CENTRAL STATE UNIVERSITY • Wilberforce, OH 45384

Institute for Development and International Affairs * *(513) 376-6180*

January 27, 1994

Dr. Ruth Frischer
R&D/UC
Agency for International Development
Room 309-SA18
Washington, D.C. 20523-1807

Dear Dr. Frischer:

In accordance with the reporting requirements of the linkage agreement between Central State University and the University of Science and Technology, the following report is enclosed:

a. Quarterly Activity Report (October-December)

This report was compiled based upon feedback from the respective departments involved in the linkage program at both universities. Any questions/concerns should be addressed to the undersigned.

Sincerely,

G. Koryoe Anim-Wright
Program Manager, CSU/UST Linkage Project

cc: Dr. Ajayi-Majebi, Manufacturing Engineering
Dr. Victor Okereke, Water Resources Management
Mr. James H. Sangster, International Affairs
Dr. Albert Schlueter, Chemistry
Prof. F.O. Kwami, UST Linkage Coordinator

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A. BRIEF STATEMENT OF ACCOMPLISHMENTS, COMPARING ACTUAL ACCOMPLISHMENTS WITH SPECIFIC PROGRAM OBJECTIVES ESTABLISHED FOR THE PERIOD.

CHEMISTRY

Central State University & the University of Science and Technology: This quarter began with a visit from Prof. Amonoo-Neizer, former chemistry department chairperson at the University of Science & Technology (UST) and currently the Vice-Chancellor of UST. During his week long stay here we met on several occasions to plan future linkage activities and specifically Dr. Schlueter's visit to Kumasi planned for this summer. Chemistry student Douglas Robertson demonstrated to Vice Chancellor Amonoo-Neizer the visual presentation of environmental data that he has achieved with his research. He presented his plan for doing a similar display with the Obuasi data collection by Prof. Amonoo-Neizer's graduate students. Additional discussions involved the implementation of computer usage on the Kumasi campus.

We also received from Kumasi the defective pressure regulation value and broken brass fitting from the compressor purchased for use with the atomic absorption spectrophotometer (AAS). The manufacturer was contacted and agreed to replace these parts without charge. The replacement parts have recently arrived and will be mailed to Ghana so the AAS can be put into operation.

Several communications from UST were hand delivered by Vice-Chancellor Amonoo-Neizer upon his arrival. Some of these involved requests for supplies and for copies of literature articles. Responses to the communications were made and most of the needed materials were collected and sent with the Vice-Chancellor on his trip back to UST.

Work on rewriting the research grant submitted to USAID to support and expand the research efforts begun under the linkage continues. Dr. Schlueter has now received from Prof. Golow letters from the Obuasi mining company and from Ghana government officials supporting the research effort. This documentation responds to a major criticism of the original proposal and hopefully will result in success for the re-submission.

MANUFACTURING ENGINEERING

Central State University

Student Involvement in Design Project: The fact that the department will soon graduate Mr. Panyin Hughes and Mr. Yaw Nyarko who have worked on this projects is leading to the need to identify new students interested in continuing work on the fufu-machine. Design refinement studies based on the need to introduce quality and reliability considerations in planning and designing the fufu machine is currently being executed. This is being done within the framework of the course on Product Quality MFE 421 over a 10 week period. The students being considered to take Messrs. Hughes and Nyarko's place include Mr. John Asamoah, Mr. Fred McBagonluri-Nuuri and Mr. Edward L. B. Lari.

Faculty Exchange: UST professors and researchers have been informed that this coming Summer 1994, either Dr. Morris Girgis or Dr. Augustus Morris Jr., both faculty members, are scheduled to visit the University of Science and Technology in connection with fostering the collaborative agreement under the linkage program. Arrangements on which person, and time of exchange visit is being worked out and will be communicated to the new mechanical engineering department chairman, Professor F.O. Akuffo.

