SURVEY OF MODERN AND TRADITIONAL CASSAVA CHIP DRYERS IN OSUN STATE

BY

ODUOYE MICHAEL OLAOLUWA
2003/14847EA

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINERING
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER 2008.

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A PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINNEERING (B. ENG.)

TO

DEPARTMENT OF AGRICULTURAL AND BIORESOURCES ENGINERING
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

NOVEMBER 2008.

DECLARATION

I, Oduoye Michael Olaoluwa with registration no. 2003/14847EA Department of Agricultural Engineering and Bioresources , School of Engineering and Engineering Technology, Federal University of Technology, Minna, hereby declares that this project is a personal academic work carried out under the supervision of Mr Solomon M. Dauda.

---------------------------- 20/11/08. ----------------------------

Oduoye Michael Olaoluwa   Date

2003/14847EA

CERTIFICATION

This project titled: "Survey of Modern and Traditional Cassava Chip Dryers in Osun State" by: Oduoye Michael Olaoluwa (2003/14847EA) meets the regulations governing the award of Bachelor Degree of Engineering (B. Eng.) of the Federal University of Technology, Minna and is approved for its contribution to knowledge and literary presentation.

---------------------------- 12/2/09

Mr Solomon M. Dauda — Date

Project Supervisor

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Dr. (Mrs) Z. D. Osunde — Date

(Head of Department)

---------------------------- 18-11-08

External Examiner — Date

DEDICATION

This work is humbly dedicated to the creator of heaven and earth Almighty God who has been with me throughout the duration of this programme. Also dedicated to my beloved parent Senator Simeon Oduoye AIG (RTD) and Mrs Judith Oduoye.

ACKNOWLEDGEMENT

Glory and honour be unto Almighty God for His infinite mercies, blessing and protection over me throughout the duration of this programme. My sincere gratitude goes to my project supervisor Engr. S. M. Dauda, whose immense contribution, information and supervision had led me to the success of this project from planning, traveling down for my questionnaire and to the final stage.

I am equally indebted to the Head of Department of Agricultural Engineering and Bioresources, F. U. T. Minna, Dr (Mrs) Z. D. Osunde also special regards to Engr. Peter Adeoye, Engr. John Jiya Musa, Engr Mrs Mustapha,Mr Segun,Engr Sadiq,Sister Bose and all lecturers in the Department of Agricultural and Bioresources Engineering for their elderly advice and the knowledge they impacted in me during the course of my study.

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ABSTRACT

Cassava (*Manihot spp*) is one of the major food crops in the tropics which belongs to the family *Euphorbiaceae*. This project tends to know the method which was found efficient in time of hastening drying rate between traditional and modern methods and suggest the best method in Osun State. In carrying out this research, 180 questionnaires were administered in different local government areas of Osun State, 126 were returned by the respondents. The questionnaires were analysed using both descriptive (graphical) and inferential statistics (ANOVA, Regression analysis). The results shows that traditional method was most widely used in Osun State under descriptive statistics and likewise there is significant difference in method used in processing their cassava chips in Osun State because ($P<0.05$). This shows that traditional method have effect on the processing of cassava chips in the state. Therefore, the farmer should be exposed to modern ways of drying and processing of cassava chips which will improve their production.

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CHAPTER ONE

INTRODUCTION

Cassava is one of the major food crops in the tropics, it is the largest starch producer per unit area (Elsevier, 1999). But owing to lack of other nutritive components cassava diet is rather one sided. Advantage with these crops is that harvesting can be spread over many months by leaving the in the soil. Cassava is regarded as one of the most important root crop especially in Nigeria. The demand for cassava for both domestic consumption and in the industrial sector is on the increase. There are sweet and bitter varieties according to gynogenic glycoside content which causes toxicity owing to the conservation in HCN, context of HCN may vary from 10 to 49mg/kg of roots. It is also influenced by the location where is planted (Elsevier, 1989). Cassava is also means of food for both the rich and the poor because the bitter type which contain cyanide is produced into garri and other products. Sweet type can be eaten raw or cooked or dried and processed into cassava flour (*elubo*). Cassava belongs to the family *Euphorbiacae.* Sweet cassava is known as *Manihot dulcis* while the bitter cassava is known as *Manihot esculenta.*

Otherwise, the crop can adapt itself to wide variety climate and soil, it is also resistant drought continuous for several months which may affects the yield. Cassava can withstand variation in day and night temperatures which promote carbohydrate storage in the tubers (Elsevier, 1989). The following can be obtain from cassava roots and can be processed in variety of food products such as *garri, fufu, elubo lafun* (flour). Cassava roots are also source of starch, which is utilized in food, pharmaceutical and textile industries. Cassava roots are traditionally processed in chips by cutting into small pieces (chips) and sun dried on roofs tops, major high ways and other platforms and then, grounded into flour food preparation of dough for human consumption. This method is tedious and takes longer time to dry. The chips contain up to 80% water and if not dried quickly fungi like *Aspegillus niger* may develop resulting in poor quality chips and flour.

1.1 Justification for the study

This is to carry out research and evaluation of modern and traditional cassava chip dryers to enable to know best way cassava chips is been drying, to know the method which was found efficient in time of hastening drying rate, and to suggest the best way to prevent it from virus and other diseases.

1.2 Objectives

1. Survey and evaluate the performance of the existing cassava chips drier in Osun State.
2. To suggest the best method of cassava chips dryer available in Osun State.

CHAPTER TWO

LITERATURE REVIEW

Cassava, common name for any of several related plants native to tropical regions in the America. Cassava is the West Indian name and is used in the United States *Manioc* and *Mandioc*. Cassava is called *Juca* in Brazil and *Yacca* in other parts of South Americans. It grows in a bushy environment; it has a height of 2.4m (up to 8ft) high with greenish yellow flowers. The roots are up to 8cm (up to 3inch) thick and 91cm (36cm) long.

Two varieties of the cassava are of economic value, the bitter or poisonous and the sweet, or non-poisonous because the related poison can be destroyed by heat in the process of preparation, both varieties yield a wholesome food. Cassava is the chief source of tapioca and sauce in South American. Also an intoxicating beverage are prepared cassava juice by South Americans. The root that is grind into a powdery form is used to prepared *farinha*, a meal used to make thin cakes sometime called cassava bread. The starch of cassava yields a produce called Brazilian arrow root. In Florida, where sweet cassava is grown, the roots are eaten as food, feedstock, or used in the manufacture of starch and glucose.

2.1 Scientific Clarification

Cassava belongs to the family *Euphorbiaceae*. Bitter cassava is name scientifically *Manihot eesculenta* while sweet cassava is called *M. Dulcis* (Redmond, 2008).

2.2 Current Status

Cassava is very versatile commodity with numerous uses and by products. Each component of the plant can be valuable to its cultivator. The leaves may be consumed as a vegetable, or cooked as a soup ingredient or dried and field to livestock as protein feed supplement. The stem is used for cassava propagation and grafting. The roots are typically processed for human and industrial consumption. The handbook list the numerous uses of cassava in human consumption and industrial use.

In Nigeria, the consumption pattern varies according to ecological zone (Table 2.1) garri, a roasted granule is the dominant produce and is widely accepted in both rural and urban areas. It can be consumed without any additive such as sugar, groundnut, fish, meat and stew.

