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BUSH BURNING AGRICULTURAL PRACTICE AND CLIMATE CHANGE MITIGATION IN CROSS RIVER STATE, NIGERIA

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Abstract

The study was on the influence of bush burning agricultural practice on climate change mitigation in Cross River State, Nigeria. a research questions and corresponding hypothesis was coined to give direction to the study. The study sample comprised of four hundred and ninety-five (495) registered farmers with the Agricultural Development Programme in Cross River State. The stratified random sampling technique and proportionate sampling approach was adopted to select the four hundred and ninety-five respondents used for the study. A thirty-five item four-point Likert scale questionnaire was the instrument used for collection of data. The research instrument was subjected to validity test by relevant authorities. Cronbach alpha method was utilized to establish the reliability of the research instrument. The testing of hypotheses in the study was done with simple linear regression statistical tools. The hypotheses were tested at 0.05 level of significance. The result that was obtained from data analysis and hypotheses testing in the study revealed that there was a significant negative impact of bush burning on climate change mitigation. Based on the findings obtained in this study, the researcher recommended that bush burning should be discouraged among farmers in the study area because of its negative contribution to climate change and its potentials to militate significantly against efforts to promote climate change mitigation

Keywords: Bush burning, climate change, mitigation, agricultural practices, Cross River State.

1.0 Introduction

The challenge is intensified by agriculture's extreme vulnerability to climate change. Climate change's negative impacts are already being felt, in the form of increasing temperatures, weather variability, shifting agroecosystem boundaries, invasive crops and pests, and more frequent extreme weather events. On farms, climate change is reducing crop yields, the nutritional quality of major cereals, and lowering livestock productivity. Substantial investments in adaptation will be required to maintain current yields and to achieve production and food quality increases to meet demand. The problem also works in reverse. Agriculture is

a major part of the climate problem. It currently generates 19–29% of total greenhouse gas (GHG) emissions. Without action, that percentage could rise substantially as other sectors reduce their emissions. Additionally, 1/3 of food produced globally is either lost or wasted. Addressing food loss and waste is critical to helping meet climate goals and reduce stress on the environment. The impact of climate change is more pronounced on smallholder farmers who are highly dependent on agriculture. Land degradation, frequent floods, and droughts are among the manifestations of climate change leading to productivity losses. Hence, efforts made to minimize the adverse effects of climate change on smallholder farmers in particular and agriculture in general are very crucial (Odi, 2018). Adaptation has been considered by many as the most efficient way of reducing the negative impacts of climate change. Adaptation enables farmers to maintain food, income and livelihood security while facing changes in climate and socio-economic conditions (Obadan, 2017). Climate change and variability have aggravated the vulnerability of the people in the South –South region to climate change impacts and the overall degradation of natural resources. Climate change-induced problems such as drought and land degradation are the vital physical challenges to rain-fed agriculture in the South-South Nigeria.

Bush burning is considered as another agricultural practice that relates with climate change mitigation. Ntia (2019) sees bush burning as a farming practice that can militate against forest conservation and subsequent climate regulation. The author further maintains that in most communities in Nigeria, bush burning is a predominant feature in land preparation for cultivation. In the rainforest zones, it has become almost impossible to plant crops without resorting to bush burning because of the thick nature of the forest involved, which might not be easily cut down and easily packed. This burning process emits methane and carbon dioxide into the atmosphere, which can increase greenhouse effects and hinder efforts made to mitigate climate change.

United States Department of Agriculture (2018) reported that bush burning is an act that is commonly practices by farmers especially in Africa in the process of clearing the forest for planting. Isaac (2016) describes the processes as that which involves setting the forest on fire. As forest burns, there are huge flames with thick smoke and layers of ashes are later deposited on the ground. The author observed that huge amount of carbon (about 400 tons per hectare) contained in most plants are released as carbon dioxide (CO_2). The thick smoke also carries away most of the nitrogen and Sulphur that hitherto exists in the tress (Obadan, 2017). The implication of the burning is that some population of beneficial microorganisms may be eliminated. The organic matter in the soil will be destroyed and the soil structure disrupted, thereby rendering such soil highly infertile. All of these combines to contribute to three key natural processes which are erosion, nutrient recycling (site productivity and succession and vegetative recovery rates. According to the United States Department of Agriculture (2018), as erosion increases, site productivity and vegetative recovery rates decreases" the implication of this is that, as vegetative recovery rates decrease, erosion increases and site productivity decreases. This results in greenhouse effects resulting in climate change.

