African Research Review

An International Multi-Disciplinary Journal, Ethiopia
Vol. 4 (3a) July, 2010
ISSN 1994-9057 (Print) ISSN 2070-0083 (Online)

Perception of People about Shelterbelts in Kaita Local Government Area of Katsina State, Nigeria

(Pp. 56-68)

Udofia, Samuel I. - Department of Forestry and Wildlife, University of Uyo Akwa Ibom State, Nigeria.
E-mail: udofias@yahoo.com

Udo, Enefiok S. - Obong University, Obong Ntak, Akwa Ibom State, Nigeria

Abstract

A study was carried out to determine the perception of people about the role of shelterbelts in checking the incidence of windstorm on buildings, crops, livestock and humans before and after shelterbelts establishment in Kaita Local Government Area (LGA) of Katsina State. A two-stage random sampling technique was adopted to select 300 households from six randomly selected villages in the LGA. Data on respondents' perception of incidence of windstorm before and after shelterbelts establishment were collected using structured questionnaires, analyzed by ANOVA and tested at 5% significance level to determine whether the belts reduced the incidence of windstorm or not. There were significant reductions in the incidence of windstorm on buildings, crops and humans (p□0.05). However, there was no significant reduction in the incidence of windstorm on livestock (p□0.05), apparently because of the restrictions resulting from protective measures in the shelterbelts, which denied livestock access to fodder.

Key words: Shelterbelts, incidence, windstorm, reduction, Kaita, Katsina State).

Introduction

Shelterbelts are rows of trees grown across the direction of prevailing winds for the purpose of reducing wind velocity and thereby minimizing the adverse effects of climatic elements (Baleidi *et al*, 1974). Udofia (1991) describes shelterbelts as long narrow strips of trees planted at right angle to the prevailing wind direction, that are normally arranged in series containing several belts planted some meters apart for effective result. Shelterbelts also serve as barriers of trees on agricultural land purposely to reduce damage on crops. Shelterbelts are investments in both the future and long-term productivity of the soil (Kort and Braddle, 1991). Its long term importance notwithstanding, as soon as initial shelter is established, the primary shelterbelt could be diversified to meet some of the multi-purpose potentials of the belt (Moller *et al*., 2005). Dimensions of shelterbelt differ according to the various functions. Each shelterbelt could be 2000m in length and 30m wide as in Katsina State and when mature, would provide considerable protection to surrounding farmlands as well as providing a potentially valuable source of forest produce from thinning and pruning.

Shelterbelts act as break screen to reduce wind velocity on both the windward and leeward sides, which at times could be up to a distance of five to ten times the expected height of the mature trees. The amount of reduction depends on the structure and permeability of shelterbelt. Baleidi *et al.,* (1974) stated that wind permeability can be classified into three major groups:

(i) Compact or wind-proof which allows minimum airflow.

(ii) Permeable; allows about 30 percent airflow.

(iii) Porous; allows more than 40 percent airflow.

At first, a good deal of silvicultural management is required to establish the trees. Hence, careful planning is the first and most important process to undertake (Kort and Braddle, 1991). The principal concern in the design of shelterbelts is to achieve a maximum protection with a minimum sacrifice of land area without impairing the stability of the shelterbelts. Baleidi *et al*., (1974) further reported that compact shelterbelts are the most effective in reducing wind velocity, but only over limited distances, while permeable and porous shelterbelts provide less absolute reduction of wind velocity but affect a greater distance downward. The most effective belts are those that consist of one or two rows of slow-growing shrubs or trees of fast growing trees in the inside. The aim of the shrub species as outer rows is to increase wind resistance at the trunk level of the fast growing trees, and to give the belt a more aerodynamic profile, cutting down turbulence close to the belt. Theoretically, a single row of trees suffices (Delawulle, 1977).

The vertical structure of shelterbelts depends on the form of tree species, the number of rows, the distance between rows and the number of trees within rows. Baleidi, *et al*, (1974) stated that from studies made in the United States of America, Russia and the People Republic of Yemen, narrow shelterbelts of one to three rows have considerable efficiency, but in sheltering livestock for optimum efficacy, belt configurations of V, U, X or square shapes are recommended.

