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WOODY PLANT SPECIES ENUMERATION IN ABANDONED FARMLANDS WITHIN OMUIGWE AGRARIAN COMMUNITY IN ALUU, RIVERS STATE, NIGERIA

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ABSTRACT

This study was conducted to enumerate woody plant species in abandoned farmlands of different ages in Omuigwe community, ALUU, Rivers State, with a view to ascertaining the impact of different fallow periods on woody species composition and diversity. Four fallow farmlands: FL_1 (1 year old), FL_2 (3 years old), FL_3 (5 years old) and FL_4 (7 years old), were purposively chosen for the study. Tree enumeration was carried out using five 20 m x 20 m quadrats randomly distributed on each fallow land. All woody species found in the quadrats were identified to species level, and the number of individuals counted and recorded for each fallow period. Woody species diversity was measured using Simpson (1-D) and Shannon-Wienner (H') indices while similarity in woody species between fallow lands was computed using Sorensen's index. Total height and diameter of the woody species were measured using a pole graduated in metres and a caliper respectively. Woody species that contribute to livelihoods in the community were identified through oral interviews with twenty randomly selected Heads of households in the community. A total of twenty-five species belonging to nineteen families were identified as contributing to livelihoods in the community. This information was used to ascertain the number of the key livelihood species among the woody species in the fallow farmlands. Populations of woody species in fallow farmlands among the species identified as contributing to livelihoods in the community were low (20%, 20%, 29% and 20% in FL_1, FL_2, FL_3 and FL_4, respectively). Total woody species population decreased with an increase in the age of fallow land while woody species diversity was slightly higher in FL_3 (1-D = 0.86; H' =2. 21) than in FL_1 (1-D = 0.85; H' = 2.11), FL_2 (1-D = 0.84; H' = 2.10) and FL_4 (1-D = 0.82; H' = 2.10). Woody species diameter and height showed an increasing trend with increase in fallow period with some species and varied significantly ($p < 0.05$) amongst fallow farmlands in some cases. Similarity in woody species composition between sites was generally low (below 50% except between FL_2 and FL_3 where a similarity of 50% was recorded). Woody species diversity and the populations of woody species contributing to rural livelihoods decreased after a fallow period of five years. Integrated land use system like agroforestry is suggested for effective regeneration and conservation of woody species in the community especially those that contribute to rural livelihoods.

Key words: Shifting cultivation, fallow period, woody species, rural livelihood, regeneration

INTRODUCTION

Human beings have depended on trees and other woody species for various aspects of their livelihood from time immemorial. The end to this dependence is not yet in sight as World Bank (2001) noted that almost 1.6 billion people in the world rely on forest resources for their livelihood. Woody plants being vital components of the ecosystem have productive, protective and recreational functions (Atiku *et al.*, 2013). They control soil erosion, stabilize regional and global climates, serve as carbon sinks, and help in pollution control (Adamu, 2006). However, the extent to which forest trees are being exploited calls for urgent attention (Zaki, 2004).

One of the factors responsible for deforestation and reduction in populations of woody species including trees, especially in Africa, is shifting cultivation. Shifting cultivation posed no serious threat to forests and their resources when human populations were low enough to allow longer fallow periods that enhanced regeneration and restoration of forest ecosystems. However, increased population pressure and regulations limiting access to land have resulted in shorter fallow periods. The negative effects of deforestation are likely to worsen following increases in land use intensity as a result of growing human populations (Chazdon, 2003).

Apart from the various products that are directly derived from woody species, the presence of woody species on farms results to improved soil fertility, increase in organic matter content, soil erosion control, higher carbon sequestration and enhanced nutrient cycling efficiency. However, reduced fallow periods and increased pressure on land are reducing populations of woody species thereby reducing their capacity to provide these essential services and contribute to rural livelihood.

Given the importance of woody plant species and the negative impact of shifting cultivation on their populations, there is the need to ascertain if shifting cultivation and its associated farming practices can support the recovery of important woody species especially those that contribute hugely to rural livelihood. Such information is required to guide decisions on how to effectively regenerate and conserve such species, and thus, promote rural livelihoods and also sustain the ecological services they render. This study attempted to provide such information by evaluating the populations of woody plant species in abandoned farmlands of different fallow periods within Omuigwe, an agrarian community in Aluu, Rivers State, Nigeria.