Table 2.1: Consumption Pattern by Zone of Cassava Products in some parts of Nigeria

Zone	Order of Importance
South West	Garri, Lafun, fufu, Akpu
South East	Garrri, Akpu
South South	Garri Fufu/Akpu
North Central	Garri, Fufu, Akpu, Starch, Rogo
North East	Fufu/Akpu, Garri, Ebacha, Rogo

Source: (Ministry of Health and Nutrition of Nigeria, 2004)

Fufu and Akpu, is a fermented paste from cassava is also widely consumed throughout the country especially in the southern zones. Most consumers of processed wet cassava paste and ready to eat forms of fufu complained that it has shelf life of two to three days.

Estimates of industrial cassava use suggest that approximately 16 percent of cassava root production was utilized or serve as industrial raw material in 2001 in Nigeria. Ten percent was used as chips in animal feed. Five percent was processed into a syrup concentrate for soft drinks and less than one percent was processed into high quality cassava flour used in biscuits and confectionary, dextrin pre – gelled starch for adhesive, starch and hydrosates for pharmaceuticals and seasonings (Kornawa and Akoroda, 2003).

This estimate leaves 84% or 28.9 million tonnes of production for food consumption, a portion of this course being lose in post harvest and waste. Comparable time series data describing cassava processing and utilization at the national regional and state level is virtually non – existent. Fortunately it was possible to obtain a preliminary analysis of the first national consumption survey of Nigeria since the early 1980's (Ministry of Health and Nutrition of Nigeria, 2004). Table 2.1 illustrates daily cassava consumption per capital by geographic region. Surprisingly, urban consumption are not dissimilar confirming the fact that the cassava is truly a national food with an urban market presence. Cassava appears to be a food of choice even in the face of alternative food option in urban areas.

Table 2.2: Daily Consumption of Cassava per Capital

	Grains per person per day
National	226.93
Dry savanna	131.16
Moist savanna	192.37
Humid forest Zone	284.42
Rural	239.74
Medium	220.53
Urban	213.76

Source: Ministry of Health and Nutrition of Nigeria, 2004

Assuming per capital urban consumption is 213.76gm of cassava per day, the rural micro, and small medium food processors is supplying 4 million metric tonnes of process cassava product a year. This is equivalent to 6.6million tonnes in cassava root. This estimate of cassava utilization is low given earlier estimate that work backwards from production. Clearly these suggest that a more – in depth study is required on the production of cassava product via – a – vis its consumption by populace.

The informed impression in most cassava circles suggests that the demand for tradition foods in a convenience form is increasing in Nigeria. Cassava consumption is finding new place in the diet of both rural dwellers and coming urban edicts. Cassava is no longer only grown by the poor. It is Nigeria most staple with industrial potential.

In terms of frequency of cassava, a consumption in survey state. It is encouraging to processors and producers of cassava alike to find high levels of consumption as reported in Table 2.3.

Table 2.5: Frequency of Cassava Consumption

Percentage of people that consumed cassava in a week

State	*1 – 2times*	*3 – 4 times*	*4 times*
Osun	29%	36%	33%
Akwa Ibom	29%	36%	33%
Bayelsa	21%	15%	51%
Edo	21%	25%	53%
Imo	24%	21%	43%
Kaduna	77%	18%	4%
Kano	57%	37%	4%
Kebbi	84%	5%	0%
Kwara	27%	38%	35%
Nasarawa	57%	28%	35%
Borno	65%	28%	4%
Taraba	37%	25%	33%

Source: Ministry of Health and Nutrition, 2004

Cassava processing operation in Nigeria can be described at 5 level of capacity. The common terms used to describe this capacity level are household (or cottage) micro small, medium and large. Household level processing typically does not empty any outside labour. The household consumers virtually all of the processed products and sells a small amount to raise income for additional household needs. It present, most Nigeria processors fall within this category. At the micro processing capacity the employment of one or two units of labour may take place while processing a variety of cassava products.

This enterprise typically uses batch processing. Batch processing may take four hours per day and this could be inefficient for the owner operator.

Nigeria has few cassava processors in category of operator. The small and medium processing operations typically employed 3 – 10workers and are very sparse at present large scale processing is virtually non – existent Nigeria. Cassava as a crop (*Manihot esculenta*). Cassava is the major stable food crop in the tropics. It is the largest starch producer per unit area, but owing to lack of other nutritive components a cassava diet is rather one sided. An advantage with this crop is that harvesting can be spread over many months by leaving the root in the soil (Agu *et al*., 2000).

Thee are sweet and bitter varieties according to the cyanopanic glucoside content which causes toxicity owing to the conversion into HCN. Content of HCN may vary from 10 to 490mg/kg of roots. It is also influenced by the location where is planted (Elsevier, 1989).

2.6 Climate

Cassava does well in warm area with an average daily temperature of 25 – 29% and it need a minimum of 500mm of well distributed rainfall. Otherwise, the crop can adopt itself to wide variety climate and soil. It is also drought resistant continues for several months, this will affect the yield. Cassava cannot withstand frost. Variation in day and night temperatures promotes carbohydrate storage in the tubers (Elsevier, 1989).

2.7 Soil

The crop responds well to soil with good structure, a good internal drainage and high organic matter content. Fairly light soil is needed for root formation. The pH may vary between 5 and 9. If the pH is lower than 5 liming is necessary (Elsevier, 1989).

2.8 Planting and Planting Material

The land should be hoed or ploughed well and mounds or ridges prepared because this make digging easier at harvest time. The plants are propagated vegetative. Any matured part of the stem is suitable for cuttings; the middle portion is the best, while use of the top part should be avoided. Cuttings are 20 – 30cm long and contain 4 – 6 nodes. Planting material should be taken from varies free plants cutting can be planted in a vertical, oblique or horizontal provision. A spacing of 1 metre x 1 metre is generally used where cultivation methods. One hectare of cassava can supply planting material for 3 – 4ha.

2.9 Growth Period

Growth period varies between 12 and 24 months. In case of direct consumption. In case of direct consumption cassava is usually lifted about 12 months after planting for industrial processing, this is done at a later stage when the crop is 16 – 20month old (Elservier, 1989). Plant population is between 10,000 and 30,000 plants hectare.

2.10 Fertilizer Requirement

Cassava is not very execrating in its fertilizer requirement. In case of intensified agriculture a considerable amount of fertilizer is needed especially nitrogen and potassium. The nutrient removed by a crop of 20 tonnes of roots per hectare are 125kg of N, 30kg of $P_2\,0_5$ – 150kg of K_2O (Elservier, 1989).

2.11 Weed Control

Pest, red mites are wide spread. Rot attaching grubs are frequently reported. Monkeys, wild pigs and rodents feed on the roots. Green spider mite has become a major pest in Africa. Some control is achieved by variety resistance and introduction of natural enemies diseases misdealt (manihot virus) transmitted by white flies (Bernisiapp) is the main disease.

2.12 Yields

The average is about 10 tonnes/ha but varies greatly from 7 t/ha (Zaire) to 19t/ha under suitable climate condition and with proper cultivation. Practice yield and reach 25 tonnes of root/hectares (Elsevier, 1989).

2.13 Harvesting

After the growth period which is between 12 and 24 months, the cassava can be harvest in the higher soil, the roots can be lifted simply by pulling, while in heavier soils. Lifting is done with a hoe. Because the roots keep in the soil, it can be harvested over a long period.