Researchers have shown that shelterbelts are effective in improving the microclimate, reducing erosion and increasing farm yield (Kort and Braddle, 1991; Moller *et al*., 2005). Ujah (1982) reported of improved weather condition of farmlands in the Dambala area of Kano State through reduction in the surface wind speed immediately on the leeward side by an average of 20.8%, increasing total soil moisture storage to a depth of 100cm and increasing yield of millet within 40m from the belt. Shelterbelts also improve health of animals by providing resting shade, increasing food, improving feeding conditions, and reducing energy consumption and mortality in a manner that stabilizes production (Johnson and Braddle, 2003; El-Lakany, 1983). Through physical interception of dust and other aerosols in arid zones, shelterbelts clean the air of micro-particles of all sizes by combing out twenty fold better than barren land (Moller *et al*., 2005; Burke, 1998).

Between 1976 and 1996, about 150km of shelterbelts were established in the Northern States of Nigeria under the Arid Zone Afforestation Project alone (Igugu and Osemeobo, 1999). About 2,623.97 hectares of shelterbelts were established in Katsina State alone before year 2002, through the assistance of various agencies such as the World Bank, European Union and International Fund for Agricultural Development (Katsina State Ministry of Agriculture, 2004). The dimensions and areas of some of the shelterbelts are shown in Table 1.

The main goal of massive investment in shelterbelts in the State was to cushion the effects of droughts and desertification on the living conditions of both the rural and urban dwellers, improve agricultural production and provide a conducive environment and abundance of fodder for livestock. Available literature has not shown any detailed study on the perception of the host communities about the impact of such shelterbelts on the incidence of windstorms on farm crops, livestock, buildings and humans in Katsina State in recent years. The study was particular about Kaita Local Government Area (LGA) because it is located within the zone that is frequently threatened by destructive windstorms. Although no scientific study has been conducted to obtain quantitative information about the effects of sand dunes, windstorm and desertification in the study area, residents of the area had severally made representatives to Afforestation Agencies in Katsina State for possible intervention, particularly in mitigating the incidence of windstorm on crops, animals and humans (Udofia, 1991). For this reason also, Kaita LGA was one of the Local Government Areas (LGAs) that were given priority in shelterbelt establishment in Katsina State. The results of the study will, therefore, enable the State Government and other international agencies to justify the huge investments in shelterbelts establishment in Katsina State.

The Study Area: Kaita LGA is one of the thirty-four Local Government Area (LGAs) in Katsina State. It lies between latitudes $13^{o}0^{/}$N and $13^{o}21^{/}$N, and longitudes $07^{0}30^{/}$E and $08^{o}0^{/}$E. It is located in the Sahel savanna region of Nigeria. The rainy season starts from June to September and the average annual rainfall is 285mm. The dry season is from October to May with an average temperature of 35^{o}C during the hot season, and 19^{o}C during the harmattan period (Muhammad, 1992). The LGA has a total land area of $486km^2$ and a population of 184,401 people (FRN, 2007). The inhabitants are mainly farmers, growing mostly grains, except for the Fadama area where mainly rice, vegetable and sugarcane are grown. Other commonly cultivated crops are millet, guinea corn, beans, groundnuts and wheat.

Materials and Method

Simple random sampling was used in selecting six (38%) of the 16 villages in the LGA for the study. These were Kaita, Matsai, Yandaki, Yanhoho, Dankaba and Dankama. Thereafter, 50 households, represented by their respective heads, were randomly selected from each of the six selected villages. This gave a total sample size of 300 households.

Three hundred structured questionnaires were administered on the selected households. Information required was on respondents' perception of the incidence of windstorms before and after the establishment of the shelterbelts, and benefits derived from the shelterbelts. Data on respondents' biodata and benefits of shelterbelts were analyzed using frequency distributions and percentages. Data collected on effects of shelterbelts before and after their establishment were analyzed using the one way classification analysis of variance (ANOVA).

