EVALUATION OF LEVELS OF MECHANIZATION OF RICE PROCESSING IN NIGER STATE

BY

ADEWALE OLUSHOLA OLUYEMISI

2003/14766EA

DEPARTMENT OF AGRICULTURAL AND BIORESOURCE ENGINEERING, SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY,

MINNA, NIGER STATE.

NOVEMBER, 2008.

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BEING A FINAL YEAR PROJECT SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF ENGINEERING (B. ENG.) DEGREE IN AGRICULTURAL AND BIORESOURCE ENGINEERING.

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MINNA, NIGER STATE.

NOVEMBER, 2008.

DECLARATION

I hereby declare that this project is a record of a research work that was undertaken and written by me. It has not been presented before for any degree, diploma or certificate at any University or institution. Information derived from personal communication, published and unpublished works of others were duly referenced in the text.

19/11/2008

ADEWALE OLUSHOLA OLUYEMISI — DATE

2003/ 14766EA

CERTIFICATION

This project entitled "Evaluation of Levels of Mechanization of Rice Processing In Niger State" by Adewale Olushola Oluyemisi, meets the regulations governing the award of Bachelor of engineering (B. ENG) of the Federal University of Technology, Minna, and it is approved for its contribution to scientific knowledge and literary presentation.

19/11/2008

Engr .Dr. Mrs. Z. D. Osunde — Date

Supervisor

19/11/2008

Engr .Dr. Mrs. Z. D. Osunde — Date

Head of Department of Agricultural Engineering.

19-11-08

External Examiner — Date

DEDICATION

This project work is dedicated to Almighty God who in his infinite mercy makes it possible for me to successfully complete my degree programme in the Federal University of Technology Minna. And also to those whom God use to anchor me to this world, Chief and Chief (Mrs.) J.A. Adewale.

ACKNOWLEDGEMENT

This research work is a product of a will at becoming a member of the revered class of academics. This strong will is not the product of author alone, all be it, it has been the collective responsibilities of the community, lecturers and colleagues. Therefore, I must begin by thanking the almighty God for the abundant mercies for sparing my life, giving me perfect health, wisdom, knowledge and understanding to see me through the duration of my course to contribute my own humble and little quota towards the development of the nation.

This acknowledgement will never be without expressing my profound gratitude to my project supervisor, Engr. Dr. (Mrs.) Z. D. Osunde, who also happens to be my Head of Department (H.O.D). Inspite of her numerous academic engagements has been able to provide necessary and constructive advice, valuable suggestion and criticisms through the pedical of my writing. More so her wealth of experience and unflinching support have led to the success of this work. This has reinforced the belief that in her is a great potential as a mother, mentor, guardian and teacher.

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I also wish to express my gratitude to my loving and caring husband. Mr Olaleye Olanrewaju Oluwole. Thanks for your love, prayer, advice, counsel, moral support, financial support. Your consistent pressing on me contributed in no small amount in turning me into a hardworking lady. I can never wish for a better husband. You mean the whole world to me. May God enrich and strengthen you. You are a dream come true and a crown on my head.

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ABSTRACT

The Evaluation of Levels of Mechanization of Rice Processing in Niger State, were evaluated through a survey by personal interview and standard questionnaire. This was done base on visits to Badeggi in Katcha local government area, Doko in Lavun local government area and in Kaffinkoro in Paikoro local government area. One hundred and ten (110) questionnaires were distributed and ninety (90) were collected. The result based on responses given in the questionnaire and field assessment showed that the evaluation of levels of mechanization of rice processing in Niger State is generally not effective compared with the local and manual method. Among the factors preventing the efficient evaluation of levels of mechanization of rice processing in Niger State are; lack of knowledge on the improved method of boiling, lack of knowledge on the improved method of threshing, lack of capital to acquire the rice thresher, lack of capital to acquire improved parboilers and lack of capitals to acquire the milling machine. All this makes a small holder alone not to own and operate an efficient rice processing methods. Therefore, it is recommended that;

i. The government should come to the aid of local rice processors by granting them loans in order to acquire the improved equipments.

ii. Periodic trainings/workshops should be done to educate and update the local rice processors and extension agents on improved rice processing.

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CHAPTER ONE

INTRODUCTION.

1.1 BACKGROUND OF THE STUDY

Rice (Oryza sativa) is a semi- aquatic crop which thrives under flooded soil condition. It is one of the most important cereal crop grown in Nigeria. Rice is used primarily for human consumption and provides mainly energy, proteins and vitamins. The major components of rice are: starch and protein. Small lipids, fibre and minerals (Nkama *et al.*, 1993).

The Rice grain is a covered caryopsis. The husk comprises about 15-30% of the entire weight. Rice varieties are classified according to kernel weight, length and shape, which is described as short, medium or long grain relation to the length and width ratio. (Nkama, 1992).

After Rice is harvested, dried and stored, it must be milled before it can be cooked and eaten. The milling process or husking removes the outer and indigestible husk, and also remove the thin bran layer around the Rice kernel itself. This prevents rancidification and spoilage of the milled Rice during subsequent storage and produces the white Rice desired by consumers.

In some countries such as Nigeria, Rice is parboiled before milling. The paddy is soaked in water for between half a day and two days until the kernel is wet to its center, after which it is steamed briefly to gelatinize the starch.

Parboiling of Rice toughens the kernel, resulting in less breakage during milling and thus increasing the yield of finished Rice. Parboiling also diffuses nutrients from the bran layer into the starchy part of the kernel, so polished parboiled Rice is nutritious than polished raw (not parboiled) Rice (Lockwood,1991).

