integrity Research Journals

**Advanced Journal of Plant Biology**
Volume 3(2), pages 23-30, June 2022
Article Number: EEE01C342
ISSN: 2992-4928
https://doi.org/10.31248/AJPB2022.022
https://integrityresjournals.org/journal/AJPB

*Full Length Research*

# The influence of climate change on rural community food crops production pattern in high humid rainforest agroecology in the southern part of Nigeria

**Chinedum A. Ogazie*, Edache B. Ochekwu and Ikechukwu O. Agbagwa**

Department of Plant Science and Biotechnology, Faculty of Science, University of Port Harcourt, Nigeria.

*Corresponding author. Email: chinedum.ogazie@uniport.edu.ng



Received 24th May 2022; Accepted 27th June 2022

**ABSTRACT:** This study investigates the impact of climate change on the crop production pattern of the rural community in the southern part of Nigeria. The crop production pattern identified from the survey was multicropping of two or more crop species on the same piece of arable farmland. It was carried out to evaluate the crop species associated with adopted multicropping practice by the community in the face of climate change and classified into foodstuff forms and dietary requirements. Data was collected in wet and dry seasons through a reconnaissance survey of walk-through diagonally and on-the-spot assessment of each of the 22 arable farmlands cultivated for the study and crop species were identified and recorded. The survey revealed 27 crop species in 15 families and the most common crop species planted were *Zea mays* L., *Telfairia occidentalis* Hook. f., *Manihot esculenta* Crantz, and the least been *Cucurbita moschata* Duchesne, *Vigna unguiculata* L. It also indicated that the least number of crop species was 3 and the highest 12 per arable farmland. All the crop species identified were later classified into tubers/corms; vegetables; fruits; spices; drugs; grain legumes; soup thickeners and cereals which are the common food classification/dietary combination in the community. Multicropping of crop species on the same piece of arable farmland might be considered a way out of the climate change which has continued to impact crop species yield decline in recent times. This practice necessitated by climate change provided multiple benefits to the farmer's homestead, community and environment because each crop species require different conditions within the environment, soil nutrients and water to thrive and therefore a balance in the agroecosystems dynamics is sustained. In conclusion, multicropping practice should be encouraged as it provides several benefits to the community resilience, the soil and various organisms that dwell on and in it, the crop species, income, the environment, biodiversity and also varieties of foodstuff which provide the needed dietary food calories in the community.

**Keywords:** Climate change, community, crop species, multicropping, reconnaissance survey.

## INTRODUCTION

Agriculture generally is strongly influenced by climate. Climate change has often contributed to drought, low rain, high rainfall leading to flooding and destruction of crops and farmlands (Francis and Porter, 2017). Agriculture is an economic activity that is highly dependent upon climate in order to produce food and fiber necessary to sustain human life. Surprisingly, agriculture is deemed to be an economic activity that is expected to be vulnerable to climate variability and change. According to Yohannes (2016) involves natural processes that frequently require fixed proportions of nutrients, temperatures, precipitation, and other conditions necessary for crop production.

It is on this note that rural farmers are consistently faced with crop species to plant in their farms and gardens that would be appropriate with the prevailing climate conditions of their locality. Climate most often times dictate the type of soil/land to plant on, and the crops species to plant.

Raza *et al*. (2019) noted that land and its agricultural processes are affected by climate changes in different ways, e.g., variations in annual rainfall, average temperature, heat waves, medications in weeds, pests or microbes, global change of atmospheric $CO_2$ or ozone

level, and fluctuation in sea level and while Balasubramanian (2017) stated that climate is an embodiment of solar radiation, temperature, atmospheric pressure, wind, humidity, precipitation, topography, and cloudiness. All these interplay with each other and make up the climate conditions of a particular locality under which the farmer plan and plant his crops species for food production.

Cropping practices are ways adopted by farmers to plant crops to meet the need of their immediate families and the excess are sold or given out in return for what the families lacked. This was when the population was very low and incomparable with today's population. The revolution in agricultural practices due to breaking through in science and technology, and population raise has brought many modifications to agricultural cropping practices from multicropping earlier practised in our rural community gardens and back yards farms to mono cropping of late for large commercial farms (Francis and Porter, 2017; Azam-Ali, 2003).

The idea of planting one or two crops is been threatened by the world population which is expected to be over 9 billion by 2050, demand for daily dietary food composition and coupled with greenhouse effect on crop production. Hence, the emphasis on planting more crop species on the same available piece of arable farmland would help to reduce soil degradation, soil erosion, reduction of pests and diseases, and soil nutrients management to a level that the environment and its biodiversity are protected and sustained (Francis and Porter, 2017; Waha *et al*., 2020).