Four hypotheses were formulated and tested at 5% level of significance to determine whether the shelterbelts reduced the adverse effects of windstorms in the L.G.A. This assessment was done by comparing the responses of respondents about incidence of windstorms situation before and after the establishment of the shelterbelts.

The Null Hypotheses were:

Ho_1: *There was no significant reduction in the incidence of windstorm damage on buildings after the establishment of shelterbelts in the study areas.*

Ho_2: *There was no significant reduction in the incidence of windstorm damage on crops after the establishment of shelterbelts in the study areas.*

Ho_3: *There was no significant reduction in the incidence of adverse windstorm and dust on livestock after the establishment of shelterbelts in the study areas.*

Ho_4: *There was no significant reduction in the incidence of adverse windstorm and dust on people after the establishment of shelterbelts in the study areas.*

Results and Discussion

Biodata about the respondents

Table 2 shows that all the respondents were male. This can be explained by the fact that household leaders in the area; as in many other parts of Nigeria, are men because the families are patrilineal. About 86.70% of the respondents were farmers, while 13.3% were civil servants. The Table also shows that 22.7% of the respondents had western (formal) education, while 84.3% had Arabic education. The family system was predominantly polygamous (65.3%) while 34.7% was monogamous. This can be explained by the fact that the respondents were predominantly Moslems whose religion permits polygamy. According to Table 2, the average size of households in the L.G.A ranged from nine to thirteen with a mean of four.

Benefits Derived from Shelterbelts by Respondents

Apart from environmental protection, the people received other benefits from the shelterbelts. These included better quality air (less dust laden air) (46.3%

of the respondents), small poles (44.3% of respondents); fuelwood (35.3% of respondents) and fodder (43.7% of respondents) (table 3). The low percentages of respondents who benefited in these ways from the shelterbelts (35.3% -46.3%) could be attributed to the restriction of the public from directly exploiting the shelterbelts. If access were not restricted, public pressure on the shelterbelts, especially for fuelwood on which about 96% of people in Katsina State depend wholly or partly for domestic cooking (Udofia, 1995), could have resulted in overexploitation, thereby defeating the main objective of establishing the belts which was environmental protection. These restrictions for purposes of protecting the shelterbelts were by fencing and patrols to check trespassers. This not withstanding, shelterbelts, according to Ojo *et al* (1987), are possible sources of poles and fuelwood for rural inhabitants in arid zones.

Incidence of Windstorms Damage on Buildings

Table 4 shows that 151 (50.3%) of the respondents perceived the destructive incidence of windstorm on buildings before shelterbelts were established. On the other hand, only 37 (12.3%) of them indicated that such incidence of windstorm on buildings persisted after shelterbelts were established. Thus, more of the respondents perceived the destructive effects of wind before than after the establishment of the belts. According to Table 8, the F-value at 5% level of significance was 19.60, which was higher than the table value of 4.96 ($p>0.05$). Thus, there were significant differences between adverse effects of wind on buildings before and after shelterbelt establishment. This implies that there was a significant reduction of the destructive impact of windstorm on buildings by the shelterbelts.

Incidence of windstorm damage on crops

Table 5 shows that 191 (63.7%) and 50 (16.7%) of the respondents perceived the adverse effects of windstorm on crops before and after shelterbelt establishment respectively. This indicated a reduction in the incidence of destructive windstorm on crops after shelterbelt establishment. Table 8 shows an F value of 46.53, which was higher than the table value of 4.96 ($p>0.05$). Therefore, there was a significant reduction in the destructive effects of wind on crops by the shelterbelts. The finding corroborates the fact that shelterbelts, by reducing windstorm, prevent mechanical damage and excessive evapo-transpiration in plants and modifies air and soil temperature, all of which result in increased crop yield (Burke, 1998; El-Lakany, 1983; Ojo *et al*., 1987; Oboho, 1988).