MATERIALS AND METHODS

Study area

Omuigwe Community is located in Aluu, Rivers State, South-south, Nigeria. Aluu is located at latitude 04^{o} 55' 14.8" North and longitude 06^{o} 55' 07.7" East with an elevation of 15.2 m in Ikwere Local Government Area of Rivers State, Nigeria. Aluu is characterized by alternate seasons of wet and dry (Iloeje, 1972) with total annual rainfall of about 240 cm, relative humidity of over 90% and average annual temperature of 27 ^{o}C (Udom, 2005). Major tree species found in the area include; *Elaeis guineensis, Psidium guajava, Theobroma cacao, Chrysophyllum albidum, Cocos nucifera* to mention but a few. The occupation of the people of Omuigwe community in Aluu is mainly trading and farming. They produce crops such as cassava, maize, vegetables, and yam, among others.

Selection of study sites

Four fallow farmlands were purposively chosen for the study after a reconnaissance survey. The sites represent different chronosequences of fallow land (1, 3, 5, and 7 years).

Methods of data collection

Documentation of native woody species and their uses

Twenty Heads of households were randomly selected for oral interview to document the woody species that contribute to livelihoods in the community and their uses (including parts used).

Woody species enumeration

Quadrat method was used to enumerate the native species in each fallow farmland. Five 20 x 20m quadrats were randomly laid in each site. All woody plants were identified to species level and the number of individuals counted. In addition, the heights and diametres of the woody species were measured for each site, using a pole graduated in metres and a caliper, respectively.

Methods of Data Analysis

Analysis of Variance and T-test

One-way analysis of variance was used to test for significant difference in the heights and diameters of woody species where a particular species occurred in up to three of the fallow lands while T-test was used when a species occurred only in two of the fallow lands. However, neither analysis of variance nor t-test was performed in situations where a species occurred only in one fallow land.

Measurement of Alpha Diversity

Alpha (within-community) diversity was computed for each fallow land using Simpson Index (Simpson, 1949) and Shannon-Wiener Index (Pielou, 1969).

Simpson's Index is expressed as:

$$D = \frac{\sum_{i=1}^{q} ni(ni-1)}{N(N-1)} \quad \ldots\ldots 1$$

Where: ni = the number of individuals in the ith woody species

N = the total number of individuals counted for all woody species

Shannon-Wiener Index is expressed as:

$$H = -\sum_{i=1}^{s} pi \log pi \quad \ldots\ldots 2$$

Where: pi = the proportion of individuals in the ith woody species

s = the total number of species enumerated

Measurement of Beta Diversity

Sorensen's similarity index was used to measure beta diversity using the formula below after Ogunleye *et al*. (2004), Ojo (2004), Ihenyen *et al.* (2010), and Ihuma *et al*. (2011).

$$SI = \frac{a}{a+b+c} \; X\,100 \qquad \text{…………} \; 3$$

Where:

a = number of woody species present in both fallow sites under consideration

b = number of woody species present in fallow Site 1 but absent in fallow Site 2

c = number of woody species present in fallow Site 2 but absent in fallow Site 1

RESULTS

Woody species that support livelihoods in the community

A total of twenty-five species belonging to nineteen families identified as contributing to livelihoods in the study area, their uses and parts used, are presented in Table 1. These species are used for treating various ailments, income generation, timber, energy generation (fuel wood), food, among other uses; and almost all the parts of the species are used. The species were evenly distributed among families with 68.42% of the families represented by one species each, 15.79% represented by two species each, and 10.53% (Anacardiaceae and Fabaceae) represented by three species each. The percentages of the species that support livelihoods found in each of the fallow lands are shown in Figure 1. Generally, percentages were low (< 30%) with the highest percentage recorded for Fallow Land 3 (five years old) and the lowest for fallow lands 1, 2 and 4 (one, three and seven years old, respectively).

