

Global Change and Sustainable Development in Africa: A Role for South-South Cooperation? <i>Oyejide T. Ademola</i>	1
Sustainable Development: What Role for Economic Integration, Trade and Investment policies? <i>Adewoye Omoniyi</i>	13
Strengthening Sustainable Development Practice in Sub-Saharan Africa: Role of the Centre for Sustainable Development, University of Ibadan, Nigeria <i>Popoola Labode, Olanrewaju Olaniyan &amp; Olawale Olayide</i>	37
Indigenous Knowledge, Cultural Values and Sustainable Development in Africa <i>Apusigah A. Atia</i>	49
Sustainable Education Provision: Can the Poor afford Private Schools? <i>Olaniyan Olanrewaju</i>	73
Climate Change Impact on Public Health: A Nigerian Case Scenario <i>Ana Godson R.E.E., Oluwaseun O Akinyemi &amp; Gregory A. Fakunle</i>	97
Effects of Anthropogenic Interferences on Taylor Creek Forest Reserve and its People in Bayelsa State, Niger Delta Region, Nigeria <i>Asimiea A. O. &amp; G. E. Omokhua</i>	115
Community Participation and Sustainable Forest Management in Edo State, Nigeria <i>Azeez I. O., Labode Popoola &amp; O. S. Ikponmwonba</i>	129
Determining the Optimum Shape and Orientation of a Greenhouse on the Basis of Total Radiation availability <i>Odesola I. F. &amp; Chidozie Ezekwem</i>	155
Paperless University System: Fiction, Mirage or a Possibility <i>Olubusoye Olusanya E.</i>	175
Utilization of Palm Kernel Shell Ash as Partial Cement Replacement in Concrete <i>Olutoge F. A. &amp; I. A. Otunla</i>	187
Maximizing Contribution of Wildlife to Sustainable Development: A brief Overview <i>Onadeko S. A., O. A. Jayeola &amp; A. A. Ogunjinmi</i>	201



- Fan, T., J. X. Wang, and J.S. Buckley (2002). Evaluating Crude Oils by SAR Analysis. Paper SPE 75228. In SPE/DOE Symp. On Improved Oil Recovery, Tulsa, OK. 15-17 Apr. 2002. IOR, Tulsa, OK.
- Houghton, R. M., Bonne, R. D., Fruci, J. R., Hobbie, J. E., Melillo, C. A., Peterson, J., Shaver, G. R. and Woodwell, G. M. (1987). The flux of carbon from terrestrial ecosystems to the atmosphere in 1980 due to changes in land use: geographic distribution of the global flux. *Tellus* 39: 122-139.
- Keay, R.W.J (1989). *Tree of Nigeria*. Oxford Science Publications. Clarendon Press Oxford. 476pp.
- Marcet, P., M. L. Fernandez Feal, M. L. Andrade Couce, and M. J. Montero Vilarino (2000).. Efecto de la influencia antropica sobre las caracteristicas fisicoquimicas de dos suelos de marisma. (In Spanish, with English abstract.) *Edafologia* 7(3):11-19.
- Marguba, L. B. (1996). The need for practicable conservation programmes to meet human needs. In: *Natural Resource Conservation and Medicinal Plants: A Symposium (Nig. National Parks)*. Proceedings of National Workshop on Medicinal Plants, Sept. 13-14, 1996, Abuja.
- Owonubi, J. J. and G. O. Otegbeye (2004). *Disappearing Forests: A Review of the Challenges for Conservation of Genetic Resources and Environmental Management*. (1&2):1-11pp.
- Picot, J. C. and Gill, D. A. (1996). "The Exxon Valdez Oil Spill and Chronic Psychological Stress". In *Proceedings of the Exxon Valdez Oil Spill Symposium*, eds. F. Rice, R. Spies, D. Wolfe, and B. Wright. Bethesda, MD: American Fisheries Society.
- Sobowale, A., Igboanugo A. B. I., Aluko A. P and Onwuegbunam D. (2007). Land Degradation and Forest Depletion in Forest Plantations of the Guinea Savannah Zone of Nigeria. 50-59pp.
- Spies, R. B., S. D. Rice, D. A. Wolfe, and B. A. Wright. (1996). The effects of the Exxon Valdez oil spill on the Alaskan coastal environment. *American Fisheries Society Symposium* 18: 1-16.
- U.S. Fish & Wildlife Service (1987). *Comparison of actual and predicted impacts of the Trans-Alaska Pipeline System and Prudhoe Bay oilfields on the North Slope of Alaska*. Draft report prepared by Fairbanks Fish and Wildlife Enhancement Office.

## Community Participation and Sustainable Forest Management in Edo State, Nigeria

AZEEZ I. O., Labode POPOOLA & O. S. IKPONMWONBA

### Abstract

Contributions of forests to human well-being can only be sustained if the forests are sustained and local communities living within and around forest reserves have been identified to be central to meaningful planning for sustainable management of forest reserves. Studies in this direction are expected to contribute to poverty alleviation, environmental protection, and sustainable wood production. This study is directed at ascertaining how participatory approach involving local communities and other stakeholders can be used for sustainable management of forest reserves in Edo State.

Stratified random sampling technique with a minimum of 30% sampling intensity was used to select 296 rural dwellers in the settlements within and around Ehor, Okomu, and Sakpoba forest reserves in the study area. Information was obtained on demographic and social status of the respondents, importance of the reserves to livelihoods, impressions about management system, forest resource use and willingness to participate in JFM using structured questionnaire, Rapid Rural Appraisal and Participatory-Rural Appraisal techniques. Data obtained were subjected to descriptive and Chi-square test statistics at  $p = 0.05$ .

