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Ecosystem Services Protection

Genetic Parameters and Diversity

Highlights

Financial Literacy in Nigeria

Agricultural Production Resources

Discovering Thoughts, Inventing Future

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Genetic Parameters and Diversity and Correlations in Onion Strains

By Vanessa Cláudia Vasconcelos Segundo, Renato Innecco, Joelson André Freitas, Eveline Nogueira Lima, Ana Paula Oliveira Nogueira & José Magno Queiroz Luz

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Abstract- Plant breeding programs have been investing in the development of high commercial standard onions; thus, they depend on the genetic resources available for obtaining commercial hybrids. The objective of this study was to evaluate genetic parameters and diversity, and phenotypic and genotypic correlations of characters related to onion production. The experiment was conducted in Uberlândia, Minas Gerais, Brazil. Fifty-three onion strains were evaluated, and a randomized block design was used. The number of plant and bulb characteristics evaluated was 13. The statistical analyses were performed using Genes and R software. A genetic variability among the genotypes was found for most of the characters at 1% level of significance in the F test. The heritability of most characters presented moderate to high values (≥ 70%) and high CVg/CVe ratio (≥ 1). The UPGMA method separated the genotypes into 20 groups, while the Tocher method separated them into 19 groups. The groups that stood out were V, XIV, XV, XV, XVI, XVII, XVIII, XIX, and XX.

Keywords: *allium cepa L, genetic resources, heritability, genetic variability, indirect selection.*

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Genetic Parameters and Diversity, and Correlations in Onion Strains

Parâmetros Genéticos, Diversidade Genética E Correlações Em Linhagens De Cebola

Vanessa Cláudia Vasconcelos Segundo [α], Renato Innecco [σ], Joelson André Freitas [ρ], Eveline Nogueira Lima [ω], Ana Paula Oliveira Nogueira[¥] & José Magno Queiroz Luz[§]

Abstract- Plant breeding programs have been investing in the development of high commercial standard onions; thus, they depend on the genetic resources available for obtaining commercial hybrids. The objective of this study was to evaluate genetic parameters and diversity, and phenotypic and genotypic correlations of characters related to onion production. The experiment was conducted in Uberlândia, Minas Gerais, Brazil. Fifty-three onion strains were evaluated, and a randomized block design was used. The number of plant and bulb characteristics evaluated was 13. The statistical analyses were performed using Genes and R software. A genetic variability among the genotypes was found for most of the characters at 1% level of significance in the F test. The heritability of most characters presented moderate to high values (≥ 70%) and high CVg/CVe ratio (≥ 1). The UPGMA method separated the genotypes into 20 groups, while the Tocher method separated them into 19 groups. The groups that stood out were V, XIV, XV, XV, XVI, XVII, XVIII, XIX, and XX. The results of t-test showed six significant phenotypic correlations with low to moderate degree of association, and the genotypic correlations, in most cases, were higher than the phenotypic ones and showed the same sign. From the genetic parameters studied, the possibility of gains in the selection is high. The separation of groups of divergent genitors was possible due to the wide genetic variability for the studied characters. Moreover, the phenotypic and genotypic correlations showed that indirect selection is not feasible.

Keywords: allium cepa L, genetic resources, heritability, genetic variability, indirect selection.

Resumo- Os programas de melhoramento vegetal têm investido no desenvolvimento de cebolas com alto padrão comercial e para tal dependem dos recursos genéticos disponíveis para a obtenção de híbridos comerciais. O objetivo deste estudo foi avaliar parâmetros genéticos, diversidade genética e as correlações fenotípicas e genotípicas de caracteres relacionados à produção de cebola. O experimento foi realizado em Uberlândia - Minas Gerais, Brasil. Foram avaliadas 53 linhagens de cebola. Foi utilizado o delineamento em blocos ao acaso. Foram avaliadas 13 características de planta e bulbo. As análises estatísticas foram realizadas no programa Genes e R. Observou-se a existência de variabilidade genética entre os genótipos para a maioria dos caracteres ao nível de 1% pelo teste F. A herdabilidade da maioria dos caracteres apresentou valores moderados a altos (≥ 70%) e relação CVg/CVe alta (≥1). O método UPGMA possibilitou separar os genótipos em 20 grupos e de forma semelhante o método de Tocher separou os mesmos em 19 grupos. Os grupos que mais se destacaram foram V, XIV, XV, XVI, XVII, XVIII, XIX e XX. Houve seis correlações fenotípicas significativas pelo teste t com grau de associação baixo a moderado, e as correlações genotípicas, em sua maioria, mostraram-se superiores às fenotípicas e apresentaram o mesmo sinal. A partir dos parâmetros genéticos estudados existe alta possibilidade de ganhos na seleção. Há ampla variabilidade genética para os caracteres estudados o que permitiu a separação de grupos de genitores divergentes. Adicionalmente, as correlações fenotípicas e genotípicas mostraram inviabilidade para seleção indireta.

Palavras-chave: allium cepa L, recursos genéticos, herdabilidade, variabilidade genetic, seleção indireta.

I. Introduction

Onion (*Allium cepa* L.) is one of the most widespread crops in the world and is consumed by almost all peoples on the planet, regardless of ethnic and cultural origin, constituting an important element of family labor occupation (BOITEUX; MELO, 2004). It is the third most economically important vegetable in the world, and especially in Brazil (AGRIANUAL, 2016).

According to the systematic survey of agricultural production, the states with the largest productions were Santa Catarina, Rio Grande do Sul, Paraná, Minas Gerais, São Paulo, Goiás, Bahia, and Pernambuco, with harvests ranging from 55,460 to 509,389 tons (IBGE, 2017).

Given the relevance of this crop, research on onions is essential, especially for plant breeding programs. The aim of these programs, is to produce high-quality commercial products; thus, breeders need a broad genetic base and good breeding strategies to promote favorable genetic improvements in the crop (SANTOS, 2011).

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One way for plant breeders to verify the existence of genetic variability in a given population is through genetic parameter estimates (VENCOVSKY, 1978). These are theoretical quantities that describe the genetic structure of quantitative traits, providing important information on the magnitude of the additive variance and the variance due to dominance shifts (RAMALHO; SANTOS; PINTO, 2004).

One of the most important parameters is heritability, which expresses the reliability of the phenotypic value as an estimator of the genotypic value in such a way that the greater it is, the greater the genetic gain by selection (CRUZ, 2005). Another useful parameter for selection efficiency is the relationship between the coefficient of genetic and environmental variation, which evaluates the genetic proportion in relation to environmental variation (LIMA FILHO, 2015).

Besides the knowledge of genetic variability, it is necessary to know the genetic diversity and the existing correlations between the characteristics of interest. For selective breeding, studies involving genetic diversity among a group of genotypes are extremely relevant for the knowledge of the genetic resources available. This kind of research can employ multivariate techniques, especially cluster analysis, which allows combining multiple information of each genotype, facilitating selection from a combination of variables and identification of superior genotypes (CRUZ; REGAZZI; CARNEIRO, 2014).

Correlation analysis determines the degree of association between characters that can contribute to the adoption of indirect selection, especially among characters that present complications regarding selection due to low heritability or measurement and identification problems (TEIXEIRA et al. 2012; CRUZ; REGAZZI; CARNEIRO, 2012).

In view of the above, the objective of the present study is to evaluate genetic parameters and diversity, in addition to the phenotypic and genotypic correlations of characters related to onion production.

II. Materials and Methods

The experiment was conducted in an agricultural experimental station in Uberlândia, Minas Gerais (MG), Brazil (18° 55' S latitude, 48° 16' W longitude, and 873 m altitude) in 2017. This study analyzed a set of genotypes consisting of 53 advanced strains. Some of the genotypes studied originated from O. P. populations (open pollination) adapted to cultivation in Brazil, especially those predominant in the south of the country, some from the onion breeding program maintained by the company in California, USA, and some from crosses between special subjects of these two origins (F2).

The strains were obtained through successive self-fertilizations (which varied from 4 to 5) and/or self-fertilizations intercalated with intercrossing sibs between 2-3 plants. The criterion to define if the genotype would be successively self-fertilized or if it would advance through one or more generations in sib intercalated with self-fertilization or not, was based on the phenotypic state of seed production. Genotypes with lower seed production were subjected to sibs (2-3 plants) rather than being successively self-fertilized. In genotypes of advanced strains, an average of five generations of advancement through self-fertilization and/or sibs were involved.

A randomized block design (RBD) with two repetitions was used. Each plot consisted of a 1 m x 90 cm bed, with five rows spaced 20 cm apart, with plants spaced 5 cm apart, totaling to 100 plants per plot. For the characteristics that were not directly measured, scores from 1 to 9 were assigned, where 1 represented the worst value and 9 the best value of the variable. These characteristics were evaluated at plot level.

Sowing was performed in March and transplantation in May 2017. The beds were prepared and fertilized following the recommendations for onion crop. The morpho-agronomic characters evaluated were: plant vigor, a score (1-9) was assigned for plant vigor at 90 days after sowing (DAS) by assessing leaf diameter, plant height, and number of leaves; pseudostem 'neck' diameter: 1 for pseudostem with excessive thickening and 9 for those with less thickness; plant architecture: 1 for prostrate, 9 for erect; leaf waxiness: 1 for absence of wax and 9 for presence of a lot of wax; drying of leaf tips: the highest score was assigned to plants that did not present drying of leaf tissues and the lowest grade for the inverse situation; and plant cycle: quantity of days from sowing date to harvest.

The following evaluations were performed on the bulbs after their harvest: bulb mean mass, in grams; bulb density, d = mass/volume, g. cm-3; bulb color, with the highest score given for bulbs with dark brown color; bulb shape: with 1 for flat bulbs and 9 for rounded bulbs; uniformity of bulb shape: the greater the predominance of a shape in the plot, the higher the score; bulb firmness: with the aid of a penetrometer with a 6-mm tip, unit kgf.cm-2; durability after harvest of bulbs: the percentage of marketable bulbs was evaluated after 60 days of storage in ambient conditions.

All characters in the present study were treated as quantitative, considering the study by Sneath and Sokal (1973). Since the values of the multi-categorical characters could be ordered, i.e., they are of ordinal nature and reported on a scale, it is possible for them to be analyzed as quantitative variables.

Genetic variability among the genotypes was verified using analysis of variance and genetic parameters, such as broad-sense heritability and the relationship between genetic and environmental

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coefficients of variation, in addition to experimental coefficient of variation.

Genetic dissimilarity was estimated using the generalized Mahalanobis distance. Data were grouped using the hierarchical method, unweighted pair-group method using arithmetic averages (UPGMA), and an optimization method, Tocher.

A dendrogram was obtained from the UPGMA, which was defined by the genotypes with the highest similarity. The adequacy of the hierarchical grouping method was verified using the cophenetic correlation coefficient. The relative importance of each variable was estimated by the Singh's method (1981). The performance of each group, formed by the UPGMA, was evaluated based on the average of each group.

Phenotypic and genotypic correlations were evaluated. The significance of the phenotypic correlation was estimated using the t-test with *n*-2 degrees of freedom, where *n* is the number of genotypes evaluated. The significance of the genotypic correlations was evaluated by the bootstrap with 5,000 simulations.

Path analysis was used to estimate direct and indirect effects. In this analysis, the mean mass of bulbs was considered as the main dependent variable, and it was performed only when its correlations with other characters had correlation estimates ≥ 0.5 and were significant. Prior to the analysis, the degree of multicollinearity was calculated following the criteria established by Montgomery and Peck (1981).

The Genes software (CRUZ, 2013) was used to perform the analyses, and the dendrogram was generated using the graphics and dendextend packages in the R version 3.5.2 software (R CORE TEAM, 2018).

III. Results and Discussion

This study found the existence of genetic variability among the genotypes for most of the characters evaluated at the significance level of 1% by the F test (Table 1), showing that strain selection is possible. The variables that were not significant were neglected in the subsequent analyses.