Crop species planting requires different farming systems practices, which begin with land acquisition to land clearing, land preparations/tillage, sowing, weeding, watering/maintenance and finally crop harvest. Before then, all the necessary inputs for example source for clean and healthy planting materials, fertilizer/manure, pesticides generally, and simple handheld tools/machines would have been made available. It is also necessary that different life forms, lifespan, demand for nutrients, water, and crop species suitable to the rural people are also considered in the plan of the farmer for sustainability (Francis and Porter, 2017).

Deep and shallow rooted crops complement each other in terms of soil nutrients demand, redistribution and also the ability to hold the soil together and prevent soil and wind erosion through root binding and canopy formations. Hence, farmers put into planting plans tuberous root crops/corms, cereals, grain legumes for soil restoration and conservation, varieties of vegetable species to enhance food taste, calories, minerals and vitamins required for good health and that of the soil through leaves droppings and other plants parts added to the soil to enrich the organic matter content when they decay (Schoonover and Crim, 2015; Richardville *et al*., 2020).

Anthropogenic activities have added enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warning. With the awaking spirit of all and also the realization of the enormous dangers ahead with the impact already created by anthropogenic activities on the environment and biodiversity which has led to global warming, it is very necessary to look into the reinforcement of multicropping practice as a way of planting and producing more varieties of food crops to feed the teaming population and also serve as a carbon sink under the prevailing climate conditions of rural and urban communities in our locality (Wang *et al*., 2010; Martinez-Mena *et al*., 2021).

Most studies (Mihailescu and Bruno Soares, 2020; Arora, 2019; Ali *et al*., 2017) on the influence of climate change are mainly on food production and its impact on crop yield, and not much work has been carried out on multicropping crop species practice under the prevailing climate conditions and its impact on the rural community in high humid rainforest agroecology in Southern part of Nigeria. Hence, we examine the impact of multicropping of crop species on the same piece of arable farmland in rural communities.

## MATERIALS AND METHODS

### Study site

The study site is the University of Port Harcourt and its environs. It is on geographical coordinates: latitude 4°52'N and 4°55'N Longitudes 6°54'E and 6°56'E in Obio/Akpor Local Government Area Rivers State. It is situated in the Niger Delta wetland of Southern Nigeria. The climatic weather condition of the area is characterized by a tropical monsoon climate with a mean annual temperature of 25 to 28°C and annual rainfall of over 3000 mm. The relative humidity is very high with an annual mean of 85% while the soil is usually sandy or sandy loam underlain by a layer of impervious pan.

### Sources of data

Data for this work were obtained from 22 continuously cropped arable farmlands with crop species in the arable farmlands aged 6 weeks from the date of planting. An inventory of crop species planted by individual farmers on the farmland was carried out in June 2020, as the wet season (rainy) and January 2021 as the dry season. Two separate lists were documented for wet and dry seasons enumerations respectively.

### Experimental site and design

A diagonal reconnaissance survey of walk through and on the spot assessment of each of the 22 arable farmlands cultivated for the study and crop species were identified and recorded. This method was used in June 2020 and

January 2021 for the wet and dry seasons respectively.

### Data analyses

Microsoft Excel 2018 was used to calculate percentages and makeup charts of individual crop species per farmer in the study group.

## RESULTS

A total of 27 crop species were identified from the inventory of 22 arable farmlands in the wet season and 10 were recorded in the dry season even though they have been recorded in the wet season; and still growing due to their life forms and life span at the time of dry season inventory. A number of those that died on or before the dry season were short lived annuals which mature within 3 and less than 12 months, while those that did appear in the dry season were either bi-annuals or lives more than 12 months. The crop species found in the arable farmland are as follows: *Abelmoschus esculentus* (L.) Moench; *Amaranthus hybridus* L.; *Ananas comosus* (l.) Merrill; *Arachis hypogaea* L.; *Capsicum annuum* L.; *Capsicum frutescens* L.; *Citrullus colocynthis* (L.) Schrad; *Colocasia esculenta* (L.) Schott. *Cucumis sativus* L.; *Cucurbita moschata* Duchesne; *Dioscorea alata* L.; *Dioscorea dumetorum* (Kunth.) Pax; *Dioscorea rotundata* Poir; *Ipomoea batatas* (L.)Lam.; *Manihot esculenta* Crantz; *Mucuna sloanii* Rendle & Fawc.; *Musa paradisiac* L.; *Ocimum americanum* L.; *Ocimum gratissimum* L.; *Solanum lycopersicon* L.; *Talinum triangulare* )Jacq.) Will.; *Telfairia occidentalis* Hook.f.; *Vernonia amygdalina* Del.; *Vigna unguiculata* L.; *Xanthosoma mafaffa* Schott; *Zea mays* L.; *Solanum sp*. All these crop types were found within 15 families: Malvaceae 1; Amaranthaceae 1; Bromeliaceae 1; Fabaceae 3; Solanaceae 4; Cucurbitaceae 4; Araceae 2; Dioscoraceae 3; Convolvulaceae 1; Euphorbiaceae 1; Poaceae 1; Asteraceae 1; Musaceae 1; Lamiaceae 2 and Portulaceae 1.