Table 1: Checklist of woody species that support livelihood in the community

S/no.	Species	Family	Uses	Parts used
1	*Allanblackia floribunda*	Clusiaceae	For treating dysentery, and construction of doors and window frames	Bark, branches and stem
2	*Anacardium occidentale*	Anacardiaceae	For food and gum production	Fruit, stem
3	*Anthonatha macrophylla*	Leguminosae	For fire wood	Branches
4	*Baphia nitida*	Fabaceae	For dye production	Stem
5	*Chrysophyllum albidum*	Sapotaceae	For food and income	Fruit
6	*Citrus sinensis*	Rutaceae	For food and income	Fruit
7	*Cocos nucifera*	Arecaceae	For food	Fruit
8	*Cola nitida*	Malvaceae	Used for treating cough and for tannin production	Fruit
9	*Dacryodes edulis*	Burseraceae	For food	Fruit
10	*Dennettia tripetala*	Annonaceae	Used traditionally as a remedy for cough. Leaves are used to treat fever	Fruit, Leaf
11	*Detarium microcarpum*	Fabaceae	For furniture and fuel wood	Stem, branches
12	*Elaeis guineensis*	Arecaceae	Used to make palm oil and cream	Fruit
13	*Gmelina arborea*	Verbenaceae	For construction of mortar and pestle	Stem
14	*Gongronema latifolium*	Asclepiadaceae	Leaves are used to treat stomach ache and constipation	Leaf
15	*Irvingia gabonensis*	Irvingiaceae	For food and income	Fruit
16	*Mangifera indica*	Anacardiaceae	For food and income	Fruit
17	*Melicia exelsa*	Moraceae	For timber production	Stem/Branches
18	*Persea americana*	Lauraceae	For income generation	Fruit
19	*Piper guineense*	Piperaceae	Leaves are used as flavour in stew	Leaf
20	*Psidium guajava*	Myrtaceae	For staking of crops/food	Branches/fruits
21	*Pterocarpus mildbraedii*	Papilionaceae	For timber production	Stem
22	*Pterocarpus soyauxii*	Fabaceae	For dyeing of clothes	Leaf, bark
23	*Spondias mombin*	Anacardiaceae	For food	Fruit
24	*Theobroma cacao*	Malvaceae	For food and dyeing	Fruit
25	*Vitex doniana*	Verbenaceae	For flavour in pepper soup	Fruit

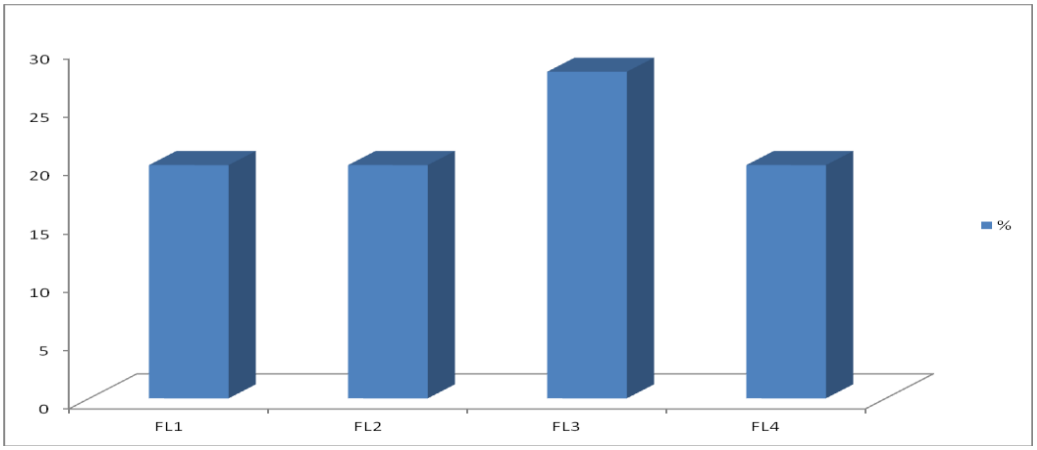

Figure 1: Percentages of the woody species that contribute to rural livelihood found in the fallow lands

Population and diversity of woody species found in different fallow lands

The populations of woody species at the fallow lands are presented in Table 2 while the diversity indices for the various fallow lands are presented in Table 3. Woody species populations ranged from 0 to 25 in FL_1, 0 to 22 in FL_2, 0 to 20 in FL_3, and 0 to 18 in FL_4. Total populations of woody species decreased with an increase in the age of fallow lands, while woody species diversity was higher in FL_3 than in the other fallow lands.