Table 1: Mean Square. Broad-Sense Heritability. Cvg/Cve Ratio. and Coefficient of Variation of Agronomic Characters of a Set of Advanced Onion Strains. in the Municipality of Uberlândia, MG, Brazil.

Characters	MS	h^2a (%)	CVg/CVe	CV (%)
Plant vigor	1.66**	56.99	0.81	14.26
Pseud. diam.	0.40*	41.03	0.58	7.41
Plant archit.	1.54**	49.80	0.70	15.80
Leaf waxiness	1.25**	52.08	0.73	11.11
Leaf dryness	4.48**	76.94	1.29	17.89
Cycle	415.57**	93.74	2.73	2.99
Mean mass	96816.85**	70.09	1.08	14.99
Density	0.01 ^{ns}	0.00	0.00	7.94
Bulb color	0.92**	87.48	1.86	5.09
Bulb shape	0.63**	71.46	1.11	6.06
Shape unif.	0.71**	71.24	1.11	6.31
Bulb firm.	3.22**	88.40	1.95	9.43
Post-harvest	41.06**	82.98	1.56	28.47

*^{ns}: not significant; **: significant at 1% level by F test; *: significant at 5% level by F test.*

The heritability (h^2a) of most characters showed moderate to high values (≥ 70%). The vigor of plants did not show the highest values of heritability (56.99%) in this study. The mean mass variable is indicative of crop production, and the heritability of this variable, with a value of 70.09%, was considered moderate according to the literature.

The results for heritability can be explained by the additive effect present in the advanced genotypes, resulting from their genetic homozygosity. As for the bulb density variable, several genes might be responsible for it, which would explain its low heritability value and the small density values. The genetic gain from selection for this variable seems to be very low.

Porta et al. (2014) studied the heritability of characters in onion landrace and S1 varieties and obtained the highest value of broad-sense heritability for the characteristics of dry matter, maximum leaf length and soluble solid content, respectively. Some authors attribute relative importance to the characteristics, dry matter and soluble solids content, due to their direct relationship with post-harvest, because they imply the storage capacity and commercial quality of bulbs. This study considered the storage period, and the heritability was high (82.98%).

Heritability allows predicting genetic gains in the future selection cycles. Traits with higher heritability will bring greater gains. Thus, the characters' cycle, mean

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mass, color, shape, and uniformity of bulb shape, in addition to firmness and preservation after harvest, tend to respond favorably to the selection process for genetic gains. Oliveira (2015) estimated the broad-sense heritability of total and commercial bulb yields of Valenciana onion populations in two environments, and the highest values obtained were 77% and 81%, respectively.

Similarly, the inferences about the success of the selection can be made by analyzing the values of the CVg/CVe ratios. Table 1 shows values above one unit for leaf dryness, cycle, bulb color, bulb shape, bulb shape uniformity, mean mass of bulbs, bulb firmness, and post-harvest durability. The characteristic that presented the highest CVg/CVe ratio was cycle, and the lowest was bulb density, which also presented low heritability.

The study of the relationship between the coefficients of genetic and environmental variation (CVg/CVe) indicates the possibility of gain with selection. This ratio serves as a parameter of the superiority of the genetic components in comparison to the environmental components. When this ratio is ≥ 1.0, the possibility of obtaining gains by selection is high (TORRES, 2015).

In this study, with the lowest CV values for the characteristics: cycle, color, shape, and uniformity of bulb shape, the experimental coefficients of variation were corroborated by those observed in the literature, reinforcing the accuracy of the statistical inferences made for these characteristics. The experimental CV of the advanced strains varied from 2.99% (cycle) to 28.47% (post-harvest durability).

CV is a measure of dispersion for estimating the experimental precision. The lower the CV, the greater the experimental accuracy, although the idea of accuracy is inherently related to each research area (RODRIGUES, 2013); therefore, for most of the characters evaluated, the experimental precision was medium to high.

Some studies by other authors showed that the CV values obtained in this study are in the range that is commonly obtained in research with onions. Ricci et al. (2014) reached values of 12.5%, 12.5%, and 13.7%.

In the UPGMA, the delimitation of groups obtained in dendrograms can be determined through a visual examination and subjectively observing the points of high-level change in the dendrogram (CRUZ; REGAZZI; CARNEIRO, 2012). Following this assumption, Figure 1 shows the formation of 20 groups with 32.5% dissimilarity as the delimitation criterion.

The cophenetic correlation coefficient (CCC) obtained, $r = 0.64$ (at 1% probability, i.e., $p \leq 0.01$), being significant for clustering, allowed visual inferences through the dendrogram.

Some studies by Filho and Guadagnin (2011) showed that in experiments with many cultivars and variables, there is a tendency for lower CCC; thus, corroborating the CCC value obtained in this study.

Of the 20 groups formed, groups I, VIII, X, XI, and XVI together were responsible for grouping 47.2% of the genotypes studied. Moreover, a considerable number of groups contained only one genotype each. These were groups III, IV, VI, VII, IX, XII, XIII, XVII, and XIX. In other words, their isolation in one group shows that they present an accentuated degree of divergence compared to the others.

The Tocher optimization method, based on the Mahalanobis matrix, segregated the 53 genotypes into 19 groups (Table 2), of which 56.6% of the genotypes were gathered in groups I, II, and III, and the rest in smaller groups.

The UPGMA and Tocher methods gave similar results for the number of groups formed. In both the methods, genotypes 17A1, 17A2, 17A13, 17A30, 17A38, 17A47, and 17A52 formed one group each, showing once again that they differed considerably from the rest of the genotypes studied. Moreover, the UPGMA method presented nine groups with only one genotype, while the Tocher method formed 12 groups.

In both the methods, group V was practically identical - UPGMA: 17A33, 17A14, and 17A49, and Tocher: 17A33, 17A14, 17A49 and 17A35. So were the groups XVIII and VI with genotypes 17A12 and 17A43, and groups XX and IV with genotypes 17A8 and 17A9 in UPGMA and Tocher, respectively. In the other groups, there was not much similarity.

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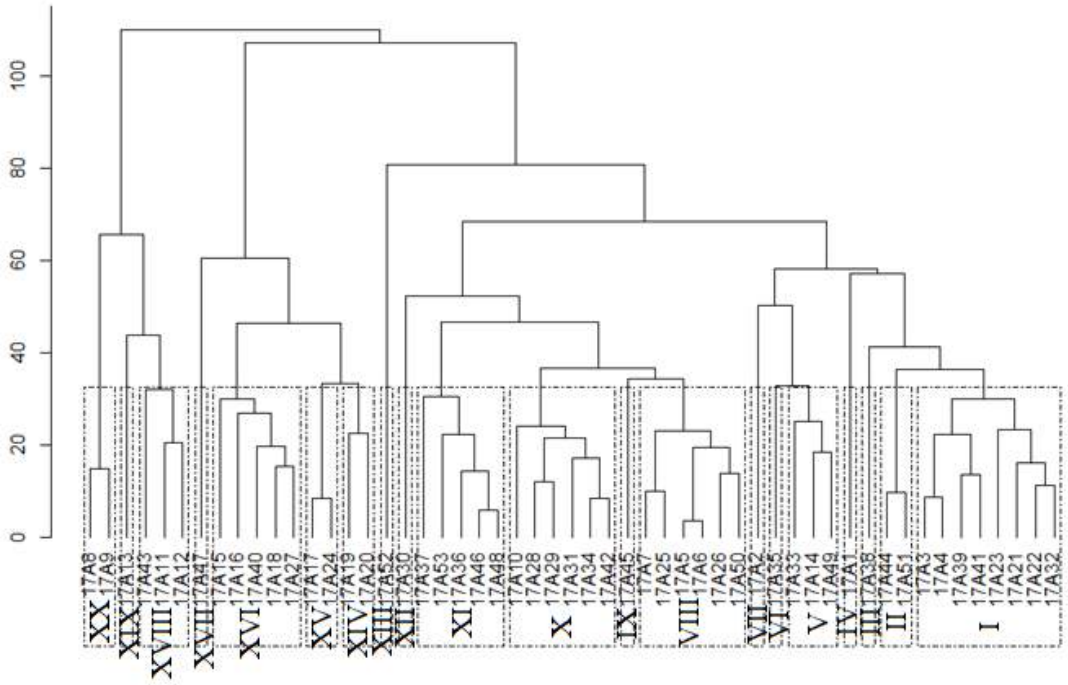

Figure 1: Representative Dendrogram of Genetic Dissimilarity Among 53 Advanced Onion Strains Obtained by the UPGMA Method using the Generalized Mahalanobis Matrix. Uberlândia, MG, Brazil.

Table 2: Optimization Clustering of 53 Advanced Onion Strains Obtained by the Tocher Method. using the Generalized Mahalanobis Distance. Uberlândia, MG, Brazil.

Groups	Genotypes
I	17A5 17A6 17A26 17A34 17A25 17A7 17A50 17A50 17A42 17A29 17A31 17A28 17A48 17A36 17A46
II	17A17 17A24 17A18 17A16 17A19 17A40 17A27
III	17A3 17A4 17A22 17A41 17A39 17A21 17A32 17A44 17A51
IV	17A8 17A9
V	17A14 17A49 17A33 17A35
VI	17A11 17A12 17A43
VII	17A23 17A53
VIII	17A15
IX	17A30
X	17A20
XI	17A10
XII	17A37
XIII	17A1
XIV	17A38
XV	17A52
XVI	17A2
XVII	17A13
XVIII	17A45
XIX	17A47

Buzar, Oliveira, and Boiteux (2007) studied the genetic divergence of 64 tropical and subtropical onion accessions, which were evaluated using 23 morphological, biochemical and agronomic descriptors. The generalized Mahalanobis distance was adopted as a measure of dissimilarity, and the methods of Tocher's optimization and hierarchical nearest-neighbor were used for clustering. The authors found that both the grouping methods provided similar results and formed approximately the same number of groups, corroborating what occurred in this study.

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From the mean of the 12 variables in the groups generated by the UPGMA method, it is evident that groups XIV, XVIII, and XIX stood out with highest values in the greatest number of characters of interest for onion production (Table 3).

Table 3: Average Performance of each Group of Onion Genotypes. Obtained by the UPGMA Method. in Relation to the 12 Characters. Uberlândia, MG, Brazil.

Groups	VIG	PD	ARQ	LW	LD	PC	MBM	BC	BS	UNI	FIR	POS
I	6	7	6	7	5	170	110.3	6	7	7	5.7	11
II	8	6	6	8	5	182	115.0	6	7	7	5.2	8
III	7	7	5	8	4	165	113.3	5	7	6	5.5	14
IV	6	7	8	7	3	181	140.0	7	6	8	4.8	4
V	6	6	5	7	5	156	136.8	7	7	7	6.5	11
VI	6	7	5	7	6	174	151.0	7	7	6	5.6	11
VII	6	7	4	6	7	170	133.3	6	6	8	6.3	13
VIII	5	7	5	7	7	184	104.6	7	7	7	6.3	3
IX	6	7	4	7	6	182	85.5	7	7	6	5.7	2
X	5	7	6	7	5	185	79.7	7	7	7	6.7	5
XI	6	7	6	8	7	184	114.1	7	7	7	7.6	9
XII	7	5	6	7	8	182	115.3	7	8	8	6.3	6
XIII	7	6	7	7	5	189	95.0	6	8	8	7.5	3
XIV	5	7	6	7	8	167	106.1	7	8	8	5.5	13
XV	5	6	5	8	7	151	145.0	7	8	8	6.2	15
XVI	7	6	6	7	6	149	119.2	7	8	7	5.8	14
XVII	8	6	6	8	8	145	169.0	6	8	8	4.6	14
XVIII	7	7	5	7	5	153	114.9	8	7	7	8.5	13
XIX	7	7	6	8	6	148	122.8	7	7	6	10.8	15
XX	5	7	6	6	4	166	119.8	8	6	8	8.9	15

Vigor (VIG), pseudostem diameter (PD), plant architecture (ARQ), leaf waxiness (LW), leaf dryness (LD), plant cycle (PC), mean bulb mass (MBM), bulb color (BC), bulb shape (BS), plot uniformity (UNI), firmness (FIR), and post-harvest (POS) of bulbs.

