while *Phytophthora megakarya* Brasier and Griffin, can cause up to 80% of the losses (Mfegue et al. 2012). Therefore, *P. megakarya*, which is endemic to Africa, is considered the most aggressive *Phytophthora* species that attacks

cacao plants causing BPR throughout the world (Tahi et al., 2006). *P. palmivora* is currently present in all continents where cacao is produced, contrary to *P. capsici* that has only been found in the Americas (Bowers et al., 2001). These two species can attack many other tropical plants; however, the only known host for *P. megakarya* is cacao. In Colombia, only *P. palmivora* has been reported as the causal agent of BPR disease in cacao (Rodriguez & Vera, 2015).

Promotion of cocoa crops in the country started in the year 2000, leading to an increase of newly planted areas at altitudes above 800 meters above the sea level (masl), where lower temperatures prevail, favoring the development of the BPR disease. With these favorable edaphoclimatic conditions, BPR exceeds in importance and economic losses diseases caused by *Monilia*, and positions *P. Palmivora* as the main pathogen for cocoa production in these areas (Rodriguez & Vera, 2015). This situation, together with an increase in the use of the highly susceptible cacao genotype CCN51 to BPR when establishing new plantations, increased production losses up to 25% caused by *P. palmivora*, while *Monilia* (*Moniliophthora roreli* (Cif.)) only caused up to 4.2% losses (Rodriguez & Vera, 2015; Ramirez, 2016).

Traditionally, BPR management strategies have been based mainly on cultural practices, such as phytosanitary pruning and early elimination of diseased fruits. These are efficient and potential control methods that seem to be less expensive and environmentally sustainable compared to the application of chemical products (Ndoumbe et al., 2004; Djocgoue et al., 2006). Although the use of copper-based fungicides has been effective in reducing the level of *Phytophthora* infection, the high cost of these products makes them in many cases inaccessible for small farmers that produce more than 50% of the cocoa around the world (Oliveira & Newman, 2005). Further, biological control is another alternative explored (Deberdt et al., 2008).

Due to the considerable decrease in crop yield caused by the attack of different species of *Phytophthora*, genetic resistance is considered as the

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most economical and effective alternative for the control of *Phytophthora* sp. (Surujdeo et al., 2001). The genetic cocoa improvement programs are commonly oriented to get resistant cultivars to diseases that allow better crop quality and productivity (Dias, 2001; Phillips-Mora et al. 2012). Different methods for assessing the degree of genetic resistance in cocoa planting materials, include observation of yield in the field under of natural infection conditions and artificial inoculation in fruits and leaves have been tested and adopted (Blaha, 1974; Nyassé et al., 1995; Iwaro et al., 1997; Saul Mora et al., 2003).

The reliability of artificial inoculation tests depends on their correlation with the resistance rates observed in the field (Amponsah & Asare-Nyako, 1973; Nyassé, 1997). Therefore, a significant and positive correlation between artificial inoculation results of fruits and total incidence of BPR in the field (including ripe and immature fruits), indicates that artificial inoculation of attached and detached fruits is a reliable method to evaluate resistance to the BPR disease (Pokou et al., 2008).

However, correlations with field resistance were not always significant, suggesting the influence of uncontrolled environmental factors affecting field observations or results in screening tests (Efombagn et al., 2011). These authors concluded that, if leaf disc and detached pod tests are applied under standardized conditions, these can be of great value to speed up the selection of cacao clones resistant to BPR.

Studies on the genetic control of cocoa resistance to three species of *Phytophthora* (*P. palmivora*, *P. megakarya*, and *P. capsici*) have shown QTLs located in many genomic regions (Flament et al., 2001; Lanaud et al., 2009), with some of these, common to the three *Phytophthora* species. This situation offers the possibility of improving resistance in cocoa by a possible accumulation of many different resistance genes located in different chromosome regions using marker-assisted selection. Nyadanu et al. (2013) reported that insoluble sugar, flavonoid, tannin, and lignin were the most reliable biochemical factors that can be used as marker traits to screen and select for resistance to the BPR disease of cocoa. The expression of resistance in the host is observed as a decrease in the rate of disease development since one or more stages are delayed or completely blocked. Each resistance factor that plays a role in a step of the life cycle of the pathogen may be considered as a horizontal resistance component (Vanderplank, 1966).

According to what was mentioned above, the aim of this study was to establish the response of detached fruits from six cocoa clones to the artificial inoculation with five isolates of *P. palmivora*. Besides, discuss the degree of resistance in the materials evaluated.

II. MATERIALS AND METHODS

Two artificial inoculation experiments of cacao fruits were carried out in the Laboratory of Phytopathology at the Nataima Research Center (C.I. Nataima) of AGROSAVIA, located in the municipality of Espinal, Tolima, Colombia. The center is located in the following geographic coordinates: 40° 12' Latitude N, and 74° 56' Longitude W, at an altitude of 430 m.a.s.l. The laboratory had an average temperature of 22 °C and relative humidity of 70%.

a) *Phytophthora palmivora* isolates

Five isolates of *P. palmivora* were selected from the C.I. Nataima collection, obtained from different cacao producing regions of Colombia (Table 1). The isolates used were selected for showing the highest levels of aggressiveness in screening tests, previously performed on detached fruits of clone IMC67.

Isolates were previously characterized by colony morphology (texture, aerial development of mycelia and color) and biometric characteristics of sporangia and chlamydospores (length, width, and length/width ratio of sporangia, diameter of chlamydospores, length of the pedicel and presence or absence of papilla and chlamydospores, and sporangia dehiscence). The identification of the isolates was supported using molecular markers (ITS4, ITS6, and COX). Isolates were conserved in Eppendorf tubes with sterile distilled water at 10°C. These were reactivated on cacao fruits of the cacao clone IMC67 to minimize any epigenetic influence on the virulence of the pathogen. Besides, the environment in which the experiments were conducted was maintained constant with a relative humidity of 90% and a temperature of 28 °C, to standardize the environmental influence on the virulence of the pathogen.

b) Plant material

Healthy fruits were obtained from commercial cacao plantations located in Palocabildo, department of Tolima, Colombia, where two-month-old fruits were bagged to avoid infection in the field. Once fruits reached an age of 4.5 months, they were cut and taken to the laboratory for artificial inoculation with *P. palmivora*. Cacao fruits of clones CCN51, ICS95, EET8, TSH565, PA46, and IMC67, were used. The cacao clones selected for this study represent the two major types of cacao planted in most cacao-growing regions of Colombia, i.e., PA46 (cluster marañon-PA series) and IMC67 (cluster Iquitos-IMC series) (Motamayor et al., 2008), and Trinitarian (CCN51, ICS95, EET8, and TSH565). Clone PA46 was used as a resistant control (R) and clone CCN51 as a susceptible control (S) (Iwaro et al., 2003; Phillips-Mora et al. 2012).

c) *Inoculation of fruits and resistance reaction qualification*

Ten fruits of approximately 4.5 months old from each of the clones selected were inoculated with a suspension of 1.5×10^5 zoospores mL⁻¹ from Petri dishes with 12-day-old cultures with each of the isolates selected, impregnated in two discs of filter paper of 0.5 cm of diameter and placed at equidistant points in the equatorial zone of the cacao pod. Fruits inoculated with sterile distilled water corresponded to the absolute control treatment (Phillips-Mora et al. 2012; Rodríguez et al., 2015). Subsequently, the fruits were incubated individually in a humid chamber (airtight plastic bag with a paper towel moistened with sterile distilled water) at 28 °C. Subsequently, six and ten days after inoculation (DAI), the incidence, i.e., the presence or absence of injuries, and the severity, measured as the average lesion diameter (ALD) obtained from two perpendicular sides of the pod, were evaluated. With the ALD, the response to the infection in each clone was made, and the degree of genetic resistance was graded according to the scales published by Phillips-Mora & Galindo (1989) (Table 2). The level of aggressiveness of the isolates was also established according to the diameter of the lesion in the clones evaluated.