Parboiling of Rice is a hydrothermal treatment of paddy before milling (Wimberly, 1983). Parboiling is an age old process and involves three basic processes; viz soaking, steaming and drying. Soaking is done to increase rice moisture content to about 30% and gelatinize the starch in the Rice. It is then steamed for about 10-15 minutes depending on paddy variety, splitting of the paddy indicates the completion of steaming. The steamed paddy is finally dried before milling.

The quality of the parboiled Rice depends on how efficient the parboiling processes were carried out. Incorrect parboiling processes such as over soaking can bring about bad smell and colour to the milled parboiled Rice, over steaming brings about disfigured Rice.

There are basically two methods of parboiling: The traditional and modern methods. Under the traditional methods, there are two types; the single boiling in which the paddy after cleaning is put into a container and soaked for 24-72 hours in an ordinary water and then steamed and dried before milling. The double boiling methods involve placing the paddy in a container and sufficient unheated water is added. The container is then heated with firewood until the temperature rises to about 60°C. The fire is then put out and the paddy is allowed to soak overnight. There after the soaked paddy is steamed and subsequently dried before milling.

In the modern method; the paddy soaked at about 70°C for 3-4 hours. The water is drained off and the paddy is removed for drying before milling. In some modern process fully automatic and modern equipment such as steam boilers and mechanical dryers are used. However, the principle is basically the same.

Milling is a stage at which the husk and the outer bran layer of the Rice are removed (Idris, 1996). There are two types of milled Rice, raw and parboiled. The raw Rice is a milled Rice

directly from paddy after harvest and no other processes carried out on it. Parboiled milled Rice is obtained after parboiling the paddy Rice

1.2 Objectives of the Study

The main objective of this project is to Evaluate the levels of Mechanization of the different unit operations in Rice processing. The evaluation will be done by the use of structured questionnaires and a visit to different rice processing centers.

1.3 justification of The Study

The enormous Rice production capability of Nigeria has not been fully exploited due principally to lack of appropriate indigenous processing evaluation as obtained in other developing countries. Therefore there is need to do some research on an efficient and affordable rice processing methods. There is a need for base line data to ascertain the level of mechanization of rice processing in Niger State. This project study is aimed at evaluating the level of mechanization of rice processing in Niger State.

CHAPTER TWO

LITERATURE REVIEW

2.1 Cultivation and Production of Rice

Rice (*Oryza sativa*) is cultivated in swampy fields in many tropical countries, where it is used mainly for human food. It occurs as a grain. The grains of Rice consists of endosperms, the main starch portion are the embryo or germ, which are separated by Scutellum. This is all contained within a hull or husk, which comprises an outer pericarp. Testa and a leurone layer. The starch granules themselves are tightly bound to the endosperm protein (Ihekoronye and Ngady, 1985).

In contrast to other cereal, Rice is generally consumed as a whole grain or flour. The grain is usually cleaned and dehusked, then scoured and polished prior to consumption. The grains, are heat treated with water or steam. Although in the case of parboiled Rice previous soaking, heating and drying steps have been carried out on the unhusked material.

According to (Ihekoronye *et al.*, 1985), Rice is grown from latitudes 50°N to 39°S. This encompasses the "tropics". It is by far the most important food crop in Asia which contains over half the world's still expanding population. In latin America and Africa, Rice is important in number of countries like Nigeria.

2.2 Rice Origin

Rice have been cultivated for such countless ages that its origin must always be a matter of conjuncture. Botanists base their evidence of the origin of Rice on the habitants of wild species. The genus Oryza comprises 25 species distributed through tropical and sub-tropical regions of Asia, Africa, Central and South America and Australia. Both diploid (2n=24) and tetraploid species occur, the diploid being more numerous. The taxonomy is complex and no final agreement has being reached on synonymy or relationships between some of the species (Grist, 1986).

According to (Vavilov 1930), the longer a group has being established in an area, the larger will be the number of species to be found there. He concludes that the wealth of forms and varieties

of rice found in South West of Himalayas which are closely allied to many Chinese varieties points to this region as the center and region of Rice.

Chang (1975), concludes that Rice was first domesticated in the area between Northern India pacific coast adjoining Vietnam and China. He pointed out that recognizable races of Rice resulted from man's extension of its culture and persistent selection within a geographic region. Rapid changes in this predominant varieties occurring among people. In contrast, the African Rice *Oryza glaberima* has undergone less genetic diversification because it was not subjected to the intense forces of selection associated with dispersal and cultivation (Grist, 1986).

Ting (1949), concluded that in view of the number of wild Rice found in Southern China, Rice cultivation probably started in this region and spread northwards.(Copelan 1924), added linguistic evidence to prove Rice originated in South east Asia. He pointed out that in Chinese many other languages in South-east Asia, agriculture, Rice and food are synonymous, indicating that Rice was first cultivated in this part of the world.

The weight of evidence points to the conclusion that the center of origin *Oryza Sativa* is South Asia, particularly India and Indo-China where the riches diversity of cultivated forms have been recorded (Chanraratna, 1964). It spreads northward in Asia before the later movement of the Aryan dispersal, for the name is alike in Zind and Sanskrit and similar in old Persian. From the land of the continent is also spread south and east through the Malay Archipelago with the flow of human culture (Grist, 1986).

2.3 Harvesting

It is essential that Rice crop be harvested on time reduce losses due to rats, birds, insects and from shattering and lodging. The best to harvest is 32-42 days after heading in wet season and between 28-30 days after heading in dry season depending on variety under cultivation. The crop should be ready for harvest when about 80% of the panicles and straw coloured and the grains in lower portion are in hard- dough stage (Nkama, 1992).