Table 3 shows that groups V, XV, XVI, XVII, and XX presented the most precocious genotypes (with shorter plant cycles), and stood out for bulb-related characters (color, shape, plot uniformity, mean mass, and post-harvest).

These results point out that the combination between the superior and contrasting genotypes for onion production of groups V, XIV, XVIV, XVI, XVII, XVIII, XIX, and XX, will enable the expansion of favorable genetic variability.

The characters plant cycle, bulb firmness, and bulb color together comprised more than 50% of the relative contribution to the divergence of the genotypes. The remaining characters showed smaller relative contribution and therefore were less influential for the divergence (Table 4).

Six significant phenotypic correlations were found using the t-test. The estimates ranged from 0.28 to 0.77, showing a low to moderate degree of association (Table 5). Most of the genotypic correlations were higher than the phenotypic ones, and presented the same sign, positive or negative.

The phenotypic association was probably minimized by the environment. The degree of freedom improves the estimates as a result of the increased number of repetitions. In addition, it improves the estimates of genotypic variances, and consequently, the estimates of correlations.

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Table 4: Relative Contribution of the Variables in 53 Advanced Onion Strains. According to Singh's Criterion. Uberlândia, MG, Brazil.

Characters	S.j.	Value (%)
Cycle	28196.41	25.35
Bulb firmness	15665.36	14.08
Bulb color	12028.74	10.81
Bulb weight	8592.56	7.72
Bulb post-harvest durability	8530.50	7.67
Plot uniformity of bulbs	8168.16	7.34
Bulb shape	7657.19	6.88
Leaf dryness	7062.31	6.35
Architecture	4494.53	4.04
Vigor	4113.94	3.69
Leaf waxiness	3890.72	3.49
Pseudostem diameter	2789.14	2.50

Characters S.j. Value (%) Cycle 28196.41 25.35 Bulb firmness 15665.36 14.08 Bulb color 12028.74 10.81 Bulb weight 8592.56 7.72 Bulb post-harvest durability 8530.50 7.67 Plot uniformity of bulbs 8168.16 7.34 Bulb shape 7657.19 6.88 Leaf dryness 7062.31 6.35 Architecture 4494.53 4.04 Vigor 4113.94 3.69 Leaf waxiness 3890.72 3.49 Pseudostem diameter 2789.14 2.50 1

Table 5: Phenotypic (Rp) and Genotypic (Rg) Correlation Coefficient Involving 12 Characters, in 53 Onion Genotypes, In Uberlândia, MG, Brazil.

		PD	ARQ	LW	LD	PC	MBM	BC	BS	UNI	FIR	POS
VIG	rp	-0.42**	0.19	0.23	-0.14	-0.22	0.28*	-0.21	0.18	-0.13	-0.06	0.16
	rg	-0.41	0.20	0.33	-0.22	-0.23	0.25	-0.36	0.39	-0.33	-0.14	0.22
PD	rp		0.09	-0.02	0.00	0.14	-0.33*	0.27	-0.24	-0.15	0.23	-0.12
	rg		0.18	-0.04	0.02	0.16	-0.53+	0.46	-0.62	-0.31	0.44+	-0.17
ARQ	rp			0.13	0.00	-0.05	0.00	0.00	0.26	0.27	-0.11	0.02
	rg			0.32	0.02	-0.10	-0.17	0.07	0.62	0.51	-0.12	0.09
LW	rp				0.27	-0.14	0.18	0.07	0.23	-0.14	-0.13	0.02
	rg				0.48	-0.21	0.23	0.12	0.49	-0.44	-0.11	0.09
LD	rp					0.02	0.12	0.09	0.13	-0.01	0.00	-0.03
	rg					0.00	0.20	0.12	0.19	0.02	-0.01	-0.04
PC	rp						-0.50**	0.10	-0.28	-0.01	-0.05	-0.77**
	rg						-0.64++	0.13	-0.35	-0.01	-0.04	-0.85++
MBM	rp							-0.21	0.19	0.10	-0.03	0.49**
	rg							-0.22	0.31	0.08	-0.11	0.70++
BC	rp								-0.19	0.00	0.54	-0.20
	rg								-0.26	-0.03	0.59	-0.21
BS	rp									0.02	-0.18	0.30
	rg									0.12	-0.22	0.39
UNI	rp										-0.10	0.05
	rg										-0.16	0.13
FIR	rp											0.15
	rg											0.20

Vigor (VIG), pseudostem diameter (PD), plant architecture (ARQ), leaf waxiness (LW), leaf dryness (LD), plant cycle (PC), mean bulb mass (MBM), bulb color (BC), bulb shape (BS), plot uniformity (UNI), bulb firmness (FIR), and post-harvest (POS).

Phenotypic correlations have genetic and environmental causes; however, only the genetic ones are heritable, implying their use in guiding selective breeding programs (CRUZ; REGAZZZI; CARNEIRO, 2012). Therefore, the genetic phenotypic correlation has to receive special attention.

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A negative and significant genetic correlation between pseudostem diameter and mean bulb mass (0.53), plant maturity cycle and mean bulb mass (-0.64), and plant maturity cycle and bulb post-harvest durability (-0.85) was identified, showing that one characteristic increases at the expense of another.

The correlations between mean bulb mass and post-harvest were significant with an emphasis on the genetic correlation (rp = 0.49** and rg = 0.70++). This result shows a direct relationship between these characteristics, and a possibility of performing indirect selection. In a study on soybeans, Machado et al. (2017a) confirmed that indirect selection by the number of pods per plant is efficient to select more productive plants.

The correlation between plant maturation cycle and mean bulb mass possibly reflects the interference of photoperiod that was probably insufficient for plant maturation and bulb formation (cycle), which favors lower mean mass. According to Singh et al. (2019), photoperiod plays a key role in the development of different phenophases.

If the photoperiod requirement for bulb formation is between 12 to 14 hours for Brazilian conditions (WAMSER et al., 2012), a better formation and a larger bulb size would be expected in a given period of time (cycle). It is evident, therefore, that the grouping of germplasms with similarity in photoperiodic requirements is necessary for studies involving characteristics related to production, such as pseudostem diameter, cycle, and mean bulb mass. In this experiment, however, a large number of genotypes with variations in photoperiodic requirements were evaluated, which may explain these results.

Aditika, Priyanka and Sharma (2015) studied 21 onion genotypes, and observed associations among characters related to onion bulb yield. Similarly, in this study, the authors have found significant genetic associations between bulb weight and neck thickness, and between bulb weight and number of days to taken to reach plant maturity. However, conversely, the correlations found by the authors were positive. These results confirm how the heterogeneity of the genotypes studied and the climatic conditions can affect the characters in question.

The estimated correlation between the variables plant maturation cycle and post-harvest bulb harvest showed high magnitude, but in negative association, indicating that plants that attain maturity early have a better post-harvest preservation. However, part of the effect of the high negative correlation between these two characters may also have come from the fact that some genotypes have poor bulb formation, due to the short photoperiod, which contributes greatly to lower post-harvest preservation.

From the correlations between mean bulb mass and post-harvest, it is assumed that heavier the bulb, greater is its preservation post-harvest. On the other hand, lighter bulbs tend to have lower post-harvest preservation. It is worth considering that the same effects explained for previous correlations, where bulbs of small size, due to malformation by photoperiodic insufficiency, also tend to have a lower post-harvest preservation.

The study of correlations has great relevance when it comes to quantifying the magnitude and direction of factors in determining characters, however, the direct and indirect effects of these factors are not given due importance. On the other hand, path analysis allows the unfolding of correlations of direct and indirect effects of the characteristics on a variable (CRUZ; REGAZZI; CARNEIRO, 2012).

In this study, the opposite association observed between the diameter of the pseudostem and the mean bulb mass was possibly due to the fact that in this correlation the mean mass of bulbs is greatly influenced by the photoperiod required for their formation, as when the photoperiod is insufficient, which probably occurred in this experiment, the pseudostem is thicker. It also shows that it is not feasible to use these characters for indirect selection.

The mean bulb mass showed significant genetic correlations > 0.5 with more than one variable (diameter of the pseudostem, cycle of maturation of the plants, and post-harvest preservation of bulbs); thus, a path analysis was performed to check if they really have strong cause-and-effect relationship.

The variables studied in the path analysis did not present multicollinearity problems. The low value of the coefficient of determination of the path (0.35) and the high effect of the residual variable (0.80) shows that the cause-and-effect relationship between the variables studied are weak (Table 6).

The estimation of direct genotypic effects showed that post-harvest preservation of bulbs had the greatest direct effect on the mean bulb mass. The positive indirect effect of the maturation cycle of the plants influenced the positive correlation with the mean mass of bulbs, and the diameter of the pseudostem was also influenced in the same way but to a lesser degree.

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Table 6: Estimates of Phenotypic and Genotypic Direct and Indirect Effects of Pseudostem Diameter (PD), Plant Cycle (PC), and Post-Harvest Bulb (POS) on the Mean Bulb Mass (MBM) in 53 Onion Genotypes Grown in Uberlândia, MG, Brazil.

Characters	Phenotypic effects	Genotypic effects
Direct effect PD / MBM	-0.267	-0.430
Indirect effect via PC	-0.040	-0.031
Indirect effect via POS	-0.029	-0.078
Total	-0.338	-0.539
Direct effect PC / MBM	-0.276	-0.195
Indirect effect via PD	-0.039	-0.068
Indirect effect via POS	-0.189	-0.381
Total	-0.505	-0.645
Direct effect POS / MBM	0.245	0.449
Indirect effect via PD	0.032	0.075
Indirect effect via PC	0.213	0.165
Total	0.492	0.690
Coefficient of determination	0.35	0.67
Residual effect	0.80	0.58

The direct effects showed the same sign as the correlations, but their magnitudes were low (less than the estimated residual effect), both for phenotypic and genotypic effects, proving that the explanatory variables (pseudostem diameter, plant cycle, and post-harvest bulbs) are not the main ones responsible for the variation of the main variable (mean bulb mass), and consequently, indirect selection is likely to have low efficiency.

The phenotypic and genotypic variations that were not explained by the path analysis were 80% and 58%, respectively. This predicts that only 20% and 42% of the variations in mean bulb mass at the phenotypic and genotypic level, respectively, were determined by means of the path analysis.

In this study, plant health was not considered in the evaluation because during the management of the crop, an efficient phytosanitary control was performed. However, Machado et al. (2017b) studied onion populations and observed a high correlation between plant architecture and *Botrytis* spp. Torres et al. (2016), in their experiments on *Urochloa brizantha*, also confirmed in their results that phenotypic expression reduced under the influence of the environment; therefore, this is a variable to be considered in future studies. Parvez et al. (2020) studied the performance of purple onions, and detected cultivars tolerant to purple spot disease, so they can be used as source material in selective breeding programs.

IV. Conclusion

The genetic parameters studied shows the possibility of gains in the selection for most of the characters evaluated. The study identified a wide genetic variability for the morpho-agronomic traits evaluated, allowing the discrimination of groups of divergent genitors in onion. The phenotypic and genotypic correlations showed low associations between the evaluated characters, making the use of indirect selection unfeasible.