In (Tables 1 and 2 and Figures 1 and 2) shows preferred individual crop species planted and enumerated from the arable farmlands in the study area; along with crop percentages from the total 22 arable farmland in wet and dry season. A total of 27 crop species were planted by all the farmers across the sampled arable farmlands. The most common crops types were cassava (*Manihot esculenta*), corn (*Zea mays*) and the least been musking gourd (*Cucurbita moschata*), beans (*Vigna unguiculata*) etc.

Table 1 also revealed that cassava(*M. esculenta*) and corn(*Z. mays*) were the most preferred crops types planted by all the farmers with 90.90% respectively; next are okra(*A. esculentus*), pumpkin(*T. occidentalis*), cocoyam (*X. mafaffa*), yam(*D. rotundata*) and plantain (*M. paradisiac*), each with 86.36; 81.81; 68.18; 59.09 and 54.54%, respectively. It revealed yam (*D. dumetorum*), water leaf (*T. triangulare*), cucumber (*C. sativus*), pepper (*C. annuum*), yam (*D. alata*), melon (*C. colocynthis*), bitter leaf (*V. amygdalina*), pepper (*C. frutescens*), scent leaf (O. gratissimum) and sweet potato (*I. batatas*) were the next planted crops with 45.45; 31.81; 27.27; 22.72; 22.72 and 1.63% respectively. The least crops types in the table were musking gourd (*C. moschata*), beans (*Vigna unguiculata* L.) groundnut (*A. hypogaea*), (pineapple (*A. comosus*), soup thickener (*M. sloanii*), garden egg (*Solanum sp.),* tomato (*S. lycopersicon),* green amaranth (*A. hybridus*), coco yam(*C. esculenta*) and curry leaf (*O. americanum*) with 9.09; 9.09; 9.09; 9.09; 9.09; 4.54; 4.54; 4.54; 4.54 and 4.54% respectively.

These 27 crop species planted and enumerated from the 22 arable farmlands were classified into dietary forms as needed by humans to maintain healthy food consumption (Tables 1 and 2). The groups are tuber/corm, vegetables, fruits, spices, drugs, grain legumes, soup thickeners and cereals.

## DISCUSSION

The result from the survey carried out on 22 pieces of arable farmlands in the community revealed that the community practised multicropping practice of two or more crop species on the same piece of land. This survey provided information of how crop species are planted in rural communities to provide different varieties of foodstuffs. The crop species to plant on a piece of arable farmland depends on the climate of the place, soil, the available crop species, natural supply of water or irrigation, eating habits and taste are also considered in the choice of cropping practices and crop species to adopt. The result from this survey on the crop species gave an insight into dietary food intake components classification.

### Tubers/corms

The following crop species *C. esculenta*, *D. alata*, *D. dumetorum*, *I. batatas. M. esculenta* and *X. maffafa* as shown in Tables 1 and 2 were classified as tubers/corms which are high in carbohydrate yield and provide the energy for the daily activities of the community. Planting of such crop species in the community provided food round the cropping season and income as each crop species matures at different times for harvest. This is in line with Francis and Porter (2017) who noted that the very essence of multicropping is resilience in production and income in biodiverse systems. These crop species can also be used as biofuels as their cultivation provides high yield output when compared with other crop types in the system. This is in line with the works of Marx and Nquma (2013) that cassava which is one of the crop species planted in the community could also provide biofuel when not considered