Incidence of Windstorm and Dust on People

Table 6 shows that 77 (25.7%) and 50 (16.7%) respondents respectively indicated that there were adverse incidence of windstorm and dust on livestock before and after the shelterbelts were established. The F value of 3.23 ($p>0.05$) (Table 8) indicated that there was no significant reduction in the adverse effects of wind on livestock by the shelterbelts. Although shelterbelts could provide shelter, shade and fodder for livestock (El-Lakany, 1983; Muhammad, 1992), the restrictions placed on them in an attempt to protect the shelterbelts (Ojo *et al*., 1987), were probably responsible for the non-reduction of adverse effects of wind on livestock by the shelterbelts. The restrictions did not give the livestock direct access to fodder in the shelterbelts for improved feeding. Moreover, although certain belt configurations are recommended for optimum efficacy in sheltering livestock (Baleidi *et al*, 1974), it would appear that the planners gave no consideration to belt configuration in the design of the shelterbelts in Katsina State. Onyewotu *et al.,* (2003) identified shelterbelt design error as one of the factors affecting the efficacy of shelterbelts in Yambawa in Kano State of Nigeria.

Incidence of Windstorm on People

Table 7 shows that 157 (52.3%) and 48 (16%) respondents respectively indicated that there were adverse incidence of windstorm and dust on the people of the study areas before and after the shelterbelts were established in the areas. According to Table 8, the F value was 71.31 (p□0.05). Thus, there was significant reduction in incidence of adverse windstorm on people of the study areas. This could be attributed to the fact that shelterbelts provide shelter and comfort for human by screening buildings from excessive dust (El-Lakany, 1983; Ojo *et al*., 1987).

Conclusion and Recommendations

This study has shown that the general objective of establishing shelterbelts in Kaita LGA, which was environmental protection, has been achieved. This is because the belts, according to the people's perceptions, have significantly reduced the incidence of destructive windstorm on buildings and crops, and have consequently, significantly improved the living environment of humans through improved micro-climatic conditions such as reduction in wind velocity, dust-laden air and temperature. However, the shelterbelts had no significant and positive effects on livestock due to restrictions aimed at protecting the belts from destruction through browsing by livestock. Moreover, in designing and planting the shelterbelts, no consideration was

Indexed African Journals Online: www.ajol.info

given to the belts configuration, which would have made the shelterbelts to be effective in sheltering livestock. If shelterbelts are properly designed and maintained, they can provide large quantities of fuelwood, poles, fodder and other uses without jeopardizing the primary objective of environmental protection. These should be adequately considered in the design of future shelterbelts for optimal benefits to livestock and the people.

Table 1: Shelterbelts Established in Katsina State before 2004.

Agencies	Shelterbelts established		
	Number	Dimensions	Area (ha)
State Forestry	54	1609m x 90m	781.97
eec/ktsg kazp (European Economic Community/ Katsina State Government Katsina Arid Zone Programme)	202	2000m x 30m	781.97
ktapu (Katsina Afforestation Project unit)	50	2000m x 30m	300
Kartarda (Katsina Agricultural and Rural Development Authority)	50	1000m x 30m	150
Local Governments	60	1000m x 30m	180
Total	**416**		**2623.97**

Source: Katsina State Ministry of Agriculture (2004).

Table 2: Biodata of respondents

Sample Village	Respondents	Gender		Occupation		Type of education *		Type of family		Average size of household
		M	F	FM	CS	Western	Arabic	PYG	MNG	
Kaita	50	50	0	40	10	20	42	37	13	6
Yandaki	50	50	0	47	3	15	44	25	25	5
Yanhoho	50	50	0	45	5	12	28	31	19	3
Matsai	50	50	0	43	7	10	50	28	22	3
Dankaba	50	50	0	44	6	14	50	40	10	4
Dankama	50	50	0	41	9	12	39	35	15	5
Total	300	300	0	260	40	83	253	196	104	LGA
%	**100**	**100**	**0**	**86.7**	**13.3**	**27.7**	**84.3**	**65.3**	**34.7**	Average = 4
SD				**2.6**	**2.6**	**3.5**	**8.2**	**5.7**	**5.7**	**1.2**

Source: Field Survey (2006). *Total above samples size because of multiple responses.