Table 2: Populations of woody species in the fallow lands

S/No.	Species	Family	Population			
			FL_1	FL_2	FL_3	FL_4
1	*Alchornea cordifolia*	Euphorbiaceae	20	10	7	5
2	*Allanblackia floribunda*	Clusiaceae	0	1	3	1
3	*Alstonia boonei*	Apocynaceae	0	4	0	0
4	*Anthocleista vogelii*	Loganiaceae	5	5	9	4
5	*Anthonatha macrophylla*	Leguminosae	25	8	20	0
6	*Baphia nitida*	Fabaceae	0	5	3	0
7	*Dacryodes edulis*	Burseraceae	0	0	0	1
8	*Dracaena sp.*	Agavaceae	0	0	0	3
9	*Elaeis guineensis*	Arecaceae	13	22	10	3
10	*Ficus exasperata*	Moraceae	7	0	0	2
11	*Ficus mucoso*	Moraceae	0	1	0	0
12	*Funtumia elastica*	Apocynaceae	0	0	0	1
13	*Gmelina arborea*	Verbenaceae	0	0	0	18
14	*Harungana madagascarensis*	Guttiferae	5	1	0	0
15	*Hura crepitans*	Euphorbiaceae	0	0	0	4
16	*Massularia acuminata*	Rubiaceae	0	0	1	0
17	*Milicia excelsa*	Moraceae	3	0	0	0
18	*Nauclea latifolia*	Rubiaceae	3	0	5	0
19	*Newbouldia laevis*	Bignoniaceae	0	0	2	0
20	*Pentaclethra macrophylla*	Leguminosae	1	0	0	3
21	*Psidium guajava*	Myrtaceae	7	6	4	0
22	*Pterocarpus mildbraedii*	Papilionaceae	0	0	3	0
23	*Pycnanthus angolensis*	Myristicaceae	0	1	0	0
24	*Spondias mombin*	Anacardiaceae	11	10	10	5

FL_1= Fallow Land 1 (1 Year); FL_2= Fallow Land 2 (3 Years); FL_3= Fallow Land 3 (5 Years); FL_4= Fallow Land 4 (7 Years)

Table 3: Diversity of woody species in different fallow lands

	FL_1	FL_2	FL_3	FL_4
No. of species	11	12	12	12
Individuals	100	74	77	50
Simpson 1-D	0.85	0.84	0.86	0.82
Shannon H'	2.11	2.10	2.21	2.10

FL_1= Fallow Land 1 (1 Year); FL_2= Fallow Land 2 (3 Years); FL_3= Fallow Land 3 (5 Years); FL_4= Fallow Land 4 (7 Years)

Growth attributes of woody species in different fallow lands

The diameter of woody species at the various fallow lands is shown in Table 4 while the total height is shown in Table 5. Diameter ranged from 0.03 to 0.16 m in FL_1, 0.05 to 0.32m in FL_2, 0.08 to 0.24 m in FL_3, and 0.15 to 0.38 in FL_4. The total height of the woody perennials ranged from 1.33 to 3.85 m in FL_1, 3.00 to 6.00 m in FL_2, 3.00 to 5.50 m in FL_3, and 3.25 to 8.00 m in FL_4. There was no regular pattern observed in diameter and height increment with respect to the age of the fallow lands. With some species, an increasing trend was observed while it was not so in some other species. However, in most species, there was usually no significant difference between the one year and three years old fallow lands, between the three years and five years old fallow lands, and between the five years old and the seven years old fallow lands.