2.4 processing of Rice

Rice like other cereal grains is subject to deterioration because of changes in temperature and relative humidity. Insects and diseases become more active with increase in temperature and relative humidity (Eziuloh *et al.*, 1993). The processes of Rice are in various stages.

2.4.1 Threshing.

For ease of processing the paddy should be threshed. Threshing methods are usually classified as manual (hand or threading) or mechanical (by using rotating drums with spikes or rasp bars). Each of these methods involves impact forces (Nkama, 1992).

2.4.1.1 Traditional Method of Threshing

The traditional method of rice threshing in Nigeria could either be by beating the bundles against a solid object such as drums or logs of wood, foot threading or beating the bundle with sticks. Considerable losses of grain losses are experienced during the operations. This method is not only inefficient but also very laborious and the output is low, resulting in delay in handling volumes of harvested grain and subsequently leading to losses. It introduces considerable impurities into the paddy (Dauda and Agidi, 2002).

2.4.1.2 Improved Method of Threshing

The improved method of threshing in Nigeria was by the development of a rice thresher. It was developed at the National Cereals Research Institute, Badeggi to minimize these problems. The main features of the rice thresher are: the hopper, the transmission unit, straw outlet, grain outlet and the supporting frame. Rice heads are fed uniformly into the hopper. The heads fall by gravity on the rotating cylinder and are threshed by impact of the spikes and are whirled round between the concave and the rotating cylinder. The grains and the little chaff fall through the concave openings onto the collection chute/grain outlet, the blower air stream blows off the chaff over the second screen leaving behind clean grains (Dauda and Agidi, 2003).

2.4.2 Soaking

Soaking sometimes called steeping is to soak the paddy in water to increase its moisture content to about 30%. Steeping is done in pre-heated water at 75°C for three hours. In this process, the

void spaces in the null and the Rice kernel are filled with waters, the starch granules absorbs this water and swells up. Steeping provides the starch with quantity of water sufficient for gelatinization (Nkama *et al*, 1993).

The minimum moisture content of 30% is required to fully gelatinize the starch caryopsis. The soaked water temperature should not exceed 75°C to avoid cooking the paddy. Prolong soaking result in fermentative changes that will lead to bad smell and colour production in the rice. Insufficient soaking on the other hand leads to increase breakage during milling in addition to the appearance of chalky grains. However, different rice varieties show different responses as regards their hydration characteristics when soaked under the same condition of temperature and time (Nkama *et al* 1993).

2 .4. 3 Parboiling

Parboiling is hydrothermal treatment of paddy prior to milling. It is done to improve milling recovery of Rice to salvage poor quality to meet the demands of certain consumer preference (Idris, 1996). In Nigeria, paroiling of paddy before milling is widely practiced.

2.4.3.1 Traditional Method of Parboiling.

Local traditional method of parboiling involves soaking of winnowed paddy in cold water for about 24-48 hours. The soaked paddy is then transferred to a pot or a drum that is half filled with fresh water and heated until the paddy cracks. Thereafter the parboiled paddy is sun-dried before milling.

Rice grains processed in this way have poor characteristics. These includes undesirable odour due to fermentation resulting from over-soaking of the paddy, black specs due to partially filled and diseased grains that escaped winnowing and the impurities like sand and other soil contaminants packed along during threshing. Others are dirty brown or white belly appearance due to over parboiling or under parboiling respectively and broken grains resulting from over drying the parboiled paddy before milling (Misari S.M., Ukwungwu M.N and Maji E.A, 1999).

2.4.3.2 The Improved Method of Parboiling

The improved method of parboiling developed by National Cereals Research Institute, Badeggi has reduced the soaking time to a few hours (5-6 hours) depending on the variety. This is followed by steaming the paddy under atmospheric pressure (100°C) for 15-20 minutes. The hot water soaking method prevents fermentation odour inherent in the traditional method of parboiling. The steamed rice is first dried in the sun to 16% moisture content, then slowly dried to 13-14% in the shade and tempered to 12-14 hours. The milling product from this parboiling method has high milling recovery and high consumer acceptability (Misari S.M *et al* 1999).

2.4.3.3 Factors Affecting Parboiling

Each paddy variety behave differently when parboiled. Physical and Chemical properties, degree of maturity, agro-climatic conditions, pre-harvest conditions, drying and storage conditions and initial moisture content all affect the end result. Each variety has a different hydration rate that is different temperature and time of soaking to achieve gelatinization (Wimberly, 1983). Leaching losses (loss of solid matter from grain) during soaking is nil at 60°C and below, and are 1-2% at 80°C. Cold soaking for about 30 hours or longer result in 0.5-1% loss. Paddy soaked at 60°C produce darker colour. Colour darkens as temperature increases. Paddy soaked in cold water for extended periods develops into bad odour. If paddy is under soaked, steam consumption increases, while bellies appear and grain hardness is less, and more breakage occur during milling. Over soaked paddy requires less steaming, Rice becomes disfigured, leaching losses are higher, grains are harder, and more time and energy are required to polished and cooked the Rice. Higher steamed temperature for long periods results in harder grain with darker colours of about 300-350 gallons of water for parboiling a ton of paddy; 60 gallons are absorbed by the paddy (Wimberly, 1983).

2.4.4 Drying

Drying reduces the moisture content of grain to a level that discourages the growth of micro-organisms. Drying the paddy from 14-16% moisture content safe for milling and to ensure minimum breakage of the kernel is another important consideration in drying of Rice. Slow

drying gives opportunity for micro organisms to grow and spoil the paddy while rapid drying cause cracks and breakages in the paddy. Shade drying takes longer time but it is the best (Idris, 1996). Most of the paddy produced in Nigeria are sun dried.