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In Vitro Testing of the Trichoderma Species as Bio-control Agents of (Neofusicoccum. Mangiferae. Crous) Pathogen of Branch Disease in Shade and Fruit Trees

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Abstract- This study carried out in 2013 to test the fungicidal potentiality of three Trichoderma species under laboratory condition. The laboratory experiments were conducted at the laboratory of plant quarantine- Administration of Plant Protection Ministry of Agriculture. Any Trichoderma specie was considered as treatment in addition to one synthetic fungicide (Amstar-Top) for comparison, each treatment replicated 6 times and arranged in CRD. The result revealed that: Amistar-Top at concentration of 200 ppm, had given significant inhibition compared with the three species of Trichoderma with different isolates of the pathogen. However, there was no significant difference between inhibition percentages from Amistar-Top in some treatments. More over *T. harzianum* with *N. mangiferae* isolated from *Mangifera indica* and *T. viride* with the fungal isolate from *F. benjamina* were more effective than Amistar-Top.

Keywords: *trichoedrma spp., pathogen, neofusicoccum. mangiferae .crous, inhibition.*

GJSFR-D Classification: *DDC Code: 628.161 LCC Code: QR105.5*



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Fatin Abdalla Osman [α], Mohamed Abbaker Hassan [σ] & Taha Mohmed Shareef [ρ]

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Keywords: trichoedrma spp., pathogen, neofusicoccum. mangiferae .crous, inhibition.

I. Introduction

One of the strategies used to control pathogens is mycoparasitism whereby a species or strain of fungus directly attacks and feeds on other fungi (Harman, 2000).The antagonistic ability of *Trichoderma* species was discovered 70 years ago. *Trichoedrma* spp. are now the most common fungal biological control agents throughout the world. The primary mechanism of antagonism in Trichoderma is mycoparaasitism (Chet, 1987).

Over the past several decades, various attempts to control plant diseases have been made for eradication or prevention through the development of systemic fungicides. Continued and repeated application of fungicides has disturbed the biological control by natural enemies and let to out-break in disease and development of resistance to various types of fungicides toxicity to non-target organisms and environmental problems (Hayes and Law, 1991). In addition, use of fungicides is uneconomic due to longevity of trees that necessitates repeated application over a long period of time. Triazoles antifungal such as tebuconazole are now widely used for treatment of fungal infections due to their broad spectra activity and improved safety profile compared to other fungicides (Kamai *et al*., 2002).

Due to the importance of bio-agents to control plant diseases, this work is considered a contribution in this aspect especially, to test inhibition activity of three *Trichoderma* species to *N. mangiferae*.

II. Materials and Methods

a) *Effect of Trichoderma Species on the Growth of N. Mangiferae*

Three species of the genus Trichoderma were obtained from the laboratory of plant quarantine-Administration of Plant Protection, Ministry of Agriculture. Active pure culture from each species was prepared by transferring samples from each species into PDA plates and incubated at 28°c for seven days (until the Petri dishes completely covered). Five mm discs of PDA from seven days old culture of each isolate of *N. mangiferae* and the same size disc from seven days old cultures of *Trichoderma* species were placed 3 cm apart from each other and 3 cm from the edge of the plate. The antagonistic potentiality of the three *Trichoderma* species against *N. mangiferae* isolates was measured as inhibition % considering the radial growth in the opposite directions from the centre of the inoculums discs as control (R) and the growth towards the disc of pathogen as treatment (R_1). The inhibition percent was calculated according to the following formula;

$$I\ \% = R\text{-}R_1/R$$

I %= Inhibition percentage

Whereas R= the growth length from the centre of the inoculums disc towards the edge of the plate

R_1= the growth towards *Trichoderma* disc

b) *Effect of Amistar-Top on the Radial Growth of N. Mangiferae*

Five mm discs of PDA from seven days old culture of each isolate of *N. mangiferae* and placed in

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the center of PDA media amended with different concentrations of the fungicide (Amstar-Top), clean discs were placed for control treatment. The fungicidal potentiality of Amstar-Top was measured as inhibition % considering the radial growth from the center of the Petri-dish. The inhibition percent was calculated according to the following formula;

$$I\ \% = D\text{-}D1/D$$

I %= Inhibition percentage

Whereas D= growth diameter in control, D1= growth diameter in the treatment

III. Results

a) Effect of Trichoderma Species on the Radial Growth of Four Isolates of N. Mangiferae

The biological interaction between *N. mangiferae* isolates and *Trichoderma* spp. resulted into reduction of the radial growth of the *N. mangiferae In vitro.* The inhibition percent ranged between 49.8% and 82.14% (Fig-1). *Trichoderma viride* was the most effective against *N. mangiferae* isolated from *C. lemon*, it has resulted in 82.14% inhibition percent. The least inhibition percent was of *N. mangiferae* was that of *T. koningei* with *N. mangiferae* isolated from *F. nitida*. However the statistical analysis showed no significant differences between the means of inhibition percent regarding different *Trichoderma* spp. (Table 1).

Table 1: Inhibition Percentages of Radial Growth of Four N. Mangiferae Isolates Treated with Three Trichoderma Species

Treatments (Trichoderma species)	Isolates of N. Mangiferae			
	Host plants			
	Inhibition%			
	Citrus lemon	F. benjamina	F. nitida	M. Indica
T. harzianum	78.44a	49.80a	53.02a	66.90 a
T. viride	82.14a	64.30a	68.54a	78.82 a
T. koningei	78.76a	54.96a	50.86a	72.78a
LSD	17.63	18.47	35.77	18.47

Mean with the same letter(s) in the column are not significantly different at P< 0.05.

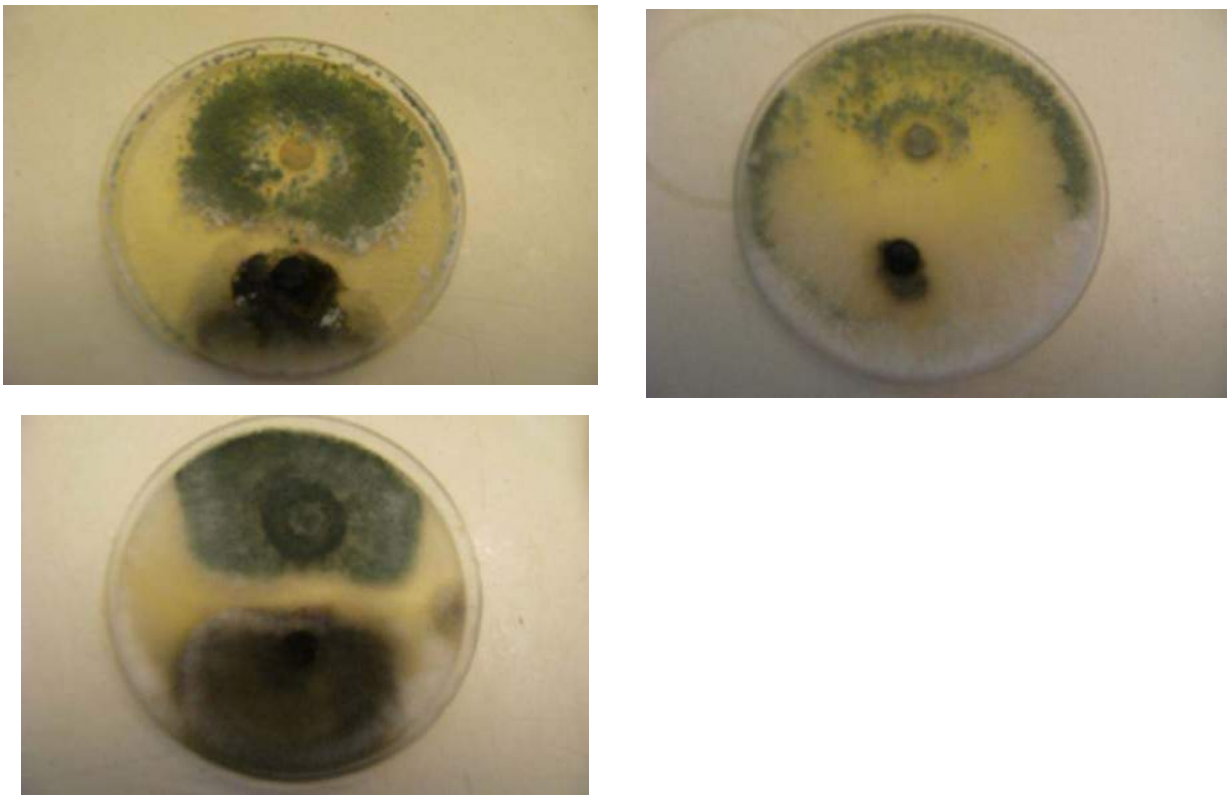

Fig.-1: Effect of Trichoderma Spp. on the Radial Growth of N. Mangiferae

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b) *Effect of Different Concentration of Amistar-Top on the Radial Growth of N. Mangiferae Isolates*

The systemic fungicide Amistar-top was very effective in reduction of radial growth of *N. mangiferae* isolates. Three concentrations of the fungicide have been tested *In vitro*: 100, 200 and 500 ppm. The results showed that there was no significant different between the two concentrations of 200ppm and 500ppm, but they differed significantly from the concentration of 100ppm. This result means that the concentrations 200ppm and 500ppm have the same efficacy (Table-2) and (Fig-2).

Table-2: Effect of Amistar- Top on the Radial Growth of Four Isolates of N. Mangiferae

Concentrations	Isolates of N. mangiferae			
	Host plants			
	C. lemon	F. benjamina	F. nitida	M. indica
	Inhibition %			
100ppm	55.98b	52.96 b	52.04b	51.06b
200ppm	88.08a	85.16a	82.72a	85.00a
500ppm	90.44a	89.64a	90.32a	90.75a
LSD	8.077	19.92	17.30	12.43

Mean with the same letter(s) in the column are not significantly different at P< 0.05.

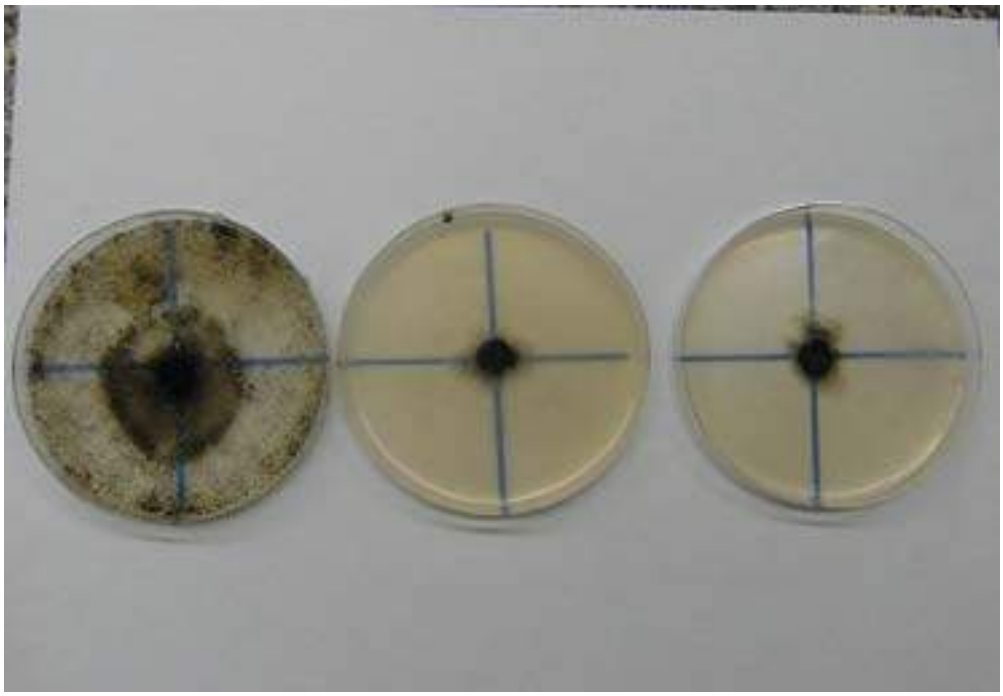

Fig.-2: Effect of Amistar Top on the Radial Growth of N. Mangiferae

c) *Effect of Three Trichoderma Species on the Growth of N. Mangiferae Isolates Compared with Amistar-Top*

The bio-agents tested were compared with the fungicide Amistar-Top tested in the laboratory showed that *Trichodema* spp. have approximately similar effect as Amistar-Top on the pathogen isolates radial growth and (Fig-3). Amistar-top with *N. mangiferae* isolated from *M. indica* was significantly better than *T. harzianum*. However, there was no significant differences between Amistar-Top effect and *T. viride* with *N. mangiferae* isolated from *Citrus lemon, Ficus nitida* and *mangiferae indica*. On the other hand Amistar-top showed its significant superior to *T. viride* with *N. mangiferae* isolated from *F. benjamina*.