d) *Expression and development period of BPR symptoms in cacao*

The periods of symptom expression of *P. palmivora* were identified in an artificial inoculation experiment established in the field in an experimental plot in La Isla (C.I. La Suiza, department of Santander, Colombia). Growing cacao fruits of approximately one and a half months selected from clone ICS39, ICS40, ICS60, and ICS95 were bagged in order to guarantee their health until they reached an age of approximately 4.5 months. Subsequently, 10 fruits of each of the clones were artificially inoculated with a suspension of 1.5×10^5 zoospores mL⁻¹, as described above. The absolute control consisted of inoculation with sterile distilled water. Observations were made every 24 hours from the moment inoculation was performed until symptom onset time was recorded. Then, these were categorized according to their development as necrotic points (first symptoms), evident spots (≥ 2 cm in diameter), presence of mycelium (white mycelium), and sporulation (formation of sporangia). In this trial, the *P. palmivora* isolate SAR10189 was used due to its high level of aggressiveness that was previously established.

e) *Statistical design and analysis*

Fruit inoculation and symptom observation: Two independent experiments were carried out in a completely randomized design (CRD) with six clones and five isolates to evaluate the average lesion diameter (ALD), with ten repetitions per treatment. Data from ADL of the two experiments were combined after establishing

homogeneity of the variance using Cochran's test (Gomez & Gomez, 1983), normality of the residuals employing Shapiro-Wilk's test, and homogeneity of the variances using Levene's test. ALD data were subjected to a two-way variance analysis with clone and isolate as factors, to assess the significance of the treatment effect and the interaction between treatments; the means were compared by the *t*-test ($p \leq 0.05$) using the InfoStat software (2009).

f) *Periods of expression and development of BPR symptoms*

This experiment was carried out using a completely randomized design with ten repetitions per treatment. The data were assessed using an analysis of variance (ANOVA). The normality of the residuals and the homogeneity of the variances were verified employing Shapiro-Wilk and Levene's tests, respectively. ALD data were subjected to an analysis of variance, and the treatment means were compared by the *t*-test ($p \leq 0.05$) using the InfoStat software (2009).

III. RESULTS

a) *Fruit inoculation, resistance evaluation and virulence reaction of isolates*

Analysis of variance of ADL was significantly ($p \leq 0.001$) influenced by cacao genotypes and *P. palmivora* isolates. Host genotype x isolate interaction effects were, however, not significant ($p \leq 0.005$), Table 3.

Results of artificial inoculation in detached cacao pods showed significant differences ($p \leq 0.05$) in the lesion size for the clones evaluated at 6 DAI (Table 4). The CCN51 clone showed the highest significant value in lesion size and was superior in 46.08% and 46.39% when compared to clones IMC 67 and PA 46, respectively. Clone CCN51 was classified as susceptible (S), and clones PA 46 and IMC 67 were classified as moderately susceptible (MS). Clones ICS95, EET8, and TSH565 did not show significant differences between them and were classified as susceptible (S) according to their response to infection. In all clones, incidence reached a value of 100% (Table 4).

Results of the analysis of variance of artificial inoculation in detached cacao pods indicated significant statistical differences ($p \leq 0.05$) in the size of the lesion for clones evaluated at 10 DAI (Table 4). Clones CCN51, ICS95, and EET8 showed the highest values with 21.86 cm, 19.29 cm, and 19.25 cm, respectively, and were statistically similar between them ($p \leq 0.05$). The lowest values for lesion size corresponded to clones TSH565, IMC67, and PA46 with averages of 15.30 cm, 13.95 cm, and 13.25 cm, respectively. All clones tested reached values higher than 12 cm in lesion size, so they were classified as susceptible (S) (Phillips-Mora et al. 2012).

b) Aggressiveness of *P. palmivora* isolates

The aggressiveness variability of *P. palmivora* isolates was established as the average size of the lesion measured in two perpendicular directions of the cacao pod in five clones evaluated at six DAI. Significant differences ($p \leq 0.05$) were found among the five isolates used (Table 5). The most aggressive isolate corresponded to HURV19 with a value of 13.79 cm and was higher in 45.98% compared to ANYA228, which exhibited the lowest aggressiveness amongst all isolates evaluated. Isolates SARIO189 and ARAR153 did not show significant differences between them, with lesion size values of 10.84 and 12.11 cm, respectively, showing an intermediate behavior in aggressiveness (Table 5).

c) Periods of expression and development of *P. palmivora* symptoms

Symptom development indicated that, on average, the clones inoculated showed the first symptoms (necrotic points) in the inoculation zone at 2.7 DAI. Necrotic spots appeared at 5.2 DAI and increased in size as the infection process in the cortex tissue progressed until the appearance of mycelia at 7.1 DAI. Finally, the formation of sporangia occurred at 8.8 DAI (Table 6). Clone ICS95 had the pathogen isolate with the shortest periods of symptom expression that, on average, lasted 8 days until sporulation. The opposite behavior was observed in clone ICS39, where *P. palmivora* required 9.6 DAI for the formation of reproductive structures. In all inoculated clones, the incidence of *P. palmivora* was 100% at 6 DAI.

IV. DISCUSSION

Disease symptoms were observed in cacao pods of all genotypes inoculated with *P. palmivora* at 6 DAI, showing that none of them were immune to the pathogen. This indicates the existence of variation in the reaction of the evaluated plant material, suggesting that in this pathosystem, there is a resistance gradient, quantitative resistance, or that it is a non-specific race, as has been indicated in previous studies (Blaha, 1974; Surujdeo et al., 2001; Legavre, 2015). This type of resistance is controlled by many genes that interact delaying the development of the pathogen, and its multigene character makes it more challenging to overcome (Eulgem, 2005).

This study showed a different response to infection in the clones, which can provide evidence of the existence of quantitative resistance or a non-specific race of *P. palmivora* in cocoa. Symptoms of the disease were observed in all genotypes inoculated with each of the five isolates of *P. palmivora* collected in geographically distant cacao-producing regions in the country. These experiments indicate that resistance is expressed with similar patterns, although with different

values when pods are inoculated with each of the five isolates of *P. palmivora*.

Lesion size values obtained indicated significant differences ($p \leq 0.05$), confirming the differentiated response of each cacao genotype to infection by *P. palmivora* (Table 3). A broad genetic variation for resistance to BPR has been reported in cacao by Iwaro et al. (1997), Tahí et al. (2006), and Nyadanu et al. (2009). Previous studies indicated that six days of incubation are not enough to accurately separate resistant from susceptible genotypes, whereas after ten days, the lesion size (LS) observed in each fruit tends to stabilize (Phillips-Mora & Galindo, 1989). The melon-shaped genotype PA46 showed the smallest lesion size, and this agrees with the fact that resistance to BPR has been found predominantly associated with high Amazonian Forastero genotypes (Tahí et al., 1999; Bartley, 2005). Among these, SCA6, PA150, and P7 have shown lower susceptibility to the pathogen, and some lower Amazonian Forasteros (*amelonado* or melon-shaped) are included in this group. In general, Trinitarian materials are considered more susceptible to the BPR disease (Paulin et al., 2008), as was confirmed with the genotypes evaluated in this study, with the Trinitarian genotype CCN51, exhibiting the highest lesion values size, followed by ICS95, EET8, and TSH565 (Table 4). This observation agrees with previous research reports, where this material has been classified as highly susceptible in several regions in Colombia (Phillips-Mora & Galindo, 1989; Rodríguez et al., 2015; Ramirez, 2016). Iwaro et al. (1997) estimated that 90% of the known commercial cacao genotypes are susceptible to this disease. In fact, clone CCN51 may be used as a control in tests that involve the evaluation of resistance to black pod rot in cacao genotypes (Lisboa et al., 2011).