None of the socio-economic characteristics of the respondents apart from religion ( $t = 2.39$ ;  $P \leq 0.02$ ) in Okomu forest reserve significantly impacted their interest in forest conservation. However, ethnic background ( $t = 2.09$ ), marital status ( $t = 2.22$ ) and gender ( $t = -2.09$ ) significantly ( $P \leq 0.04$ ) impacted interest in tree planting. Also, awareness of, and

participation in local management activities were impacted by socio-economic status, most especially in Ehor and Okomu. Most of the respondents (85.14%) obtained produce from forest reserves, however, access to forest products was not significantly dependent on the income generating potential of the produce ( $\chi^2 = 9.35$ ;  $df = 4$ ). Some 14.43% of the respondents made an annual income of between ₦10,000:00 and ₦50,000:00 while 57.5% of other stakeholders made between ₦1.5 and 3.5 million per annum. Conflict with forest officials is significantly ( $P \leq 0.05$ ) dependent on access to forest products ( $\chi^2 = 70.44$ ;  $df = 4$ ) while perception of forest reserve law enforcement is not significantly dependent on access to forest produce. ( $\chi^2 = 9.01$ ;  $df = 4$ ). Attitude of forest officials to forest law enforcement is a constraint to income generating activities in the study area. There exists no significant linear relationship between the willingness to participate in forest management and the identified socio-economic characteristics of rural dwellers in Okomu ( $F = 0.82$ ), Sakpoba ( $F = 0.27$ ) and Ehor ( $0.35$ ) forest reserves. Also, apart from religion ( $t = 2.07$ ) in Okomu forest reserve, none of the socio-economic attributes of rural dwellers had significant linear relationship with their opinion on JFM affecting livelihood ( $t = 2.07$ ).

### Introduction

Nigeria's forests and woodlands play important roles in providing economic, social and ecological benefits apart from providing wide arrays of forest products and services for the people. But, the contributions of forests to human well-being can only be sustained if the forests are themselves sustained (FAO, 1994). Thus, Sustainable Forest Management (SFM) is essential for the continuous supply of natural forest resources. Nigeria has however, lost most of her natural forests cover with the rate of forest depletion put at about 3.5% per annum, which translates to a loss of 350,000 – 400,000 hectares per annum (Adedoyin, 2001, Aruofor, 2002).

Aruofor (2000) had earlier submitted that due to high rate of population and economic growth, which placed high demands on

natural forest resources, both natural and plantation forests supplied less than 100 million  $m^3$  as against 180 million  $m^3$  of wood demand in year 2000. Popoola (2000) observed an alarming and progressive annual rate of forest loss in Nigeria. Reposing this, FAO (2005) observed an increasing permanent destruction of tropical forests and asserted that 10.4m/ha was destroyed between years 2000-2005 as against 10.16m/ha in 1990-2000. In Nigeria, these have been linked partly but not exclusively to past forest management practices, arising from conflicting and inconsistent policies, strong desire for forest revenue, weak legislation, community alienation, lack of awareness and over-exploitation of natural resources (Papka, 2005).

Generally, forest conservation and management in Nigeria and Edo State in particular still largely remain under the exclusive control of government. Consequently, community participation is minimal or non-existent in the management of forest resources. This management approach assumed that forests and other natural resources should be completely protected from communities who would only degrade them further. But, as posited by The World Bank (2005), restricting access to these resources has increased poverty, particularly for local communities living around the reserves. Moreover, their views and interests are not taken into consideration in the management of the forests. As a result, all the forest reserves in Edo State have witnessed an orchestrated breakdown of the polycyclic management system.

According to Bada (1998), local communities living within and around forest reserves are very central to any meaningful planning for sustainable management of forest reserves. Similarly, the global trend has been to adopt a participatory approach to forest management that will integrate local communities in order to secure their commitment and achieve resource sustainability. Furthermore, Kio (2002) suggested radical change in forest policy as necessary for mobilizing the rural population in the interest of sustainable management of forest resources, which would arrest further deforestation and check land degradation.

It is noteworthy that, in the middle of the last century and even before independence, forest conservation and management under the

Benin Native Authority (and later the Benin Divisional Council) recorded huge success. But, present local and global reality demands the support and cooperation of local communities for sustainable forest management because: they have large population than any state forestry department, and so can police the forest estates and regulate entry; and they are the main beneficiaries of forest products, and forest disappearance will have greater impact on them and their livelihoods than any other segment of the society. Furthermore, they have local knowledge of forests within and around their environment. Although, conflicts often arise from participatory approach, but it creates opportunity for it to be properly addressed since participatory approach is based on consultation and dialogue.

Proper and sustainable implementation of sustainable forest management in the study area, is expected to strengthen and enhance biodiversity of the state. It will also affords the opportunity to reforest the degraded areas, restore and protect the remaining high forests, conduct sustainable harvesting of forest products, and ensure equitable distribution to all stakeholders including the local communities. Such increased levels of economic and social activities, resulting in huge employment and income generating potentials under sustainable forest management with intrinsic labour intensive characteristics, offers huge scope for poverty alleviation, especially given the emphasis on equitable distribution of responsibility and benefit sharing of all forest resources among stakeholders.

This will be a major paradigm shift from the old classical method to the new, that will enable forestry contribute to poverty alleviation, environmental protection, and sustainable wood production (Oyebo, 2004). It will also protect the vulnerable, especially women, very poor farmers, children, and the youth. Thus, this study is directed at ascertaining how participatory approach involving local communities and other stakeholders can be used for sustainable management of forest reserves in Edo State.

## Methodology

### Study Area

The study was carried out in the southern part of Edo State (Figure. 4). Edo State is situated between latitudes 5° 5'N and 7° 35'N and between longitudes 5°E and 6° 40'E, Wright, *et al* (1985). It is located inland, in the Southern part of Nigeria and is bounded partly by Ondo and Kogi States on the West, Kogi and Delta states on the East while only shares boundary with Delta state on the South. The State has a total land area of 19,840km<sup>2</sup> and a population of approximately 2.2 million people (1991 census). The population density is medium at 174.4 persons per km<sup>2</sup>. Generally, the state is in a low-lying area except to the north where it is marked by undulating hills rising to a peak of about 672 meters above sea level.

The climate is mainly tropical, characterized by the dry and wet seasons. November to March is dry and usually accompanied the dry northeast trade winds, which causes harmattan. The rainy season commences at about late March to October. Presently, there are 18 Local Government Areas (LGAs) in the State. The state forestry department has area offices in each of the LGAs for administrative purposes (FORMECU, 1998).

- Okomu Forest Reserve

Location: Okomu Forest Reserve is situated between longitudes 5° and 5° 30' E and latitudes 6° N' and 6° 10'N. It is located in Ovia South-West LGA of Edo State and about 40km west of Benin City. It lies between Rivers Osse and Siluko to the East and West respectively (Figure.5). The reserve derived its name from River Okomu from the Benin word 'Akomu' meaning unity. The reserve was named Okomu during the colonial constitution of the reserve. Some of the villages/settlements within and around the forest reserve are Nikrowa, Ofunama, Udo, Okomu, Iguohuan, Arakhuan, Iguelaho, Iguagbado, Igueze, Urhezen, Iguafole, Iguokakhan, Odobaiho, Izide-Noke, Izide Namen etc (Figure. 5). The Benins' are the original land owners and still form 60% of the population but there are other groups of settlers like Ijaw, Urhobo, Esan within and around the reserve.