2.14 Cassava in Food Processing

Cassava and other root crops in general are cheap, available and essential energy source for many poor people who face problems of food availability. Although they contain little protein or fat.

2.15 Advantages of cassava of crop and food

i. Cheaper source of energy
ii. It can be cultivated easily
iii. It provide more dietary energy per hectare at a lower cost to the farmer principally because of reduce labour inputs.
iv. It can be store for up to 2 years in the soil until required.
v. Cassava process provides employment and income for rural women.

2.16 Drying

Traditionally drying is the elimination and way of taking excess water from the material in order to bring the total moisture content to a level considered to be safe for long storage. Excess of water in cassava is responsible for intensive microbial activity leading to the formation of moulds and general deterioration of the product.

This is mostly done in the open air under sunlight on the roofs of building, roadsides, concrete patches, spread on mat or direct on tamped soil. Traditional method of drying, however have problems. The quantity of the product is low due to contamination by dust, particles of plant and other foreign matters, sometimes stones and fragments of glass.

Drying becomes very difficult the raining season. It is during this time that the price of dried cassava products goes up as lack of sunny hours for drying reduces the quantity of product market, under optimal conditions (dry sunny weather for sun drying), IITA technique enables small scale primary processors to produce high quantity unfermented cassava that meets the specifications of industrial users within one dry.

Drying has been identified as the major too for expanding processing of cassava into high quantity cassava chips. Various options have been considered so far in cassava project at IITA (Onabolu *et al.*,1998).

2.17 Natural Dryer

Local processors expose cassava mash on a polythene sheet directly to the sun. This is referred to as 'sun drying'. The project observed that drying at rural or domestic levels cannot be done artificially because of the high capital investment in equipment and energy required and hence, natural sun drying is done. Sun drying is beset by several inherent drawbacks, such as susceptibility to damage due to inclement weather, slow drying rates, and contamination. Because of these limitations and the high cost and low utilization of more efficient traditional dryers, the adoption of a modified sun drying process, solar drying, has been considered for drying HQCF in rural areas.

2.18 Artificial Drying

If a controllable source of energy is used for drying operations, the process is referred to as artificial or mechanical drying. There is a further classification in which the air used for drying is heated, either by solar means or controlled means such as electricity, renewable fuels, or fossils fuels. These methods are referred to as hybrid drying.

2.19 Rotary Dryer

IITA is building up a coalition local fabricators to mass produce an already tested locally fabricated rotary dryer for use by the processors of high quality cassava flour. The dryer could be fired by charcoal or gas and rotated by a diesel engine. The dryer consists of an insulated drying chamber (drum – like). The dryer is cost effective and user friendly.

2.20 Flash dryer

IITA modified the design and fabrication of a locally fabricated flash dryer with peak product, Abeokuta, Nigeria. The flash dryer has capacity of 3tonnes per day and is well insulated with the product contact surface made of stainless steel and a semi – automated feeder. It could be operated with combined kerosene/spent oil. The dryer is user friendly and will encourage greater cassava flour production.

2.21Chips

Chipping is some with kind knives which the cassava tubers are cut into small unequal. Improved methods, both manual and in model way.

2.22 Cassava roots

Cassava root is an alternate feed that based on extensive research shows considerable potential for use in the Mexican tropics. In this area more than 450,000ha of land have been indentified with the characteristics to support cassava production without displacing other crops. If the maximum level of cassava crop yield calculated as 80ton/ha, were achieved the production of cassava starch, using the land available, would be sufficient totally satisfy Mexico's animal feed demand. However, the actual yield of cassava in Mexico averages only 12 tonnes/ha, and the dedicated to cassava production is around 40,000ha per year.

Most cassava is grown on very small peasant farms with well defined harvesting periods, and the major part of the cassava root produced is destined for human and animal feed, partly because cassava producers are rarely involved in formal animal production. Further, if it is intended for animal consumption, cassava must be viewed either as a cash crop or as a part of a production system, neither of these options is currently applied in the field.

The source of nitrogen ensiled with cassava is an important consideration and needs further investigation: indications are that urea gives results similar to those described digestibility is lower, but absorbable nitrogen, as true protein is of better quality (Cruz *et al.*,1990).

The carbohydrate content of cassava can also be utilized to preserve other feed sources by means of lactic acid produced during fermentation. This was used to preserve waste by – catch fish from shrimp fishing, where the fermentable carbohydrate was fresh cassava root and cane molasses (Loeza *et al.*,1980). Several mixtures of the ingredients were tested and the conclusion was that the best proportions of each, on a dry matter basis, were 45% fish (finely chopped), 40% cassava root, 10% molasses and 5% of a culture of acidifying bacteria in a cabbage solution. The resulting silage had stabilized pH of 4.31 and a protein content of 33% of dry matter, which was of similar quality to fish meal, as measured by chemically available lysine determination. Other organic materials could be added to ensiling cassava, to either preserve then or to improve the nutritional value of the resulting silage e.g. cassava fodder, fruits and other food by products etc.

2.3.2 Economic Importance

Cassava originated in Latin America and is now cultivated in almost all parts of the world. Total cultivated area is about 15.7 million ha, of which 9.30million ha are in Africa and 3.79million ha in Asia. In the early 1900s world production of cassava was approximately 140 million ton, and the top producer were Brazil, Thailand, Zaire, Nigeria, Indonesia, Tanzania, Uganda, India, Paraguay and Mozambique. Current global annual production of cassava is estimated 152.22 million tones of which about 46.28% is produced in Africa, 33.66% in Asia and 19.28% in South–America. Average cassava annual world yield has been estimated to be 9.66 tonnes/ha and experimental yields. (Amirante *et al.*, 1992). During the period from 1988 through 1990, developing countries produced 149million tonnes of cassava and between 1961 and 1998 production increased by 100%. Also during the period from 1961 through 1988, the cassava production increased by about 50% and yields increased by 32%.

During the past four decades,, the output of cassava has grown much faster in Africa than in the other major producing regions, due mainly to increase in activated area. Cassava ranks as the most important root crop in term of world production ahead of the sweet potato. It is also the most tropical countries and provides the major source of dietary calories for about 500 million people in many developing countries in Africa, Latin America and Asia.

The roots used as food for human and livestock, and leaves of many cultivators are used vegetable. Many cultivars can be cooked and eaten or processed in secondary food products. Industrial uses of cassava include starch extraction and incorporation into animals feeds. Cassava is an important export commodity in some countries, such as Thailand, where it is grown mainly for export in processed products.