The finding of this study is also in support of that of Ntia, (2019) who stated that in most

communities in Nigeria, bush burning is a predominant feature in land preparation for cultivation. In the rainforest zones, it has become almost impossible to plant crops without resorting to bush burning because of the thick nature of the forest involves which could not easily packed away. For now, it is difficult to provide a more realistic meaningful and feasible approach to farming in the forest zones without bush burning. Environmentalists and soil scientists are aware of the damages done go biodiversity in the process of bush burning (Ntia, 2019). Fire is normally set on a piece of land before or after clearing (slash and burn). In some cases, too, the forest or bush may be set on fire to make clearing easy. The effects of bush burning are enormous. Some of these are, it destroys the organic matter content of the soil, it kills micro-organism like nitrogen fixing bacteria, earthworm, and termites which are very beneficial to the soil much of the soil micro and macro nutrients like carbon, nitrogen etc. are not lost during bush burning; bush burning also help increases the rate of leaching downward movement of most essential nutrients beyond the reach of the plant roots; loss of habitats for most organism also occur during bush burning; it encourages soil erosion, that is making it to be exposed to all the vagaries of weather (Omoogun, 2014).

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Bush burning is a predominant feature in land preparation for cultivation in most rural communities. The peasant still treasures fire as a mean of modifying and shaping his environment (as in slash and burn) and other drudgery work in his farm that fire can actually take care of. He relies on bush burning to clear and remove debris from the new areas of land. Apart from the damage to biodiversity, reduction in soil fertility and exposure of top soil to erosion, bush burning contributes to gases imbalance in the atmosphere and global warming. The process of allowing the fire to burn as a land preparation activity omits carbon dioxide into the atmosphere. This results in an imbalance in the amount of carbon and house effects that have far-reaching environmental and health effects in the long run (Obi, 2018).

Slash and burn are an agricultural practice where grasses are usually cut down and set on fire during land preparation activities for cultivation of crops. It is a common practice in both savannah and forest zones of Nigeria and has greatly altered the original vegetation. In recent years, the environment which was taken for granted has become a subject of great concern to the society (Yunana, Siaka, Nale, Simon & Markus, 2019). In some cases, the fire spreads far beyond the confines of the farmlands if uncontrolled and destroys the adjourning forests or wood land areas (Okonkwo & Kareem 2019). As more land is being cleared and prepared for cropping, hunting and grazing annually, burning has become the easiest and most convenient method quite often employed. Most areas burnt and cleared annually for cropping, invariably results in heating and drying of the soil hereby destroying the ecosystem (Isah &Adegeye, 2019). The soil temperature reached during such burnings ranged from 930c to 10040C as a result of burning different types of materials and the time of exposure to heating (Yunana, Siaka, Nale, Simon & Markus, 2019).

Bush burning causes changes in the micro-climate at the soil - atmosphere interface. McKnight (2017) argued that atmospheric carbon dioxide continues to be on the increase because, there are fewer trees to absorb it and because burning of trees for forest cleaning releases more carbon dioxide to the atmosphere. It is currently believed that the earth's atmosphere is heating up due to increasing amounts of carbon dioxide and other gases resulting from human activities such as bush burning. Droughts and high temperatures in certain regions of the world are early signs of global warming. Changes in global climate would have major implications for economic development and environmental health. The most significant of the atmospheric changes most likely contributed by bush burning are: The greenhouse effect, depletion of the protective ozone layer, atmospheric pollution. (Peters, 2018). Human and natural resources like structures, plantations, estates, and farmlands are destroyed due mainly to careless and uncontrolled fires (Umoh, 2018). Natural resources such as timber, plants of exotic value are burnt and destroyed during forest fires. The fire that devastated Nigeria telecommunication facility in 1984 was due mainly to careless bush burning (Umoh, 2017). Setting wildfires on forest where

petroleum pipelines passes has been very devastating and have caused untold hardships to victims. They have lost their farmlands, human lives and all other resources of the environment as was the case of Jassi community of Delta State in 2009.