• Sakpoba Forest Reserve

Sakpoba Forest Reserve lies between latitudes 4° and 4° 30' and longitudes 6° and 6° 5'E. It is bounded on the south by Delta State, on the East by Urhonigbe Forest Reserve and on the West by Free Area, B.C. 30 (Fig. 6). It is located in Orhionmwon Local Government Area, about 30 kilometres South-East of Benin City. Some of the major villages located within and around the reserve are Ugo, Ikobi, Oben, Iguelaba and Amaladi in Area B.C 32/4, and Ugboko-Niro, Iguere, Idunmwowina, Evbarhue, Idu, Evbueka, Iguomokhua, Ona, Abe, Igbakele, Adeyanba, Evbuosa in Area B.C 29. The Benins are the original landowners and still form 80% of the population living within and around the forest reserve. There are other ethnic groups such as Urhobo, Itsekiri and Esan (Bada, 1998).

• Ehor Forest Reserve

Ehor Forest Reserve lies between latitudes 6° and 6° 32' and longitudes 5° 58' and 5° 7' E. It is bounded on the North and North West by Owan (S & N) Forest Reserves, on the East by Free Areas BC 13/2, 16/2 on the South by free areas B.C 21/2, 16/2, 21/1 and on the West by Ekiador Forest and Owan (S) Forest Reserves (Fig. 6). It is located in Uhumwode Local Government Area, about 40 kilometres from Benin City along Benin Auchu road. Some major villages located within and around the forest reserves are Odighi, Osasimwioba Igbekhue, Egba, Urhokuosa Ugha, Obagie. Ehor, Oke, Okemuen, Osazuwa, Eguaholor, Ohe, Egbisi, Evbowe, Igieghudu and Uhi. It derives its name from Ehor being the major town then and now the headquarters of Uhumwode Local Government Area. The Benins are the predominant tribe which forms more than 75% of the population. The other ethnic groups are Esan, Igbanke and Ibo (Bada, 1998).

Sampling Procedure

Stratified random sampling design was used to select respondents in this study. To remove bias, the selection of respondents cut across such variables as religion, age occupation, income, ethnicity, educational attainment, nativity, family size, size of farmland etc. Data were collected using a combination of structured questionnaire and

participatory methods: Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal technique (PRAT). PRAT is an excellent tool, which bring together the researcher and forest communities with the view of defining the development needs of such communities by the community groups and relevant non-governmental organisation (Messesehmidt, 1995). A minimum of 19% sampling intensity was used in selecting settlements inside and around the forest reserves, which were also randomly selected.

Sampling Intensity

The study identified 106, 35 and 58 enclaves and villages in and around Okomu, Sakpoba and Ehor forest reserves using participatory rural appraisal technique. Out of the identified settlements, 19, 17 and 16 were randomly selected for sampling based on their nearness, importance and population size (Table 3). This represented between 18 and 49 percent sampling intensity at this stage of sampling. Finally 200, 80 and 120 sets of structured questionnaire were randomly administered to residents of Okomu, Sakpoba and Ehor forest reserves enclaves and villages to achieve at least 1% sampling intensity at respondent level. However, only 165, 40 and 91 sets of questionnaire were retrieved. It should however be noted that despite this low return of administered research instrument, all the required information were gotten and even for so many variables there were little or no variation in responses.

Table 3: Sampled Villages and Enclaves within and around the Study Sites

Okomu Forest Reserve			Sakpoba Forest Reserve		
S/No	Villages and Enclaves	Population (2000)	S/No.	Villages and Enclaves	Population (2000)
1	A.T. & P Camp.	1195	1	Adeyanba	1137
2	Ajakurama	2064	2	Akpajigha	297
3	Gbelebu	1340	3	Akpobi	225
4	Gbelemotin	471	4	camp	104
5	Gbolomosho	244	5	Amaladin	694
6	Iguagbado	346	6	Avbiugo	694
7	Iguelaho	1387	7	Evbuehia	395
8	Iguelaho camp	737	8	Evbueka	484
				Evbuosa	347

9	Iguerhahon	563	9	Idu	221
10	Iguohuan	432	10	Iguere	478
11	Izide - Namen	345	11	Iguomokhua	717
12	Izide - Noke	418	12	Ikobi	640
13	Madagbayo	846	13	Ikpe	98
14	Nikrowa	3663	14	Obayantor	367
15	Ofunama	2330	15	Oben	1027
16	Okomu	1160	16	Obozogbe - Niro	1523
17	Ora	560	17	Okporu camp	39
18	Udo	6714		<b>Total</b>	<b>8793</b>
19	Urhezen	675			
	<b>Total</b>	<b>25490</b>			

#### Ehor Forest Reserve

S/N o.	Villages and Enclaves	Population (2000)
1	Ehor	7191
2	Eke - Aimufua	421
3	Ekudo	200
4	Erhua	1248
5	Idunmwungha	1060
6	Iguo-Ovbiahiamwen	875
7	Inner Erhua	663
8	Irhue	786
9	Ofunmuegbe camp	288
10	Obagie	1967
11	Okemuen	592
12	Egbisi	204
13	Obazagbon	476
14	Ugbiyaya camp	665
15	Iriwe camp	283
16	Ayen	872
	<b>Total</b>	<b>17791</b>

#### Questionnaire Administration

Structured questionnaires were used to obtain information from the respondents during interview. The questions were open-ended and structured and sought for information on demographic and social status of the respondents, importance of the reserves to their livelihoods,

impression about present management system, forest resource use and willingness to participate in joint forest management. Also Focus Group Discussions (FGDs) were conducted to supplement information gathered from the interviews especially from non-literate participants who were not willing to volunteer information freely and clearly as it involved fewer numbers of people.

#### Analytical Technique

The data collected in the course of this study were subjected to descriptive and inferential statistical analysis. Data collected were coded and entered into the computer for analysis. Descriptive statistics, which involve the collation, simplifying and giving the properties of data, such as frequency counts; percentages and mean were used to describe variables and their occurrences among the population. Tables, histograms and bar charts were used to present data. The hypotheses, using appropriate inferential statistics, were used in making judgments on population based on properties of some samples obtained from the population.