**Table 1.** Individual crop species and farmers share in the wet and dry seasons.

| Names of crops | English name | Family | No. of farmers | % in wet season | No. of farmers | % in dry season |
|---|---|---|---|---|---|---|
| *A. esculentus* | Okra | Malvaceae | 19 | 86.36 | 0 | 0.00 |
| *A.hybridus* | Green amaranth | Amaranthaceae | 1 | 4.54 | 0 | 0.00 |
| *A. comosus* | Pineapple | Bromeliaceae | 2 | 9.09 | 2 | 20.00 |
| *A. hypogaea* | Groundnut | Fabaceae | 2 | 9.09 | 0 | 0.00 |
| *C.annuum* | Pepper | Solanaceae | 5 | 22.72 | 5 | 50.00 |
| *C.frutescens* | Pepper | Solanaceae | 3 | 13.63 | 3 | 30.00 |
| *C.colocynthis* | Melon | Cucurbitaceae | 4 | 18.18 | 0 | 0.00 |
| *C.esculenta* | Cocoyam | Araceae | 1 | 4.54 | 0 | 0.00 |
| *C.sativus* | Cucumber | Cucurbitaceae | 6 | 27.27 | 0 | 0.00 |
| *C.moschata* | Musking gourd | Cucurbitaceae | 2 | 9.09 | 0 | 0.00 |
| *D.alata* | Water yam | Dioscoraceae | 5 | 22.72 | 0 | 0.00 |
| *D.dumetorum* | Yam | Dioscoraceae | 10 | 45.45 | 0 | 0.00 |
| *D.rotundata* | True yam | Dioscoraceae | 13 | 59.09 | 0 | 0.00 |
| *I.batatas* | Sweet potato | Convolvulaceae | 3 | 13.63 | 0 | 0.00 |
| *M.esculenta* | Cassava | Euphorbiaceae | 20 | 90.90 | 20 | 200.00 |
| *M.sloanii* | Soup thickener | Fabaceae | 2 | 9.09 | 0 | 0.00 |
| *M.paradisiac* | Plantain | Musaceae | 12 | 54.54 | 12 | 120.00 |
| *O.americanum* | Curry leaf | Lamiaceae | 1 | 4.54 | 10 | 10.00 |
| *O.gratssimum* | Scent leaf | Lamiaceae | 5 | 22.72 | 50 | 50.00 |
| *S.lycopersicum* | Tomato | Solanaceae | 1 | 4.54 | 0 | 0.00 |
| *T.traingulare* | Waterleaf | Portulaceae | 7 | 31.81 | 70 | 70.00 |
| *T.occidentalis* | Pumpkin | Cucurbitaceae | 18 | 81.81 | 18 | 180.00 |
| *V.amygdalina* | Bitter leaf | Asteraceae | 4 | 18.18 | 4 | 40.00 |
| *V.unguiculata* | Beans | Fabaceae | 2 | 9.09 | 0 | 0.00 |
| *X.mafaffa* | Cocoyam | Araceae | 15 | 68.18 | 0 | 0.00 |
| *Z.mays* | Corn | Poaceae | 20 | 90.90 | 0 | 0.00 |
| *Solanum sp.* | Garden egg | Solanaceae | 1 | 4.54 | 0 | 0.00 |

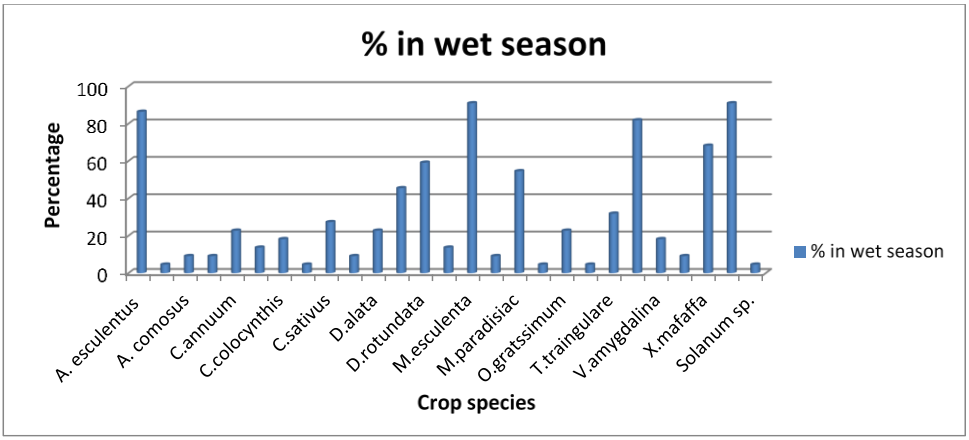


**Figure 1.** Percentage of farmers cultivating each of twenty two crop species in wet season.

as foodstuff and planted on a very large scale for industrial use.

Tubers and corms are major sources of carbohydrates and they are more popular in community arable farmlands, it provides security, income, and community needs on short notice and demand. This corroborates the findings of Maharani *et al*. (2022) that when food production is combined, it enhances to compensate population growth