2.3.3 Storage of Processed Cassava Products

Adequately dried products can be store to 3 to 6months provided insect infestation is controlled. The storage life and keeping quantity depend on the moisture content of the product. For dried chips, the moisture content normally should be less than 14% and polythene lined jute bags can be used successfully to store the chips. For cassava flour, it is advisable to store dried chips and milk them when flour is required. The milled product then can be store in thick – gauge airtight plastic bags. Moisture and meet ingress into packages must be prevented (Abbas *et al.*, 2001).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Information about Osun State

Osun State is an inland state in south-western Nigeria. Its capital is Osogbo. It is bounded in the north by Kwara State, in the east partly by Ekiti State and partly by Ondo State, in the south by Ogun State and in the west by Oyo State. The state's current governor is Olagunsoye Oyinlola, who was elected in 2003 along with his Deputy Governor, Erelu Olusola Obada. Osun State is home to several of Nigeria's most famous landmarks, including the campus of Obafemi Awolowo University, Nigeria's pre-eminent institution of higher learning. The university is also located in the ancient town of Ile-Ifẹ, an important early center of political and religious development for Yoruba culture. Other important cities and towns include the ancient kingdom-capitals of Oke-Ila Orangun, Ila Orangun. Osun State is divided into three federal senatorial districts, each of which is composed of two administrative zones. The state consists of thirty Local Government Areas, the primary (third tier) unit of government in Nigeria. Osun State's 30 Local Government Areas are listed below with their headquarters in parentheses:

Table 3.1: List of Local Government Areas in Osun State

• Atakunmosa East (Iperindo) • Atakunmosa West (Osu) • Ayedaade (Gbongan) • Ayedire (Ile Ogbo) • Boluwaduro (Otan-Ayegbaju) • Boripe (Iragbiji) • Ede North (Oja Timi) • Ede South (Ede) • Egbedore (Awo) • Ejigbo (Ejigbo)	• Ife Central (Ile-Ife) • Ife East (Oke-Ogbo) • Ife North (Ipetumodu) • Ife South (Ifetedo) • Ifedayo (Oke-Ila Orangun) • Ifelodun (Ikirun) • Ila (Ila Orangun) • Ilesa East (Iyemogun) • Ilesa West (Ereja Square) • Irepodun (Ilobu)	• Irewole (Ikire) • Isokan (Apomu) • Iwo (Iwo) • Obokun (Ibokun) • Odo Otin (Okuku) • Ola Oluwa (Bode Osi) • Olorunda (Igbonna, Osogbo) • Oriade (Ijebu-Jesa) • Orolu (Ifon-Osun) • Osogbo (Osogbo)

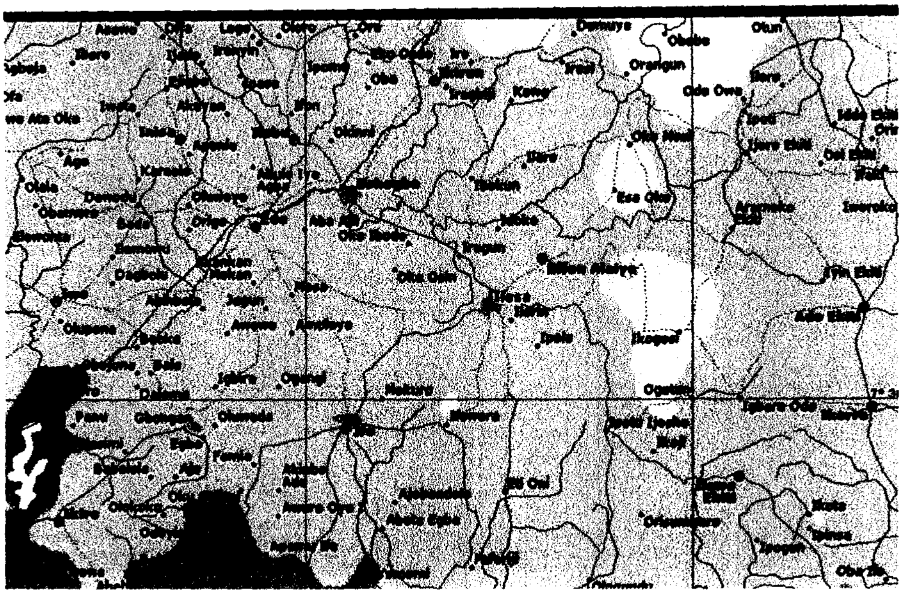


Fig 1: Map showing some study areas (Microsoft Encarta 2008[DVD])

3.2 Method of Data Collection

The selection of different area was done at random in order to cover the senatorial districts; this involves the use of questionnaires which are was administered in three local government areas w within each of the senatorial district of the state.

Table 3.2: Distribution of the various local government areas and the total number of town and villages visited.

S/No	Senatorial District	Local Government	No of Villages
1	Osun Central	Ifelodun	Ikirun and Eko – Ende
		Boripe	Iragbiji and Iree
		Oshogbo	Oke Osun and Gaa Fulani
2	Osun west	Odo otin	Inisa and Oyan
		Ifedayo	Ora and Oke Ila
		Ede north	Ede
3	Osun north	Olorunda	Ola – Efun and Ile
		Orolu	Ifon Osun, Ilobu, and Origbongbo
		Bolowaduro	Otan Ayegbaju and Eripa

The questionnaire was carefully distributed for easy adminstration and collection throughout the three senatorial district in Osun State. A total number of one hundred and eighty (180) questionnaires were administered to individuals while a total of one hundred and twenty six (126) questionnaires were collected back. This represent a total percentage of 70 (i.e. 70% returned their questionnaires) which acceptable for analysis. Out of 126 returned questionnaires collected, 99 filled it completely while 27 did not filled iot completely.

The questionnaires were interpreted where necessary and they where prepared to collect information as it affects the drying of cassava using the traditional and modern methods. During the interview, the various methods of cassava chip drier were cafrefully examined. The following shows the various steps being taken in the process of cassava to its drying state.

3.3 Statistical Method

The 126 questionnaires were analyzed using both descriptive (graphical) and inferential statistics (Regression and ANOVA) to know the relationship and effect of both traditional and modern way of drying cassava chips in Osun State. MINITAB 14 (2003 version) software was used to analyze the data. The regression and ANOVA analysis output result would be attached as an appendix.

3.3 Field Survey

At the field different picture where taken to show traditional method of processing of cassava chips Plate 1, 2, 3 and 4. Plate 1 shows the peeling of cassava tubers which is part of traditional method of processing of cassava chips in the study area.

Plate 1: Manual Peeling of Cassava Tubers

Plate 2: A cassava Processing centre

Plate 3: A man filling questionnaire in the field

Plate 4: Animal Raving and urinating on the chips

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

Results and findings of this study are hereby presented and discussed, however, it is pertinent to note that cassava chips drier is most carry out in traditional methods.

4.1 Constraints Bound to the Production

The analysis of cassava chips producers' perception shows that first three constraints in chips production are by order of importance. The hardness of the harvest, the long length of the drying and the hardness of the peeling. This observation allows to make inference before analysis that these problems are due to chips production (dry season), the lack of adequate device of drying and the peeling that are manual. Indeed, in dry season soil is hard because of lack of water, so the harvest becomes difficult. It is precisely during this period that cassava chips production is easy due to availability of solar energy (sun) that is constant because solar drying which is traditional practices in Osun State. This makes their production to slow during rainy season, and they have to wait till drying season. This farmers face various problem during processing of cassava chips such as long period drying with solar energy, none availability of water to wash during processing and to protect it from animals raving around.