The statistical tools used include:

- (i) Chi-square test, which was used to show the relationship between Forest Reserve use by the Local Communities and their demographic and socio-economic characteristics.
- (ii) Multiple regression technique was used to determine whether demographic and socio-economic characteristics of respondents affected their willingness to participate in forest management.
- (iii) Multiple regression was also used to determine whether factors such as income, sex, age, education, religion, occupation, family size etc influenced opinion expressed by respondents on forest management.

#### Results and Discussion

##### • Demographic Background

Findings from this study shows that Okomu, Sakpoba and Ehor forest reserve enclaves were fraught with 86.1%, 97.5% and 75.8% male respondents, which is high, compared to 13.3%, 2.5% and 20.9% female respondents interviewed in the three reserve enclaves respectively.

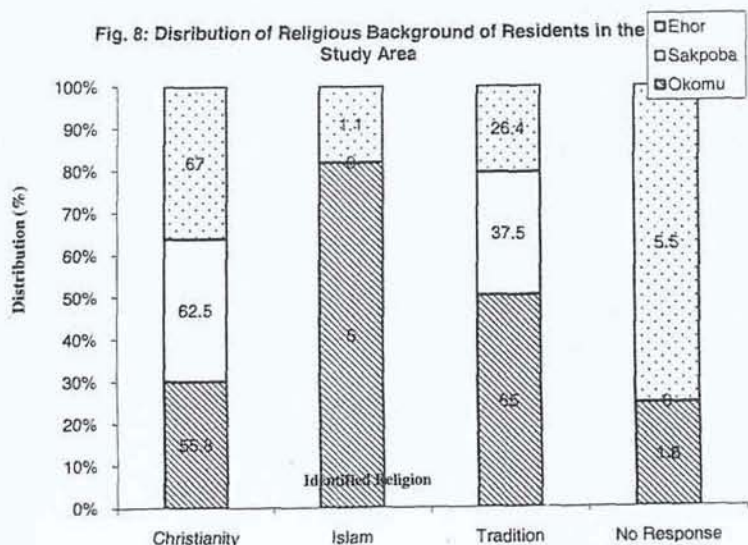
Thus, the male gender (an average of 84.69%) is higher in the study area than the female (14.3%). However, age distribution of the enclave dwellers in the three forest reserves cut across age range from 20 to more than 80 years of age (Table 4). This does not necessarily mean that dwellers whose age is less than twenty does not reside in forest enclaves, but they may not have the necessary experience needed to respond to questions posed. Further, more than half of the respondent fall within the age bracket of 40 and 60 yrs. But, respondent within the age bracket of between 20 and 30 years were low (2.04%) compared to those within 30 and 40 yrs (17.4%). Also, respondents with their ages above 70 years were few (5.10%).

On marital status, an average of 94.0% of the respondents was married while only 3.0% of them were single (Table 4). Identified modal (34.3%) household size was between 6 and 10 people while 17.7% of the respondents (on the average) are living with between 11 and 15 people. Religious diversity (Fig. 8) is more obvious in Ehor and Okomu Forest Reserves compared to Sakpoba where Islamic religion was not recorded among any of the respondents (Fig. 7). An average of 59.6% of enclave dwellers in the three study sites was found to be Christians. Tradition religion worshippers were next to Christianity in term of population (35.4%) in the study area, while only 2.0% practice Islam religion. Also, ethnic diversity is more pronounced in Okomu Forest reserve environment than the other two study sites (Table 4). Majority of the enclave dwellers in the study area are the Benins (78.5%). Other identified ethnic groups in the enclaves are Urhobo (9.2%), Esan (9.18%), Calabar (1.02%) and Ibo (1.02%). Hausa and Yoruba tribes are found only in Okomu forest reserve enclaves (Fig. 8)

Table 4: Demographic Characteristics of Rural Dwellers

Demographic Variables	Okomu		Sakpoba		Ehor		Mean	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Gender								
Male	142	86.1	39	97.5	69	75.8	83.0	84.69
Female	22	13.3	1	2.5	19	20.9	14.0	14.29
No Response	1	0.6	0	0.0	3	3.3	1.0	1.02
Age								

20 - 30 yrs	4	2.4	1	2.5	3	3.3	2	2.04
>30 - 40 yrs	31	18.8	7	17.5	14	15.4	17	17.35
>40 - 50 yrs	42	25.5	11	27.5	31	34.1	28	28.57
>50 - 60 yrs	43	26.1	10	25.0	20	22.0	24	24.49
>60 - 70 yrs	31	18.8	7	17.5	12	13.2	17	17.35
>70 - 80 yrs	6	3.6	2	5.0	7	7.7	5	5.10
>80 - 90 yrs	2	1.2	2	5.0	1	1.1	2	2.04
No response	6	3.6	0	0.0	3	3.3	3	3.06
Marital Status								
Single	6	3.6	1	2.5	1	1.1	3	3.00
Married	154	93.3	38	95.0	89	97.8	94	94.00
No Response	5	3.0	1	2.5	1	1.1	3	3.00
Religion								
Christianity	92	55.8	25	62.5	61	67	59	59.6
Islam	5	3.0	-	-	1	1.1	2	2.0
Tradition	65	39.4	15	37.5	24	26.4	35	35.4
No Response	3	1.8	-	-	5	5.5	3	3.0
Ethnic Background								
Benin	118	71.5	31	77.5	81	89	77	78.6
Urhobo	22	13.3	4	10.0	2	2.2	9	9.2
Yoruba	1	0.6	-	-	-	-	0	0.0
Ibo	2	1.2	-	-	1	1.1	1	1.0
Esan	15	9.1	4	10.0	7	7.7	9	9.2
Calabar	4	2.4	-	-	-	-	1	1.0
Hausa	1	0.6	-	-	-	-	0	0.0
No Response	2	1.2	1	2.5	-	-	1	1.0
Household size								
1 - 5	7	33.3	3	7.5	5	5.5	5	4.90
6 - 10	64	38.8	14	35.0	27	29.7	35	34.31
11 - 15	31	18.8	5	12.5	17	18.7	18	17.65
16 - 20	12	7.2	2	5.0	9	9.9	11	10.78
≥ 21	3	1.8	1	2.5	3	3.3	2	1.96
No response	48	29.1	15	37.5	30	33.0	31	30.39



**Socio-Economic Background**

Data generated from the study instrument reveal that western education is not a priority in the study area. An average of 23.6% of the respondent was illiterate while 37.8% (the highest) have primary school certificates. Only 1.2% on the average had degrees (Table 5). This may not be unconnected with the prevalent primary occupation in this part of the state, which does not demand western knowledge but traditional skill. Frequency analysis of respondents' occupation (Table 5) reveals that 94.9% of the entire study population is farming. Other activities they are primarily engaged in are wine tapping/palm oil processing (3.06%), trading (1.02%) and civil service work (1.02%).