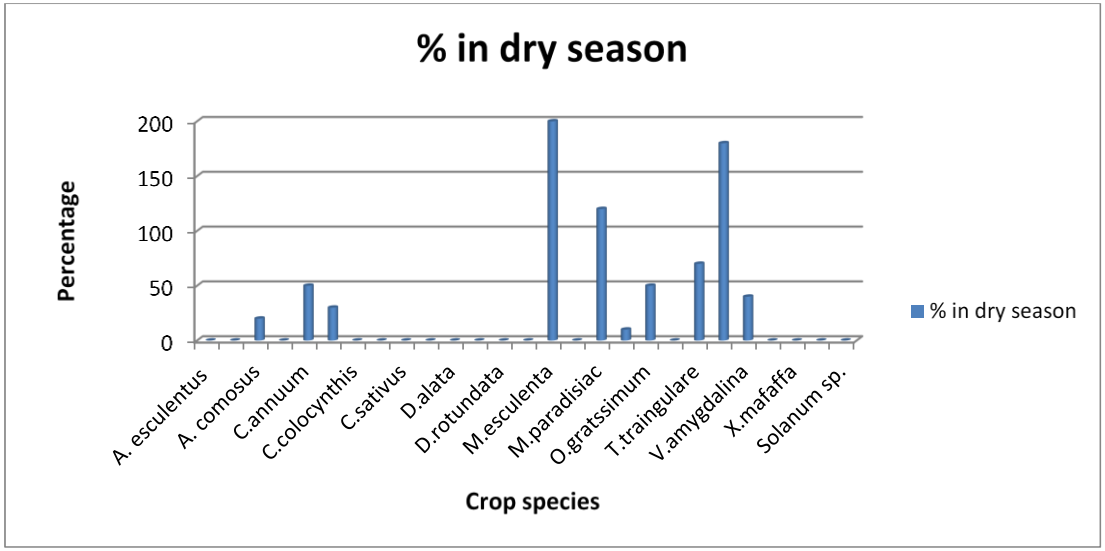


**Figure 2.** Percentage of farmers with each of ten crop species left in to dry season.

**Table 2**. Crops species dietary classification.

| Tubers/corms | Vegetables | Fruits | Spices | Drugs | Grain legumes | Soup thickeners | Cereal |
|---|---|---|---|---|---|---|---|
| *C. esculenta* | *A. hybridus* | *C. sativus* | *C. annuum* | *O. gratissimum* | *V.unguiculata* | *M. sloanii* | *Z. mays* |
| *D. alata* | *C. moschata* | *A. esculentus.* | *C. frutescens* | *V.amygdalina* | *A.hypogaea* | *C.colocynthis* | |
| *D. dumetorum* | *T. triangulare* | *M. paradisiac* | | | | *C. esculenta* | |
| *D. rotundata* | *T. occidentalis* | *S. lycopersicum* | | | | *X. mafaffa* | |
| *I. batatas* | *A. esculentus* | *Solanum sp.* | | | | *D. rotundata* | |
| *M. esculenta* | *Solanum sp.* | *A. comosus* | | | | | |
| *X. mafaffa* | | | | | | | |

with the improvement of agricultural marketable products to increase household income.

However, much or too little carbohydrate intake could be a threat to the health of the community and little daily intake could also constitute a health risk as well. Hence, planting of the other dietary crop species could complement carbohydrate intake. Multicropping practice provides such an opportunity. This corroborates the findings of Seidelmann *et al*. (2018) that both high and low carbohydrates in diets increased mortality, with minimal risk observed at 50-55% intake of carbohydrates. They also noted that there is a low mortality rate with dietary combinations associated with cereals and grain legumes. Hence, this was the essence of the multicropping to provide assorted food varieties for healthy living in the rural community.

## Vegetables

The crop species considered as vegetables were *A. hybridus*, *C. moschata*, *T. triangulare*, *T. occidentalis*, *A. esculentus* and *Solanum sp*.

Most vegetables are readily available in the community in both wet and dry seasons and forms part of the daily requirement in dietary intake of the rural community to provide good nutritional values, provide additional income to the people and act as supplement to carbohydrate based nutrition. This corroborates the findings of Rishitha *et al*. (2017) and Schreinemachers *et al*. (2018) that vegetables help to improve malnutrition problems, source of income for small and marginal farmers in the rural community reducing rural poverty and unemployment in developing countries and is a key component of farm diversification strategies. Vegetable planting provides livelihood in multicropping practice due to its ability to provide leafy materials and when sold improves the socio-economic of those who engage in its production by the numerous crop species produced as vegetables. This is in line with the finding of Bhandari and Paudel (2021) that those farmers who engaged in vegetable farming had improved socio-economic conditions because they chose from different crop species to sell and consume as well. They also noted that before the beginning of commercial vegetable cultivation, farmers do cultivate potatoes and exchanged with cereals with the neighbouring villages to meet up with the family need within the community. Multicropping practice in effect has reduced such a practice of exchange of foodstuff for the other.

