ERGONOMIC ASSESSMENT OF SMALL SCALE MILLS IN NIGER STATE

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Abstract

Processing of food to various forms helps in the reduction of losses in agricultural produce and also facilitates the circulation of food. Tubers and grains are produced in large quantities in Niger State and there is the need to process them for use. Some mills were selected randomly and measurements were taken for ergonomic compliance. The measurement include physical dimension of structures, machine dimensions, man machine dimensions temperature and sound level. The result shows that, the structures differ in size and in materials used for construction, mills were erected not on basis of any architectural standard but on the basis of available land within the area of interest (mostly major road sides), structures do not follow any architectural design, small windows used do not permit enough ventilation into the structure. Lowest temperature of 28°C was recorded betweenl2:00 noon to 2:00pm and highest temperature of 49°C was recorded between 2.30pm - 3.00pm. The noise level was between 83.4dBA - HOdBA. This value is higher than the recommended noise level of 80dBA. For efficiency, comfort and good healthy condition, the structures should be erected based on architectural standards, the operators of small scale mills must work in well ventilated structures for good air circulations and also wear nose/ear protective device so as to prevent particles from entering the nose and to protect the ear drum from damage.

Introduction

Niger state lies between latitude 9° and 11° 20'North and longitude 6°30' and 7° 40'East, and covers a total land area of 74.22km^2. The state is ranked 6^{,h} in landmass in the country. About 80% of the land is arable (Nmadu 1998). The land is agrarian in nature with over 80% of her food needs being produced by peasant farmers cultivating between 2-4 hectares. The farmers in the state produce large quantities of grains (Sorghum, Millet, Maize, Rice) and tubers (Yam and Cassava). The farmers of each region are known for at least one of these crops. Bida people are known for rice and millet production, Minna and Suleja are known for yam production while the people in Kontagora are known for maize production. The various crops cultivated are subjected to different processes before they are ready for consumption, one of such processes is the conversion of the grains or the tubers (in the case of cassava and yam) into flour by size reduction. In the past, this operation was done traditionally using stones which is labour intensive, Plate 1

Plate 1: Traditional Method of grinding using stories

Today, as a result of mechanization of agriculture and advancement in technology generally, there are tools apd machines for performing this operation (Asiegbu, 1989). The size reduction process is done at the small-scale level using hammer or burr mills. The capacity of such mills can be as low as 15kg/h to as high as 80kg/h. These mills are of different sizes and designs. They are equally housed in structures made of different materials and some are without structure. Visual assessment of the mills shows that they are dusty and noisy. This may be hazardous to the operators and clients. See plate 2. Studies are yet to be conducted to ascertain the extent of this problem. This study is therefore aimed at assessing the ergonomic characteristics of these mills in view of their importance to the Nigerian populace with a view to making appropriate recommendations for improvement in their design and operation.