Table 4: Diameter of woody species at the different fallow lands

Species	**Diameter at the base (m)**			
	FL_1	**FL_2**	**FL_3**	**FL_4**
Alchornea cordifolia	0.06 ± 0.00^{a}	0.15 ± 0.00^{b}	0.16 ± 0.02^{b}	0.24 ± 0.03^{c}
Allanblackia floribunda	_	0.25 ± 0.00^{a}	0.20 ± 0.05^{a}	0.18 ± 0.00^{a}
Alstonia boonei	_	0.28 ± 0.03	_	_
Anthocleista vogelii	0.06 ± 0.01^{a}	0.09 ± 0.01^{ab}	0.12 ± 0.01^{bc}	0.15 ± 0.03^{cd}
Antonata microphylla	0.15 ± 0.01^{a}	0.18 ± 0.03^{a}	0.18 ± 0.01^{a}	_
Baphia nitida	_	0.12 ± 0.02^{a}	0.17 ± 0.03^{b}	_
Dacryodes edulis	_	_	_	0.38 ± 0.00
Dracaena spp	_	_	_	0.15 ± 0.03
Elaeis guineensis	0.10 ± 0.01^{a}	0.17 ± 0.01^{ab}	0.24 ± 0.02^{bc}	0.27 ± 0.06^{cd}
Ficus exasperata	0.16 ± 0.01^{a}	_	_	0.33 ± 0.08^{b}
Ficus mucoso	_	0.05 ± 0.00	_	_
Funtumia elastica	_	_	_	0.32 ± 0.00
Gmelina arborea	_	_	_	0.28 ± 0.01
Harungana madagascarensis	0.15 ± 0.01^{a}	0.29 ± 0.00^{b}	_	_
Hura crepitans	_	_	_	0.20 ± 0.03
Massularia acuminata	_	_	0.08 ± 0	_
Milicia exelsa	0.14 ± 0.04	_	_	_
Nauclea latifolia	0.13 ± 0.02^{a}	_	0.19 ± 0.02^{b}	_
Newbouldia laevis	_	_	0.24 ± 0.05	_
Pentaclethra macrophylla	0.03 ± 0.00^{a}	_	_	0.19 ± 0.05^{b}
Psidium guajava	0.13 ± 0.02^{a}	0.18 ± 0.03^{a}	0.14 ± 0.02^{a}	_
Pterocarpus mildbraedii	_	_	0.19 ± 0.02	_
Pycnanthus angolensis	_	0.32 ± 0.00	_	_
Spondias mombin	0.15 ± 0.01^{a}	0.28 ± 0.03^{b}	0.18 ± 0.02^{ac}	0.22 ± 0.03^{cd}

Means on the same row with the same superscript are not significantly different ($p > 0.05$)
FL_1= Fallow Land 1 (1 Year); FL_2= Fallow Land 2 (3 Years); FL_3= Fallow Land 3 (5 Years); FL_4= Fallow Land 4 (7 Years)

Table 5: Height of woody species at the different fallow lands

Species	Height (m)			
	FL_1	FL_2	FL_3	FL_4
Alchornea cordifolia	1.85 ± 0.18^a	4.80 ± 0.25^b	3.57 ± 0.57^b	5.00 ± 0.45^b
Allanblackia floribunda	_	4.00 ± 0.00^a	4.67 ± 0.88^a	4.00 ± 0.00^a
Alstonia boonei	_	4.00 ± 0.71	_	_
Anthocleista vogelii	3.20 ± 0.58^a	4.40 ± 0.75^b	3.67 ± 0.60^b	3.25 ± 0.63^a
Antonata microphylla	2.00 ± 0.22^a	3.13 ± 0.48^b	4.00 ± 0.19^c	_
Baphia nitida	_	3.20 ± 0.58^a	3.67 ± 0.88^a	_
Dacryodes edulis	_	_	_	7.00 ± 0.00
Dracaena spp	_	_	_	4.00 ± 0.58
Elaeis guineensis	3.85 ± 0.25^a	5.19 ± 0.25^b	4.40 ± 0.43^a	8.00 ± 2.08^c
Ficus exasperate	3.29 ± 0.52	_	_	7.50 ± 1.50
Ficus mucuso	_	3.00 ± 0.00	_	_
Funtumia elastica	_	_	_	8.00 ± 0.00
Gmelina arborea	_	_	_	6.39 ± 0.43
Harungana madagascarensis	1.60 ± 0.40^a	6.00 ± 0.00^b	_	_
Hura crepitans	_	_	_	3.75 ± 0.48
Massularia acuminata	_	_	3.00 ± 0.00	_
Milicia exelsa	2.00 ± 0.58	_	_	_
Nauclea latifolia	1.33 ± 0.33^a	_	3.40 ± 0.25^b	_
Newbouldia laevis	_	_	5.50 ± 1.50	_
Pentaclethra macrophylla	2.00 ± 0.00^a	_	_	4.67 ± 0.88^b
Psidium guajava	2.14 ± 0.40^a	3.17 ± 0.48^b	3.00 ± 0.41^b	_
Pterocarpus mildbraedii	_	_	5.33 ± 0.88	_
Pycnanthus angolensis	_	6.00 ± 0.00	_	_
Spondias mombin	2.55 ± 0.37^a	3.00 ± 0.29^a	4.60 ± 0.40^b	3.80 ± 0.37^b