As mentioned, genotype ICS95 was the most susceptible after CCN51. Moreover, the values obtained coincided with the observation of the life cycle of *P. palmivora* in the field, where this genotype showed the lowest duration value for the infection stages, with 1.6 days less compared to genotype ICS39, which showed the most extended infection period.

A decrease in the life cycle of the pathogen may indicate the expression of some level of resistance, as one or more stages are delayed or completely blocked. Each of several factors that reflect specific affectation of a step in the life cycle of a pathogen may be considered as a component of horizontal resistance (Vanderplank, 1966). Horizontal or quantitative resistance is based on four fundamental actions: resistance to penetration, resistance to pathogen growth, resistance to sporulation, and resistance to lesion growth (Vanderplank, 1982).

This study identified a significant variation ($p \leq 0.05$) in the aggressiveness of *P. palmivora* isolates in Colombia, with a difference of 45.98% in the ALD

between the more aggressive (HURV19) and the less aggressive (ANYA228) isolates. Under semi-controlled experimental conditions in which this study was conducted, this variation may be attributed predominantly to genetic causes. According to Agrios (2005), the development of the disease is a function of the host, the pathogen, and the environment. In the current study, the selection of fruits was performed in the same development stage, and plants were grown under similar environmental conditions, minimizing the influence of environmental factors. The fact that there was no interaction between the isolate and the cacao genotype is vital in the creation of quantitative resistance to *P. palmivora*. In this sense, this characteristic allows the identification of different levels of resistance in cacao genotypes using any isolate. However, as pathogen population may be highly variable in aggressiveness as observed in our work, the use of several isolates that may reflect the population variability is highly recommended and, thus, the identification of more significant levels of resistance against this pathogen.

Furthermore, if the resistance level present in a genotype is consistent in all the evaluations with several isolates in different regions of the world, the varieties created with this resistance to *P. palmivora* in one location would also express resistance in another location (Surujdeo et al., 2001). Indeed, some similarities have been observed in the classification of cacao genotypes for resistance to *P. palmivora* and *P. megakarya* in Cameroon, Ivory Coast, and Togo; where the Trinitario parents were generally more susceptible to the disease, lower Amazon (LA) and some upper Amazon (UA) *amelonado* type parents, such as Sca 6, P 7, Pa 150 or T85/799 should help develop less susceptible cultivars (Nyasse et al., 2007). A significant difference ($p < 0.05$) was also observed among clones for pod resistance to pathogen invasion based on lesion size. Relatively smaller lesions were recorded for SCA 6 and ICS 95. Lesion sizes for ICS 6, ICS 40, ICS 84, SCA 12, and PA 46 were moderate, whereas relatively large lesions were produced on other clones (Iwaro et al., 1997).

Development and refining of the artificial inoculation method of detached cacao fruits for the identification and characterization of the level of resistance to black pod rot has shown respectability and reliability, finding a positive correlation between the data obtained with the test on detached pods and natural infection in the field (Iwaro et al., 1997; Tahi et al., 1999). Early resistance detection methods using detached leaves and pod segments have correlated well with observations of BPR disease incidence and severity in the field, so they are currently used to evaluate segregating progenies, to detect and discard highly susceptible materials (Iwaro et al., 1997; Iwaro et al., 2005). The use of these methods allows rapid and

early evaluation of resistance levels of a large number of materials. The percentage of mature fruits infected in the field is determined not only by the resistance of the fruit to the infection, but also by escape phenomena, such as the fructification cycle (production outside the main epidemic period) and fructification intensity (Cilas & Despréaux 2004). The fructification cycle usually explains about 43% of the variation in infection level (Kébé et al., 1996), and the use of an artificial inoculation technique in detached fruits may allow reducing this difficulty and reflect variation in the genetic resistance of cacao tissue to infection, as the main parameter.

The existence of polygenic or quantitative resistance to different species of *Phytophthora* in cacao indicates that this can be used for genetic improvement by recurrent selection processes (Nyassé et al., 2007), where the search for resistance to *Phytophthora* sp. should be expanded. This expansion should include selected genotypes in regions with high disease pressure and early detection of resistant progenies using artificial inoculation methods. Recent molecular studies on the genetic regulation of resistance in *Theobroma cacao* to three species of *Phytophthora* (*P. palmivora*, *P. megakarya*, and *P. capsici*) have shown that quantitative trait loci (QTLs) are located in many genomic regions (Flament et al., 2001; Lanaud et al., 2009) and some of them are common to all three *Phytophthora* species.

This situation offers the possibility of improving resistance to *Phytophthora* in cacao through a possible accumulation of many diverse resistance genes located in different chromosomal regions through the marker-assisted selection and rapid selection methods (Legavre et al., 2015).

V. CONCLUSIONS

The use of an early detection method for resistance allowed identifying PA 46 as a tolerant clone to the BPR disease; this suggests the possibility of selecting genotypes with durable resistance to the pathogen, allowing the use of these materials in breeding programs in search of resistance to *Phytophthora* sp.

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Table 1: *Phytophthora palmivora* isolates collected from different cacao producing regions and materials of Colombia in 2014

Code	Origin	Host clone	masl	Sequence identity (ITS) Gen Bank		
				Species	%	Accession No.
TOVR 01	Tolima	TSH 565	1.111	<i>P. palmivora</i>	99	KF263691.1
HURV 19	Huila	TSH 565	734	<i>P. palmivora</i>	100	M650992.1
SARIO 189	Santander	ICS95	1.199	<i>P. palmivora</i>	99	LM650992.1
ANYA 228	Antioquia	Hibrido	908	<i>P. palmivora</i>	100	LM650992.1
ARAR 153	Arauca	CCN51	166	<i>P. palmivora</i>	99	KF263691.1

^[a]masl: meters above sea level

Table 2: Scale de reaction to BPR disease based on mean diameter of lesion (cm) causada por *P.palmivora* in cacao fruits (Phillips-Mora & Galindo, 1989)

Reaction	Mean diameter of the lesion (cm) ^[a]	
	6 days	10 days
Resistant (R)	0-2	0-3
Moderately resistant (MR)	2.1-4	3.1-6
Moderately susceptible (MS)	4.1-6	6.1-9
Susceptible (S)	>6	>12

^[a]Mean diameter of cacao pod lesion calculated from length and width measurements.

Table 3: Analysis of variance of severity levels in six cocoa clones (CCN 51, ICS 95, EET 8, TSH 565, IMC 67 and PA 46), six and ten days after inoculation (DAI) with five isolates (ANYA 228, SARIO 189, ARAR 153, TOVR 01 and HURV 19) of *Phytophthora palmivora*.