Duffey (2017) opined that burning is likely to be used most effectively by the conservationist in the reclamation of rough grassland which has been ungrazed or under grazed, and where there is a considerable accumulation of dead plant materials. This is a clear pointer to the fact that most people perceive bush burning in the light of assisting to clear vegetation not minding the environmental consequences. Dasmann (2018) confirming that people's perception of bush burning influences their engagement in the act, stated that fire can also be used as a management tool which produces different effects in different grassland and forest types. Duffey (2017) concluded that fire serves useful purposes. But more often than not, the fires get out of control to consume adjacent non- target vegetation. Ultimately, destructive bush burning derives from careless disregard for the values of vegetation, perhaps because of lack of awareness or the attitude that vegetation is 'bush' and a symbol of lack of development. The burning of the bush releases carbon into the atmosphere, which results in greenhouse effects and subsequent climate change.

Graham, Vangel and Pinnick (2018) reported that prescribed burning is a common and valuable management tool for forest practitioners, but both frequent burning and the exclusion of fire may result in significant changes in vegetation communities. As a result, there has been considerable debate regarding the costs and benefits of prescribed burning for biodiversity with little resolution. In 1986, the Forestry Commission established a long-term study in the Eden region in south-eastern Australia in an attempt to record medium to long term ecological changes in response to three prescribed burning regimes (exclusion, routine burning and frequent burning) in logged and unlogged forests. Here the researchers presented some of the results from this study and use these to highlight issues for biodiversity conservation in fire management planning. Anthropogenic burning regimes resulted in changes to plant species diversity within the study area but these changes were minor and less than the magnitude predicted from other studies.

Graham, Vangel and Pinnick (2018) further reported that the major change occurring within the study appeared to be a natural response of the vegetation to the time since the last wildfire and this occurred independently of the imposed management regime. These results suggest that, while some prescribed burning regimes have minimal direct adverse impacts, they also fail to stimulate the recruitment of many plant species and thus may have longer term indirect impacts. In developing fire management plans, consideration should also be given to the intensity, seasonality and frequency of the burns because these factors will affect the conservation of biodiversity.

Kwame (2019) reported that throughout Ghana, bushfires have exacted a heavy toll of death and unquantifiable suffering on people and animals and have adversely affected the environment. There are several factors which cause bushfires and villagers have good reasons for using fire. However, some of these fires if not properly controlled end up in causing serious damage. Although bushfires occur in the forest areas, they are not as frequent and extensive as in the Savanna Zone. In the forest zone bushfires

are extensive in the outer margins of the forest where the drying effects of the Savanna conditions are felt most. This may be particularly the case where the soils are dry and desiccation is rapid. This helps to explain the impact of bush burning on soil and forest conservation. Gyan (2018) also reported that fire is widely accepted throughout the country as being a valuable tool in the management of natural vegetation, agriculture including livestock production and in other land use systems. In the past and even in some instances today hunters, herders, farmers and cigarette smokers are the primary recipients of blame for uncontrolled and indiscriminate bush burning. Many bushfires in the forest zone are deliberately started during the dry season. In many areas, farmers and hunters do so to facilitate access by men and animals. Many farmers use fire to reduce the fuel load or combustible litter in order to reduce the potential frequency and intensity of late dry season fires. This contributes to climate change through excessive emission of greenhouse gases.

Asamoah (2019) maintained that foresters cause bushfires to maintain or achieve a plant composition which is optimal for a specific management objective. For example, in the Guinea and Sudan Savanna regions foresters and range managers cause bushfires to promote the growth of forage for livestock. Sometimes fire becomes a good management tool for facilitating and promoting the introduction of exotic species such as improved forage species into the vegetation. Most herders believe that bush burning improves the acceptability and nutritional value of trees and other species (e.g., grasses) for grazing and browsing. He further revealed that Some farmers also burn in order to control dangerous animals, insects and pests. For example, it is used to destroy or control some pests and diseases (e.g. grasshoppers, ticks, locusts, anthrax) and livestock parasites which live and thrive on the vegetation. Fire is sometimes used to create conditions suitable for particular land use systems or to create a habitat for particular species, for recreational purposes or to promote tourism. Although there are good reasons for using fire as a tool if it is uncontrolled or set indiscriminately, its effects can be damaging. Burning in certain seasons of the year can be very destructive not only of vegetation but soil structure and composition, and it increases soil erosion and global warming.