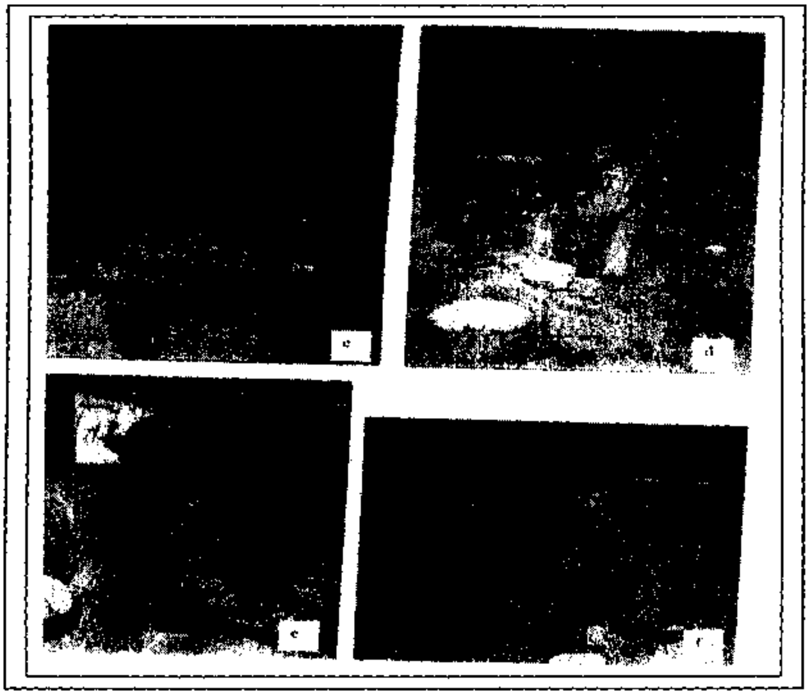

Plate 2: Operators in different working conditions.

Ergonomics

Ergonomics originates from two Greek words ergon meaning work and nomos meaning law. Ergonomic is therefore, the study of Law(s) governing work and its environment (Yisa, 2002). Ergonomics include human factors in engineering and it deals with the consideration of human characteristics, expectations and behaviours in the design of tools, equipment etc. that people use in their work and everyday lives and the environment in which they work and live (Mecormick and Sander 1986). The present trend in Agricultural Mechanization requires that attention be focused on the need to consider human beings in the design and modification of machines and devices in order to make the goals of mechanization achievable. In line with the goals of mechanization, efforts have been and are being made to adapt machines and the environment in which they are operated to suit human health, safety and comfort. The mills are being operated by both men and women, therefore, the man machine system should be one that encourages human values, such as good health, safety and comfort during operation.

Ergonomic Factors Defined

The central focus of ergonomics relates to the consideration of human beings in carrying out such functions as the design and creation of many objects, the development of procedures for performing work and other human activities, the provision of service to people and the evaluation of the materials people use in terms of their stability (Yisa, 2002). The objectives of ergonomics on these functions are two fold.

1. To enhance effectiveness and efficiency with which work and human activities are carried out.
2. To maintain or enhance certain desirable human values health, Safety, Satisfaction.

The central approach of ergonomic factors is the systematic application of relevant information about human abilities, characteristics, behaviour and motivation in the execution of such functions. Human factors are of paramount consideration in developing farm machinery knowing that these machines will often be operated by person with minimum skill and or minimum understanding of the operating principles. Therefore, farm machinery should be made simple to operate and as free from hazards as possible. (Sule 1983).

Materials and Methods

The study area is Niger State. Four major towns Bida, Minna, Kontangora and Suleja were selected Fig. I. Food crops produced are Grains (Sorghum, Maize, millet) and tuber (Yam and Cassava). These food crops are usually processes for immediate consumption, for storage and also for transportation to other parts of the country and for export.