Furthermore, than half of the respondents (58.3%) have farm sizes of between 1 and 5 hectares. An average of 11.46% has farm sizes of 5 to 10 hectares while 8.3% have farmlands of more than 10 hectares (Table 5). On land ownership (Table 5), more than half of the respondents (53.6%) rent the land on which they farm, a practice which is more prominent among residents (76.9%) in Ehor forest reserve enclave and environment. Other land ownership types identified by the study are ownership through inheritance (14.3%) and purchase (12.2%).

Results (Table 5) also show that on the average, 14.43% of the respondents make an annual income of between ten and fifty thousand naira/annum. Only 1.0% makes less than ₦10, 000/annum while the highest annual income (more than ₦300, 000) was made in Okomu forest enclaves (Table 5).

Examining nearness of respondents to forest reserves (Fig. 9), the study reveals that an average of 75.5% of the respondents resides between one and five kilometer away from the reserves. Only 1.0% of the respondents are residing below one kilometer away from the forest reserves while another 8.16% stay more than 5km away from them.

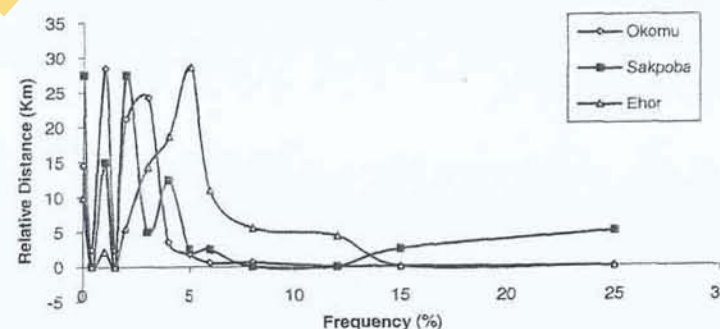


Fig. 9: Distribution of Relative Distance from Forest Reserve among Residents in the Study Area

Table 5: Socio-Economic Background of Rural Dwellers

Socio-Economic Variables	Okomu		Sakpoba		Ehor		Mean	
	Freq.	%	Freq.	%	Freq.	%	Fr	eq
<b>Educational Background</b>								
No formal Education	45	27.3	6	15.0	26	28.6	29	28.16
Primary School	54	32.7	16	40.0	38	41.8	36	34.95
Secondary	44	26.7	15	37.5	18	19.8	26	25.24



School								
OND / HND	4	2.4	2	5.0	1	1.1	3	2.91
B.Sc / M.Sc	2	1.2	1	2.5	-	-	1	0.97
No responses	16	9.7	0	-	8	8.8	8	7.77
<b>Primary Occupation</b>								
Farming	157	95.2	34	85.0	89	97.8	93	94.90
Wine	7	4.2	1	2.5	-	-	3	3.06
Tapping/ Palm Oil Processing								
Trading	1	0.6	1	2.5	1	1.1	1	1.02
Civil Service	-	-	4	10.0	-	-	1	1.02
No Response	-	-	-	-	1	1.1	0	0
<b>Farm Size</b>								
1 - 5ha	98	59.4	22	55.0	47	51.6	56	58.3
> 5 < 10ha	22	13.3	5	12.5	5	5.5	11	11.46
> 10ha	17	10.3	-	-	6	6.6	8	8.33
N.R	28	17.0	13	32.5	33	36.3	21	21.88
<b>Land Ownership Types</b>								
Inheritance	30	18.2	7	17.5	5	5.5	14	14.29
Purchase	23	13.9	6	15.0	6	6.6	12	12.25
Rent	70	42.4	17	42.5	70	76.9	52	53.06
Inheritance & Purchase	3	1.8	-	-	1	1.1	1	1.02
Inheritance & Rent	5	3.0	-	-	2	2.2	2	2.04
No response	34	20.6	10	25.0	7	7.7	17	17.35
<b>Annual Income</b>								
≤ ₦10 - 000	-	-	-	-	2	2.2	1	1.03
> ₦10 - ₦50,000	13	7.9	5	12.5	22	24.2	14	14.43
> ₦50 - ₦100,00	8	4.8	6	15.0	13	14.3	9	9.28
> ₦100 - ₦150,000	2	1.2	4	10.0	7	7.7	4	4.12
> ₦150 - ₦200,000	17	10.3	6	15.0	-	-	8	8.25
> ₦200 - ₦250,000	13	7.9	2	5.0	-	-	5	5.15
> ₦250,000 - ₦300,00	13	7.9	2	5.0	1	1.1	5	5.15
> ₦300,000	6	3.6	-	-	-	-	-	-

Source: Field Survey, 2005

Examining rural dwellers sources of income, the study reveals that 50.0% of them made more than 40% of their annual income from agricultural while 15.3% made less than 40% (Table 6). Also, 10.1% of the rural dwellers (the highest) generate less than 40% of their income from tree crops. It must also be pointed out that response to this variable is very low and only 1.01% make between 80 and 100% of their income from tree crops (Table 6). Income generation from other forest products were found to be low (Table 6) although not as low as income from tree crops in the study area. About 21.2% of the respondents make not more than 20% of their income from other forest products while another 12.1% make between 20 and 40%. Only 2.01% of the respondents make more than 40% but not more than 60% from NTFPs.

The study also investigated why respondents choose to stay in the village (Table 7). An average of about 41.0% of the respondents stayed in the village due to their closeness the village to their farms. Also, 32.0% were resident in the study area because they were indigenes. Others are residents based on their civil service status (2%) and business types (2%) while some (1.0%) are indigenes who believe their lack of education confer their rural status on them.