Taylor (2018) reported that in the forest ecosystem, fire is practically the cheapest means available for clearing slash and felled trees from fields to create a larger planting area for crops. Burning is essential for a good crop with minimum of labour. Farmers share the opinion that when the vegetation is burned, large quantities of nutrient-rich-ashes are deposited on the soil surface which provides the newly planted crops with the benefits of the biomass that has grown on the site. This observation is supported by studies which confirm the availability of nutrients (e.g., ash) for growing plants. In the Savanna region, soil and vegetation deterioration is caused by human activities especially bushfires. At the beginning of the dry season, herders often start fires to stimulate the growth of young shoots. According to herders, the regrowth or young offshoots are more palatable and contain more nutrients. Burning improves ranges because grazing animals frequently are found concentrated on burned areas where the herbage is more accessible, palatable and nutritious. This reduces the volume of greenhouse emission into the atmosphere.

Forest clearing has been identified as one of the most significant causes of deforestation in different parts of the world. The rates of

forest destruction through slash and burn method of farming is alarming in West Africa due to rapid population growth and land use (Myers, 2018). These evidences present a significant and direct role of forest clearing for farming in forests. It has been established that the highest rates of forest modification have occurred in areas with heavy dependence on forest lands for subsistence agriculture largely found in Nigeria (Allen & Barnes, 2017). The global drive towards sustainable environments provides critical need for studies involving impact of farming activities on forest vegetation and subsequent climate change. Opportunities to be derived from such studies include prediction of stability to be expected as caused by different farming types of the different zones, possible ecological effects of changes and type of vegetation occurring in different zones. These changes have continuously contributed to global changes in climatic conditions, which have raised concerns over the growing consequences of climate change. The need to modify agricultural practices that emits less greenhouse gases is gaining global attention as a means of climate change mitigation (Obi, 2018).

In many states of Nigeria, relatively little natural vegetation remains untouched by human (Myers, 2015). Rates of forest loss are accelerating due to subsistence agriculture and slash and burn. Already forest plantation establishment, slash and burn, shifting cultivation and other development features have occurred in reserves in Nigeria resulting in loss of biodiversity. The economic implication of loss of biodiversity on the local communities and on the national economy in general calls for a joint effort by all stakeholders (Ogunleye, Adeola, Ojo &Aduradola, 2016). Agriculture serves as the economic mainstay of the majority of rural households in Nigeria, despite the significant role played by the oil sector (Amaza, 2016). Agriculture was practiced over the years without the use of synthetic substance (Helga, Julia & Robert, 2017). The agricultural practices that relied on chemical substances were the result of modern technology and it played significant role in improving food productivity (Crowder & Reganold, 2019). However, the use of these chemical substances has serious long-term side effects, such as land degradation, environmental pollution and health issues relating to toxins introduced into the food (Oluwasusi, 2018).