## Fruits

The survey revealed five fruits species *C. sativus*, *A. esculentus*, *M. paradisiac*, *Solanum sp*. and *A. comosus* incorporated into the multicropping practice to add varieties to the harvest at the end of the cropping season. However, some of these crop species could produce fruit for a longer life time span than others. The findings from the survey corroborate the finding of Ibeawuchi *et al*. (2015), they considered fruits and vegetables of major interest in Nigeria. Fruits availability around us are mostly seasonal and could also be planted out of season through the application of irrigation. Fruits parse may not form part of dietary intake within rural community as fruits are readily consumed at will when available without much restriction as it is cheap, affordable and surplus in the season and preservation is just a problem in most places. Fruits are incorporated into multicropping practice as it supplies minerals and vitamins to supplement where there are deficiency from other crop species consumed. This assertion is in line with the Ibeawuchi *et al*. (2015); as the consumption of fruits which contains properties that help to regulate or stimulate digestion, act as laxatives or diuretics, pectins and phenolic compounds which plays part in regulating the pH of the intestines.

It brings about additional income to the farmer and reduces poverty and malnourishment in the community as the excess fruits are sold to neighbours for cash. This corroborates the assertion of Ibeawuchi *et al*. (2015) that fruits and vegetables also contribute to the income of both the rural and urban dweller who are engaged down the value chain.

Planting of fruits also ameliorates the ecosystem and thereby sustains the continuous use of arable farmland. This is in line with Stănică (2017) that family fruit planting is more important for the rural economy by increasing the efficient use of local resources, offering social security and comfort and by reducing the environmental fruit finger print.

## Spices

Two species of *Capsicum* were revealed from the list of crop species planted in the multicropping practice of the community. *Capsicum* species are the most common spices added in most cooking's if not all. It bring to bear its spicy taste of hotness when added to meals and some people may not even eat food if it is absent from the cooking in both rural and urban communities.

It consumption supply minerals and vitamins to the body and also extra income either sold fresh or dried. This is in line with the works of Hamadina *et al*. (2018) as one of the commonest plants within the rural communities which provide cash, food, medicine and cultural or spiritual purposes. It is readily available and at an affordable price since the quantity consumed at a time is a very small amount. It is a very important agricultural crop because of its economic importance for its nutritional and medicinal values, it adds colours to food and as antioxidant compound. This corroborates the findings of Abu *et al*. (2020) that *Capsicum* species contain various proportions of anti-nutrients, and sufficient vitamin A and β– carotene for daily recommendations and consumption.

## Drugs

The result from the crop species survey revealed only two crop species classified and used for treating ill health in the community. Every part of these crop species are useful. It is used as a fast remedy in treating sick people in the rural community as first aid before the next action is taken. This is in line with the work of Maroyi and Cheikhyoussef (2015) that most ill-health like body pain, cold, cough, fever, flu and sore throat, dermatological and venereal diseases were treated with the highest number of medicinal plants. The crop species provide sources of income to the family because the leaves are mostly used; the stems are used as chewing sticks, eaten as vegetables and excess are also sold. The findings of Alipour (2021) corroborate the findings in this study that planting medicinal plants on average generates 523.6 times more in revenue generation than planting crops. The stems are sources of propagation, serves boundary marks and also for spiritual purposes in rural community. Their presence in the community contributes to biodiversity preservation and the environment at large. This is in line with the finding

of Ssenku *et al*. (2022) that the inclusion of traditional cultural norms in conservation strategies are necessary to promote the conservation and utilization of validated herbal medicines and traditional medicine knowledge (TMK).

### Grain legumes

Two crop species of grain legumes were *V.unguiculata* and *A. hypogaea* as listed in Tables 1 and 2. Grain legumes plays very important roles in multicropping practice as it provides multiple services to man and the ecosystem; its presence support yield and smoulder pests. This is in line with the findings of Jensen *et al*. (2020) that grain legumes provide increased yield stability and yield per unit area, reduced pest problems and reduced requirements for agrochemicals, while stimulating biodiversity. It is the source of plant base protein with essential amino acids and complex carbohydrates required in the diet. This is in line with Maphosa and Jideani (2016) that the addition of legumes in diet especially in developing countries could play a major role in eradicating protein energy malnutrition especially in developing afro-Asian countries. It is readily available, not too expensive and afforded by the poor rural community.

Grain legumes in multicropping apart from providing protein rich food, also help to improve the soil conditions and in effect allow continuous use of the soil as it enriches the soil in general through nitrogen fixation capability. This corroborates Stagnari *et a*l. (2017) and Vanlauwe *et al*. (2019) that legumes fix nitrogen from the atmosphere and high quality organic matter which facilitates soil nutrient circulation and water retention.

### Soup thickeners

Five crop species were revealed from the survey as soup thickeners (Tables 1 and 2). They are plant parts used as thickening agents added to liquid cooking to improve its thickness, appeal to the face and taste in the mouth. They contain oil and are very rich in minerals and vitamins. They are readily available and also essential household must-have items. Its incorporation into multicropping practice provides an additional income to the rural community as the excess is sold to the urban communities and eventually reduces poverty in the community. The findings in this study are in line with Ndulaka *et al*. (2017) and Enaregba and Daworiye (2018) that thickeners are rich source of nutrients and medicinal importance for man and livestock complementing other sources of nutrients.