Days after inoculation	Sources of variation	df	SS	MS	F (p-values)
Six	Clones	5	476.76	79.46	12.12 (<0.0001)
	Isolates	4	66.48	33.24	5.07 (0.0091)
	Clones x isolates	20	113.55	9.46	1.44 (0.1705)
	Error	180			
Ten	Clones	5	1,004.19	167.36	11.87 (<0.0001)
	Isolates	4	117.02	58.51	4.15 (0.0072)
	Clones x isolates	20	332.65	27.72	1.97 (0.1201)
	Error	180			

Table 4: Reaction to BPR disease in detached fruits of six cocoa clones, six and ten days after artificial inoculation to *Phytophthora palmivora* (isolates ANYA 228, SARIO 189, ARAR 153, TOVRO1, HURV19). C.I. Nataima, Espinal, Tolima

Clone	6 DAI			10 DAI		
	Mean diameter of lesion (cm) ^[a]	Reaction of resistance/ Susceptibility ^[b]	Incidence(%)	Mean diameter of lesion (cm) ^[a]	Reaction of resistance/ susceptibility ^[b]	Incidence (%)
CCN 51	9.83 A	S	100	21.86 A	S	100
ICS 95	8.18 AB	S	100	19.29 A	S	100
EET 8	7.36 BC	S	100	19.25 A	S	100
TSH 565	6.67 BC	S	100	15.30 B	S	100
IMC 67	5.30 C	MS	100	13.95 B	S	100
PA 46	5.27 C	MS	100	13.25 B	S	100

^[a]Different letters in the same column represent significant differences identified by the Tukey test ($p \leq 0.05$).

^[b]S: susceptible, MS: moderately susceptible

Table 5: Virulence of selected isolate of *P. palmivora* in detached fruits of five cocoa clones (CCN51, ICS95, EET8, TSH 565, IMC 67, PA 46).C.I. Nataima, Espinal, Tolima.

Code of Isolate	Department of collection	Mean diameter of lesion (cm) ^[a]
ANYA 228	Antioquia	7.45 A
SARIO 189	Santander	10.84 B
ARAR 153	Arauca	12.11 B
TOVRO1	Tolima	12.6 C
HURV19	Huila	13.79 C

^[a]Different letters in the same column represent significant differences identified by the Tukey test ($p \leq 0.05$). Means were calculated from 10 independent measurements for each pod in five clones, six days after inoculation (DAI).

Table 6: Average number of days for the development of symptoms and signs in detached cacao fruits artificially inoculated with *Phytophthora palmivora* under field conditions (C.I. La Suiza, Rionegro, Santander)

* Clone	First symptoms (necrotic points)	Obvious spots (± 2 cm)	Appearance of mycelium	Sporulation
ICS 39	3.6	6.2	8	9.6
ICS 40	1.9	4.9	6.9	9.1
ICS 60	2.6	5.1	7.1	8.7
ICS 95	2.6	4.7	6.2	8.0
Mean	2.7	5.2	7.1	8.8

* 10 fruits per each clone. *P. palmivora* SARIO189 isolate.

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Handling and Management of Skin and Hide after Slaughtering in the Case of Rural and Urban Parts of SNNPR

By Endrias Dako Keshamo

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Abstract- This study was conducted on handling and management of skin and hide after slaughtering Wolaita zone and Kambata Tambaro zone of southern nation and nationalities people region. During survey time forty butchers/hotels, forty middlemen, twenty collectors and ten traders were identified and conducted the interview. The result showed that absence of flay cut, freshness, size and absence of dirty of the skin are major criteria for quality of hide and skin. Respondents from their experience ascertained that flay cuts, bone break on hide, blood and fresh remnant were among the major defects encountered during slaughtering process where as delay in selling and unstable market are also problems encountered after slaughtering of hide and skin. It can be concluded that during and after slaughter defects have main effect on the potential to downgrade the quality of hide and skins in the study areas. However, they can be minimized through continuous awareness creation and training and provision of more access to market.

Keywords: *hide, skin, post-slaughter, management.*

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Handling and Management of Skin and Hide after Slaughtering in the Case of Rural and Urban Parts of SNNPR

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Abstract- This study was conducted on handling and management of skin and hide after slaughtering Wolaita zone and Kambata Tambaro zone of southern nation and nationalities people region. During survey time forty butchers/hotels, forty middlemen, twenty collectors and ten traders were identified and conducted the interview. The result showed that absence of flay cut, freshness, size and absence of dirty of the skin are major criteria for quality of hide and skin. Respondents from their experience ascertained that flay cuts, bone break on hide, blood and fresh remnant were among the major defects encountered during slaughtering process where as delay in selling and unstable market are also problems encountered after slaughtering of hide and skin. It can be concluded that during and after slaughter defects have main effect on the potential to downgrade the quality of hide and skins in the study areas. However, they can be minimized through continuous awareness creation and training and provision of more access to market.

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I. INTRODUCTION

The livestock sector contributes 45% of agricultural GDP and 16 to 19% of the foreign exchange earnings of the country (Behnke and Metaferia, 2011). Furthermore, the country's foreign exchange from livestock product is increasing, with spiking trend for leather and meat products.. Skins and hides are the most valuable export item for the country other than coffee. The leather industry is one of the fastest-growing economic sectors in Ethiopia (Abadi, 2000; Bayou, 2007).

Ethiopia has 55.03 million cattle, 27.35 million sheep and 28.16 million of goats (CSA, 2014). This places the country as one of the richest countries in livestock resources. It has a huge potential for production of hide and skins. For instance, its potential was estimated at 3.78 million cattle hides, 8.41 million sheep skins and 8.42 million goatskins in 2012/13 (CSA, 2013). In Ethiopia, hides and skins contribute much to the export earnings from the livestock sector. In addition, it has a large contribution to the leather industry in the country. In 2002 hides and skins represent major source of foreign exchange earnings for the country accounting for 14-16% of the total export revenue (Zenaw & Mekonnen, 2012).

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Despite the availability of these physical resources, the leather sector contributes only marginally to the national economy so far. This could be mainly due to the presence of livestock disease and difficulties to meet international standards (CSA, 2011). Skin and hide quality is usually assessed by international standards of physicochemical tests, which are intended to guarantee leather quality and uniformity (Tsegay et al., 2012). Hide and skins are known to have varying physical and chemical properties and thus used for different purposes. Commodity trade patterns have changed during recent years and practical methods for evaluation and classification of skin are necessary (FAO, 2010).

According to the 1998/99 report of Ethiopia, the annual off take rate for cattle, sheep and goat was 7%, 33% and 35% respectively which is from the potential production of 3.1 million cattle hides, 7.8 million sheep skin and 8.2 million goat skin respectively (Bisrat G., 2013). Unfortunately this raw material of the leather industry is mainly from the local areas of the country where basic amenities for slaughtering and subsequent marketing are either not in existence or lacking.

The main constraints to increased utilization of hides and skins are low quality and lack of grading/selection of the raw hides and skins purchased. About 80% of the hides and skins in Ethiopia are produced in rural areas. (Mahamud A., 2000).

Hides and skins production in the southern region of Ethiopia are facing serious defects caused by improper skinning and handling (preservation) and also prolonged storage of untreated hides and skins at various points in its way to the tanneries. The loss to the national economy resulting, therefore, is immense unless a proper collection and prevention means is devised. Once hides and skins have been selected and purchased, every effort should be made to preserve their quality until the time comes for them to be tanned. Thus the objective of the study is to assess the handling and management of skin and hide after slaughtering and assess the postharvest loss of skin and hide.

a) Objectives of the study

i. General objective

- To assess the handling and management of skin and hide after slaughtering in the case of rural and urban part of SNNPR

ii. *Specific Objectives*

- To identify skin and hide handling and management after slaughtering in the region
- To assess the cause for skin and hide defect after slaughtering
- To suggest appropriate improvement option to enhance quality skin and hide production

II. MATERIALS AND METHODS

a) *Description of the study area and sampling techniques*

This study was conducted at Woliata and Cambata Tambaro zones. In Wolaita zone, Soddo and Areka town were selected and in Kambata Tambaro zone Durame town and Qachabira woreda were selected based on their potential on skin and hide production. Information was gathered through questionnaire by contacting various key informants such as woreda office experts, butchers, middlemen, collecting centers and traders of skin and hide in each area.

b) *Data analysis*

The questionnaire was pre-tested and then modified on the basis of the information obtained in the pre-tests. Descriptive statistics such as means, frequency distribution and percentage were used to analyze the data. The data were analyzed through software packages using SPSS (version 20).