2.4.4.1 Traditional Method of Drying

The traditional method is the sun- drying method. They are spread on mats, tarpaulins, flat rocks or specially prepared drying surfaces usually bare field. This method of drying is labour intensive and results unevenly dried paddy. In the rainy season, significant amount of the grains are lost to microbial spoilage because of insufficient sunshine to dry the grain to a safe moisture level. In addition, sun-drying method exposes the grains to bird attack resulting in considerable losses (Misari *et al.*, 1999).

2.4.4.2 The Improved Method of Drying

The National Cereals Research Institute, Badeggi uses the improved method of drying which is a concrete platform dryer of two tones capacity which allows for drying of paddy at controlled rate and level and this enhances maximum head rice recovery during milling. It also affords the opportunity to maintain safe moisture content of 14% in poor weather conditions.

2.4.4.3 Factors Affecting Drying

Factors affecting drying are shown below:

- Temperature and humidity of the blowing air: The rate at which rice dries is affected insignificantly by the temperature and humidity of the air moving through the grain.
- Initial moisture content of grains: Because wet dry rapidly in highly wet regions, the drying rate of wet grains is higher than that of comparatively dry grains.
- Shape, Size and cell tissues of grains: with falling rate drying, the drying rate is affected by the shape and the cell tissues of grains, because the rate of moisture transfer from the inside to the surface of grain differs.
- Sorption – desorption history of grains: Even if the moisture content of the grain is the same, the drying rate differs depending on the moisture distribution within grains. The moisture distribution of grains after drying is not the same as that after sorption.

- Continuous drying and tempering (intermittent) drying: when the drying of grain is temporary stopped, the moisture within the grains equalizes due to diffusion. Consequently drying is re-started, the drying rate becomes higher than the case of continuous drying due to higher moisture content o the surface.
- Air Velocity: Dependence on the drying rate on the air velocity is not seen, when the air velocity varies in the range usually used for drying thin layers of grain.

2.4.5 Milling

Rice milling is the only rice processing operation that is mechanized to an appreciable extent in Nigeria. Four categories of mills are available in the country: the traditional mills, custom mills, improved custom mills and modern large scale mills.

The traditional mill involves hand pounding of paddy in a wooden mortar with pestle to separate the husk from the gram. This is followed by winnowing. This method is however tedious, labour is intensive and inefficient.

Presently about 90% of the paddy rice milled in Nigeria is carried out by small scale custom mills with output of 230-290Kg of Milled rice per hour. This Machine removes the husks and bran from the grain in the operation. It is estimated that 80% of the existing mills are small (less than 200Kg/hour). Grain coming from such mills have poor quality and contain many broken grains.

The National Cereal Institute Badeggi has developed mills having output of 0.5tonnes of milled rice per hour with two stage operation. They constitute about 18% of the total mills in Nigeria and mill about 8% of total paddy rice (Misari *et al.*, 1999). They produce better quality than that from one-pass mill.

Modern large scale mills constitute only about 2%of these conventional industrial plants. They are equipped with sophisticated parts and accessories, and mill about 2% of the total paddy output in Nigeria (Misari *et al.*, 1999). They process about 4tonnes of paddy per hour with high percentage rice recovery. (Misari *et al.*, 1999).

CHAPTER THREE

METHODOLOGY

In this chapter, the methods of investigation and data collection of Rice processing are presented.

3.1 Sources of Data.

In order to obtain information on the Evaluation of Levels of Mechanization of Rice Processing, data were collected from both primary and secondary sources.

i. Primary Source.

Information from this source was obtained from field visit to some Rice processing areas of the state. These include Kaffinkoro in Paikoro local government area, Badeggi in Katcha local government area and Doko in Lavun local government area. The essence of going round this Rice processing areas of the state is to conduct both oral interviews and administer written questionnaires. The essence of interviewing the local Rice processors was that it is the best way of obtaining the required information needed, because it is easier to interact freely and more friendly. This method of obtaining information also is flexible, elicit spontaneous responses and allow searching more deeply into the subject matter.

Structured questionnaires were used for data collection. The questionnaire used has four sections which are:

1 The bio-data section.

2 The production section.

3 The processing section.

4 The packaging section.

ii. Secondary Data.

This includes the consultation of books and relevant literatures from agro-vet, proceedings and the Ramat polytechnics libraries. Also, information were obtained from Niger State Agricultural Development Programme library.

3.2 Method of Investigation

Those interviewed were given pre-information on the interview by personal visit, this is to enable them prepare meaningfully for answering the questions on the interview date mutually agreed upon. Those local areas in Niger State known for Rice production were selected for the work. In each local government area, a number of wards were visited and people were interviewed. The people interviewed were selected randomly. A total number of people interviewed were presented comprising of farmers, rice processors, traders, agric extension workers.

Table 3.3 shows the distribution of the local government visited, the village/ward and the number of persons interviewed.

Local government Area	Village visited	Number of persons interviewed.
Katcha	Badeggi	29
Lavun	Doko	30
Paikoro	Kaffinkoro	31

The questionnaires were distributed and collected four (4) days after. Apart from the questionnaire, visual inspections were conducted and oral interview were done as well.

3.3 Data Collection

Biodata

local government Area	Sex		Marital status	
	Male	female	Single	married
Katcha	26	3	9	20
Lavun	19	11	8	22
Paikoro	22	9	9	22

Professional status

Famer	Civil servant	Trader
3	14	
12	5	
14	2	

Educational background of persons interviewed.