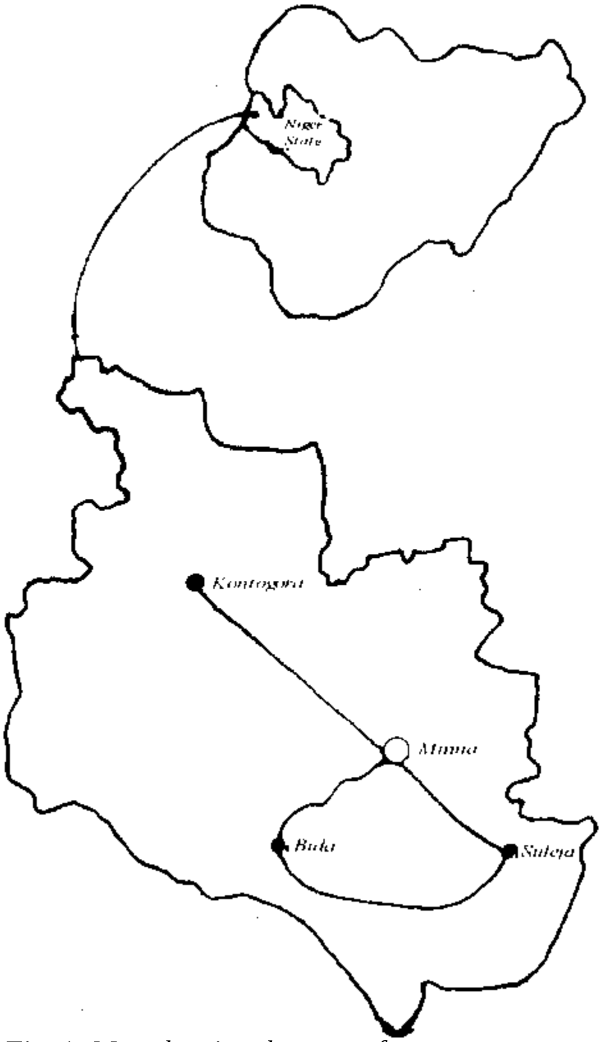

Fig. 1: Map showing the area of coverage

a. The Mills

The functional mills in the major towns selected were visited and numbered. Ten mills were randomly selected from each town. The selected mills were then assessed for ergonomic compliance. The parameters assessed include: Physical dimensions of the building housing the mills. These were measured with a measuring tape. The doors, windows, the Space occupied by the engine(s) and other facilities were measured. The difference between the total area and the area occupied gives the workspace.

b. Machine Dimension

The dimension of the control of the machine was measured with reference to the floor e.g. Hopper to floor, the control to the floor, the starting control to the floor and the switch to the floor.

c. Man — Machine Dimensions

Man machine dimensions were measured using the centre of the operators seat as reference point. The centre of the seat to the control handle, centre of seat to the hopper and centre of seat to the floor.

d. Temperature

The temperature within the mill was measured using wall thermometer for several days between the hours of 12:00 noon and 3:30pm at intervals of 30 minutes.

e. Sound

The sound produced was measured using a sound level meter placed close to the operators ears.

f **General Observation**

There are some parameter which could not be measured due to lack of instrument. They include

i) The amount of dust in the atmosphere
ii) The amount of discomfort during operation
iii) The level of congestion in the mills
iv) The quantity of particles entering the operator(s) nose.

However photographs were taken using Yashica MF - 2 super camera to actually reveals that these situation exist in the mills.

Results and Discussion Physical
Dimension of the Building

The result shows that the mill structures differed with in and between the major towns in the state. The materials used for construction includes sandcrete blocks, Mud blocks, used (Old) roofing sheets, left over timbers and weaved thatched grasses. See Plate 3. It was also observed that mill structures were erected not on the basis of any Standard but on the basis of available land within the area of interest. The installation of machinery was based purely on the owner's preference. Many of the mills were found very close to high ways, probably for ease of accessibility. Doors and windows were of different sizes and in some cases do not follow any architectural design. Furthermore, many of the windows were too small to provide the required ventilation.

Machine Dimensions

The machines should be installed in a manner that guarantees easy reach to the hopper, the switch and the control without the operators overstretching his body.

Table 1: Major Dimensions of the Machine in Relation to the Floor

Dimension Measured	**Means (m)**	**Standard Dimension**
Hopper to Floor	1.03	0.05
Control to Floor	0.60	0.04
Switch to Floor	1.51	0.14

,Table 1: shows the dimensions considered critical to guarantee this need. The values would seem adequate since the operators do not have to stretch their bodies before reaching any of the position. However, in some mills where operators seat were not provided, operators had to bend to reach the grain inside the container on the ground and the control wheel. Doing this intermittently for twelve hours a day, since some of them work that long, will constitute a health hazard.

Man - Machine and Human Dimensions

The interaction between man, machine and the environment in which he works affects not only the efficiency of the system but also the safety of operation. Using the centre of the seat as a reference point the distances, which the operator must reach during his work, are shown in table 2.

Table 2: Distance between the Operator's seat to Strategic Locations in the Man-Machine System

Name of Part Measured	**Means (m)**	**Standard Deviation**
Seat to control handle	0.56	-.08
Seat to push button	0.62	0.02
Seat to hopper	0.60	0.08
Seat to floor	0.44	0.06

All the dimension but one are within the arm length for both the 5th percentile and 95th percentile of all subjects. Table 3.