III. RESULTS AND DISCUSSION

a) *Characteristics of hide and skin producers and marketers*

The household characteristics such as gender category, age group and educational status of the respondents are described in Table1. Out of the total interviewed butchers the average household male respondents were 95% and the average mean number of females were 5% while the average household male

respondents were 100% for middleman, collectors and traders of different age and educational status. The study observed that hide and skin producers and marketers were mainly a male domain than women. Similar ideas were reported by (Alemnesh *et al.* 2018).

Out of the total interviewed butchers about 70% of the house hold respondents were found in age group between 30 and 50 years, 10% of the households were below 30 years old and 20% of the house hold respondents were above 50 years old. About 55% interviewed middlemen of the house hold respondents were found in age group between 30 and 50 years, 25% of the households were below 30 years old and 20% of the houses hold respondents were above 50 years old. About 60% interviewed Collectors of the house hold respondents were found in age group between 30 and 50 years, 15% of the households were below 30 years old and 25% of the houses hold respondents were above 50 years old. About 80% interviewed traders of the house hold respondents were found in age group between 30 and 50 years, 5% of the households were below 30 years old and 15% of the houses hold respondents were above 50 years old. The study observed tha hide and skin producers and marketers were found in age group between 30 and 50 years mainly a male domain than women.

In the study area, total interviewed butchers 15% respondents were illiterate, 25% only read and write, 37.5% completed primary school, 17.5% joined secondary school and 5% had diploma. About 40% interviewed middlemen were illiterate, 35% only read and write, 20% completed primary school, 5% joined secondary school and none had diploma. On the other hand, about 20% interviewed collectors were illiterate, 50% only read and write, 30% completed primary school and non had joined secondary school or diploma while 10% interviewed traders were illiterate, 25% only read and write, 45% completed primary school, 15% joined secondary school and 5% had diploma.

Table 1: Characteristics of hide and skin producers and marketers

Variables	Type of respondents			
	Bucher (M=40)	Middleman (N=40)	Collectors (N=20)	Traders (N=10)
Sex				
Male (%)	95	100	100	100
Female (%)	5	0	0	0
Age(year)				
<30 (%)	10	25	15	5
30-50 (%)	70	55	60	80
>50 (%)	20	20	25	15
Education level				
Illiterate (%)	15	40	20	10
Read and write (%)	25	35	50	25
Primary school (%)	37.5	20	30	45
Secondary school (%)	17.5	5	0	15
Diploma (%)	5	0	0	5

b) Perception on major criteria for quality of hide and skin

Based on the survey result there are different criteria used by respondents for quality skin and hide. These include size, absence of flay cut, weight, absence of dirt, freshness as shown in table2. Absence of flay cut (100%) and freshness (100%) of the skin are the main criteria for butchers followed by size (65%), absence of dirt (45%) and weight (10%) of the goat and sheep skin the same trend is observed in case of middlemen. Whereas in case of collectors size (100%), absence of flay cut (100%) and freshness (100%) of the skin are the main criteria followed by absence of dirt (75%) and weight (5%) of the goat and sheep skin. Except weight (5%) of the goat and sheep skin size, absence of flay cut, absence of dirt and freshness are the main criteria for traders. This study shows that except weight of goat

and sheep skin size, absence of flay cut, absence of dirt and freshness are very important criteria for selling and buying of goat and sheep skin for all respondents. Similar idea was reported by (Ahmed, 2000, Chemonics, 2002, Kagunyu *et al.*, 2011 and Hagos *et al.*, 2013).

On the other hand, absence of flay cut (100%), weight (100%) and freshness (100%) of the hide are the main criteria for butchers followed by absence of dirt (90%) and size (30%) the cattle hide. The mean average middlemen result shows that absence of flay cut (100%), absence of dirt (100%) and weight (100%) of the hide are the main criteria followed freshness(55%) and size(50%) of hide. In case of collectors and traders absence of flay cut, weight, absence of dirt and freshness are the main criteria for selection of cattle hide followed by size. Similar finding was reported by (Jabbar and Benin 2002, Berhe 2009 and Tekle, 2009)

Table 2: Perception on major criteria for quality of hide and skin

Selection criteria	Type of respondents				
	Bucher (N=40)	Middle man(N=40)	Collectors(N=20)	Traders(N=10)	
Skin	Size	65	95	100	100
	Absence of flay cuts	100	100	100	100
	Weight	10%	5%	5%	2%
	Absence of dirt	45	80	75	100
	Freshness	100	100	100	100
Hide	Size	30	50	45	40
	Absence of flay cuts	100	100	100	100
	Weight	100	100	100	100
	Absence of dirt	90	100	100	100
	Freshness	100	95	100	100
	Size	37.5	20	30	45
	Absence of flay cuts	17.5	5	0	15

c) Slaughtering area selection by butchers

Based on the survey result slaughtering practices, causes of defects during slaughtering and time of selling hide and skin after flaying are shown in table3. All butchers (100%) interviewed during survey time showed that bleeding of sheep and goats was done on ground this is the same in case of cattle. On the other hand, the finishing area of sheep and goat slaughter is done mostly by hoisting which is 70% and remain 30% is on the ground. About 80% of finishing practice of slaughtering of cattle is done on the ground and the rest 20% is done by hoisting. Flay cut (75%) is the main defect during slaughtering of hide & skin which is followed by bone break on hide (15%), flesh remnant (8%) and blood (2%). Similar idea was reported by Hagos *et al.*, (2013), Zembaba *et al.*(2013) and Melkamu (2014). Most of the respondents (65%) of confirmed that time of hide and skin selling after flaying was within 24 hours this affects quality of hide and skin in the study areas.

Table 3: Butchers perception during slaughtering of hide & skin

Slaughtering type	Variables	Bucher (N=40)
Slaughtering sheep and goat	On ground	100
	Hoisting	0
Finishing	On ground	30
	Hoisting	70
Slaughtering/bleeding cattle	On ground	100
	Hoisting	0
finishing	On ground	80
	Hoisting	20
Defects during slaughtering	Fly cuts	75
	Bone break on hide	15
	Flesh remnant	8
	blood	2
Timing of hide and skin selling after flaying	Within 12 hours	23
	within 24 hours	65
	within 48 hours	12

d) Hide and skin marketing constraints

In this study the major sources of products for collection centers were butchers, middleman and collectors. In all interviewed actors marketing is the main problem in the study areas table 4 below. The problems faced by hide and skin traders in all survey areas include market problem such as lack of competitive market, fluctuating price, poor quality and lack of price information. Based on the survey, in case of interviewed butcher major constraints in marketing were lack of

competitive market (60%), followed by lack of price information (17%) and fluctuating price (12%) as in hide and skin marketing. On the other hand, lack of competitive market (52%), followed by fluctuating price (30%) and poor quality (18%) as in hide and skin marketing in interviewed middlemen. The same trend was observed in case of all collectors and collecting centers. This agrees with the finding of Berhe (2009) and Kagunyu *et al.*, (2011).