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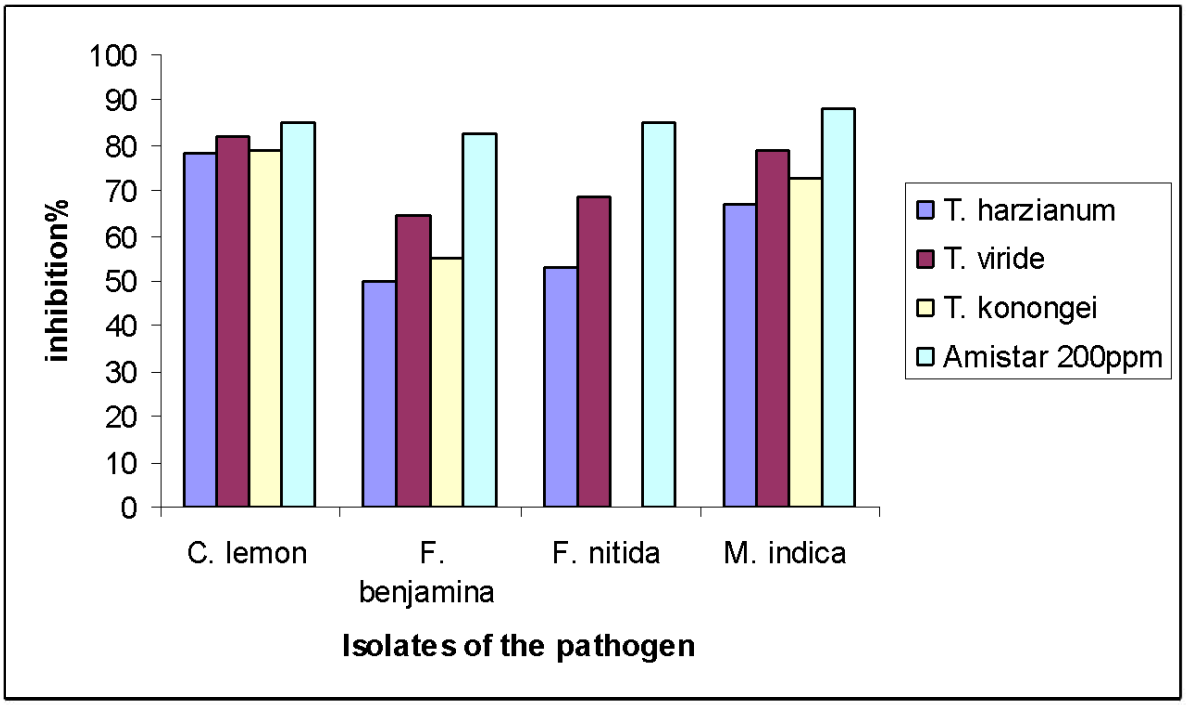

Fig.- 3: Comperison of Inhibition Effect (%) of Three Trichoderma Spp. and Amistar on Four Isolates of N. Mangiferae

IV. Discussion

Trichoerman spp. plays a major role as biocontrol agents, owing to their capability of improving crop yield by multiple roles, such as bio-pesticide, bio-herbicide and plant growth promotion (Mausam, 2007). Currently the roles of BCAs are a well-established fact and become increasingly crucial, and in several cases complementary or even replacing the synthetic chemical components where antagonistic fungi play an important part (Templeten, and Heiny, 1989). Bio-interaction between *Trichoderma* spp. and plant pathogenic fungi tested in the laboratory showed that *Trichoderma* species were differently effective in inhibiting the different isolates of the pathogen (*N. mangiferae*). *T. viride* gave the highest inhibitory action on *N. mangiferae* isolated from symptomic lime tree with 80% inhibition. In counterpart *T. harzianum* have the least inhibition with *N. mangiferae* isolated from *F. benjamina* with 49.8% inhibition. This inhibition of the pathogen can be attributed to the different biological interactions between *Trichoderma* spp. and the pathogen. The systemic fungicide Amstar-Top was used as reference revealed that it is highly effective in reducing the radial growth of different isolates of the pathogen, exactly 88.08% inhibition. This is due to the fact that in case of synthetic chemical fungicides the formulations applied are very accurately calculated according to the recommendations of the company. On the other hand in case of bio-control agents it is difficult to setup formulations for application as the activity of the control agent is subjected to biological factors and environmental conditions. This fact may give the farmer evident to rely on chemicals more than bio-agents application.

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Gender Accessibility to Agricultural Production Resources and Extension Services Amongst Rural Farmers in the North-East Nigeria

By Aliyu M. K., Ibrahim A. L., Garuba H. S., A. M Umar., Muhammad K., Lawal. A., Olanipekun. O. A. & Qasim O. H

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Abstract- This paper reviewed gender issues on accessibility to agricultural production resources and extension services amongst rural farmers in the predominant crises regions of North-East Nigeria, The study applied qualitative analysis in reviewing related literatures, workshop proceedings, seminars, intervention projects, and situation reports on the crisis-torn regions of the Country to elicit cogent facts and figures, The findings revealed that there is a great deal of gender disparity in favor of the men folk as against women and youths in the accessibility to production resources and extension services in the affected regions of the study. This has not only affected their production output but also makes them vulnerable in crisis situations. The paper thus recommends strongly for gender mainstreaming policies towards ensuring equitable access to production resources and extension services in periods of emergencies in these regions.

Keywords: gender, accessibility, extension, production resources, rural farmers and crisis regions of north-east, nigeria.

GJSFR-D Classification: DDC Code: 529.43 LCC Code: AY751



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Gender Accessibility to Agricultural Production Resources and Extension Services Amongst Rural Farmers in the North-East Nigeria

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Keywords: gender, accessibility, extension, production resources, rural farmers and crisis regions of north-east, nigeria.

I. Introduction

Agriculture is critical to achieving sustainable development, by generating a greater proportion of rural households' incomes. In Nigeria, women are involved in food production and provide a majority share of the total agricultural labour force. Despite their significant contribution, women still face challenges in participating in agricultural production. For example, both men and women have different levels of access to agricultural resources, despite the equal roles they play in agricultural activities. It has been argued that if women's incomes were increased, they would have more access to resources and invest in their children's education, health care and nutrition (World Bank 2018).

Women are often hampered in accessing new opportunities by poor access to resources, including new markets, due to their limited educational background, poor networks and mobility restrictions. Also, women have poor access to financing, which hinders them from hiring labour for agricultural activities, forcing them to depend on their own labour and that of family members. Women face high transaction costs for credit, a situation that is exacerbated by their limited property rights and their poverty. Although men also face this barrier, women are more vulnerable in rural areas. In cases where women have access to credit, the amounts are usually very small and repayment conditions are unsuitable (Anaglo et al., 2018).

Gender equality doesn't mean that men and women will become the same, but rather that their rights, responsibilities and opportunities will not depend on whether they were born male or female. Empowering and enabling men and women to participate more effectively in agriculture also translates into improved well-being for their children, thereby building human capital for future generations. As such, achieving gender equality and empowering rural women, men, girls and boys will not only improve nutrition, health and education outcomes, it will also bring both immediate and long-term economic and social benefits for families, communities and nations at large.(FAO, 2017).

For agricultural transformation to be truly inclusive, women must have equitable opportunities to participate and prosper. Around the world, women play important roles in agriculture, including growing crops and tending livestock. But despite high levels of participation, women have consistently lower productivity than men. While this gap is partly due to cultural circumstances, evidence shows that systemic barriers affect the ability of women farmers to control productive resources and access information, credit, and markets. The consequences include lower farm yields and lower household incomes, as well as less potential to improve family welfare, given that women tend to invest more readily than men in their family's well-being. Our efforts to empower women farmers therefore magnify our contributions to improving productivity, income, and nutrition outcomes for vulnerable households Bill & Melinda Gates Foundation (2021).

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Given the prominence of women in the agricultural sector in Nigeria, women are particularly affected by frequent crisis and the climate-related impacts. While the need to build rural adaptive capacity and to empower rural women is well documented, there needs to be greater recognition of women's agency and attention to how women's entrepreneurship development can improve adaptation responses (Akinbami et al., 2019). A study on women's empowerment in farming communities in Southeast Nigeria recommends, for example, that women's participation in the construction, maintenance and management of sustainable water and irrigation systems should be encouraged to counter the impacts of water shortage (Nnadi et al., 2019).

Since 2009, northeastern Nigeria has been hit by a violent conflict which have led to continued large-scale displacements, disruption of basic services, food insecurity, malnutrition, and protection issues. As a matter of fact, the extreme violence caused by non-state armed groups (NSAGs) has resulted in the forced displacement of several millions of civilians from their homes and total loss of their livelihoods. Agricultural livelihoods have been devastated through the destruction of irrigation and farming facilities, the loss of livestock and reduced access to fishing grounds, the collapse of extension services. The value chain for crops, livestock and fisheries has been also severely disrupted as a consequence of the conflict. Additionally, looting and fear of attacks have prevented farmers from working in their fields, leading to reduced harvests, loss of productive assets and extremely reduced purchasing power (FAO.2017).

The impact of the conflict on agriculture in the Northeast was estimated at USD 3.7 billion in 2015, in a country where the agriculture sector provides livelihoods for about 90 percent of the rural population. According to the October 2018 Displacement Tracking Matrix (DTM)3 developed by the International Organization for Migration (IOM) and the National Emergency Management Agency (NEMA), 2,026, 602 internally displaced persons (IDPs) were identified in the six northeastern State. The states in the North East badly hit by the ongoing crisis includes: Borno, Adamawa and Yobe (OCHA Nigeria. 2017).

Agricultural livelihoods in these regions have been devastated through the destruction of irrigation and farming facilities, the loss of livestock, reduced access to fishing grounds, the collapse of extension services. The value chain for crops, livestock and fisheries has been also severely disrupted as a consequence of the ongoing conflict. Additionally, looting and fear of attacks have prevented farmers from working in their fields, leading to reduced harvests, loss of productive assets and extremely reduced purchasing power. (FAO 2016).

In recent years, the conflict has worsened the food security and nutrition situation, with widespread loss of livelihoods and reduced access to essential social services. OCHA Nigeria. (2018). The conflict has reduced the food security of both internally displaced persons and host communities as farmland has become inaccessible, irrigation material destroyed and animals looted. Food prices have increased, and labour wage rates fallen. Other contributors to severe food insecurity include below-average crop production and a financial crisis linked to local currency depreciation. NSRP & UNICEF Nigeria. (2017).

Though there are available literatures on women's access to resources in general, but there is little or a lack of consensus on the actual magnitude and effects of gender differences in access to agricultural resources in the crisis zones of the North-Eastern part of Nigeria. This paper thus intends to critically review the gender accessibility to agricultural production resources and extension services amongst rural farmers in the crisis regions of North-East Nigeria.

II. Methodology

The study applied a qualitative analysis of reviewing related works of literature, workshop proceedings, seminars, intervention projects, and situation reports on the crisis-torn regions of North-East Nigeria to elicit cogent facts and figures. A total of 50 materials were reviewed on the subject matter of which 45 were found to be directly relevant to the study.