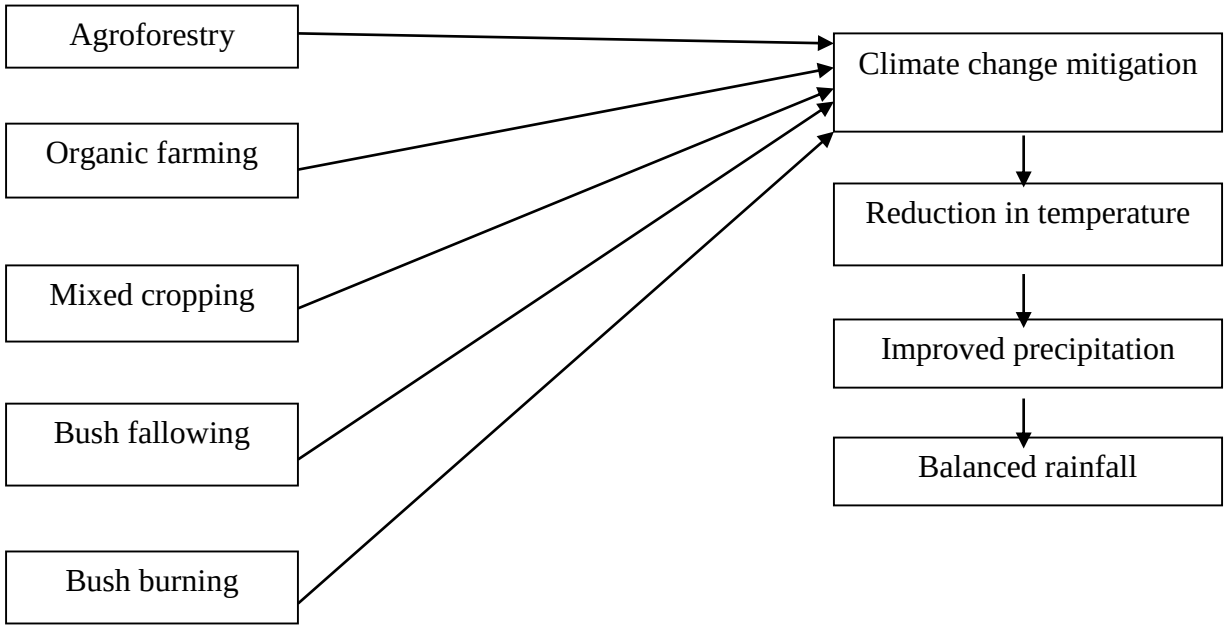
2.0 Statement of the problem

This continuous degradation of the environment has resulted in the destruction of plant species and emission of greenhouse gases into the atmosphere. The regular emission of greenhouse gases into the atmosphere has resulted in severe alteration of natural climatic conditions. These changes in climatic condition due to loss of plants in particular have brought about adverse consequences including increasing temperature, reduction of oxygen in the atmosphere, drought, flooding, deforestation, erosion among others. These consequences have brought about varying thoughts, fear and assumptions among people in various locations within the study area on the negative effects of climate change.

The irony of this situation is that, despite the glaring consequences of climate change facing people in the study area, many people still do not seem convinced on the need to carry out sustainable agricultural practices as a means of reducing the adverse effect of climate change. Residents of the study still indulge in farming practices that promote the emission of greenhouse gases into the

atmosphere. Government and other stakeholders have made efforts in creating awareness and sensitizing people on adaptation strategies and on the need to consider alternative farming practices that constitute severe climatic problems. These efforts have yielded insignificant results as the incidence of climate change seem to be on the increase in the study area.

These efforts are geared towards raising a citizenry that is aware of and committed to finding lasting solutions to the increasing incidence of climate change. One of the approaches adopted to mitigate climate change in the study area is the introduction of sustainable agriculture. Agriculture has long been identified as a major contributor to increasing climate change. The need for farmers to adopt farming practices that would consistently contribute to climate change mitigation has become imperative as part of efforts made to change the narrative. This is because the mitigation of climate change will enhance food production, ecosystem sustainability, regulate temperature, and ensure continuity of society. This emphasizes the need to consciously promote climate change mitigation among farmers in the study area. This study is geared towards attempting to find answers to the question, how does bush burning farming practices influence climate change mitigation in Cross River State Nigeria?



Source: Ukam (2022).

3.0 Conceptual framework

The conceptual framework for this study portrays the relationship between agricultural practices and climate change mitigation in South – South Nigeria. Climate change mitigation can be influenced significantly through agricultural practices like agroforestry, organic farming, mixed cropping, bush fallowing and bush burning. Climate change mitigation has taken various approaches with the aim of reducing temperature, improving precipitation and balanced rainfall. Climate change is caused by greenhouse emissions, which are partly

linked to agricultural operations over the years. This informed the need to empower and encourage farmers to adopt agricultural practices that would emit little or no greenhouse gas. The adoption of sustainable agriculture can significantly reduce the emission of harmful substances into the atmosphere, which will guarantee safe and conducive climatic conditions. The continuous practice of food production using agricultural operations or systems that consistently emit gases into the atmosphere will continue to hinder efforts aimed at mitigating climate change at various levels including the study area of the research. There seem to be a very clear link between agriculture, climate change and climate change mitigation. This informed the need to adopt agricultural practices that would continue to protect and promote the regulation of climate at all times.