### Cereals

In the list of crop species planted in the multicropping practice of the community, the only cereal was *Zea mays*. It is a crop that can be intercropped with many other crop species as it provides early food for the community while waiting for other crop species to mature, hence reducing hunger and poverty. It contains minerals and essential vitamins, rich in fibre and is readily available throughout the season. It provides early income for the community and therefore improves the social-economic wellbeing of the people and thereby alleviating poverty in the community. The findings in this study corroborate the study of Ahmadu and Edeoghon (2018) in a survey on the effect of maize production on poverty alleviation of farmers in Edo State, Nigeria and concluded that maize production has influenced significantly on the income and hence alleviating farmers poverty. Also, Ojide *et al*. (2021) noted that diversification and necessary interventions have the capacity to remove farmers from the poverty trap in the community, hence should be encouraged.

## Conclusion

Climate change impact necessitated the adoption of multicropping practice which has influenced the rural community in high humid rainforest agroecology in Southern Nigeria to plant crop species suitable in the locality. Therefore, multicropping of two or more crop species have significantly improved the availability of different varieties of crop species for food, income, socio-economic wellbeing, the environment, biodiversity preservation, carbon sink, healthy life styles through the consumption of vegetables, fruits and other crop species found in the community. This practice deserves to be encouraged for its numerous benefits and more work on other agro ecological zones in Nigeria. .

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

## REFERENCES

Abu, N. E., Chimdi, G. O., & Ojua, E. O. (2020). Nutritional and anti-nutritional evaluation of ten genotypes of pepper (*Capsicum annuum* L.) grown in a derived savanna ecology of Nigeria. *Ethiopian Journal of Science and Technology*, *13*(1), 17-30.

Ahmadu, J., & Edeoghon, C. O. (2018). Effect of maize production on poverty alleviation of farmers in Edo state, Nigeria. *Agrosearch*, *18*(1), 53-65.

Ali, S., Liu, Y., Ishaq, M., Shah, T., Ilyas, A., & Din, I. U. (2017). Climate change and its impact on the yield of major food crops: Evidence from Pakistan. *Foods*, *6*, 39.

Alipour, M., Jafari, H., & Alizadeh, K. (2021). The effect of cultivation of medicinal plants on the economic development of rural settlements case study: Villages of Kalat City. *Propósitos y Representaciones*, *9*(SPE2), e957.

Arora, N. K. (2019). Impact of climate change on agriculture production and its sustainable solutions. *Environmental Sustainability*, *2*(2), 95-96.

Azam-Ali, S. N. (2003). Multiple cropping. In: Thomas, B. (ed.). *Encyclopedia of Applied Plant Sciences*. London: Elsevier. Pp. 978-984.

Balasubramanian, A. (2017). *Elements of climate and weather*. Publication of the Centre for Advanced Studies in Earth Science, Pp. 1-19.

Bhandari, K., & Paudel, B. (2021). Impact of vegetable farming on farmers livelihood patterns in Dhankuta, Nepal. *Geographical Journal of Nepal*, *14*, 131-150.

Enaregba, E. B., & Daworiye, S. P. (2018). Nutritional, ant nutritional and mineral study of seeds used as soup thickener. IOSR Journal of Pharmacy and Biological Sciences, *13*(4), 43-47.

Francis, C. A., & Porter, P. (2017). *Multicropping*. Academic Press, 2nd edition, Volume 3, Pp. 29-33.

Hamadina, E. I., Hamadina, M. K., & Solomon, T. B. (2018). Food security in the face of climate change: Potential roles of underutilised plant species around some rural homesteads in the Niger Delta. *Natural Resources*, *9*(3), 55-72.

Ibeawuchi, I. I., Okoli, N. A., Alagba, R. A., Ofar, M. O., Emma-Okafor, L. C., Peter-Onoh, C. A., & Obiefuna, J. C. (2015). Fruit and vegetable crops production in Nigeria: The gains, challenges and the way forward. *Journal of Biology, Agriculture and Healthcare,* 5(2), 109-28.

Jensen, E. S., Carlsson, G., & Hauggaard-Nielsen, H. (2020). Intercropping of grain legumes and cereals improves the use of soil N resources and reduces the requirement for synthetic fertilizer N: A global-scale analysis. *Agronomy for Sustainable Development*, *40,* Article number 5.

Maharani, D., Sudomo, A., Swestiani, D., Sabastian, G. E., Roshetko, J. M., & Fambayun, R. A. (2022). Intercropping Tuber Crops with Teak in Gunungkidul Regency, Yogyakarta, Indonesia. *Agronomy*, *12*(2), 449.