Illiterate	Primary	Secondary	OND	NCE	HND	HNC
		8	9		12	
	7	9	14			
	11	14	6			

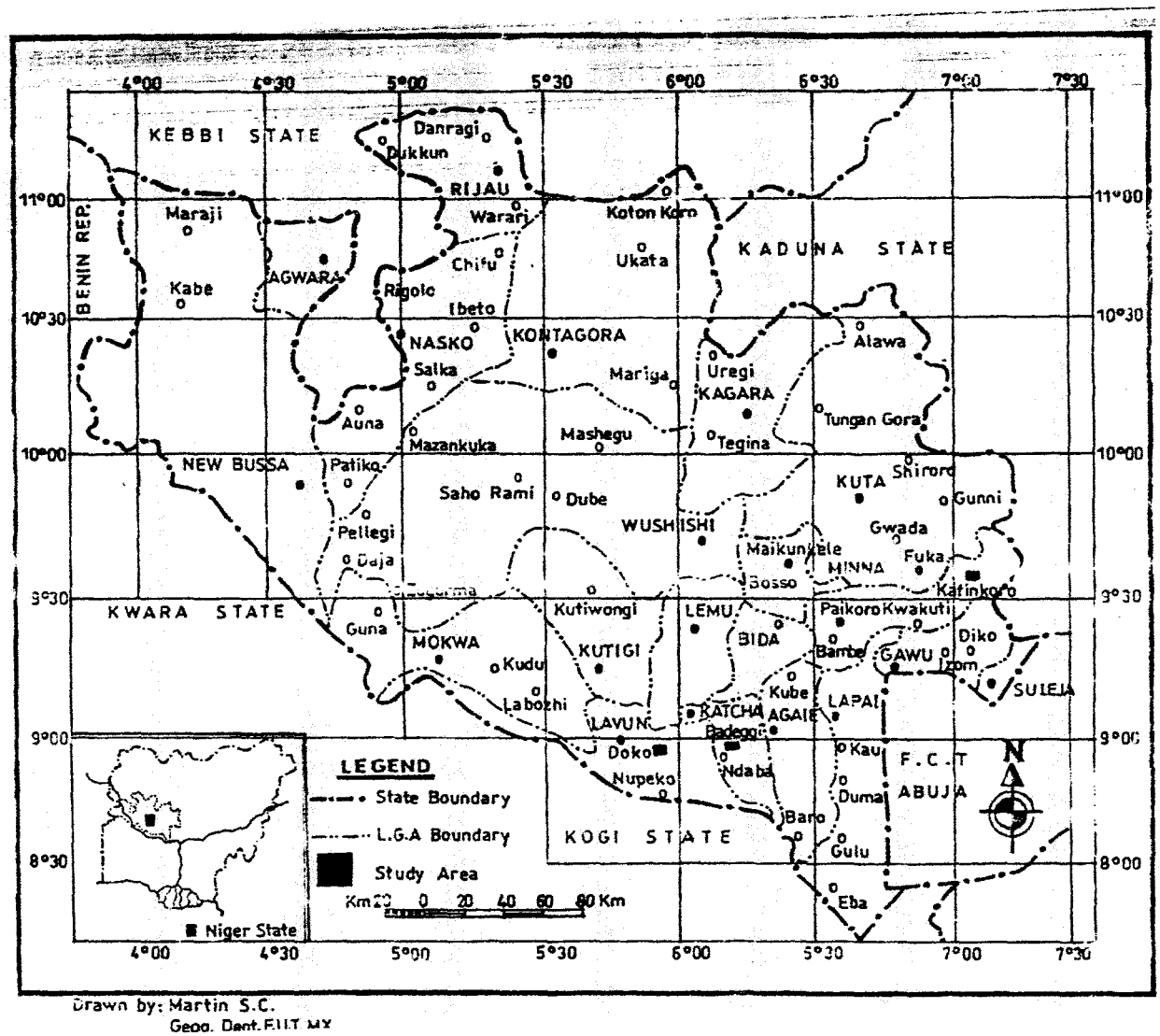
Approximate amount of rice produced in the selected local government areas assuming 70% of famers produce rice.

Data collection on production, processing

Local government area	Total number of persons interviewed	Total number of bags produced	Average production per person	Approximate values of farmers producing rice	Total production in each Local government area
Katcha	29	406	14	27486	384804
Lavun	30	270	9	47790	430110
Paikoro	31	217	7	35636	249452

From the table above, it was gotten that in Katcha Local Government Area, there are 39265 farmers. Assuming that 70% of them are producing rice, i.e. there are 27486 farmers producing rice. In Lavun Local Government Area, there are 68271 farmers. Assuming that 70% of them are producing rice, i.e. there are 47790 farmers producing rice. In Paikoro Local Government Area,

there are 50908 farmers. Assuming that 70% of them are producing rice, i.e there are 35636 famers producing rice.