Table 4: Hide and skin marketing constraints

Variables	Type of respondents						
	Bucher (N=40)	Middleman (N=40)	Collectors (N=20)	Collecting Center(N=10)			
Management		Is there market	yes	100	100	100	100
		problems	no	0	0	0	0
Main Problems in marketing	fluctuating price	12	30	45	35		
	lack of competitive market	60	52	40	55		
	lack of price information	17	0	0	0		
	poor quality	1	18	15	10		

IV. CONCLUSION AND RECOMMENDATIONS

Accordingly to the current study in all survey areas attention on hide and skin handling, management and marketing system was very low. It was found that majority of hide and skin produced are brought to collecting centers although there are a significant number that fail to reach the formal market due to sever defects. Major defects that were observed during slaughtering by respondents were flaying cut, break down of bone and other process on the hide, blood, flesh remnant. Major defects that were observed after slaughtering prolong storage and delay in sell.

Since hide and skin defects primarily originate during the slaughtering process, adequate slaughter facilities should be made available to producers so that slaughtering will be done properly. Both during slaughter and post-slaughter defects can be avoided or minimized through trainings and continuous awareness creation of all stockholders. A means of marketing access of hide and skin should be facilitate by government.

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Comparative Effects of Covid-19 Pandemic on Agricultural Production and Marketing in Nigeria

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Abstract- As the global population decreases due to the Covid-19 pandemic and possible hunger in most developing countries of the world, it is noteworthy to say animal products suffer consumption as an average individual just wants to survive without considering the nutritional requirement of the body system for functionality and production. Humanity has observed various pandemics throughout history, where some of them were more disastrous than the others to humans. We observe a very hard time once again fighting an invisible enemy; the novel COVID-19 (stay home, stay safe slogan). The nationwide lockdown in the country has revealed the various lacunae in the agricultural marketing system; supply chain disruptions exposed critical infrastructure gaps and governance issues regarding the competitiveness of Nigeria's agricultural sector. Many poultry farmers across the country have suffered severe losses due to the COVID-19 pandemic control measures imposed by the government. The situation has impacted their livelihoods negatively, with many closing down their businesses.

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Comparative Effects of Covid-19 Pandemic on Agricultural Production and Marketing in Nigeria

Oyetoro Blessing Abiola ^α, Abdulraheem Mukhtar Iderawumi ^σ & Adefare Tomisin ^ρ

Abstract- As the global population decreases due to the Covid-19 pandemic and possible hunger in most developing countries of the world, it is noteworthy to say animal products suffer consumption as an average individual just wants to survive without considering the nutritional requirement of the body system for functionality and production. Humanity has observed various pandemics throughout history, where some of them were more disastrous than the others to humans. We observe a very hard time once again fighting an invisible enemy; the novel COVID-19 (stay home, stay safe slogan). The nationwide lockdown in the country has revealed the various lacunae in the agricultural marketing system; supply chain disruptions exposed critical infrastructure gaps and governance issues regarding the competitiveness of Nigeria's agricultural sector. Many poultry farmers across the country have suffered severe losses due to the COVID-19 pandemic control measures imposed by the government. The situation has impacted their livelihoods negatively, with many closing down their businesses. Broiler production is one of the paramount areas of poultry farming that has generated employment opportunities for the unemployed and underemployed citizens of Nigeria. This sector has also cushioned the effect of malnourishment in terms of animal protein sources faced with the country. It has however, contributed to the increase of the gross domestic product of the nation and as well eased the livelihood of her citizens until recently, that the world was struck with the covid-19 pandemic. COVID-19 pandemic has brought difficult situations for citizens of nations across the globe. The effects, however, may be more severe for others, especially those in the Third World countries, who are in desperate situations, and whose conditions may well further deteriorate if not put into consideration. The covid-19 pandemic therefore, made a need to examine the effect of covid-19 on broiler production and marketing in Nigeria. Also, the Covid-19 pandemic has caused an upsurge in the availability of these products, making it hard for farmers to get them out to markets due to the lockdown orders and sudden high cost of feed and feed materials. This, in turn means there is little/no profit for animal producers at this crucial time.

Keywords: agriculture, marketing, pandemic, production, covid-19.

I. INTRODUCTION

The World Bank (2020) estimated that 60 million individuals living on less than US\$2 per day would be forced into extreme poverty as a result of the

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COVID-19 pandemic lockdown under the worst-case scenario. While the best-case synopsis, an estimated 49 million people will be forced into extreme poverty due to COVID-19, this is due to shut down in economic activities all over the globe. The first COVID-19 case in Africa was recorded in Egypt on February 14, 2020. Over 52 African countries are recorded on COVID-19 cases (WHO, 2020b). The origin of COVID-19 infection in Nigeria can be traced back to 27th February 2020 when the first index case involving an Italian national was recorded in Lagos. COVID-19 has a direct relationship with food security, in that the origin of the virus is directly from the food system traced to the wet market of Wuhan city in China; that deals in a wild animal. The pandemic is presently threatening the food security of billions of people and the already existing challenges of food security highlighted earlier, even though it was assumed initially that the pandemic would not affect the global food security (Vos, Martin & Laborde, 2020).

Livestock production, in general and chickens in particular, play vital socioeconomic roles in developing countries (Alders, 2004; Salam, 2005). Poultry production has a crucial role in the economy of developing countries, including a substantial role in poverty alleviation using income generation and household food security (Abdelqader *et al.*, 2007). Available evidence suggests that, poultry production is the fastest means of bridging the animal protein deficit in Africa (Awoke, 2015). Provision of animal protein, generation of extra cash incomes and religious or cultural considerations are amongst the keys reasons for keeping village chickens by rural communities (Alders *et al.*, 2009). Available evidence suggests that, poultry production is the fastest means of bridging the animal protein deficit in Africa (Gondwe, 2004), this is because, poultry has a short generation interval, a high rate of reproduction, and is characterized by relatively high efficiency of nutrient transformation into quality animal protein (Delgado, 2005). At the age of 5 to 6 weeks, the broiler can reach a slaughter weight of 1.5 to 2.0 kg (Asghar *et al.*, 2000).

Okolo (2004) described the agricultural sector as the most crucial sector of Nigeria's economy which holds a lot of potentials for the future economic development of the nation as it had done in the past. Notwithstanding, the enviable position of the oil sector in the Nigerian economy over the past three decades, the

agricultural sector is arguably the most crucial sector of the economy (Abdulraheem & Iderawumi, 2019).

II. BROILER PRODUCTION

Livestock systems have both positive and negative effects on the natural resource base, public health, social equity, and economic growth (World Bank, 2019). Currently, livestock is one of the fastest-growing agricultural subsectors in developing countries. Its share of agricultural GDP is already 33 percent and is quickly increasing. This growth is driven by the rapidly increasing demand for livestock products; this demand is driven by population growth, urbanization, and rising incomes in developing countries (Delgado, 2005).

Production of chicken meat is growing into the larger component of the poultry industry in Nigeria and nearby countries. Hardly two decades ago, had most of the chicken marketed for meat in this region come only from the layer-type spent hen and the native chicken, still, in recent years the proportion of broiler meat in poultry meat production has gone up considerably (Awoke, 2015).