Descriptive Presentation of Results

Table 4.1: Age Distribution of the respondents

Age (years)	*Frequency*	*Percentage (%)*
20 – 25	0	0
26 – 30	7	13.20
30 – 35	13	24.52
36 – 40	13	24.52
41 – 50	24	45.30
51 – above	9	16.90

Source: Field Survey

Fig 1: Age Distribution of the Respondents

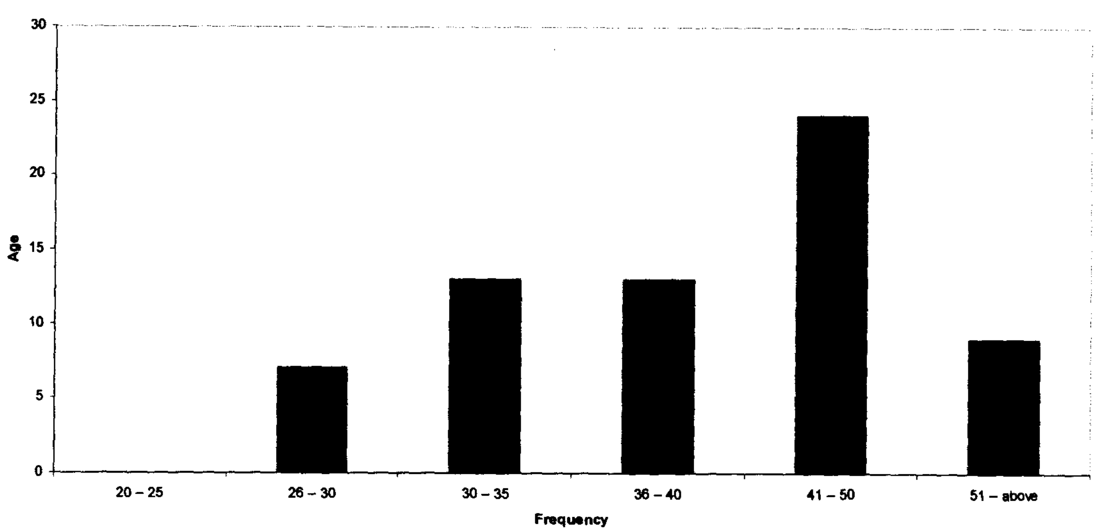


Table 4.2: Educational level of respondents

Education Level	*Frequency*	*Percentage (%)*
Primary	32	25.40
Secondary	48	38.10
Tertiary	20	15.87
Others	26	20.63

Source: Field Survey

Fig 2: Educational Level of respondents

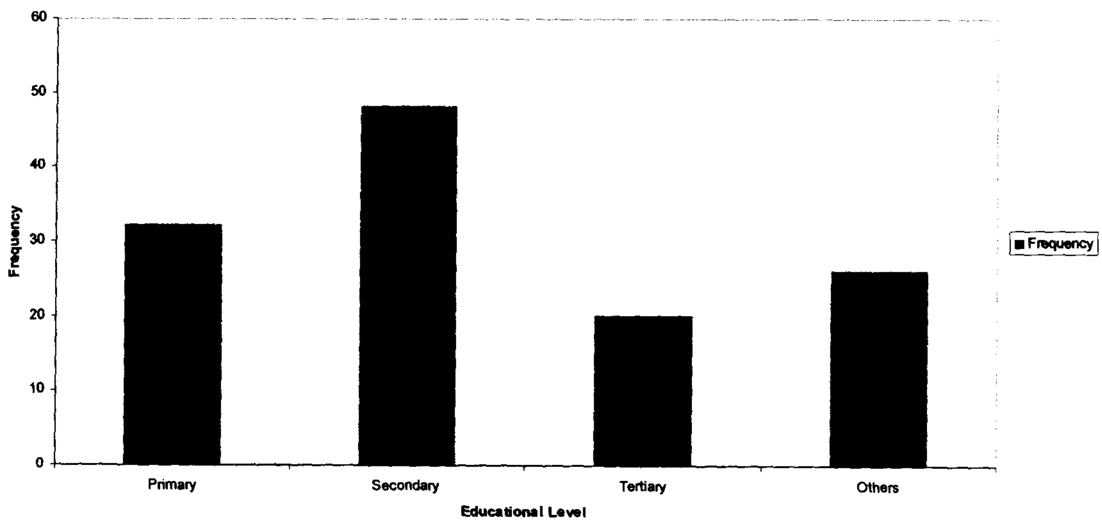


Table 4.3: Marital status of respodents

Marital Status	*Frequency*	*Percentage (%)*
Single	38	35.85
Married	53	50
Divorced	15	14.15

Source: Field Survey

Fig 3: Marital Status of respondents

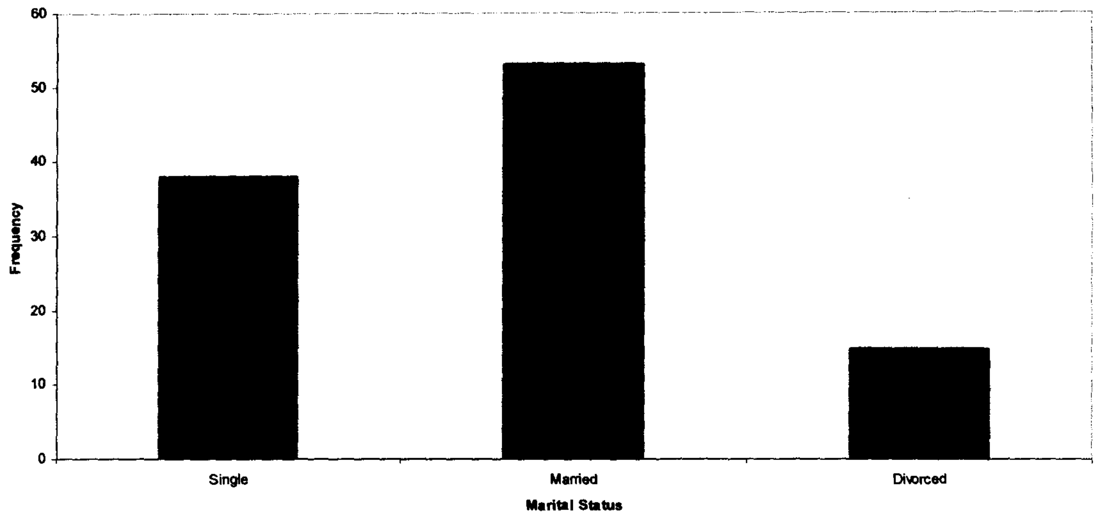


Table 4.4: Types of Cassava planted according to the Respondents

Cassava Planted	*Frequency*	*Percentage (%)*
Bitter Cassava	76	60.32
Sweet Cassava	50	38.68

Source: Field Survey

Fig 4: Types of Cassava Planted

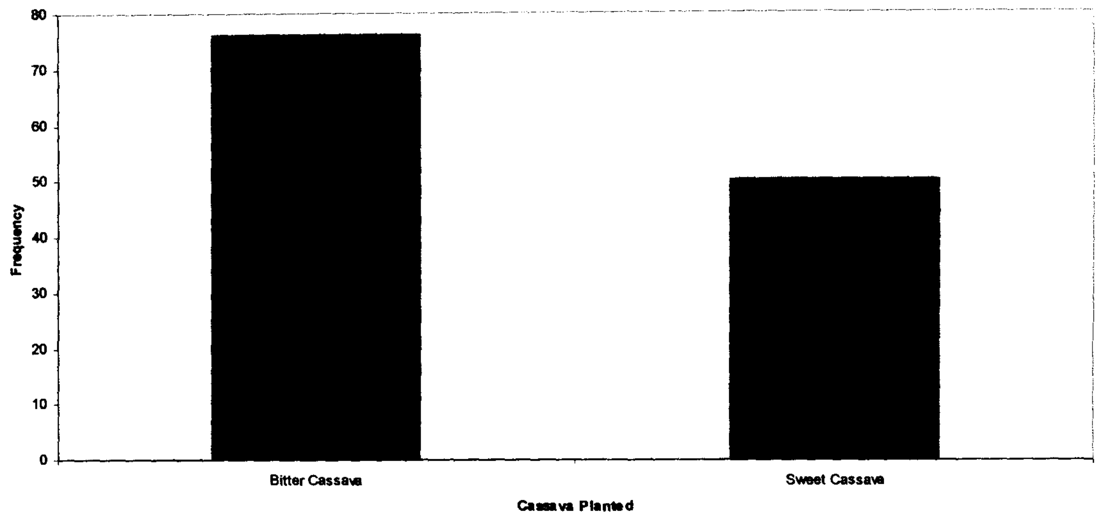


Table 4.5: Quantity of cassava produced per season according to Respodents

Quantity	*Frequency*	*Percentage (%)*
50 – 100kg	24	19.05
100 – 500kg	24	19.05
501 – 1000kg	73	57.94
1000kg and above	5	3.97