Table 6: Other Background Information about Rural Dwellers

Other Variable	Okomu		Sakpoba		Ehor		Mean	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<b>Frequency of Visits to Farms</b>								
Everyday	-	-	-	-	1	1.1	-	-
Once or Twice/ wk	4	2.4	2	5.0	1	1.1	2	2.04
3ce or 4 Times/ wk	-	-	-	-	3	3.3	1	1.02
Six days / week	1	0.6	-	-	-	-	-	-
Weekends	4	2.4	-	-	1	1.1	2	2.04
No Response	156	94.5	38	95.0	85	93.4	93	94.90

Years of Experience in Taungya System of Farming									
1 - 10 Yrs	29	17.6	5	12.5	41	45.1	25	26.32	
> 10 - 20 Yrs	77	46.7	10	25.0	17	18.7	31	32.63	
> 20 - 30 Yrs	28	17.0	14	35.0	21	23.1	21	22.11	
> 30 - 40 Yrs	22	13.3	6	15.0	6	6.6	11	11.58	
> 40 - 50 Yrs	2	1.2	1	2.5	4	4.4	2	2.11	
> 50 - 63 Yrs	-	-	2	5.0	-	-	1	1.05	
> 60 Yrs	-	-	2	5.0	-	-	1	1.05	
No response	7	4.2	-	-	2	2.2	3	3.16	
Income from Agricultural Crops									
0 - 20%	7	4.3	-	-	17	18.7	8	8.16	
> 20 - 40%	13	7.8	3	7.5	5	5.5	7	7.14	
> 40 - 60%	37	22.4	11	27.5	19	20.9	22	22.45	
> 60 - 80%	45	27.2	13	32.5	5	5.5	21	21.43	
> 80 - 100%	10	6.0	4	10.0	4	4.4	6	6.12	
No response	53	32.1	09	22.5	41	45.1	34	34.69	
Income from Tree Crops									
0 - 20%	7	4.2	3	7.5	5	5.5	5	5.05	
> 20 - 40%	2	1.2	7	12.5	5	5.5	5	5.05	
> 40 - 60%	-	-	-	-	-	-	-	-	
> 60 - 80%	-	-	-	-	-	-	-	-	
> 80 - 100%	1	0.6	-	-	1	1.1	1	1.01	
No response	155	93.9	30	75.0	80	87.9	88	88.89	
Income from other Forest Products									
0 - 20%	37	22.4	16	40.0	10	9.0	21	21.21	

> 20 - 40%	25	15.1	9	22.5	1	1.1	12	12.12
> 40 - 60%	6	3.4	-	-	-	-	2	2.02
> 60 - 80%	-	-	-	-	-	-	-	-
> 80 - 100%	-	-	-	-	-	-	-	-
No response	97	58.8	15	37.5	80	87.9	64	64.65

Source: Field Survey, 2005

#### Attitude to and Awareness of Forest Conservation among Rural Dwellers

Awareness among respondents about forest reserves in their environment was found (Fig. 11) to be highest among residents surrounding Ehor Forest reserve (100.0%) and lowest (88.5%) among Okomu Forest reserve respondents (Fig. 11). But generally, awareness about forest reserves is high throughout the study area. Moreso, 42.4% of rural dwellers did not respond to selling forest products, did consented to doing so (Table 11). The higher percentage of those who own up to selling forest products (45%) was from Sakpoba Forest reserve while the least (35.2%) were from Okomu Forest reserve. But most importantly, an average of 70.7% of the rural dwellers agreed to using forest products to satisfy domestic needs with the highest response (85.0%) coming from Sakpoba Forest reserve (Table 11).

Respondents' interest in tree planting was also investigated by asking if they planted trees on their private land. The result (Table 11) shows that averagely, more than 40% (45.56%) of them did not, while 21.21% did not respond to the question. Another thing of interest is that while more of the respondents (65.9%) in Ehor forest reserve did not plant trees in their farm land, the reverse was the case in Sakpoba where more (57.5%) did plant trees. But, majority of the respondent (85.7%) are exploiting their respective forest reserves for timber and other allied products: exploitation was highest (100%) in Sakpoba and lowest (68.1%) in Ehor forest reserve (Fig. 11).

Investigating what informed respondents' interest in forest conservation (Table 11) revealed their anticipated community benefit as the major (28.07%) reason for their interest in the practice. Conservation of forest is also perceived as contributing to the sustainability of their forests (17.40%) and can lead to future enjoyment or better tomorrow (14.04%). However, tree husbandry was found to be more popular among Sakpoba residents than in Okomu and Ehor forest reserve environments (Fig. 12). Also, Figure 13 show that participation of rural dwellers in the management of the three forest reserves under study was high. It was highest in Ehor and lowest in Sakpoba.

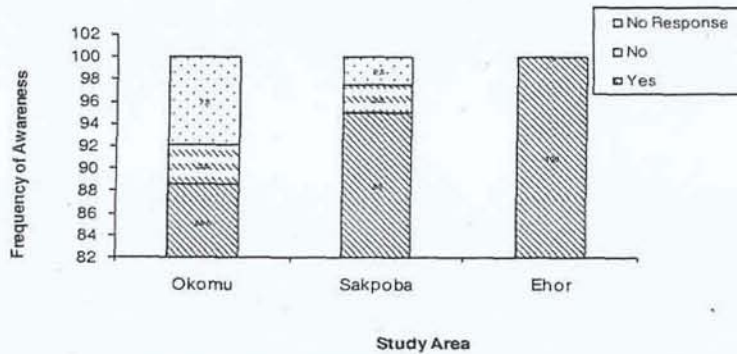


Fig. 11: Distribution of Consent to Awareness of Forest Reserve among Residents in the Study Area

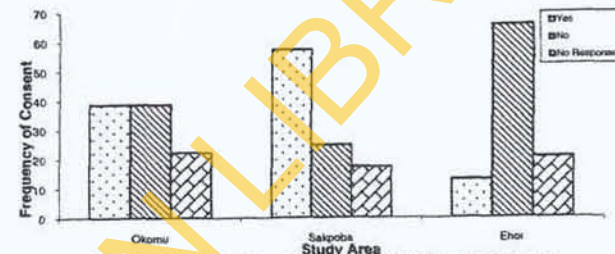


Fig. 12: Rural Dwellers Consent to Planting of Trees on their Private Holdings

Table 11: Respondents' Interest in Forest Conservation

	Okomu		Sakpoba		Ehor		Mean	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
<b>Consent to Sale of Forest Products</b>								
Yes	58	35.2	18	5.0	45.0	51	42	42.42
No	24	14.5	2	-	-	-	9	9.09
No Response	83	50.3	20	50.0	40	56.0	48	48.49
<b>Consent to Use of Forest Products</b>								
Yes	111	67.3	34	85.0	65	71.4	70	70.71
No	23	13.9	4	10.0	-	-	9	9.09
No Response	31	18.8	2	5.0	26	28.6	20	20.20
<b>Plant Trees?</b>								
Yes	64	38.8	23	57.5	12	13.2	33	33.33
No	64	38.8	10	25.0	60	65.9	45	45.46
No Response	37	22.4	7	17.5	19	20.9	21	21.21
<b>Exploit Reserve?</b>								
Yes	150	90.9	40	100.0	62	68.1	84	85.71
No	2	1.2	-	-	5	5.5	2	2.04
No Response	13	7.9	-	-	24	26.4	12	12.25
<b>Identified Interest of Rural Dwellers in Forest Conservation</b>								