The broiler production activity starts from the importing of grandparent stock of commercial meat-type hybrid strains by franchise hatcheries. These follow the suggested line of breeding activities and produce high-performing hybrid broiler chicks in two generations which are sold as day-old chicks to the farmers. The broiler farmer buys the day-old hybrid broiler chicks and grows them to market age (6-7 weeks) on his premises, arranging for the necessary infrastructure facilities and other inputs (Asghar *et al.*, 2000). In Nigeria, animal protein, especially meat, is expensive, in short supply, and is out of reach to the majority of the population. The effect of inadequate animal intake is felt more by a large proportion of the population, especially in rural areas, whose inhabitants constitute over 70% of the Nigeria population and who constitute over 85% of the extremely poor in the country (Chukwuji *et al.*, 2006)

Broiler production is carried out in all parts of the country, with no known religious, social, or cultural inhibitions associated with their consumption. Specifically, investment in broiler enterprises is attractive because the production cost per unit is low relative to other livestock types, poultry meat is very tender, and broiler enterprises have short production cycles. Owing to these pronounced advantages of broiler enterprises, large numbers of farmers, men and women, go into their production, many do so for income generation purposes (Nwajiuba and Nwoke, 2000).

III. COVID 19 PANDEMIC

Infectious diseases are a leading cause of death worldwide, accounting for a quarter to a third of all mortality. In most industrialized countries, contagious disease ranks after cancer and

heart disease as a leading cause of mortality (Abdulraheem, 2019). Despite developments in pharmaceuticals, infectious disease rates rise due to changes in human behavior, major and densercities, increased trade and travel, inappropriate use of antibiotic drugs, and the emergence of new and resurgent pathogens. Infectious disease outbreaks can easily cross borders to threaten economic and regional stability, as demonstrated historically by the HIV, 2009 H1N1 influenza, H5N1, and SARS epidemics and pandemics.

As of today, 25th October 2020 at exactly 5:30 pm, there are 43,150,030 Coronavirus cases, with 1,157,005 deaths while 31,787,545 have been recovered with 10,211,042 active cases (i.e. 10,133,562 (99%) in mild condition and 77,480 (1%) in serious/critical stage). In the total Coronavirus, patients died, interestingly, the highest number belongs to the United States of America, i.e. 230,176 deaths. The death toll is followed by the Brazil (156,926) India (118,804), Mexico (88,743), Italy (37,338), Spain (34,752), France (34,645), and China the originating point of infection (4,634). Nigeria, presently with 61,930 total index cases with 57,285 recovered, 1,129 deaths and 3,516 active cases. [<https://www.worldometers.info/coronavirus/>].

Coronavirus disease 2019 is an infectious disease popularly known as Covid-19 (Akanbi *et al.*, 2020). The disease is caused by severe acute respiratory syndrome coronavirus 2, otherwise known as SARS- CoV-2 (Harapan *et al.*, 2020). Its symptoms include fever, cough, shortness of breath, sore throat, runny nose, sneezing, among others (Harapan *et al.*, 2020). It is a highly communicable disease (Adhikar *et al.*, 2020), and its mode of transmission is from person-to-person. Transmission occurs among close contacts mostly through respiratory droplets released when the infected person sneezes or coughs (Harapan *et al.*, 2020). Preventive measures such as lockdown, social distancing, self-isolation or self-quarantine and observation of simple hygiene habits such as regular washing of hands, wearing of facemasks and covering the mouth with a handkerchief when coughing or sneezing have been recommended to contain the spread of the disease among people (Akanbi, *et al.*, 2020) it is paramount to note that there is no any known cure or vaccine for the Covid-19 pandemic presently (Zhu *et al.*, 2020). Nevertheless, different countries and international organizations like WHO are making efforts to develop vaccines or drugs for the Covid-19 disease (Innocent, 2020)

a) *Effects of Covid-19 Pandemic on Broiler Production and Marketing*

As the world battles the Covid-19 pandemic with focused health measures such as hand washing, social distancing, and personal protection equipment,

the developing world has to make an extra consideration; food security.

The coronavirus has had a great impact on daily life, from the man on the street to businesses. And the poultry sector, even more, essential than ever, has not gone unscathed. Zero Hunger by 2030 is the second of the sustainable development goals. In 2016/2017, FAO classified approximately 27.4% of the population in Africa as severely food insecure. This is almost four times as high as any other region and was before the Covid-19 crisis disrupted food supply chains in both rural and urban localities in Nigeria. Even though food has been identified as an essential service to be provided, local media reports that due to the Covid-19 crisis small and medium scale husbandry, poultry production farmers have cut their production by more than 50%.

Zurayk (2020) observed that the pandemic has a negative impact on all the four fundamental dimensions of food security, as defined by FANTA (2003), which include availability, accessibility, utility, and stability, which will further affect the sustainability of food security in the world.

The Covid-19 pandemic has social, religious, political, and economic consequences on the economy. Some people might argue that it is too early to discuss the effects of the pandemic. However, the pertinent question is, when likely will the pandemic be over? According to experts, the Covid-19 pandemic may not go away anytime soon (Barro *et al.*, 2020). Besides, there is no cure for it now. Therefore, it is essential to discuss the consequences now so that measures or actions will be taken to cushion the effects of the pandemic (Innocent 2020). With that said, the following are the effects of the Covid-19 pandemic in Nigeria. Animals suffer a great deal due to restrictions on the movement of personnel, availability of feed ingredients/materials, drugs, and vaccines, which are very vital in animal production. Farmers are making a lesser profit due to reduced consumption of different animal products; the paying of farm workers is paramount and important in farm growth. (Akanbi *et al.*, 2020)

COVID-19, in general, affected the economic activities and subsequently increased the costs of food items. Annual inflation in the country has risen for straight eight-month peaking up in April as a result of the spread of COVID-19, which resulted in higher food prices throughout the country due to a lockdown in economic activities. The inflation rate was 12.34 percent, which represents the highest level in more than two (2) years in the country (NBS, 2020); this is in addition to the current rate of unemployment and low level of livelihood in the country even before the COVID-19 pandemic. This raises red flags on the ripple effect this will have on the supply of meat and eggs during this period. Part of the focus of securing food supply as an essential service is to provide access to nutrient diversity

that is paramount in the immunity of a population. Poultry meat and eggs are copious and readily available sources of protein. With lowered production, limited availability is inevitable, which will likely result in prices going up. Most farmers have lost between 35 and 40 percent of their resources because sometimes they cannot sell, but they keep producing. Like hatcheries, day-old-chicks when you hatch, you cannot deliver them to farms. Eggs are supposed to be the number one thing as a palliative. In fact, the demand for eggs is supposed to have risen drastically due to its nutritional content, but the reverse is the case. The impact on the poultry sector has a domino effect on the rest of the agricultural chain.

The high cost of key inputs such as seeds, vaccines, and feeds across the country is frustrating farmers who are struggling to survive the difficult moment. The prices of farm inputs are surging owing to foreign exchange (FX) volatility, as most of the vaccines and drugs used in the country's livestock industry are imported. Naira exchanged at N360 to a dollar at the parallel market before the COVID-19 outbreak, but this has skyrocketed to N480 to a dollar due to dollar scarcity attributed to low oil prices and oil glut. Nigeria depends on crude oil for over 70 percent of its FX needs and revenue, according to the National Bureau of Statistics (NBS). Business Day survey at some Lagos markets shows that a 25kg bag of layers marsh now sells for N3, 600 as against N3,200 sold before the COVID-19 outbreak, while broiler finisher marsh now sells for N4,200 as against N3,750 pre-COVID-19. Even prices of day-old chicks have also surged by 10 percent amid the virus. The fact is that anything that affects poultry affects other sectors of agriculture. If you cannot sell day-old chicks, how can you afford to buy poultry feeds? If you cannot sell poultry feed, how will you be able to buy soybeans and corn? So these are the challenges.

b) *Effect of Covid 19 Pandemic on Nigeria Economy*

Nigeria's economy is bleak, sliding towards a recession or an economic contraction due to the Covid-19 pandemic. Indices of economic recession abound. Prices of goods and services have skyrocketed during this pandemic. Unemployment has increased, and the exchange rate has become volatile. Moreover, economic activities have been significantly disrupted, and the Covid-19 pandemic has no cure for now. This situation makes the economy unpredictable. Additionally, production and job losses and changes in buying habits have strained the economy. Moreover, the steep decline in oil revenues occasioned by the sharp fall in crude oil price is likely to deplete Nigeria's external reserves, thereby making the future unpredictable. The effect of disrupting the agricultural market supply chains was observed in 2014, with the Ebola outbreak where restrictions and market closures disrupted flows of food

and necessities. Shortages of goods led to an increase in prices of basic commodities. The nutritional impact was predominantly attributable to reduced food access driven by a reduction in economic activity that reduced families' purchasing power.