III. Findings and Discussions

a) *Gender Disparity and its Effect on the Accessibility to Production Resources*

Rural women play a key role in supporting their households and communities in achieving food and nutrition security, generating income, and improving rural livelihoods and overall well-being. They contribute to agriculture and rural enterprises and fuel local and global economies. As such, they are active players in achieving the MDGs. Yet, every day, around the world, rural women and girls face persistent structural constraints that prevent them from fully enjoying their human rights and hamper their efforts to improve their lives as well as those of others around them. In this sense, they are also an important target group for the MDGs.FAO 2017,

In a report by World Bank 2018, which reveals that Agricultural gender inequalities remain strong, women farmers are particularly at risk of hunger, especially when crisis strikes. On average, rural women account for nearly half the agricultural workforce in developing countries. Despite their crucial roles in household food security, they face discrimination and limited bargaining power. Patriarchal norms create

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disadvantages for women farmers, specifically in land rights (small plots, difficulties attaining ownership, discriminatory inheritance rights), productive resources (no access to credit, extension services or inputs), unpaid work, insecure employment and exclusion from decision making and political representation. Within the household, because of weaker bargaining position they frequently eat least, last and least well. Women farmers who control resources generally have better-quality diets. World Bank (2018).

Women are vulnerable on all dimensions of food security: availability, access, utilization and stability. They suffer the most from macro- and micronutrient deficiencies, especially during reproductive years, with long-term negative development impacts for society as a whole. Food-price spikes have negative repercussions for female household heads. They suffer labour market discrimination, which confines them to informal and casual employment, as well as pay inequity. Also, they frequently spend a bigger share of their family budget on food than male heads of household. Women's coping strategies In times of crisis, poor households face asset losses and lower incomes. Men have more access to social capital and pathways out of crisis (their income pays past debts and secures new farm loans), whereas women often face severe time burdens, given their household food-security roles. As they usually have a weak bargaining position with regard to household income, they frequently must reduce spending on nutrition and family well-being. Indeed, households adjust to reduced food purchasing power by shifting to cheaper, less diverse diets. Women tend to buffer the impact through extreme strategies: reducing their own consumption to feed others, collecting wild food, migrating or selling assets, and even taking on risky jobs. World Bank (2018).

In a report by OXFAM 2019 titled: 'Gender inequalities and food insecurity in Northern Nigeria' reveals that poor households face asset losses and lower incomes. Men have more access to social capital and pathways out of crisis (their income pays past debts and secures new farm loans), whereas women often face severe time burdens, given their household food-security roles. As they usually have a weak bargaining position with regard to household income, they frequently must reduce spending on nutrition and family well-being. Indeed, households adjust to reduced food purchasing power by shifting to cheaper, less diverse diets. Women tend to buffer the impact through extreme strategies: reducing their own consumption to feed others, collecting wild food, migrating or selling assets, and even taking on risky jobs.

In a study by (FAO, 2018) which reveals that on the average, women make up about 43 percent of the agricultural labour force in developing countries. Evidence indicates that if these women had the same access to productive resources as men, they could increase yields on their farms by 20 to 30 percent, raising total agricultural output in developing countries by 2.5 to 4 percent, in turn reducing the number of hungry people in the world by 12 to 17 percent.

More so, for rural women and men, land is perhaps the most important household asset to support production and provide for food, nutrition and income security. Yet an international comparison of agricultural census data shows that due to a range of legal and cultural constraints in land inheritance, ownership and use, less than 20 percent of landholders are women. Women represent fewer than 5 percent of all agricultural land holders in North Africa and West Asia, while across Sub-Saharan Africa, women average 15 percent of agricultural land holders (UN, 2017).

In a related study by Oxfam (2019) with extensive evidence shows that rural female-headed households also have more limited access than male-headed households to a whole range of critical productive assets and services required for rural livelihoods, including fertilizer, livestock, mechanical equipment, improved seed varieties, extension services and agricultural education . Similarly, in seven out of nine countries across Africa, Asia and Latin America, female-headed households were less likely to use credit than male-headed households.

(FAO, 2019) in a report reveals that rural women play a key role in supporting their households and communities in achieving food and nutrition security, generating income, and improving rural livelihoods and overall well-being. They contribute to agriculture and rural enterprises and fuel local and global economies. As such, they are active players in achieving the MDGs. Yet, every day, around the world, rural women and girls face persistent structural constraints that prevent them from fully enjoying their human rights and hamper their efforts to improve their lives as well as those of others around them. In this sense, they are also an important target group for the MDGs.

These findings tallies with a study by (Mercy corps, 2017), titled: 'An assessment on the joint livelihood and market recovery in the Northeast of Nigeria'. It highlights the progress of rural women against key Millennium Development Goal (MDG) indicators, pointing to some of the advancements made and gaps that still exist. It suggests that globally, and with only a few exceptions, rural women fare worse than rural men and urban women and men for every MDG indicator for which data are available. While data collection along these lines has improved in recent years — in part because of increased donor and government interest — there still remains a general lack of data not only disaggregated by sex, but also by rural and urban areas. This has an impact on our global

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ability to confidently monitor progress toward the MDGs for all people in all regions, urban and rural, and particularly where progress is needed most.

Similarly, (IFAD 2019) in a study reveals that on average, women make up about 43 percent of the agricultural labour force in developing countries. Evidence indicates that if these women had the same access to productive resources as men, they could increase yields on their farms by 20 to 30 percent, raising total agricultural output in developing countries by 2.5 to 4 percent, in turn reducing the number of hungry people in the world by 12 to 17 percent.

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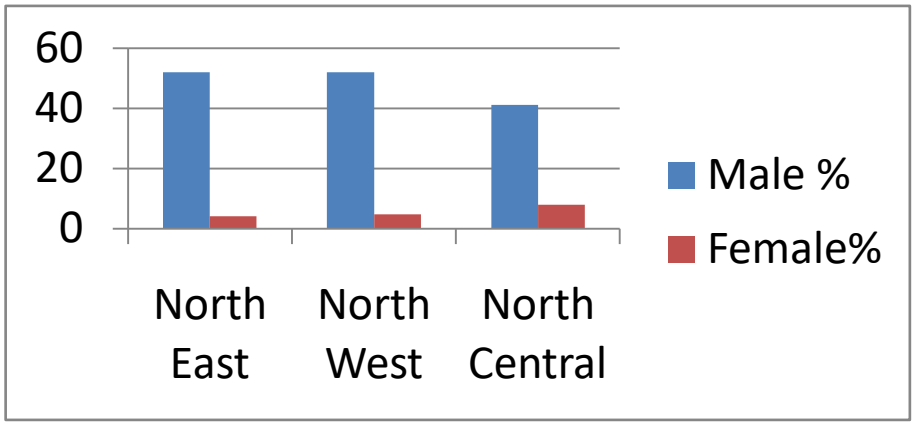
(UNDP, 2019) in a study reveals that because rural women tend to underreport their employment as contributing family members, according to available data female employment in agriculture is consistently lower than it is for men across the total adult population in developing countries, although it varies greatly by region The jobs of rural women who are employed tend to be shorter term, more precarious and less protected than those of rural men and urban people. The lack of flexible hours to accommodate family work combined with wage and job discrimination and limited representation of women in workers' organizations are partly responsible for this.

FAO, 2019 in a report reveals that in Nigeria, gender plays a critical role in land ownership. While women farmers contribute about 70 per cent of food production in the country, land rights discrimination, fuelled by social, economic and cultural factors, affects their productivity. This low-productivity trap, in turn, inhibits an efficient functioning of value chains and an expansion of trade, as women input providers miss out on potential markets, and agribusinesses miss out on the potential for high-quality and reliable supplies of produce from women farmers and agro-processors (FAO, 2019). This denotes that there is a significant correlation between accessibility to land resources and Agricultural productivity.

Figure 1 below shows the distribution of land ownership by gender in the Northern regions of Nigeria. In the North-east, plagued by the jihadist Boko Haram insurgency, only four per cent of women own land against 52.2 per cent of men. In the North-west, which is also facing a severe security crisis caused by herders and the so-called bandits, 4.7 per cent of women own land compared to 50.1 per cent of men. In the North-central, the ratio is 7.9 per cent against 41.2 per cent. (FAO, 2017). These findings connotes that there is wide gap disparity in the ownership of land by the Gender groups especially in the worst affected regions in North Eastern Nigeria.



Source: National Bureau of Statistics (NBS, 2016)

Figure 1: Distribution of Land Ownership by Gender in the Northern Regions of Nigeria

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Table 1: Mean Distribution of Characteristics of Male House Holds (MHHs) and Female House Holds (FHHs)

Gender	Rural (N)	Urban (N)	Land Size (Acres)	Non Farm Income	Farm Income	House hold Size
Male	871	153	2.33	32.69	202.04	7.09
Female	58	14	0.49	22.53	59.53	4.62

Source: 2016 Nigerian GHS Data.

Table 1 above shows that, on average, MHHs have about 3.4 and 1.4 times more farm and nonfarm income than FHHs, respectively. One reason for the large difference in farm income between both types of households is that FHHs generally have less access to agricultural land. Even in cases where they do have similar access, they may not have enough family labor, access to markets, and inputs to cultivate their land productively.

MHHs are larger than FHHs. (NBS. 2016). These findings implies that MHH have better opportunities of maximizing their agricultural productivity due to their access to land, labour and market.

Table 2: The table depicts that in terms of ownership structure, men typically own more land compared to women in Nigeria .Majority of the land owners inherited it from their family, while only 7 and 2.2% of male and female, respectively, reported purchase of land. (National Bureau of Statistics, 2019). World Bank and Federal Ministry of Agriculture and Rural Development. This findings implies that on the average men own more land in comparism to their female counterparts and thus more likely to increase their agricultural productivity.

Table 2: Land ownership structure in Nigeria

Outright purchase		Rented		Used free of charge		Allocated by		Family Inheritance		community	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female		
%	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)		
7.0	2.2	6.8	11.8	7.9	11.8	7.1	5.9	71.2	68.4		

Source: NBS 2019

FAO, 2017 in a related report recognizes that rural women and men, together, hold the keys to ending hunger and extreme poverty. Rural women and girls, in particular, are recognized as major agents of change. Across low-income countries, women make up 48 percent of agricultural employment. As farmers and farm workers, horticulturists and market sellers, businesswomen, entrepreneurs and community leaders, they fulfill important roles throughout agrifood value chains, as well as in the management of natural resources such as land and water.

Women are more likely to be food-insecure than men in every region of the world. And as producers, rural women face even greater constraints than their male counterparts in accessing essential productive resources and services, technology, market information and financial assets. They are under-represented in local institutions and governance mechanisms, and tend to have less decision-making power. In addition to these constraints, prevailing gender norms and discrimination often mean that women face an excessive work burden, and that much of their labour remains unpaid and unrecognized.

More so, on decision-making, findings by a Gender based violence Sub Sector Working Group Nigeria (2017) in a study in the North East, the respondents indicated that, traditionally, it is the men (father, spouse, intimate partner) who incarnate authority within the household and are the decision makers in the family. They continue to control decisions about how family income has to be spent, which includes income earned by women. Women and children are considered to be the persons with low status at community level. Induced change in gender roles has created female headed households with the primary responsibility of ensuring family economic survival, hence women have had to take on extra roles which traditionally were not theirs before the conflict (GBV SSWGN, 2017).