Maphosa, Y., & Jideani, V. A. (2017). The role of legumes in human nutrition. In: *Functional food-improve health through adequate food.* Pp. 103-120.

Maroyi, A., & Cheikhyoussef, A. (2015). A comparative study of medicinal plants used in rural areas of Namibia and Zimbabwe. *Indian Journal of Traditional Knowledge,* 14(3), 401-406.

Martínez-Mena, M., Boix-Fayos, C., Carrillo-López, E., Díaz-Pereira, E., Zornoza, R., Sánchez-Navarro, V., Acosta, J. A., Martinez-Martinez, S., & Almagro, M. (2021). Short-term impact of crop diversification on soil carbon fluxes and balance in rainfed and irrigated woody cropping systems under semiarid Mediterranean conditions. *Plant and Soil*, *467*(1), 499-514.

Marx, S., & Nguma, Y. (2013). Cassava as feedstock for ethanol production in South Africa. *African Journal of Biotechnology* 12(31), 4975-4983.

Mihailescu, E., & Bruno Soares, M. (2020). The influence of climate on agricultural decisions for three European crops: A systematic review. *Frontiers in Sustainable Food Systems*, *4*, 64.

Ndulaka, J. C., Ekaiko, M. U., Onuh, E. F. and Okoro, O. A. (2017). Comparative studies on the nutritional and anti-nutritional properties of indigenous seeds used as soup thickeners in South-East Nigeria. *IOSR Journal of Biotechnology and Biochemistry,* 3(5), 39-44.

Ojide, M. G., Busie, M. D., & Tahirou, A. (2021). Contribution of Maize-based products to the livelihood of smallholder processors in rural northern Nigeria. *International Journal of Rural Management*. Retrieved from https://www.researcher-app.com/paper/7380399.

Raza, A., Razzaq, A., Mehmood, S. S., Zou, X., Zhang, X., Lv, Y., & Xu, J. (2019). Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. *Plants*, *8*(2), 34.

Richardville, K., Egel, D., Flachs, A., Jaiswal, A., Perkins, D., Thompson, A., & Hoagland, L. (2022). Leaf mold compost reduces waste, improves soil and microbial properties, and increases tomato productivity. *Urban Agriculture & Regional Food Systems*, *7*(1), e20022.

Schoonover, J. E., & Crim, J. F. (2015). An introduction to soil concepts and the role of soils in watershed management. *Journal of Contemporary Water Research & Education*, *154*(1), 21-47.

Schreinemachers, P., Simmons, E. B., & Wopereis, M. C. (2018). Tapping the economic and nutritional power of vegetables. *Global Food Security*, *16*, 36-45.

Seidelmann, S. B., Claggett, B., Cheng, S., Henglin, M., Shah, A., Steffen, L. M., Folsom, A. R., Rimm, E. B., Willett, W. C., & Solomon, S. D. (2018). Dietary carbohydrate intake and mortality: a prospective cohort study and meta-analysis. *The Lancet Public Health*, *3*(9), e419-e428.

Ssenku, J. E., Okurut, S. A., Namuli, A., Kudamba, A., Tugume, P., Matovu, P., Wasige, G., Kafeero, H. M., & Walusansa, A. (2022). Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda. *Tropical Medicine and Health*, *50,* Article number 39.

Stagnari, F., Maggio, A., Galieni, A., & Pisante, M. (2017). Multiple benefits of legumes for agriculture sustainability: an overview. *Chemical and Biological Technologies in Agriculture*, *4,* Article number 2.

Stănică, F. (2017). Efficient exploitation of local fruit resources through sustainable production and high added value processing. *2nd International Conference on Sustainable Agriculture and Food Security: A comprehensive approach.* KnE Life Sciences. Pp. 1-10.

Vanlauwe, B., Hungria, M., Kanampiu, F., & Giller, K. E. (2019). The role of legumes in the sustainable intensification of African smallholder agriculture: Lessons learnt and challenges for the future. *Agriculture, Ecosystems & Environment*, *284*, 106583.

Waha, K., Dietrich, J. P., Portmann, F. T., Siebert, S., Thornton, P. K., Bondeau, A., & Herrero, M. (2020). Multiple cropping systems of the world and the potential for increasing cropping intensity. *Global Environmental Change*, *64*, 102131.

Wang, Q., Li, Y., & Alva, A. (2010). Cropping systems to improve carbon sequestration for mitigation of climate change. *Journal of Environmental Protection*, *1*(03), 207-215.

Yohannes, H. (2016). A review on relationship between climate change and agriculture. *Journal of Earth Science & Climatic Change*, *7*(2), 335.