M = Male; F =Female; FM = Farming; CS = Civil Service PYG = Polygamous; MNG = Monogamous

Table 3: Some benefits derived from shelterbelts as reported by respondents.

Sample Village	Number of questionnaires sent out	Benefits							
		Air		Small poles		Fuelwood		Fodder	
		F	%	F	%	F.	%	F	%
Kaita	50	25	50.0	22	44.0	36	72.0	13	26.0
Yandaki	50	18	36.0	37	74.0	23	46.0	27	54.0
Yanhoho	50	22	44.0	13	26.0	14	28.0	15	30.0
Matsai	50	37	74.0	19	38.0	17	34.0	24	48.0
Dankaba	50	23	46.0	27	54.0	5	10.0	30	60.0
Dankama	50	14	28.0	15	30.0	11	22.0	22	44.0
Total	300	139		133		106		131	
%	**100**	**46.3**		**44.3**		**35.3**		**43.7**	
SD		**7.8**		**8.8**		**10.8**		**6.7**	

Source: Field Survey, (2006). F = Frequency

Table 4: Incidence of adverse effects of windstorm on buildings before and after shelterbelt establishment as reported by respondents

Villages	Frequency of Responses		
	Before (No)	After (No)	Total (No)
Kaita	35	5	40
Yandaki	17	9	26
Yanhoho	23	11	34
Matsai	40	3	43
Dankaba	17	7	24
Dankama	19	2	21
Total	151	37	188
Mean	**25.2**	**6.2**	**15.7**
SD	**9.9**	**3.5**	**9.0**

Source: Field Survey (2006).

Table 5: Incidence of windstorm damage on crops before and after shelterbelt establishment as reported by respondents

Villages	Frequency of responses		
	Before (no.)	After (no.)	Total (no.)
Kaita	27	9	36
Yandaki	39	8	47
Yanhoho	23	7	30
Matsai	28	9	37
Dankaba	45	10	55
Dankama	29	7	36
Total	191	50	241
Mean	**31.80**	**8.30**	**40.17**
SD	**8.4**	**1.2**	**9.1**

Source: Field Survey (2006).

Table 6: Incidence of adverse effects of windstorm and dust on livestock before and after shelterbelt establishment as reported by respondents

Villages	Frequency of responses		
	Before (No)	After (No)	Total (No)
Kaita	17	7	24
Yandaki	9	5	14
Yanhoho	11	4	15
Matsai	7	12	19
Dankaba	13	13	26
Dankama	20	9	29
Total	77	50	127
Mean **SD**	**12.80** **4.9**	**8.30** **3.7**	**10.60** **6.1**

Source: Field Survey (2006).

Table 7: Incidence of adverse effects of windstorm on people before and after shelterbelt establishment as reported by respondents

Villages	Frequency of Responses		
	Before (No)	After (No)	Total (No)
Kaita	32	10	42
Yandaki	19	7	26
Yanhoho	29	5	34
Matsai	27	12	39
Dankaba	26	9	35
Dankama	24	5	29
Total	157	48	205
Mean **SD**	**26.17** **4.4**	**8.00** **2.8**	**17.08** **6.0**

Source: Field Survey (2006).

Table 8: Summary of data analysis

Parameters considered	F-cal	F-tab	Remark
Incidence of windstorm damage on buildings after shelterbelt establishment.	19.60	4.96	Significant
Incidence of windstorm damage on crops after shelterbelt establishment.	46.53	4.96	Significant
Incidence of adverse of windstorm and dust on livestock after shelterbelt establishment.	3.23	4.96	Not significant
Incidence of adverse windstorm and dust on people after shelterbelt establishment.	71.31	4.96	Significant

References

Baleidi, A. S., Costin, E. and Bazara, M. (1974). *Arid Region with special References to P.D.R. of Yemen.* FAO/DANIDA International Training Center, Rome. pp. 74-77.