Table 3: Human Dimensions Per Mills

Dimensions	**5th percentile (m)**	**95th percentile (m)**
Standing height erect	1.56	1.76
Knee height sitting	0.42	0.59
Knee length sitting	0.38	0.50
Popliteal height sitting	0.38	0.50
Buttock width	0.34	0.44
Arm length stretched	0.60	0.74
Eye level sitting	0.51	0.67
Popliteal length	0.38	0.51

The above values conform to human dimensions, as the operator operates his machine from his seat without overstretching himself.

Temperature

The lowest temperature inside the mills for the critical period 12:00 noon to 3.30 p.m) was 28°C obtained at noon. Temperature of 49°C was recorded between 2.30 pm - 3.00 pm. These values are higher than the recommended workspace temperature of 24°C. Milling operation is a light operation done either standing or sitting, for which the recommended maximum workspace temperature is 24°C (ASHRAE, 1985). The operators operating the studied mills must be working under unhealthy and unacceptable conditions. Apart from the discomfort and health hazard experienced, efficiency is reduced at a work place temperature of 27°C. The reduction in efficiency could be as much as 40 - 50% if the temperature reaches 30°C - 35°C (Shiru, 2001).

Noise Level

The source of power in agriculture is associated mainly with the use of engine power and with static power driven machines. It has been established that exposure to an average noise level exceeding 80dBA over an 8 hour working day can damage hearing. It is difficult to establish the average level when there are variations in noise levels below 80dBA at all times. If the noise cannot be reduced at source, some type of protection should be provided for the operators (Shiru 2001). Table 4

Table 4: Average Noise Level Recorded at the Studied Mills

	1	2	3	4	5	6	7	8	9	10
Bida (dBA)	85.3	86.3	83.4	85.7	86.4	85.3	89.4	84.0	83.4	91.2
Minna (dBA)	87.1	84.0	90.2	84.2	110.3	92.3	86.7	90.1	93.2	82.9
Kontagoi;a (dBA)	88.2	86.3	90.1	92.4	98.6	101.2	89.6	90.9	92.3	97.4
Suleja (dBA)	85.2	88.0	87.6	90.1	92.8	97.3	92.6	96.4	98.6	99.2

Table 4: Shows average noise levels measured at the operators ear in the ten mills studied in each town. The lowest noise level was 83. 4dBA while the highest was 110.3dBA. The noise levels in the mills were thus higher than the recommended value. In some of the mills communication was so hampered by the noise level that sign language became the mode of communication between the operator and the clients.

General Observation

The environment of the mills studied was generally unhygienic and did not conform to standards for food processing industries. The floors and walls are not laid with tiles as required. Drives for example belts ad gears are exposed, see plate 2 and plate 3 constituting danger to operators and clients. Black oil (used oil) is used for lubrication in some cases instead of grease.

Plate 3: Mill Structures

Recommendations

1. There must be a good and uniform architectural standard for mill structures in Niger State and these must be followed strictly during the construction.
2. The materials used for construction must be specified based on the requirement of a food processing industry.
3. The doors should be such that must permit easy access to the operator(s) and clients. Also the windows should be wide enough to give room for enough ventilation inside the structure.
4. Clients must not be allowed to stay inside the mill during operation to avoid accident that may occur during failure of belts and bearing and also to avoid noise that may cause damage to the eardrum. A separate place can be provided outside the mill structure.
5. The floors of mill structure must be laid with tiles as one of the requirement for food processing industry.

6. The mills must be installed following the manufacturers recommendations and also the maintenance practice(s) must be followed.
7. The operator(s) must be dressed properly and also be protected against other health hazards that may occur during the operation or after.

Conclusion

The ergonomic study of small-scale mills reported here has shown that there are no standards for construction, installations, operation and maintenance in place in Niger State. This is evident in the fact that make - shift structures are used without planning or design for safety and healthy operation. As a result, temperatures of 49°C and noise level exceeding 80dBA are commonplace in the mills. Similarly, the environments of the mills are not hygiene, falling far below the standards of a food processing industry. There is the need to standardize the operations of the mills in terms of structure, required finishing and installations. The results can be used for installations and design of seat for mill structures.

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