For effective change	8	4.52	3	6.98	7	7.69	6	5.21
Better tomorrow	35	19.77	8	18.60	4	4.40	1	14.04
To guard against misuse	2	1.13	-	-	1	1.10	1	0.88
For community benefit	61	34.46	9	20.93	26	28.57	3	28.07
For more experience	2	1.13	2	4.65	7	7.69	4	3.51
For sustainability of forest	32	18.08	3	6.98	3	3.29	1	11.40
To serve Time factor	-	-	1	2.33	-	-	-	-
To improve National Economy	-	-	-	-	6	6.59	2	1.75
Not employed	-	-	7	16.28	11	12.09	6	5.26
No Response	37	20.90	10	23.26	25	27.47	3	27.19
							1	

Source: Field Survey, 2005

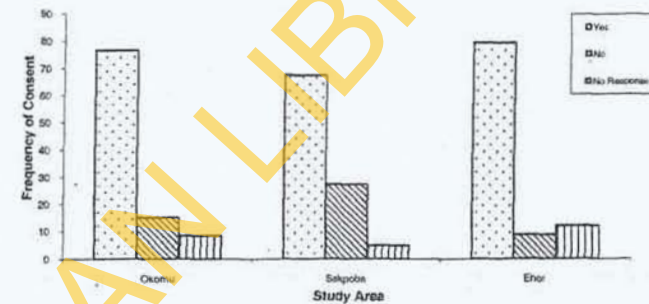


Fig. 13: Rural Dwellers Consent to participating in Local Forest Management Activities

#### Attitude of Residents to Joint Forest Management

Expressing why they did not like control of the reserve by government (Table 12), some residents of the studies reserve enclaves (24.51%) pointed to their non- involvement as a major reason. Another 21.57% and 15.68% identified ineffective control by the government agents and the non- beneficial of government control to enclave dwellers

Investigation on the perception of forest law enforcement in the study area is revealed that there are insufficient personnel (32.32%) and that some available ones are not always in their duty posts (20.20%). It was also found that forestry staff is poorly remunerated (6.06%) although some of them (3.03%) are not honest civil servants (Table 12).

The study (Table 12) also shows that an average of 82.8% of the respondents at one time or the other had problems with forest officials. The higher consent (89.1%) to having problems with forest officials is among enclave dwellers of Okomu F.R while the lowest (65%) is in Sakpoba F.R enclaves. Little wonder then why most of the respondents are not satisfied with current management structures of forest reserves in their environment (Fig. 14).

The study investigated the perception of respondents on the present management style of the forest reserves around their enclaves. It was found that some of them were not satisfied with the styles (Table 13) but some were (Table 13). About 21.7% of the respondent was of the opinion that the reserves were not well managed while some (16.98%) perceived the forest reserves have been destroyed. However, it was obvious that majority of the enclave dwellers were not satisfied with the present management structure/style in the reserves (Table 13). Among those satisfied, 6.12% are of the opinion that the reserves are beneficial to both government and the rural people (Table 13).

Table 12: Respondent's Perception of Government control of Reserves and Law Enforcement

Identified	Okomu Freq. %	Sakpoba Freq. %	Ehor Freq. %	Mean Freq. %	Mode
<b>Perceptions</b>					
<b>Perception of Government Control of Forest Reserve</b>					
Ineffective control	41	24.26	14	35.00	10 10.87 22 21.57
To avoid hijackers	6	3.55	-	-	1 1.09 2 1.96
Official are not disciplined	2	1.18	-	-	1 0.98
Community does not benefit	31	18.34	1	2.5	13 14.13 16 15.68
Official don't stay in duty post	2	1.18	7	17.5	7 7.61 5 4.9
Communities are not involved	29	17.16	12	30.00	34 36.96 25 24.51
Lack of management policy	7	4.14	1	2.5	3 3.26 4 3.92
To prevent trade hypocrisy	5	2.96	-	-	1 1.09 2 1.96
They're	18	10.65	4	10.00	18 19.57 13 12.75

better equipped	4	2.37	-	-	2	2.17	2	1.96	
It is public property	8	4.76	-	-	-	-	3	2.94	
Privatization of Resumes	16	9.47	1	2.5	3	3.26	7	6.86	
No Response									
<b>Perception of Law Enforcement</b>									
Insufficient officials	69	41.07	5	12.5	22	24.2	32	32.32	
Officers always absent	43	25.60	10	25.0	6	6.6	20	20.20	Insufficient officials
Poor remuneration of staff	14	8.33	1	2.5	3	3.3	6	6.06	
Officers are dedicated	6	3.57	-	-	6	6.6	4	4.04	
Officers are not honest	-	-	2	5.0	8	8.8	3	3.03	
Offended are not punished	-	-	-	-	4	4.4	1	1.01	
No Response	36	21.43	22	55.0	42	46.2	33	33.33	
<b>Respondents Consent to having Problem with Forest Officials</b>									
Yes	147	89.1	26	65.0	72	79.1	82	82.83	Yes
No	2	1.2	9	22.5	2	2.2	4	4.04	
No Response	16	9.7	5	12.5	17	18.7	13	13.13	