Source: Field Survey

Fig 4.5: Quantity of Cassava produced per season according to the respondents

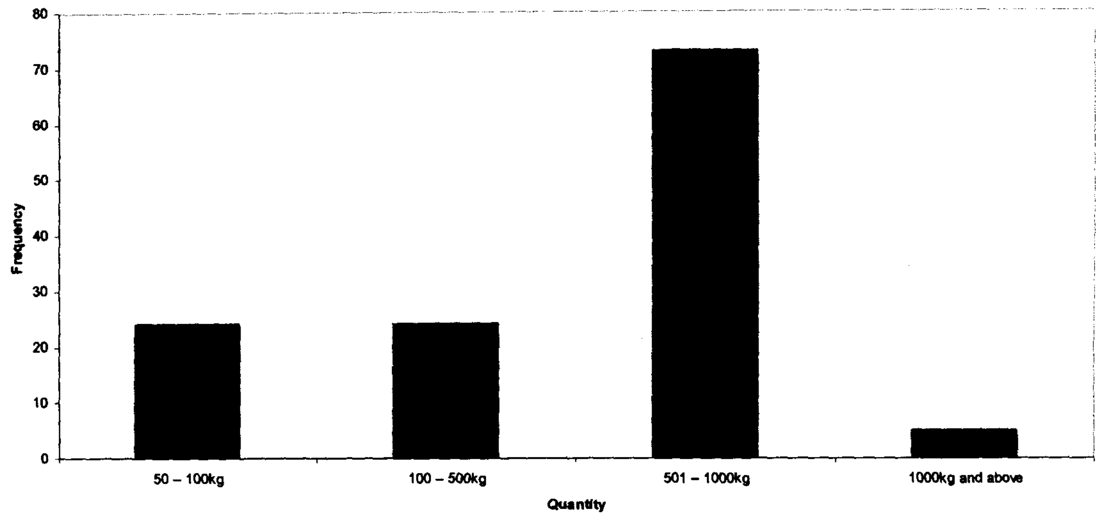


Table 4.6: Method Used for Drying Cassava Chips

Types	*Frequency*	*Percentage (%)*
Modern	20	15.87
Traditional	106	84.13

Source: Field Survey

Fig 4.6: Method Used for Drying Cassava Chips Most

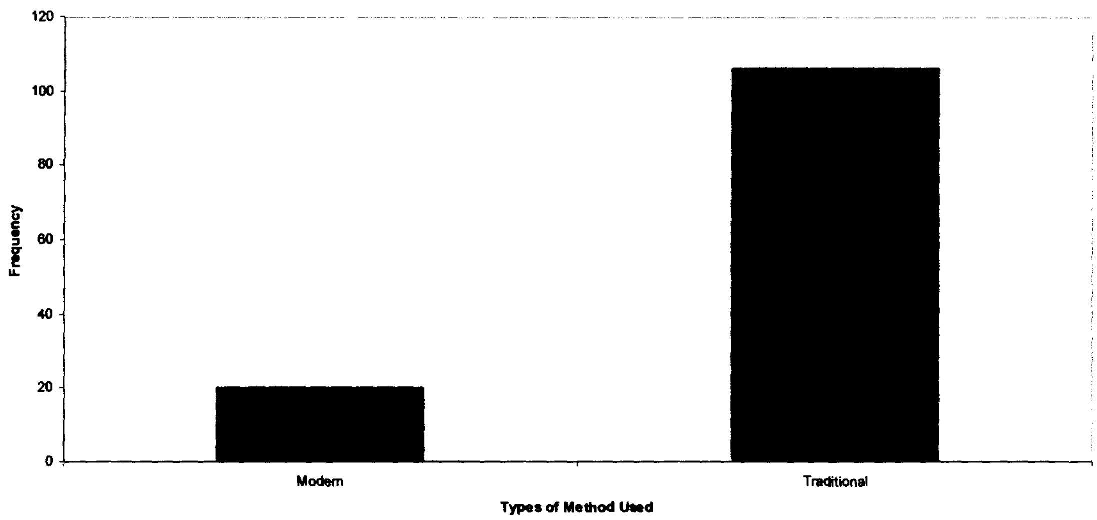
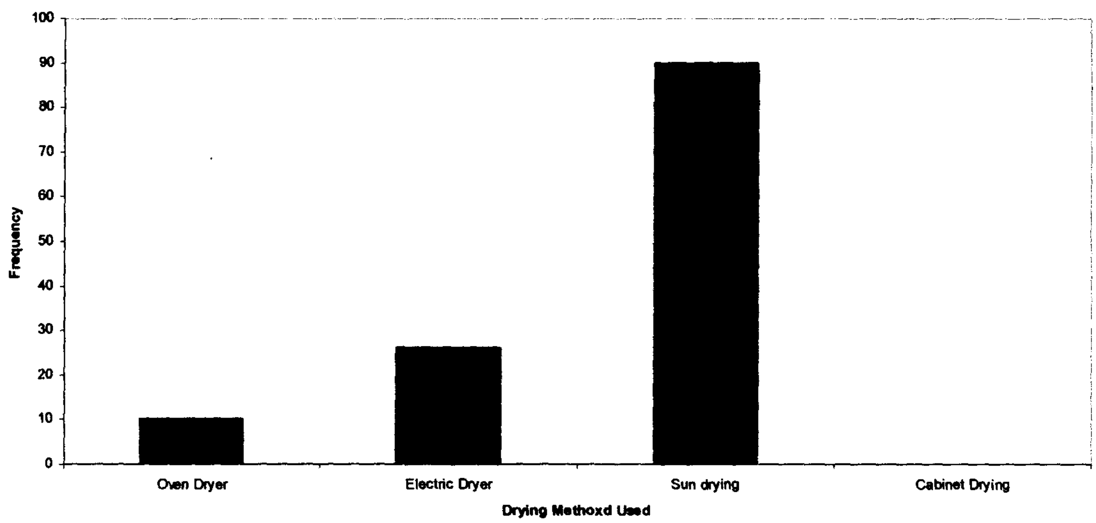


Table 4.7: Name of the method/Dryer Used by the respondents

Types	*Frequency*	*Percentage (%)*
Oven Dryer	10	7.94
Electric Dryer	26	20.63
Sun drying	90	71.43
Cabinet Drying	0	0.00

Source: Field Survey

Fig 4.7: Name of the method/dryer Used by the respodents



Discussion of Results

When results or questionnaire were analyses the analysis showed that there is significant difference quantity of cassava produced in all the local governments, this shows that the amount of cassava produced is very high. Also there is no significant difference in location of processing; this indicates that the transferring of cassava to processing area does not affect the processing and production of cassava chips. More so, there is significant difference in the method used, the shows that methods used in processing of cassava chips have effect on the production cassava in the area. Traditional method which is the common one have serious effect on the cassava chips produced either by quality or reducing the amount of processed cassava chips in all the local government area sampled.