University of Science and Technology: Two versions of the "Fufu" machine are in the closing stages of the prototype production. It is anticipated that by the middle of 1994 the two versions i.e. "The Womame" designed at UST and a modified version of a Japanese machine, will be tested. Among the activities that were undertaken by the UST team was the evaluation and selection of the right wood species (i.e. wood that will withstand all the weather conditions in Ghana and at least the West Coast of Africa, for the various components of the "Womame" fufu machine. "Danta" wood was selected from six others investigated. The set of criteria for the selection and the detailed observations can be found in Appendix 1.

By courtesy of Ehwia Forest Products, a timber firm in Kumasi, the "Danta" Wood was donated for further work on the "Womame" fufu machine. Hence, out of "Danta" wood, the remaining items for the "fufu" machine were made prior to its assembling and testing.

Seminar: A seminar on "The Progress of the Development of the Fufu Machine" was held at the School of Engineering by the Mechanical Engineering Department. The speaker was Mr. R.E. Dodoo. The Seminar gave the team (Prof. K.O. Kessey, Dr. Ansong, and Mr. Dodoo) the opportunity to answer and clarify questions and suggestions from the audience. It was a successful seminar as the enthusiasm of the audience was high, and their expectations were apparently met.

Survey on Fufu Pounding: Mr. Dodoo and Dr. Ansong led a team of undergraduates to tour the "Chop Bars" in Kumasi and carry out scientific measurements on the pounding of fufu from another popular "chop bar". Appendix 2 gives the results of the measurements as obtained from Afua Ebenezer, and Akosua Mensa "Chop Bars", at Asafo Market, Kumasi. By simple calculation, it is very easy to show the following from the results of the two experiments detailed in Appendix 2:

a. For the case where two people were pounding 11kg of cassava, (Experiment 1) power required was approximately 100 watts.

b. On the other hand, where one person was pounding 5.4kg of cassava (Experiment II), power required was only 25 watts.

c. In the conclusion, combining the two results, on the average, 7.6 watts is required to pound 1kg of cassava.

One would intuitively expect the single person operating upon approximately half of the amount of cassava by the two people to generate about 50 watts since, in effect, he was handling the same amount of cassava as the person in the first experiment. However contrary to one's intuition, he produced only half this power for the same result. The reasons for this are many and cannot be discussed in this brief report. However, suffice it to say that, human factors, such as the conscientiousness of the pounder as well as his consciousness of being observed, may play a very important role in reducing or increasing the power requirement.

Evaluation of Other Machines: The UST team at long last located a model fufu pounding unit produced by a Japanese firm for study and practical evaluation. Various food stuffs were pounded after repairs on the faulty machine were made by Mr. R.E. Dodoo of the team. Yam, plantain, and cassava separately as well as combinations of cassava and plantain were pounded.

General Observations: This Japanese model was only able to pound yam successfully. Detailed observations and the unedited comments from individuals who sampled the fufu are given in Appendix 3 & 4.

Adaptation and Modification: After the evaluation of the Japanese model the UST team began to adopt the concept and has almost finished the production of a similar model with the necessary initial modification for mounting, testing and practical evaluation.

Other Accomplishments

Other accomplishments were in the following program areas:-

1. Technology Exchange: This mainly consisted of the courses and laboratory syllabi exchange between CSU Manufacturing Engineering Department and the UST Mechanical Engineering Department; and a visit by Dr. L.E. Ansong of UST Mechanical Engineering Department. In keeping with this technology exchange, a student exchange program may start in the 1994/95 academic year to help train a student in Production Engineering who may be able to join the Mechanical Engineering academic staff.

2. Research and Development: As relates to the fufu machine, the UST team examined a number of design options and settled for a design provided in the final project supervised by Mr. R.E. Dodoo. After further improvements on the design, detailed drawings were prepared. Research into suitable wood species to be used for the nonmetallic parts of the machine was carried out. Two wood species, the "Kusia" and "Danta", were identified as most suitable in terms of ability to withstand seasonal weather fluctuations. These wood species turned out to be fairly hard to come by, but finally the team has acquired an adequate amount and initial machining process is being done on machine tools at the Forest Products Research Institute. The final machining is to be done at the UST Mechanical Engineering Workshop.