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Geog. Dept. F.U.T. MY

Fig 3.1 Research Domain with the Local Government Areas Showing the Study Areas

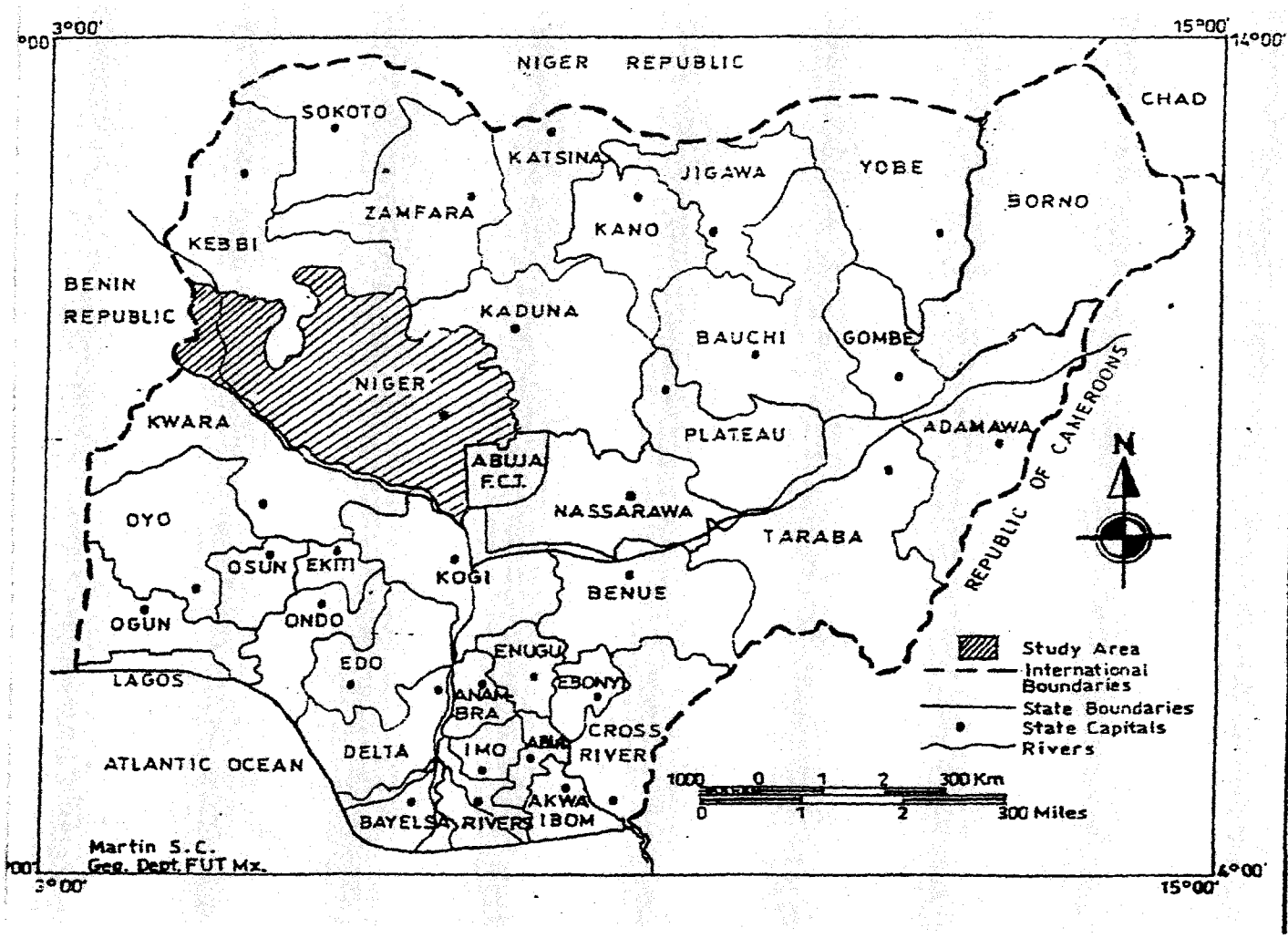


Fig 3.2 Map of Nigeria Showing the position of Study area (Niger State).

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Result

quality assessment result

the result of the quality assessment are presented in tabular form below

table 4.1 levels of mechansation of harvesting and threshing operations

	Harvesting		Threshing	
	Frequency	percentage	Frequency	percentage
Manual	50	100%	50	100%
Mechanical	0	0	0	0

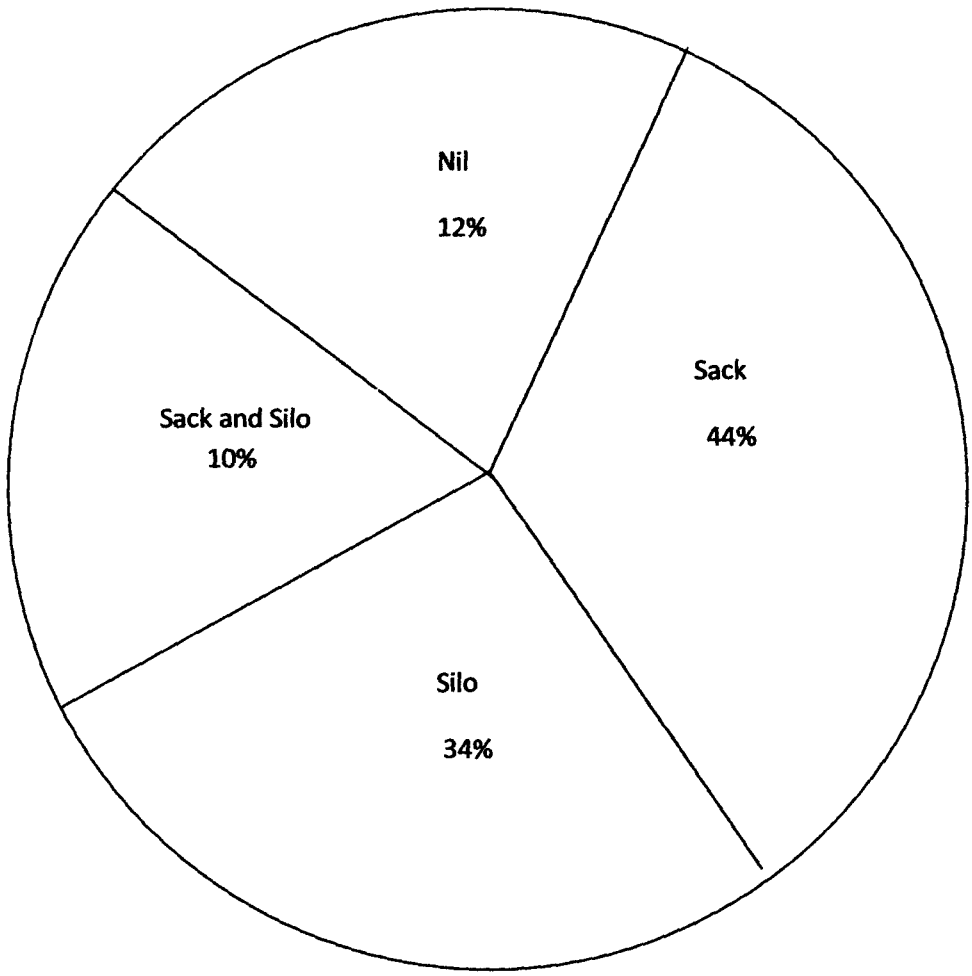
Table 4.2 levels of mechanization of soaking, parboiling and drying operations