Source: Field Survey, 2005

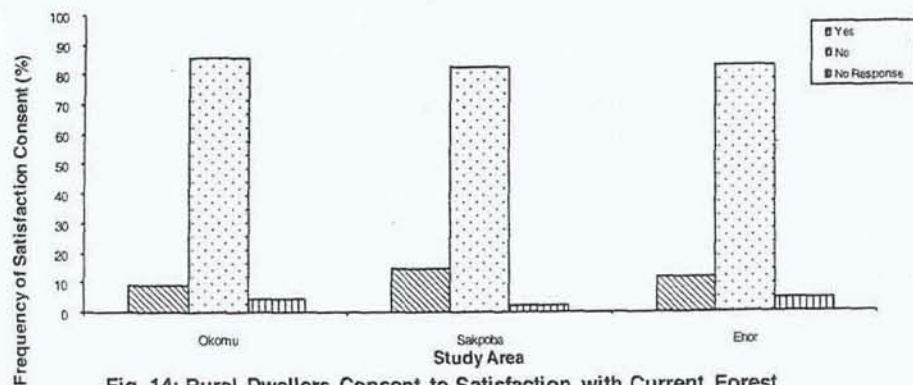


Fig. 14: Rural Dwellers Consent to Satisfaction with Current Forest Management Structure in the Study Area

Table 13: Identified Reasons for Perception of Reserve Management Styles

Why not satisfied	Okomu Freq.	Okomu %	Sakpoba Freq.	Sakpoba %	Ehor Freq.	Ehor %	Mean Freq.	Mode %
<b>Reasons for non-satisfaction with Reserve Management Style</b>								
Non-native dominance	17	9.61	-	-	1	1.1	6	5.66
It has been destroyed	33	18.64	5	12.20	15	16.4	18	16.98
No proper management	33	18.64	11	26.82	16	17.5	23	21.70
Too much exploiters	3	1.69	4	9.76	5	5.49	4	3.77
All timbers have been exploited	2	1.29	-	-	11	12.0	4	3.77
Destructive utilization	26	14.69	13	31.71	5	5.49	15	14.15
Only Government gains	13	7.34	-	-	-	-	4	3.77
Politics interference in management	1	0.56	-	-	-	-	-	-
Non involvement of locals	4	2.26	3	7.32	1	1.1	3	2.83
Non reforestation	4	2.26	-	-	5	5.49	3	2.83

No Response	41	23.16	5	12.20	32	35.1	26	24.53	
<b>Reasons for Agreeing with Reserve Management Style</b>									
No high forest is destroyed	7	04.2	-	-	-	-	2	2.04	No response
It's beneficial to Govt. & people	3	1.6	-	-	16	17.6	6	6.12	
No illegal entrance	1	0.6	-	-	-	-	0	-	
There's effective use of forest	2	1.2	-	-	1	1.1	1	1.02	
Government & People Reserve produces more food	1	0.6	-	-	5	5.5	2	2.04	
Reserve employs youth	-	-	-	-	1	1.1	0	-	
Reserve land is good for farming	1	0.6	1	2.5	-	-	1	1.02	
Honest forest personnel	1	0.6	1	2.5	-	-	1	1.02	
No Response	4	90.3	38	95.0	67	73.6	85	86.73	

Source: Field Survey, 2005

References

Adedoyin, O. S. (2001). Formulation implementation of National Forestry Programmes in Nigeria.

Aroufor, R. O. (2000). Forestry Outlook Study for Africa (FOSA). Nigeria Country Report, F.A.O, Rome, Italy.

Bada, S. O. (1998). Community participation in the Management of Omo Forest Reserve.

FAO (1994). Timber Harvesting and the problem of deforestation; forest Harvesting Bulletin; vol. 4, No.1. pp. 1-3

FAO (2005). State of the world Forest, Sixth Edition F.A.O Rome.24p

FORMECU (1998). Assessment of vegetation and land use changes in Nigeria between 1976 / 78 and 1993/95. Unpublished

report prepared by Biometric International Inc. Beak International Incorporated, and UNILAG Consult for FORMECU, Federal Department of Forestry, Abuja, Nigeria. 221pp.

- Kio, P. R. O. (2002). Community Forestry for sustainable Forest Development. In L. Popoola (ed.) Forest, People and the Environment. Proceedings of a workshop organized by FAN Consult and the Department of Forestry, Edo State, Nigeria, 5 - 6 September, 2002.
- Oyebo, M. A. (2004). Implication of the Socio-economic Reform on Nigerian Forestry and Foresters. An invitation Paper for National FANCONSULT, Workshop in Collaboration with the Afforestation Programme .Coordinating Unit, Kano held in Kano , Kano State.
- Papka, P. M. (2005). Sustainable Forest Management - Opportunities and Challenges for Nigeria. Keynote Address in L. Popoola, Mfon, P. and Oni, P. I. (eds.) Sustainable Forest Management: Lessons and Prospects. Proceeding of the 30<sup>th</sup> Annual Conference of Forestry Association of Nigeria, Kaduna, Kaduna State, 7 - 11 November, 2005. 1 - 17pp.
- Popoola Labode (2000). Practice of Environmental Management: Forest Production: Invited paper presented at the International Enabling Conference "The Green Cheque Initiative". Environmental Project of the Enabling Environment Forum, September, 2000. Abuja, Nigeria, 26pp.
- World Bank (2005). Strengthening the Nigerian Forestry Sector to Enable Sustainable Forestry and Revenue Generation in Nigeria's Productive Forests. Economic Sector Work. World Bank, Abuja, Nigeria.
- Wright, J. B., D. A. Hastings, W. B. Jones and H. R. Williams (1985). Geology and Mineral Resources of West of Africa. Springer Publishers Ltd, London, England. ISBN 0045560013. 325pp.

## Determining the Optimum Shape and Orientation of a Greenhouse on the Basis of Total Radiation availability

ODESOLA I. F. & Chidozie EZEKWEM

### Abstract

Greenhouse is a feasible option for sustainable crop production in the regions of adverse climatic conditions. For a successful greenhouse design, the selection of shape and orientation is of paramount importance.

In this study, three most commonly used single span shapes of greenhouses namely even-span, uneven-span and vinery type have been selected for comparison. The length, width and height (at the center) are kept same for all the selected shapes. The relevance of this paper was to develop a thermal model using MATLAB program for computing transmitted total solar radiation (beam, diffused and ground reflected) at each hour, for each month and at any latitude for the selected geometry greenhouses (through each wall, inclined surfaces and roofs) for both east-west and north-south orientation. The computed transmitted solar radiation is then introduced into another thermal model that is developed using MATLAB program to compute hourly inside air temperature for each shape and orientation. Statistical validation is carried out for the former model using solar radiation data for horizontal surface at (28° 35'N and 77° 12'E), New Delhi, India and (19° 07'N and 72° 51'E), Mumbai, India.

At 19°N latitude, uneven-span shape greenhouse receives 10% more yearly average solar radiation as compared to even-span shape greenhouse whereas vinery shape to