Extra research work was carried out by the UST team to gather information pertaining to important characteristics of the indigenous pounding methods. Data collected from some commercial "Fufu" pounding outfits in Kumasi were analyzed. Inquiries about the Japanese and Nigerian versions of the "Fufu" machine yielded some results after some initial frustrations. We obtained the Japanese version and a number of tests were carried out using the machine to pound "fufu" from yams, plantain, cassava and plantain combined with cassava. The findings were that except in the case of pounding yams the results from the other tests were not favorable from the point of view of the texture obtained.

Considering the fact that the most widespread "fufu" in Ghana is prepared from plantain and cassava separately or from their combination our conclusion is that the work embarked upon by the UST team needs to be intensified. Studies on the Japanese machine revealed some positive features and principles as well as some shortcomings. Relevant modifications have been suggested and incorporated to re-design the machine to ensure that it is able to pound plantain and cassava to required consistency. Presently the modified version of the machine is about 75% accomplished. It is anticipated that by the middle of the 1994 project year the two versions of the "fufu" machine would be ready for testing.

Apart from the work done on "fufu" pounding, the UST team also carried out tests on the use of powdered fufu materials. The results from these tests were quite favorable and the team intends to pursue research into this aspect during the succeeding years.

3. Establishment of the CAD/CAM/CNC laboratory as a nucleus of the Center for Design and Production: Within the framework of the CSU/UST Linkage Agreement (Production Engineering Section), by the end of the project period it is anticipated to establish a Center for Design and Production at UST. With this in mind the UST team has undertaken preliminary studies into the establishment of the Center.

As a first phase, space to accommodate CAD/CAM/CNC laboratory is being worked out. During Dr. Ansong's visit to CSU arrangements for the purchase of a selected computer and CNC milling machine with accessories were discussed with Col. Sangster, Prof. Abayomi Ajayi-Majebi and Mrs. Anim-Wright. It is expected that the selected computer, a 486 IBM

compatible, will arrive at UST at the earliest opportunity. A Bridge port "Discovery 308" Milling Center or its equivalent is being considered for purchase. This will serve to offer both teaching services and also help to introduce Ghanaian manufacturing enterprises to the advantages of CNC machine tools in medium serial production.

WATER RESOURCES MANAGEMENT

Central State University & the University of Science & Technology: During this quarter, Mrs. Esi Awuah visited our campus from the University of Science and Technology. While here, she attended the UDLP Workshop in Arlington, Texas and worked on some proposals with Dr. Victor Okereke.

Mrs. Awuah and Dr. Okereke worked on two proposals, both of which were intended to provide additional resources for the linkage program. The first was designed to provide comprehensive industrial waste monitoring and assessment in the Kumasi area. It is intended to be submitted to African Fund for funding consideration. Final editing is being done on the proposal and will be submitted after the editing is completed.

Dr. Okereke has been working on developing a short course titled "Environmental Impact Assessments" to be offered in Accra this summer, July 26-28, 1994. The goals are to teach the basic elements of environmental impact assessment to practicing engineering's in Ghana. It is now a requirement for all projects funded by the World Bank and other agencies. Another goals for the course is to extend the reach of the linkage relationship beyond the limits of UST.

URBAN DRAINAGE AND FLOOD PLAIN MANAGEMENT

Accomplishment

Study and analysis of some of the design methods and hydrological models currently in use in Ghana for Urban Drainage and Flood Plain management have been completed. Arrangements are almost completed with AESC (the agency responsible for the installation of staff gauges in Ghana), for the installation of staff gauges required for the project. In particular, the actual sites have been identified for their installation.

Ongoing Activities

- Continuation of the study, analysis, and documentation of the various methods currently used in estimating the important hydrological design parameters in Ghana.

- o Detailed study analysis and documentation of the design methods currently used for sizing such hydraulic structures as culverts and major drains.