	Soaking		Parboiling		Drying	
	Frequency	percentage	Frequency	percentage	Frequency	percentage
Manual	50	100%	35	70%	50	100%
Mechanical	0	0	15	30%	0	0

Table 4.3 levels of mechanization of milling and cleaning operations.

	Milling		Cleaning	
	Frequency	percentage	Frequency	percentage
Manual	0	0	48	96%
Mechanical	50	100%	2	4%

Fig. 4.1 method of rice packaging used in the state



4.2 Discussion

The results showed that 100% (one hundred percent) of the farmers farming rice uses manual method to harvesting rice. This manual method is done using sickle.

After harvesting, threshing is done in which 100% of the farmers farming rice uses manual method. This manual method is the use of sickle and drum and the source of energy used for threshing in all the villages visited is firewood.

The soaking is done after the rice has been threshed. Manual method is also used for soaking. This manual method is hot water method using drum and the source of energy used is firewood. 100% (one hundred percent) of the farmers farming rice uses manual method for soaking.

Further more; parboiling takes place after the rice has been soaked. In all the places visited, 70% (seventy percent) of the farmers farming rice uses firewood and 30% (thirty percent) farmers uses the improved parboiler.

The manual method is fast, efficient, less fuel consumption and more convenient to use. After the rice has been parboiled, it has to be dried and this is achieved by sun drying. The sun drying method can be; spreading on the mat, spreading the rice on the nylon or sack spread on the ground and it can also be spread on the rock itself. Then the rice is milled with the help of a milling machine.

However, this method is the mechanical method and also, the improved parboiler is a mechanical method as well. 100% (one hundred percent) of the farmers farming rice n all the villages visited uses the milling machine to mill their rice.

After the rice has been milled, it is cleaned and packaged. Majority of them uses winnowing to clean the rice (i.e. 96%) and the remaining farmers farming rice uses manure to clean the rice. Then, the rice is packaged and the packaging varies. Forty four percent (44%) uses sack to pack their rice, thirty four percent (34%) uses silo to pack the rice, ten percent (10%) uses both sack and silo while twelve percent (12%) do not pack their rice at all.

From the response gotten from the farmers during the oral interview, a lot of information was gathered in which most of them has been explained earlier. Here are some of the responses that have not been explained earlier.

- They do thresh the rice by beating the bundles against a solid object such as drums or logs of woods, foot threading or beating the bundles with stick. This method introduces a lot of impurities into the paddy.
- The only method they all use for soaking rice is the drum, i.e hot water method.
- The method they do use for parboiling is parboiling with firewood and hot water. They explained further by talking about the two methods they use which are single boiling method or double boiling method. Emphasis was laid on these two methods and they further explained thus.

Single boiling

In this method, the paddy rice is cleaned and sorted to ensure that there are no contaminate. It is then put into container, either metal drum or pot. Sufficient amount of water about 2/3 of the volume is added onto the paddy to be soaked for about 24-72 hours. The container is then heated to a boiling point until the husk is about to split. The water is then drained off. Steaming water is then added, the container is then reheated again until all husks split. The paddy is then removed

from the container and dried either in an open shade or directly under the sun; by spreading in thin layer either on mat or concrete floor.

Double boiling

In this method, a container either metal drum or pot is filed up with water to about 2/3 of its volume. The paddy rice is put inside and heated to boiling point. The fire is put out and allowed to soak over night. The water is then drained and the container reheated again to steam until the husk begins to split. The paddy is then removed and dried as in the single boiling method.

More comments were made on the two boiling methods. Both methods are alright depending on how careful either of them is used. But the double boiling method consumes less time and it is more convenient to use. These two methods are the local methods.

Also, they also talked about the improved parboiler but only a few of them can afford the improved parboiler. The improved parboiler consists of the following;

- Two chambers, (upper and lower) separated by a perforated base. The upper chamber is at least two times the volume of the lower chamber. The upper chamber has a diameter of 76cm and 60cm in height while the lower chamber is 30 cm in height.
- It has two walls separated by an insulated material to reduce the heat loss through conduction.
- The drain pipe is connected to the lower chamber to drain off the water.