IV. Conclusion and Recommendations

This review therefore unravels the various explanations for gender disparity in the accessibility to production recourses, highlighting the core place of social gender relations in structuring unequal female and male access in the crisis regions of the North-East zone of Nigeria. Variations in intensity of access barriers

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were determined by existing gender orders around household provisioning. Land access was deeply entrenched within social norms and customs, deriving from the customary rules that govern household provisioning in NE, which require both women and men to make contributions towards the family meal. Male provisioning roles override female, a fact that was dominant within all the crisis raveled states in the NE. Generally, agricultural activities engaged by the men attract more value and therefore are favored when it comes to the distribution of resources and extension services. Women's provisioning according to traditional norms, however, was not considered crucial to family survival and therefore not worthy of investments like time, money, and other agricultural inputs, especially land. This paper therefore posits for a greater attention to the existing gender disparity and thus the need for an aggressive approach to ensure gender participation in all the agricultural endeavors in the impending crisis torn regions of the NE. Indeed, women make a significant contribution to food production and processing in these regions, but men seem to take more of the farm decisions and control the productive resources. Food sufficiency can only be guaranteed by continued gender involvement in agriculture. Therefore, there is a need for all stake holders in agricultural policies and programs in these regions to uphold gender sensitivity and mainstreaming with regards to accessibility to production resources. Thus, this would ensure an accelerated rate in agricultural productivity and the attainment of food sustainability in the crisis regions of North-East of Nigeria.

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Management Objectives or Ecosystem Services Protection in Nigeria

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Abstract- People are increasingly confronted with starker choices in resource distribution to competing applications and users. At the local level, for example, land and water allocation for agricultural, industrial, municipal, recreational, and conservation operations is frequently a zero-sum game. This is evidenced by the widespread loss of water and land from natural habitats to farms and, increasingly, to urban and industrial uses. From both an ethical and a practical standpoint, these choices are getting increasingly complex and difficult to reconcile. The Ecosystem Services Framework combines the biophysical and social aspects of environmental preservation in a way that has a lot of promise for dealing with the environmental catastrophe that will most certainly peak in the twenty-first century. A quick description of this framework was presented here, along with a suggestion for immediate action.

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Management Objectives or Ecosystem Services Protection in Nigeria

Njobdi A. L [α], Boni P. G. [σ], Marja, A. S [ρ] & Mamudu, A [ω]

Abstract- People are increasingly confronted with starker choices in resource distribution to competing applications and users. At the local level, for example, land and water allocation for agricultural, industrial, municipal, recreational, and conservation operations is frequently a zero-sum game. This is evidenced by the widespread loss of water and land from natural habitats to farms and, increasingly, to urban and industrial uses. From both an ethical and a practical standpoint, these choices are getting increasingly complex and difficult to reconcile. The Ecosystem Services Framework combines the biophysical and social aspects of environmental preservation in a way that has a lot of promise for dealing with the environmental catastrophe that will most certainly peak in the twenty-first century. A quick description of this framework was presented here, along with a suggestion for immediate action.

I. Introduction

Setting goals for environmental conservation becomes increasingly necessary and urgent as human influence on the natural environment grows. In the United States, landmark policies enacted more than two decades ago address mostly local, reversible, and immediate dangers to human health. These are insufficient in controlling the consequences of human business today, impacts that are affecting the environment at an unprecedented rate, on a global scale, and with irreversible difficulties (Newman and Jennings 2012, Beatley *etal.,* 1997).

It's important to have a global perspective in mind while thinking about environmental preservation in the United States. The United States is a major contributor to and beneficiary of global impacts, both directly and indirectly, given its close biophysical, socioeconomic, and political relationships to other parts of the globe. Humans have heavily transformed v40–50 percent of the ice-free land surface; coopted v50 percent of accessible, renewable fresh water; fully exploited or overexploited v65 percent of marine fisheries; increased carbon dioxide concentration in the atmosphere by v30 percent; increased the rate of atmospheric nitrogen fixation by more than 100 percent over natural terrestrial sources; and driven v25 percent of bird species to extinction worldwide (Porrit 2012, Liu *et al.,* 2010, Costanza *et al.,* 2017, Orr 1992, and Vitousek et al., 1997). Over the next several decades, the expected worldwide rise in demand for food, fresh water, energy, and other resources suggests dramatically intensified human effect (Wuebbles and Jain 2001Schwartz and Randall 2003, Boretti and Rosa 2019).

How do these significant environmental changes affect human well-being, and how can policy respond? Which one is the most important? What are the allowed amounts and types of changes? What methods may be used to design and assess relevant standards? What institutions and policies will be most successful in providing the protection required? To answer these concerns, we must acknowledge that the nation's — and the world's — ecosystems are capital assets that, when properly managed, produce a flow of essential services. The creation of items — such as seafood, lumber, and precursors too many industrial and medicinal products — is a significant and well-known aspect of ecosystem services. Basic life-supporting activities (such as pollination, water purification, and climate management), life-fulfilling situations (such as peace, beauty, and cultural inspiration), and option preservation (such as preserving genetic and species variety for future use) are also included (Heal *et al.,* 2001; Daily 2003; Tallis and Polasky 2011). As with physical capital, proper accounting would value the flow of ecosystem services while pricing out the depreciation of the under-lying asset. Unfortunately, ecosystem capital is poorly understood, under-monitored, and – in many key circumstances — rapidly deteriorating and depleting in comparison to other types of capital. The value of ecosystem services is frequently underestimated until they are lost. As a result, ecosystem capital depreciation is frequently underestimated, if it is ever evaluated at all.

It is not difficult to comprehend this sad circumstance. Until recently, ecosystem capital was plentiful enough that the majority of ecosystem services could be considered "free." Furthermore, economic activity was restricted and had a little influence on natural systems. As a result, there was minimal cross-pollination between ecological and economics. However, as previously said, the situation has drastically changed in recent decades (Edwards-Jones 2009,Daly and Farley 2011 Raven 2012). The current scenario necessitates a much increased ability to characterize

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ecosystem services in both ecological and economic terms. This would allow the entire societal costs and benefits of various policies and courses of action to be weighed. It should, in theory, disclose what's truly at risk so that smarter decisions may be made before ecological changes become too costly and difficult (or impossible) to reverse. A rising number of municipalities in the United States are attempting to obtain natural water filtration services in their watersheds, demonstrating the benefits of acquiring and employing this capacity (Bingham *et al.,* 1995, and De Groot *et al.,* 2010). Such efforts are frequently justified solely on the basis of avoided costs of constructing and maintaining physical treatment plants; however, they may also provide many other unquantified benefits, such as flood/erosion control, carbon sequestration, recreational opportunities, scenic beauty, and so on.

a) The Framework for Ecosystem Services

A new conceptual framework for describing, monitoring, and managing environmental changes and their societal impacts is emerging. The paradigm has the potential to generate realistic and adaptable environmental protection techniques that take into account biophysical, economic, and other crucial societal elements. The Ecosystem Services Framework focuses on the many valuable services that ecosystems and biodiversity provide to civilization (Table 1). These services are provided by a complex interplay of natural cycles that are fuelled by solar energy and operate on a variety of spatial and temporal dimensions. For example, the life cycles of bacteria which take place in a space smaller than the period at the end of this sentence — as well as the planet-wide cycles of important chemical components like carbon and nitrogen, are all involved in the production of soil fertility. Ecosystem services are critical to human survival and function on such a large scale and in such complex and little-understood ways that they cannot be substituted by technology (Allenby 2000, Goble 2007 and Setten *et al.,* 2012). With examples, a categorization of ecosystem services is provided, (Edwards-Jones 2009; Farley 2011; Raven 2012). Yet, since human activities have a greater influence on natural ecosystems, their supply is jeopardized. A comprehensive biophysical and economic characterization of ecosystem services locally, regionally, and globally is urgently needed. Incorporating their worth into decision-making processes will necessitate both the development of methods for estimating their social worth and the development of institutional systems for realizing that value. The Ecosystem services Framework is made up of four main components (Farley 2011; Edwards-Jones 2009; Raven 201 and, Martinez-Alier 2003).

b) Identification of Ecosystem Services

Natural capital stocks (ecosystems, their geophysical structure, and their biodiversity) that provide ecosystem services have received less attention in comparison to physical and financial capital. The suppliers and consumers of ecosystem services must be cataloged in a systematic and quantitative manner. To enable for a nationwide evaluation of ecosystem service flows, the US would have to be classified and mapped according to ecosystem type and land use. One would like to know which services are produced and consumed locally (e.g. pollution control, pest control, soil fertility renewal, serenity), which are produced and consumed globally (e.g. genetic library preservation, climate stabilization), and which are imported or exported regionally (e.g. seafood, timber, flood control, water purification).

c) Characterization of the Services

Following the identification of the primary service kinds and flows, the ecological and economic (and maybe other) implications must be evaluated. Prior to any attempt to value ecosystem services, an ecological characterisation of ecosystem services is required to inform decision-makers about the ecological trade-offs associated with various courses of action. The forms of the production functions characterizing how ecosystems provide services would be determined by ecological categorization. In other words, it would provide light on the relationship between an ecosystem's level of services (quantity and quality) and its geographic spread, as well as the kind and degree of human alteration. For example, an ecological characterization of a forest catchment's hydrological services would characterize water flow and quality as a function of forested area and the kind and amount of human activity in and around the watershed. Because ecosystem services are so intertwined, another purpose of ecological characterisation would be to show how exploiting or damaging one might affect the operation of others. One would identify which combinations of services and human activities — and at what levels — might be sustained in the same forest catchment. Other essential functions include wood production, pollinator provision for neighboring farming, flood management, options conservation, and carbon sequestration ('Options conservation' refers to the preservation of flexibility to modify policies and actions in the future). The goal is to minimize irrevocable service losses for which there is now no apparent demand, so that they can be restored in the future). Given the current mass extinction, it would be particularly interesting to learn how dependent certain functions are on biodiversity (Bellard *et al.,* 2012 and Ceballos *et al.,* 2017). Furthermore, one would wish to discover umbrella' services, whose protection would substantially facilitate the upkeep of others.

Ecological characterisation would also assess the extent to which ecosystems providing certain services are repairable, as well as the time scale over

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which they may be repaired. Ecosystems generally respond nonlinearly to disturbance; their provision of services may not appear to alter with steadily increasing human (or natural) influences until they reach a point when the response might be significant, sluggish, and difficult to reverse. Such important times must be anticipated in order to build appropriate policy; nevertheless, they are poorly understood and are likely to stay elusive.

The ecological categorization would be used to determine the economic and other relevance of ecosystem services. There is no universal approach for calculating the societal value of ecosystem services. For various reasons, fostering the development of a rigorous and transparent valuation process would be extremely beneficial. First, it might shed light on the value of ecosystem assets before decisions are made that lead to their loss; even lower bound and qualitative measurements of importance can be useful in this context. Second, such a method may generate a "information market," spurring much-needed research into how these services work and how important they are (Pascual *et al.,* 2010). Third, the process may encourage the establishment of institutions, such as markets, to realize the value of ecosystem services. Around the world, new methods to conservation funding are being developed and implemented (Daily,*et al*., 2000).

Major difficulties would be addressed by an economic framework for quantifying ecosystem services, including:

1. What are the societal advantages and costs of alternate approaches to manage ecosystem assets (such as land and water)?
2. How can individual preferences for different options be appropriately aggregated?
3. What are the best ways to spread the costs and benefits of alternative plans fairly?
4. To what extent and on what scale may existing or prospective human technology replace ecological services?
5. How should future advantages be valued, in economic, cultural, or other terms, given that the value of ecosystems is largely in the future and will always be mostly in the future?
6. How can the most vulnerable parties – future generations — be represented at the negotiating table?

We're still a long way from using valuation as a scientific decision-making tool. Rather, valuation is now only one instrument in a much wider politic of decision-making – it is a means of organizing data to aid decision-making, but it is not a solution in and of itself. Nonetheless, valuation approaches have had a beneficial impact on decision-making and will most likely continue to do so in the future. The most crucial judgments to make are those in which the advantages considerably outweigh the expenses, or vice versa, and when total correctness is not required.