Means on the same row with the same superscript are not significantly different ($p > 0.05$)
FL_1= Fallow Land 1 (1 Year); FL_2= Fallow Land 2 (3 Years); FL_3= Fallow Land 3 (5 Years); FL_4= Fallow Land 4 (7 Years)

Similarity in woody species composition of different fallow lands

The level of similarity in woody species composition of the various fallow lands is shown in Table 6. Similarity in woody species composition between sites was generally low (below 50% except between FL_2 and FL_3). Similarity was lowest between FL_2/FL_4 and FL_3/FL_4 (26.32%).

Table 6: Similarity in woody species composition of the fallow lands

	FL_1	FL_2	FL_3	FL_4
FL1	*	43.75	43.75	35.29
FL2		*	50.00	26.32
FL3			*	26.32
FL4				*

FL_1= Fallow Land 1 (1 Year); FL_2= Fallow Land 2 (3 Years); FL_3= Fallow Land 3 (5 Years); FL_4= Fallow Land 4 (7 Years)

DISCUSSION

The twenty-five woody species belonging to nineteen families identified in this study as contributing to livelihood in the study area and their uses underscore the importance of trees in the livelihoods of the rural dwellers. World Bank

(2001) observed that the dependence of people on trees and forests is high; with almost 1.6 billion people around the globe relying on forest resources to address several needs including food, energy, medicine, folder, construction, furniture, baskets, mats, dyes, agricultural implements and utensils.

Generally, percentages of the woody species identified to be contributing to livelihoods in the community were low (<30%) in all the fallow lands. These low percentages may be as a result of exploitation of these woody species for various uses especially fuel wood. Unsustainable extraction of forest resources such as fuel wood has caused forest loss and degradation, loss of wildlife habitats, and loss of species diversity (Kakati 1999; Verma *et al.*, 1997). This also probably explains why the total woody species population at the fallow lands decreased with an increase in the age of the fallow lands. It appears that the exploitation of the woody species for various uses increases as they mature.

Fallow period has been known to affect plant species diversity. Several studies (e.g. Kammesheidt, 1998 and Lebrija-trejos *et al*., 2008) observed that plant species diversity increases with fallow age. In fact very old fallows have been known to have diversity values that are similar to that of old-growth forest (Ruiz *et al*., 2005).

Although many studies have reported an increasing trend in species diversity with fallow age, a few studies (e.g. El-sheikh, 2005; Fukushima *et al*., 2008) have found a decrease in diversity as fallows aged. El-sheikh (2005) concluded in his study that species diversity on fallow fields of dry forests in Egypt decreased when succession progressed, despite an increase found in early stages (1-3 years). The results of this study with respect to diversity, is in line with the observation of El-sheikh (2005) as woody species diversity was observed to decrease after five years of fallow (FL3). It appears that as from seven years of fallow (FL4), exploitation of the woody species worsens due to increasing maturity and better growth attributes like diameter and height. This partly explains why there was no particular trend observed with respect to increment in the diameter and height of the woody species with age of the fallow lands, as preference for certain species may have reduced their populations as the fallow period increased and consequently, their average diameters and heights. In addition, other conditions such as inherent spatial variation in soil quality and other growth conditions may also have affected the diameter and height of species irrespective of exploitation and fallow period.

CONCLUSION AND RECOMMENDATION

The study showed that the Omuigwe people rely on some woody species for their livelihoods, to a reasonable extent. However, populations of woody species contributing to livelihoods in the community were found to be low in the fallow farmlands. Woody species diversity was also generally low in the fallow farmlands and decreased after a fallow period of five years. There was no regular pattern observed in diameter and height increment with respect to the age of the fallow lands. With some species, an increasing trend was observed while it was not so in some other species. However, total woody populations of the fallow lands generally decreased with an increase in the fallow period. An integrated land use system like agroforestry is suggested for effective regeneration of woody species in farms within the community especially those that contribute to rural livelihoods.

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