Burke, S. (1998). *Windbreaks.* Inkarta Press, Sidney. pp. 23-28.

Delwaulle, J. C. (1977). Shelterbelt and Environmental Forestry. Savanna Afforestation in Africa. *Proceedings of FAO/DAN Training Course on Forest Nursery and Establishment Technique for African Savanna. Symposium on Savanna Afforestation. Kaduna, Nigeria.* pp. 173-189.

El-Lakany, M. H. (1983). Biological Effect of Shelterbelts and Windbreaks in Arid Regions. Paper presented at the International Workshop on Shelterbelts sponsored by International Development Research Center. IDRC. Morsoe, Canada. October 31 – November 3, 1983, Tunis.

Igugu, G. O. and Osemeobo, G. J. (1999). Forestry in Desertification Control: The Nigerian Experience. In *Obiaga, P. C., Abu, J. E., Popoola, L. and Ujor, G. (eds.). Proceedings of the 26th Annual Conference of the Forestry Association of Nigeria.* Maiduguri, Borno State,19th –23rd April, 1999. pp. 63-70.

Johnson, H. and Braddle, J. R. (2003). *Shelterbelt management*, Canada. pp. 9-11.

Katsina State Ministry of Agriculture (2004). *Bulletin on Afforestation Projects*. Ministry of Agriculture, Katsina State.

Kort, J. and Braddle, J. R. (1991). *A windbreak evaluation model: Economic returns from a windbreak investment in Great Britain Plains*. WBECON, Britain. pp. 3-19.

Mahammed, I. A. (1992). Shelterbelt and Farm Forestry drive for successful Afforestation. *In Akinsanmi, F. A. (ed.) Our forest, Environment and Heritage; Challenges for our people*. Forestry Association of Nigeria (FAN). pp. 207-213.

Moller, H., Wearing, C., Perley, C., Rosin, G., Blackwell, H., Campbell, H. H., Fairweather, J., Manhire, J., Benge, J., Emmanuelson, D. and Steven, D. (2005). *Biodiversity in Kiwifruit Orchards: The importance of shelterbelts*. ARGOS, New Zealand.

Oboho, E. G. 1988. *The influence of shelterbelts on site, growth and yield of millet (Pennisetum typhoides, burm) At Maman Sukan, Sokoto State. Ph. Thesis*, Department of Forest Resources Management, University of Ibadan, Nigeria.

Ojo, G. O. A., Onyewotu, l. O. Z. and Ujah, J. E. (1987). Use and Management of Shelterbelts. *In Sagua, v. o., Enabor, E. E., Kio, P. R. O., Ojanuga, A. U., Mortmore, M. and Kalu, a. e. (eds.) Ecological disasters in Nigeria: drought and desertification. Proceedings of National Workshop on Ecological Disasters in Nigeria: Droughts and Desertification, Kano, Nigeria. 9-12 December, 1985*. Federal Ministry of Science and Technology, Lagos, Nigeria. pp. 251-258.

Onyewotu, l., Stigter, k., Abdullahi, Y. and Ariyo, J. (2003). Shelterbelts and farmers' needs. *LEISA*. 19(4): 28-29.

FRN (2007). *Federal Republic of Nigeria (FRN) Official Gazette*. No 24, Vol. 94. Federal Government Printers, Lagos, Nigeria. 189p.

Udofia, S. I. (1991). Project Summary. *Greenlight Magazine*. Eec/fgn Katsina Afforestation Project. 3(2):10-11.

Udofia, S. I. (1995). Extension Impact of a Schools Forestry Programme. *M.Sc. Thesis*. University of Wales, Bangor, Britain. pp. 13-27.

Ujah, J. E. (1982). *Effects of shelterbelts on soil moisture and temperature regimes of soils at Dambatta (Kano State), Nigeria. M.Sc. Thesis.* Ahmadu Bello University, Zaria, Nigeria.