New York City, for example, was able to determine that it was preferable to attempt restoration of natural water purification services rather than construct a water treatment facility by developing rudimentary lower limit estimates for the value of ecosystem services in the Catskills watershed (Chichilnisky and Heal, 1998). Is this mechanism capable of protecting a larger area of the watershed? New York City is a special situation, with certain particularly favorable legal conditions, but the approach's long-term success there is far from guaranteed (Vaux and Chair, 2000). Nonetheless, assessing what is conceivable, at least in principle, would be instructive. For the United States, ecologist Walter Reid developed the following rough estimate. He gathered data from 74 municipal water supplies in the lower 48 states and calculated a typical figure of 0.3 ha as the land area required per person to maintain a safe drinking water supply. With a population of around 265 million people, the lower-48 states may rationally consider managing about 80 million ha (265 million people 0.3 ha per person) with water quality as a primary aim. This equates to 10% of total land area, which is a sizable chunk (Reid, 2000). Watershed preservation for drinking water supply will, of course, vary by geographic location, depending on ecological, economic, and political conditions. However, the potential for protecting a wide range of economically valuable services connected with watersheds appears to be significant enough to warrant further investigation.

d) Establishing Safeguards

The preservation of ecological services has two major components. The first is identifying the optimal mix of service output, particularly where one service (such as lumber production) may obstruct the supply of another (such as water purification). The second step is to establish institutional mechanisms for ensuring the desired variety of possibilities. Clearly, there is no one-size-fits-all approach to provide ecosystem services. Human civilizations' environmental needs and consequences are always altering, underscoring the importance of maintaining flexibility and alternatives in service delivery. An explicit accounting of ecosystem services and the effects of various actions on them is a vital first step in making informed decisions. Identifying the primary causes of ambiguity regarding the conservation of ecosystem services, as well as their relevance, is a related crucial step. The objective is to develop tools for assessing this uncertainty and incorporate it into flexible policy. Many would argue that, for the time being, the amount of uncertainty in our knowledge of ecological processes, along with the frequency of non-linearity and irreversibility's, necessitates the use of the precautionary principle. That

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is, it would be sensible to avoid actions with potentially severe and permanent repercussions and instead wait for further information before putting ecosystem capital at risk.

Institutional methods for maintaining ecosystem services are expected to differ significantly depending on the ecological and social setting. The gathering of regionally based knowledge is critical; ecosystems are unique, and the devil is in the details, so what works in one location may not work in another. Certain species, for example, play critical roles in some ecosystems while playing minor roles in others (Power *et al*., 1996). The 'umbrella' effect in conservation refers to when the protection of a reasonably well understood or valued service confers protection on others who lack the understanding or institutional backing to bring about their own direct protection. The interdependence of services might be used to enhance the advantages of safeguarding a particular service in this fashion. In theory, pollination services that aren't well-known may be conserved in cultivated, hilly areas if erosion control strategies utilised native flora (to serve as habitat for pollinators).

To protect important ecological services, what financial, legal, and other social structures are required? How might their growth be accelerated and customized to local conditions? Ecologists and economists' recognition that ecosystems are essential and valuable assets would be ineffective without the support of proper institutions. At a variety of scales, from local to international, and in government, NGO, and private sector contexts, promising new institutions for safeguarding ecosystem services have emerged in a wide range of cultures and economies (e.g., Australia, Costa Rica, Madagascar, the United States, and Vietnam), at a variety of scales, from local to international, and in government, NGO, and private sector contexts (Castro and Tattenbach, 1998; *Daily et al*., 2000). Pollination, pest control, water supply (for drinking, irrigation, and hydropower generation), soil fertility management, sustainable tropical wood harvesting, aesthetic attractiveness, and even decomposition are among the functions preserved by these new institutions (of orange peels produced by Del Oro, an orange juice company in Costa Rica).

e) Monitoring the Services/Evaluating the Safeguards

What indicators could be used to reliably and effectively track changes in the availability and quality of ecosystem services? Some areas of monitoring, such as the monitoring of specific fish stocks or the monitoring of water quality, are well-developed and frequently used. Most ecosystem services, however, are not routinely monitored; among the most important and interesting are pollination (Allen-Wardell *et al.,* 1998) and carbon sequestration (Allen-Wardell et al., 1998). (Field and Fung, 1999). This is not the place to go over all of the environmental monitoring literature. It goes without saying that, in tandem with measures to protect ecosystem services, reliable monitoring systems might be used much more extensively. Meanwhile, further study is required to establish trustworthy monitoring algorithms for lesser-known providers. Monitoring ecosystem services is essential for determining the effectiveness of institutional safeguards in place to maintain them.

f) Implementing the Ecosystem Services Framework

Ecosystem services get little clear legal safeguards in the United States. In general, pollution laws (Clean Air Act, Clean Water Act) are based on human health standards; conservation laws (Endangered Species Act, Marine Mammal Protection Act) are species-specific; and our resource management laws' planning mandates (National Forest Management Act, Federal Land Policy and Management Act) are multi-use planning mandates. Parts of these legislation, such as the Clean Water Act's 404 wetlands permit program and water quality criteria, the Endangered Species Act's essential habitat provisions, and the National Forest Management Act's indicator species provisions, certainly can protect ecosystem services (e.g. the spotted owl). However, these rules were not designed to create legal criteria for conserving ecosystem services, and they seldom do so in reality (J. Salzman, American University, personal communication, 6 September 1999).

There are several departments and agencies within the federal government that deal with conservation value and incentives, but only in a peripheral fashion. For example, under the Community-Based Environmental Protection program, the EPA Office of Policy Planning and Evaluation is collaborating with the World Resources Institute to create natural resource accounting and with The Nature Conservancy to build Compatible Economic Development Centers. The National Science Foundation and the Environmental Protection Agency jointly fund a grant program in Decision-Making and Valuation for Environmental Study, and the Water and Watersheds program requires researchers to integrate sociological components in their ecological research. However, none of these initiatives are focused on developing practical methodologies for valuing ecosystem products and services and developing new economic incentives for conservation (Raven, 1998).

The creation of effective institutions and legal measures to maintain ecosystem services is still a work in progress. It will necessitate an interactive process including natural scientists, economics, legal experts, and policymakers. The task is daunting, but the strong degree of interest displayed by members of these diverse organizations — as well as stakeholders in geographic locations where such measures are being

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tried — suggests that the prospects are bright. The first step in advancing the Ecosystem Services Framework's implementation is to identify priorities based on current data, and the second step is to strategically acquire additional data.

g) Prioritizing your Tasks

With the exception of a few isolated cases, we have little understanding of nature or the value of the services offered by the US ecosystems. With worrying signs of a lack of resource sustainability in many countries as we enter the new century, it is relevant and appropriate for the United States to establish such an understanding.

Four important measures might be performed at this point. Choose the low-hanging fruit first. Assess the ecological, economic, and societal justifications for safeguarding relatively well-known ecosystem services (such as water purification and flood control, where certain types of market institutions already exist; and for carbon sequestration, where a market may be emerging). Developing a systematic, transparent procedure for such an evaluation, as well as incorporating important stakeholders in its creation, would be a highly worthwhile exercise in and of itself. Second, live vicariously through other people's experiences. It would be extremely beneficial to keep a close eye on the results of initiatives to protect ecosystem services in the United States and abroad. Such knowledge might be used to inform debates about what works and what doesn't, as well as why.

Finally, try new things. Fostering small-scale, experimental attempts to protect undervalued but important ecological services might pay out handsomely. Promote success models in the fourth place. With institutional procedures that have shown to be highly successful in the communities where they have been implemented, a lot may be done within the current legal and economic framework.

h) Acquiring Information

While there is a wealth of knowledge regarding the functioning of ecosystems and the provision of services in broad and abstract terms, there is a scarcity of data about specific, local ecosystems and economies. Furthermore, while the services are well understood to be critical and under danger, nothing is known about marginal values (the net benefit or cost of maintaining or destroying the next unit of an ecosystem) or nonlinearities in ecological responses to human impact. This knowledge is frequently not obtained until it is too late to undo the damage that has already been done (e.g. after heavy flooding).

More case studies addressing these topics would be really beneficial. Such research would establish the range of possibilities and constraints for using the Ecosystem Services Framework, as well as reveal how universal the findings from specific locales are and serve as a guide for policy formulation. Officials in New York City, for example, are buying property and adjusting agricultural and municipal activities in the hopes of recreating the Catskills' natural water filtration services — all with very little scientific knowledge. The success of the measures is being studied carefully, but the political window for adopting this method (rather than establishing a physical filtration facility) may be closing shortly. Success in the policy arena rests on whether the scientific basis of policies are valid in this specific example, as well as in general. Many laws exist now that might be utilized to preserve the environment, but their implementation is pending more scientific data.

i) Taking Initiative

The Ecosystem Services Framework's implementation is clearly a long-term, iterative process that will change over time as experience and scientific and socioeconomic knowledge grow. Where should I start? One fruitful place to start in the United States would be to draw out ecosystem 'service area' maps for water purification on a regional or national level. Natural water purification has a substantial scientific and regulatory foundation, allowing it to I define prioritization criteria and (ii) apply them geographically to determine both the scope for using ecosystem approaches to water purification and the locations that deserve the most attention and effort. While biodiversity conservation priorities have been widely mapped based on biodiversity distributions and threats (e.g. Ricketts et al., 1999), maps of ecosystem service priority are few. Maps of ecosystem 'service areas,' like those of species or ecosystem distributions, and their associated challenges to persistence, might be employed (Balvanera *et al*., 2001). The mapping approach might reveal three important aspects: I various land management regimes necessary to deliver a particular societal benefit, (ii) the degree of geographical congruence between services and the management regimes required to maintain them (e.g. how much managing of an area for water purification would confer timber, flood control, carbon sequestration, or recreational benefits), and (iii) predicted changes in both services and society demand for them under various future demographic and land-use change scenarios.

The mapping process would also serve as a focal point for involving stakeholders, integrating social and ecological elements of ecosystem service management, experimenting with novel incentive/financing schemes, and pushing forward the policy agenda. Picking low-hanging fruit (virtually everyone understands the importance of safe drinking water), learning vicariously (ecosystem approaches to water purification are well underway in the US and internationally), developing new methodological approaches that integrate science, economics, and policy, and, last but not least, promoting models of success would be the first steps.

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Table 1: Type of Ecosystems

Categorization of Ecosystem Services with Examples
Ecosystem service
Production of goods
Food
Terrestrial animal and plant products Forage
Sea food Spice
Pharmaceuticals
Medicinal products
Precursors to synthetic pharmaceuticals
Durable materials Natural fiber Timber
Energy
Biomass fuels
Low-sediment water for hydropower

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Industrial Products
Waxes, oils, fragrances, dyes, latex, rubber, etc. Precursors to many synthetic products

Genetic Resources
Intermediate goods that enhance the production of other goods
Regeneration Processes

Cycling and Filtration Processes
Detoxification and decomposition of wastes Generation and renewal of soil fertility Purification of air
Purification of water
Translocation Processes
Dispersal of seeds necessary for regeneration, Pollination of crops and natural vegetation

Stabilizing Processes
Coastal and river channel stability
Compensation of one species for another under varying conditions
Control of the majority of potential pest species
Moderation of weather extremes (such as of temperature and wind)
Partial stabilization of climate
Regulation of hydrological cycle(mitigation of floods and droughts)
Life-fulfilling functions Aesthetic beauty
Cultural, intellectual, and spiritual inspiration Existence value
Scientific discovery Serenity

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Informal Guidelines of Research Paper Writing

Key points to remember:

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

Final points:

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

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

The discussion section:

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

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

General style:

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

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



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Mistakes to avoid:

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

Title page:

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

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

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

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

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

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

Approach:

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

Introduction:

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

The following approach can create a valuable beginning:

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

Approach:

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

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

Procedures (methods and materials):

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

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

Materials:

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

Methods:

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

Approach:

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

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

What to keep away from:

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



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Results:

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

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

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

Content:

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

What to stay away from:

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

Approach:

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

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

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

Figures and tables:

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

Discussion:

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

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

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

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

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

Approach:

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

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

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

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