4.0 Objectives of the study

Specifically, the general purpose of the study aims:

1. Determine the influence of bush burning on climate change mitigation in Cross River State

Research Questions

The following research question will guide this study:

1. How does bush burning influence climate change mitigation?

5.0 Statement of Hypotheses

1. There is no significant influence of bush burning on climate change mitigation in Cross River State

6.0 Methodology

The population of this study consisted of all farmers in Cross River State, Nigeria that are registered under the Agricultural Development Programmes across various local government areas. The sample for the study consisted of four hundred and ninety-five (495) registered farmers with the Agricultural Development Programme in Cross River State. A descriptive survey research design was adopted for the study. The stratified random sampling technique and proportionate sampling approach were used for this study. The instrument for data collection was a structured questionnaire. It was tagged Agricultural Practices and Climate Change Mitigation Questionnaire (APCCMQ). The local government areas in the state were stratified into three education zones, while proportionate sampling approach was adopted to select the local government areas used for the study. The data collected were analyzed with Simple linear regression analysis at .05 level of significance.

7.0 Results

Hypotheses One: There is no significant influence of bush burning on climate change mitigation. Bush burning is the independent variable in this hypothesis while climate change mitigation is the dependent variable. The statistical tool employed for data analysis was simple linear regression analysis. The result is presented in Table 1

The result of data analysis of hypothesis five presented in Table 1 reveals that the independent or predictor variable (bush burning) has no significant influence on the dependent or predicted variable (climate change mitigation) among residents of Cross River State. This implied that bush fallowing accounted for 0.6% of climate change mitigation in the study area.

TABLE 1
Simple linear regression analysis of the influence of bush burning on climate change mitigation in Cross River State (N = 493)

Model	R	R^2	Adj.R^2	Std error of estimate	
1	.078	.006	.004	1.01637	
Model	**SS**	**Df**	**MS**	**F**	**Sig**
Regression	3.073	1	3.073	-23.23*	.002
Residual	507.207	491	1.033		
Total	510.280	492			

a. Dependent variable: Climate change mitigation
b. Predictors: (Constant), Bush burning

Again, the result of regression ANOVA presented in Table 1revealed that there was a significant negative influence of bush burning on climate change mitigation, F (1, 491) = -23.23; p>.05. The result of this analysis showed that there is a very low contribution of bush burning practice to climate change mitigation. This indicated that bush burning is not positively influencing climate change mitigation in the study area.

8.0 Discussion of findings

Bush burning and climate change mitigation

The finding that was gotten from data analysis and testing of hypothesis five in this study showed that the null hypothesis was accepted. The indication of this finding is that there was no significant influence of bush burning on climate change mitigation in Cross River State, Nigeria. The reason for this finding could be that bush burning is a common agricultural practice in the study area. It involves burning of the debris generated from land preparation activities. In most cases, the volume of debris generated makes it almost impossible to cultivate without burning. In some reported cases, the fire has spread to unintended areas causing widespread damage to various ecosystems and habitats. The process of burning emits methane, Sulphur dioxide and carbon dioxide into the atmosphere. These activities contribute significantly to climate change. As a result, bush burning is considered as an unsustainable agricultural practice due to its implication in the attainment of a healthy and safe climate.

The finding of this study agrees with that of United States Department of Agriculture (2018) who reported that bush burning is an act that is commonly practices by farmers especially in Africa in the process of clearing the forest for planting. Isaac (2016) describes the processes as that which involves setting the forest on fire. As forest burns, there are huge flames with thick smoke and layers of ashes are later deposited on the ground. The author observed that huge amount of carbon (about 400 tons per hectare) contained in most plants are released as carbon dioxide (CO_2). The thick smoke also carries away most of the nitrogen and Sulphur that hitherto exists in the tress (Obadan, 2017). The

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9.0 Conclusion

From the analysis of data and testing of hypotheses in the study it was found that there was a significant negative influence of bush burning on climate change mitigation in the research area. In conclusion, it implies that bush burning influence climate change mitigation in Cross River State, Nigeria**.**

10.0 Recommendations

On the basis of the findings of this study, the following recommendations were made:

1. Bush burning should be discouraged among farmers in the study area because of its negative contribution to climate change and its potentials to militate significantly against efforts to promote climate change mitigation.

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