In operation, the two chambers are filled with water to 2/3 of volume of the upper chamber. The water is heated to 75°c and the rice in sack is dumped into the water to be soaked for four (4) hours, the water is then drained out from the upper chamber. The water in the lower chamber is then brought to a boiling point to steam the rice contained in the upper chamber for one (1) hour. Splitting of the husk indicates completion of the parboiling. The rice is then removed and spread

in thin layer to dry in the sun. it is continually stirred to ensure uniform drying. The dried paddy is milled in the same milling machine as the parboiled locally.

- They all complained of two kinds of problems and constrains they normally encounter in rice processing. The first problem is sun drying during rainy season is always very difficult and the second problem is labour.

From these responses, it could be deduced that all the methods they use for their rice processing are local methods except in the area of milling. And in the area of the second aspect of the method of parboiling and the improved parboiler is used, and in threshing and a rice thresher is used. Some of them complained that distonner is always a problem in their locally fabricated milling machine.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The findings of the study have also showed among other things that the local processors of rice in the state are associated with some problems and constrain, these include;

i. During soaking, some times due to lack of standard of practice, fermentation of the paddy and acquisition of bad smell and colour takes place.

ii. The result obtained in the local method of parboiling showed that there is a long period of soaking which can be reduced by using improved parboiler with even a better quality of mill rice.

iii. Lack of proper milling machine, this also has adverse effect on the quality of milled rice. Most of the machine are old and out dated resulting in many broken milled rice.

iv. Losses due to manual handling, consumption by birds, rodents and insect do occur.

v. The use of ordinary oil drum is inadequate and uneconomical because it has low capacity and high cost.

5.2 Recommendations

The following recommendations are made with a view to improving on local rice processors;

i. Government should come to the aid of local rice processor by granting them loans in order to acquire the improved equipments.

ii. Soaking time in the local method should be reduced and soaking temperature increased to 75°c to improve the quality of parboiled rice.

iii. Drying the paddy should be done to safe moisture content of 13% for milling to prevent breakage of the kernels.

iv. Milling of the rice should be done in a proper rice milling machine designed for the milling of ice only.

v. Periodic trainings/ workshops should be done to educate and update the local rice processors and extension agents on improved rice processing.

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APPENDIX

Federal University of Technology

Department of Agricultural and Bioresources Engineering

Dear Sir/Madam

QUESTIONAIRE AND ORAL INTERVIEW

I am an undergraduate student of the above named Department currently carrying out a final year research project titled EVALUATION OF LEVELS OF MECHANIZATION OF RICE PROCESSING IN NIGER STATE. The project work involves questionnaire administration and evaluation. I humbly ask you to answer the following questions. Your cooperation in answering these questions is highly appreciated and acknowledgement will be duly made.

All information will be treated as confidential and used for the purpose of academic work only.

Thanks

Adewale Oluwashola Oluwayemisi.

INSTRUCTION

Please answer the following question and indicate your response. Tick the appropriate box and give comments where necessary.

BIODATA

1. Name of Respondent

2. Name of Town/Village/Ward
3. Sex (a) Male ( ) (b) Female ( )
4. Marital Status (a) Single ( ) (b) Married ( )
5. Educational Qualification/ Level (a) Illiterate ( ) (b) Primary Education ( ) (c) Secondary Education ( ) (d) OND, NCE ( ) (e) Degree, HND/HNC ( ) (f) Msc/Phd ( ) (g) Professional ( )

6. Profession ( ) (a) Farmer ( ) (b) Civil Servant ( ) (c) trader ( )

(d) Others Specify ( )

PRODUCTION

Q1. What area of land do you use for rice cultivation?

Q2. How many time per annum do you harvest rice?

Q3. How many bags of rice (100kg) do you harvest per annum?

Q4. How much rice do you process at once? (a) less than 50kg (b) between 50kg-100kg (c) above 100kg

Q5. What method do you use for harvesting (a) Manual ( ) (b) Mechanized ( )

i. If Manual, what type?

ii. If Mechanized, what type?

Q6. What method do you use for Threshing? (a) Manual ( ) (b) Mechanized ( )

i. If Manual, what type?
ii. If Mechanized, what type

Q7. During harvesting, how many Men, Women and Children works at a particular point in time?

Q8. What is the source of energy used? (a) Electricity ( ) (b) Diesel ( )

(c) Petrol ( ) (d) Others Specify ( )

PROCESSING

Q9. What type of method do you use for soaking? (a) Manual ( )

(b) Mechanical ( )

i. If Manual, what type?

ii. If Mechanical, what type?

Q10. What is the source of energy used? (a) Electricity ( ) (b) Diesel ( )

(c) Petrol ( ) (d) Others Specify ( )

Q11. What type of method do you use for rice parboiling?

Q12. Which of these methods is fast, efficient, less fuel consumption and more

Convenient to use? (a) Manual ( ) (b) Mechanical ( )

Q13. What method of drying do you use?

Q14. What is the source of energy used when you are drying? (a) Electricity ( )

(b) Diesel ( ) (c) Petrol ( ) (d) Sun energy (e) Others Specify

Q15. What method do you use for Milling?

Q16. What is the source of energy used for Milling? (a) Electricity ( )

(b) Diesel ( ) (c) Petrol ( ) (d) Others Specify ( )

Q17. What are your problems and constraints in Rice Processing?

Q18. What method of cleaning do you use?

Q19. At what stage do you clean the rice?

(a) After harvesting ( ) (b) After parboiling ( ) (c) After drying ( ) (d)After milling ( )

PACKAGING

Q20 Do you package your processed rice?

Q21. What method of packaging do you use?

Additional information / General Comments.