There is significant difference in reasons given by the farmer in productions of cassava chips. This indicates that the farmer are not rich enough to purchased modern equipment for the processing cassava chips or sun drying which common is only method they can used due to its affordability and easy access during dry season. Also, there is significant difference in method used and type of dryer used. These shows have serious effect on the processing and type of machine used. Also, it shows that traditional method is the most common type of method used and there is no mechanized farming in processing of their cassava chips. There is no significant difference problem faced using modern and problem faced using traditional method. Conclusively, traditional method is the most common processing method that is present in all the local government area of Osun State.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Conclusively, traditional method is the most used method in Osun State in processing of cassava chips. Modern methods are not common in processing of cassava chips. Even if modern method of drying of drying present there may be problem of technical know how and failure of electricity because of no regular power supply in the nation.

5.2 Recommendations

1. Farmer should be encouraged to adopt modern way of drying of cassava chips.
2. Training of farmers or their children in how to operate machines for drying of cassava should encouraged by Osun State government.
3. Incentives should be given farmers to boost their morale in processing of cassava into chips.

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APPENDIX 1

QUESTIONNAIRE

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DEPARTMENT OF AGRICULTURAL & BIO-RESOURCE ENGINEERING

PROJECT TOPIC; SURVEY OF MODERN AND TRADITIONAL CASSAVA CHIP DRYERS IN OSUN STATE.

I am a final year student of the Department of Agricultural & Bio-Resource Engineering of the Federal University of Technology, Minna, Niger State currently embarking on a project entitled **"Survey of Modern and Traditional Cassava Chip Dryers in Osun State".** Your cooperation will be highly appreciated for the success of this work. You will be duly acknowledged and all information and data provided by you will be treated with utmost care and be used for academic works only.

Thank you sir/ma.

Please tick [ ] as appropriate or fill in the gap where necessary

Name of respondent --

Age. 20-25 [ ] 26-30 [ ] 31-35 [ ] 36-40 [ ] 50-70 [ ]

Occupation. Farmer [ ] Civil servant [ ] Trader [ ] Administrator [ ] others------------

Marital Status: Married [ ] Single [ ] Divorced [ ]

Educational Status. Primary [ ] Secondary [ ] Tertiary [ ] others -----------------

L.G.A --

Impute Information.

1. What types of cassava do you grow on your farm? Bitter cassava [ ] Sweet cassava [ ]

2. What is the quantity of cassava produced per season? 50-100kg [] 100-500kg [ ] 501-1000kg [ ] 1000kg and above [ ]

3. Where is your processing plant located? Residential [ ] on the farm [ ] industrial area [ ]

4. Which method do you use to slice your chips? Traditional method (manual) [ ] modern method (using machine)

5. Why do you dry cassava chips? To reduce the moisture content [ ] kill micro organisms [ ] to have durable storage [ ] others specify ---------------------------------------

6. What method do you used for drying your cassava chip? Modern [ ] Traditional [ ]

7. State the name of the method/dryer used. Sun dryer [ ] oven dryer [ ] Electric dryer [ ] Solar dryer [ ] Mesh tray [ ] Cabinet dryer [ ] Blanket surfaces [ ]

8. Which dryer is the commonest in your locality? Mention please ----------------------------

9. Why do you prefer the drying method adopted? Give reason--

10. Is there any pre-treatment method adopted before drying cassava chips? Specify --

11. Using the modern dryer, how long does it take to dry cassava chips to moisture content? 4 hours [ ] 8 hours [ ] 12 hours [ ] 24 hours [ ] 36 hours [ ] 2 days [ ] 3 days [ ]

12. At what temperature do you dry cassava chip to have desired moisture content? 10-15°C [ ] 16-20°C [ ] 21-25°C [ ] 26-30°C [ ] 31-35°C [ ] 36-40°C [ ] 40 and above [ ]

13. Using the modern dryer to what percentage of moisture content does your chip dried? 5% [ ] 8-10% [ ] 10-12% [ ] 13-15% [ ] 15-17% [ ]

14. What is the efficiency of your modern dryer? 40% [ ] 60% [ ] 80% [ ] 100% [ ]

15. Using the traditional dryer, how long does it take to dry cassava chips to attain desired moisture content? 1-2 days [ ] 2-3 days [ ] 3-4days [ ] 4-7 days [ ] 7 days and above [ ]

16. Does traditional method attracts insects or bacteria? Yes [ ] No [ ]

17. What are the difficulties faced when modern drying method is employed? Power failure [ ] Insufficient labour [ ] poor maintenance [ ] Logistic problem [ ]

18. What are the difficulties faced when traditional drying method is employed? Animal raving [ ] Long time drying [ ] regular attendance [ ]

19. Which method do you use to alleviate the constraint of drying during rainy season? State please. --

----

20. For how long have you been using this method of drying? 1 year [ ] 2 years [ ] 3 years [ ]

21. What is the loading capacity of your dryer? 20-100 tones [ ] 120 – 200 tones [ ] 500 -1000 tones [ ]

22. Do you dry chips on a large scale? Yes [ ] No [ ]

23. Do you hire labour for cassava chip production? Yes [ ] No [ ]

24. What is the shelf life of the dried cassava chips? 2-6 Months [ ] 6-12 Months [ ] Other --------

25. How do you store dried cassava chips? Specify --

----

26. What affects the market demand for your dried cassava chips? Odour [ ] Colour [ ] bacteria effect [ ]

27. What is the comparative cost of modern and traditional dryer? State --------------------

----

----

28. Which drying method is cheap, convenient and easy to adapt? State --------------------

----

----

29. Suggest a better method, you prefer to use to dry cassava chips ------------------------

----

APPENDIX II

———— 11/10/2008 4:39:05 PM ————————————

Welcome to Minitab, press F1 for help.