Empirical evidence of the impact of COVID-19 on food security status in the world is presently very few. The virus has a devastating effect and can easily affect the food security status of households either directly or indirectly. The pandemic has worsened the unemployment situation in Nigeria. For instance, the unemployment rate in Nigeria before the pandemic stood at 23.1 percent (CSEA, 2019; Onifade and Abdulraheem, 2019; National Bureau of Statistics, 2018; NSEG, 2019). However, due to the pandemic, the unemployment rate is estimated to rise to about 33 percent by the end of 2020 (Obiezu, 2020). An upsurge in unemployment has negative effects on the economy. For example, when unemployment increases, there is the likelihood that social vices or criminal activities would increase, and this portends grave danger for the country. Also, an upsurge in unemployment could lead to more hunger and poverty (Innocent, 2020).

Many businesses, specifically small and medium enterprises (SMEs), have been closed down due to the Covid-19 pandemic. SMEs are badly hit by the outbreak of the pandemic due to their vulnerability and limited resources. Measures such as self-isolation or quarantine, social distancing, a ban on social gatherings, and closure of markets taken to contain the spread of the disease have impacted negatively on their operations, sales, and profits. Many SMEs have experienced demand and supply chains shocks during this pandemic. Demands for goods have reduced drastically due to lockdown and restrictions of movement. Additionally, the supply chain has been badly affected. For example, business organizations in Nigeria import their goods from China (Ozili, 2020). With the ban on foreign travels during this pandemic, the supply of such goods and the continuity of such businesses would be negatively affected. Border closures have negative impacts on import and export businesses.

Loayza and Pennings (2020) opined that the pandemic reflected both worldwide public health emergency and an international economic crisis whose consequences surpassed the global financial crisis of 2008-2009. The study found that first, the human and economic costs of the Covid-19 are likely to be higher in developing countries because of the structure of their economies, which aggravates the impact of shutdowns and reduction in economic activities. Second, factors such as lower health care capacity, larger informal sectors, shallower financial markets, less fiscal space, and poorer governance are likely to stymie the gains of sundry containment measures taken. To reduce the vulnerability of citizens due to the pandemic, a viable

macroeconomic policy that would strengthen monetary transmission, and fiscal space as well as increase fiscal multipliers, is worthwhile.

This would ensure macroeconomic stability and enhance the quality of governance. The World Bank (2020), provided an explanation for the late arrival of Covid-19 and the rapid spread across Sub-Saharan Africa. The study asserted that the low number of cases recorded in the region can be best explained by the insufficient testing capacity in many countries, which might have understated the accurate number of infections. This pessimistic view undermines the containment measures taken by these African countries and the possibility of an indigenous cure for the virus, which, due to regional unique characteristics, may be viable. The study projected a grave macroeconomic effect of the pandemic on the region, which includes a decline in the economic growth of Sub-Saharan Africa from 2.4 percent in 2019 to -2.1 and -5.1 in 2020, which might lead to a possible recession in the region. Output loss in the region was estimated to be between US\$37 billion and US\$79 billion. In contrast, the region's three largest economies: Nigeria, South Africa, and Angola would experience continued poor growth and investment consequent upon the fluctuations in commodity prices (World Bank 2020).

IV. CONCLUSION AND RECOMMENDATION

The Covid-19 pandemic has affected the production and marketing of agricultural products. No doubt, the pandemic has worsened the food insecurity situation in the country. The demand and supply chains of agricultural products and foods internally and externally have been affected due to the measures adopted to contain the spread of the disease. Farmers find it difficult to obtain seedlings, fertilizers, pesticides, and farm implements. Moreover, labour-intensive agricultural production processes have been affected due to labour shortages and logistical constraints. Additionally, the timing of the outbreak of the Covid-19 pandemic in Nigeria disrupts farming activities. Empirical evidence of the impact of COVID-19 on food security status in the world is presently very few. The virus has a devastating effect and can easily affect the food security status of households either directly or indirectly. As the global population decreases due to the Covid-19 pandemic and possible hunger in most developing countries of the world, it is noteworthy to say animal products suffer consumption as an average individual just wants to survive without considering the nutritional requirement of the body system for functionality and production.

Demand for livestock products in the future can be heavily moderated by socioeconomic factors such as human health concerns and changing socio-cultural values. There is considerable uncertainty about how

these factors will play out in different regions of the world in the coming decades. Furthermore, the Covid-19 pandemic has caused an upsurge in the availability of these products, making it hard for farmers to get them out to markets due to the lockdown orders and sudden high cost of feed and feed materials. This, in turn means there is little/no profit for animal producers at this crucial time.

It is assumed that if Nigeria had fully utilized the opportunities in value addition, the impact of the pandemic on the sector would have been limited. Fresh eggs can be processed into powder, and fresh fruits can also be processed and preserved for future uses, but this is not happening on a wide scale even though the country is the largest producer of eggs in Africa, with 10.3 billion eggs produced annually. The country has been losing a lot of money due to our inability to process eggs into powder. It has really been a tough situation for poultry farmers

Finally, timing is key. Broiler and layer farming needs proper logistical planning to ensure optimal timing on maturity for the sale of meat and eggs. When maturity occurs, but producers cannot get their products to market, farmers incur additional upkeep expenses that affect the profit margin of the business.

Small and medium producers are the bulk farmers in Nigeria. For continued livelihoods and food supply of poultry products and other food value chains, the time for innovative thinking is now. This will need to be both from the producers and support partners in the value chains like day-old chicken providers and feed providers. Viable interventions include acceptance and usage of e-platforms and vendors by producers and provision of storage for the poultry products as the producers secure a sustainable market. A more in-depth study looking primarily at the farmer level is recommended. It is estimated that there will be a 10 or 12 percent reduction in farm produce this year. If the coronavirus continues to spread to rural communities, the reduction might get to 25percent. Many farmers did not receive any form of palliative from the government despite that their businesses have been heavily impacted by the COVID-19 pandemic. The government needs to come to the assistance of farmers to survive through this pandemic, most especially the poultry farmers. We need to start processing eggs into powder and also fruits into concentrate to help address the issue of wastage in the country and also increase the shelf life of our highly perishable produce. Raw eggs are said to last about four weeks, while powdered eggs can last up to a year.

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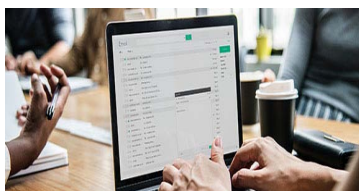
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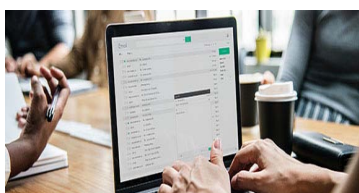


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It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

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 through 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.



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.



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.

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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
<i>Abstract</i>	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
<i>Introduction</i>	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
<i>Methods and Procedures</i>	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
<i>Result</i>	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
<i>Discussion</i>	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
<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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