Regression Analysis: Types of Cas versus Quantity Pro, Location of, ...

```
The regression equation is
Types of Cassava Planted = 3.39 - 0.303 Quantity Produced
                         + 0.0041 Location of Processing + 0.046 Method Used
                         + 0.131 Reasons for drying - 0.649 Drying Method
                         - 0.130 Dryer Used - 0.440 Reasons Choos Mtd
                         + 0.0739 Prblm Faced using mod
                         - 0.0183 prblm faced using trad
```

Predictor	Coef	SE Coef	T	P
Constant	3.3933	0.4511	7.52	0.000
Quantity Produced	-0.30339	0.06171	-4.92	0.000
Location of Processing	0.00409	0.05691	0.07	0.943
Method Used	0.0461	0.1124	0.41	0.683
Reasons for drying	0.1307	0.1139	1.15	0.003
Drying Method	-0.6492	0.1455	-4.46	0.000
Dryer Used	-0.13000	0.04181	-3.11	0.002
Reasons Choos Mtd	-0.4399	0.1848	-2.38	0.019
Prblm Faced using mod	0.07393	0.04852	1.52	0.130
prblm faced using trad	-0.01827	0.02005	-0.91	0.364

S = 0.365364   R-Sq = 41.7%   R-Sq(adj) = 37.1%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	9	11.0547	1.2283	9.20	0.000
Residual Error	116	15.4849	0.1335		
Total	125	26.5397			

Source	DF	Seq SS
Quantity Produced	1	6.6163
Location of Processing	1	0.1175
Method Used	1	0.0712
Reasons for drying	1	0.0187
Drying Method	1	0.9597
Dryer Used	1	1.5476
Reasons Choos Mtd	1	1.2692
Prblm Faced using mod	1	0.3436
prblm faced using trad	1	0.1109

Unusual Observations

Obs	Quantity Produced	Types of Cassava Planted	Fit	SE Fit	Residual	St Resid
5	2.00	1.0000	0.8966	0.3627	0.1034	2.35RX
20	2.00	1.0000	1.7988	0.1579	-0.7988	-2.42R

```
 21      2.00   2.0000  1.1497  0.0798    0.8503      2.38R
 23      2.00   2.0000  1.1537  0.0974    0.8463      2.40R
 25      2.00   2.0000  1.2277  0.1077    0.7723      2.21R
 42      1.00   1.0000  1.7646  0.0840   -0.7646     -2.15R
 77      1.00   1.0000  1.7646  0.0840   -0.7646     -2.15R
111      3.00   2.0000  1.0271  0.0557    0.9729      2.69R

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

One-way ANOVA: Types of Cassava Planted versus Quantity Produced

```
Source              DF      SS     MS      F      P
Quantity Produce     3   7.578  2.526  16.25  0.000
Error              122  18.962  0.155
Total              125  26.540

S = 0.3942   R-Sq = 28.55%   R-Sq(adj) = 26.80%


                               Individual 95% CIs For Mean Based on
                               Pooled StDev
Level   N    Mean   StDev   -------+---------+---------+---------+--
1      52  1.5192  0.5045                                (--*--)
2      20  1.5000  0.5130                              (----*----)
3      52  1.0192  0.1387                 (--*--)
4       2  1.0000  0.0000   (---------------*--------------)
                            -------+---------+---------+---------+--
                                 0.70      1.05      1.40      1.75

Pooled StDev = 0.3942
```

One-way ANOVA: Types of Cassava Planted versus Location of Processing

```
Source              DF      SS     MS     F      P
Location of Proc     2   1.955  0.977  4.89  0.009
Error              123  24.585  0.200
Total              125  26.540

S = 0.4471   R-Sq = 7.36%   R-Sq(adj) = 5.86%


                               Individual 95% CIs For Mean Based on
                               Pooled StDev
Level   N    Mean   StDev   ---+---------+---------+---------+------
1      92  1.2283  0.4220   (---*----)
2      14  1.5714  0.5136             (-----------*----------)
3      20  1.4500  0.5104         (---------*--------)
                            ---+---------+---------+---------+------
                             1.20      1.40      1.60      1.80

Pooled StDev = 0.4471
```

One-way ANOVA: Method Used versus Reasons Choos Mtd

```
Source              DF      SS     MS      F      P
Reasons Choos Mt     1   2.035  2.035  11.31  0.001
Error              124  22.322  0.180
Total              125  24.357
```

```
S = 0.4243   R-Sq = 8.36%   R-Sq(adj) = 7.62%


                             Individual 95% CIs For Mean Based on
                             Pooled StDev
Level    N    Mean   StDev   --+---------+---------+---------+-------
1      118  1.7712  0.4219                               (--*--)
2        8  1.2500  0.4629   (-----------*-----------)
                             --+---------+---------+---------+-------
                             1.00      1.25      1.50      1.75

Pooled StDev = 0.4243
```

One-way ANOVA: Prblm Faced using mod versus prblm faced using trad

```
Source             DF       SS     MS     F      P
prblm faced usin    2   12.158  6.079  6.50  0.002
Error             123  115.057  0.935
Total             125  127.214

S = 0.9672   R-Sq = 9.56%   R-Sq(adj) = 8.09%


                             Individual 95% CIs For Mean Based on
                             Pooled StDev
Level    N    Mean   StDev   ---------+---------+---------+---------+
 1      23  1.6087  0.6564                      (---*---)
 2     102  2.3627  1.0224                                (-*-)
22       1  1.0000       *   (------------------*------------------)
                             ---------+---------+---------+---------+
                                    0.0       1.0       2.0       3.0

Pooled StDev = 0.9672
```

One-way ANOVA: Location of Processing versus prblm faced using trad

```
Source             DF      SS      MS      F      P
prblm faced usin    2  21.635  10.817  27.03  0.000
Error             123  49.223   0.400
Total             125  70.857

S = 0.6326   R-Sq = 30.53%   R-Sq(adj) = 29.40%


                             Individual 95% CIs For Mean Based on
                             Pooled StDev
Level    N    Mean   StDev   ---+---------+---------+---------+------
 1      23  2.3043  0.5588                                (--*--)
 2     102  1.2353  0.6476                     (*-)
22       1  1.0000       *   (---------------*---------------)
                             ---+---------+---------+---------+------
                              0.00      0.80      1.60      2.40

Pooled StDev = 0.6326
```

One-way ANOVA: Reasons for drying versus Drying Method

```
Source            DF      SS      MS      F      P
```

```
Drying Method    1    4.070  4.070  18.48  0.000
Error          124   27.303  0.220
Total          125   31.373

S = 0.4692   R-Sq = 12.97%   R-Sq(adj) = 12.27%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level    N    Mean   StDev  ----+---------+---------+---------+-----
1       19  1.1053  0.3153  (-------*--------)
2      107  1.6075  0.4906                        (--*---)
                            ----+---------+---------+---------+-----
                              1.00      1.25      1.50      1.75

Pooled StDev = 0.4692
```

One-way ANOVA: Dryer Used versus Effnes of Tradtional Mtd

```
Source            DF       SS     MS     F      P
Effnes of Tradti   1    2.599  2.599  2.64  0.107
Error            124  121.941  0.983
Total            125  124.540

S = 0.9917   R-Sq = 2.09%   R-Sq(adj) = 1.30%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level    N    Mean   StDev  ---+---------+---------+---------+------
1      118  1.6610  1.0146  (----*---)
2        8  2.2500  0.4629   (---------------*----------------)
                            ---+---------+---------+---------+------
                             1.60      2.00      2.40      2.80

Pooled StDev = 0.9917
```

One-way ANOVA: Method Used versus Dryer Used

```
Source       DF      SS     MS      F      P
Dryer Used    3   9.398  3.133  25.55  0.000
Error       122  14.959  0.123
Total       125  24.357

S = 0.3502   R-Sq = 38.58%   R-Sq(adj) = 37.07%


                                Individual 95% CIs For Mean Based on
                                Pooled StDev
Level   N    Mean   StDev  --------+---------+---------+---------+-
1      76  1.9079  0.2911                                (--*-)
2      23  1.3478  0.4870           (----*----)
3      16  1.8750  0.3416                            (-----*----)
4      11  1.1818  0.4045  (------*------)
                           --------+---------+---------+---------+-
                                1.20      1.50      1.80      2.10

Pooled StDev = 0.3502
```