At the end of these studies it will be clear which of the currently used parameters and methods will need to be improved upon to suit conditions in various regions in Ghana.

CHARACTERIZATION OF INDUSTRIAL WASTE IN KUMASI METROPOLITAN AREA

Accomplishments

The characterization of all the waste from the soap industry in Kumasi has been completed. The effluent was found to contain high levels of chloride, high levels of suspended solids and PH. Pollution levels of soils near the industry with full boiling process was several times higher than the industries with cold process. Comparison of these results with other industries in the country could not be made as planned, this is needed for the formulation of guidelines for managing the waste from scrap industry in Ghana.

Ongoing Activities

Preparation for the Workshop on Environmental Assessment as part of the linkage program has begun.

B. DESCRIPTION OF PROBLEMS OR BARRIERS AFFECTING THE ACCOMPLISHMENT OF ESTIMATED OBJECTIVES AND ACTIVITIES IF APPLICABLE

Manufacturing Engineering: There have not been any serious problems except that the 'Kusia" and "Danta" wood species for the manufacture of the "Fufu" machine took an unexpectedly long period of time to obtain.

C. TRAVEL REQUEST FORMS

No travel is envisaged for March - May, 1994.

D. INFORMATION ON EXPENDITURE

Not applicable this quarter. Due with the second quarterly report.

APPENDIX 1

CRITERIA FOR WOOD SELECTION

i. Must withstand all weather conditions of the year without development of cracks

ii. Must not emit any offensive odour or smell when in contact with water

iii. Must not colour the material being pounded.

iv. Must have adequate strength to withstand forces in the machine

v. Must be readily available in the Ghanaian forests and be inexpensive

TYPES OF WOOD SPECIES - DATA **Appendix 1(Continued)**

No	Botanical Name	Pilot Name	Standard Trade Name(s)	Ghanaian Name(s)	Alternative Name(s)	Important End uses
1.	Pericopsis elata	Afromosia	Afromosia	Kokrodua	Assamela/ Oleo Pardo	Decorative sliced veneers, furniture, interior and exterior joinery, stairs, domestic flooring, boat building
2.	Lophira alata (Lophira procera)	Azobe	Ekki	Kaku	Bonkole/ Bongossi	Railway sleepers, harbour works (sea defence, wharves, decking, heavy duty flooring, bridges, wagon trays
3.	Nesogordomia Papaverifera	Kotibe	Danta	Danta	-	Interior and exterior joinery windows, Sliced veneers, furniture, flooring, tool handles, joinery, turnery, lorry bodies coach/wagon works.

4.	Nauclea didierrichi	Bilinga	Opepe	Kusia	-	Poles, railway sleepers, decorative sliced veneers, flooring, house framing, harbour works, general construction boat building, truck bodies.
5.	Piptadeniastrum africanmum	Dabema	Dahoma	Dahoma	Ekhimi/ Bukundu	Heavy construction, house, Framing, domestic flooring, bridges, vehicle bodies and floor, marine uses
6.	Daniella Ogea/Thuirifera	Faro	Ogea	Hyedua	Daniella	Plywood (mainly core stock), furniture components, interior joinery, mouldings, blockboards, boxes and crates.

EXPERIMENT I APPENDIX 2

Number of Persons involved in pounding = 2

VENUE: AFUA EBENEZER CHOP BAR, KUMASI

Weight of cassava + Pan before pounding	=	13kg
Weight of pan	=	2kg
Therefore weight of cassava before pounding	=	11kg
Final weight of cassava + pan after pounding	=	10.3kg
Therefore weight of pounded cassava	=	8.3kg
Weight of cassava scraps + pan	=	3.6kg
Weight of pan	=	3.05kg
Time spent before stirring cassava	=	8min. 45 sec.
Time spent before pounding was done at the same time	=	14min. 15 sec.
Therefore Time for first phase dressing time	=	1min. 35 sec.
Total time spent in pounding Cassava	=	16min. 15 sec.

Experiment II

No of Persons involved in pounding = 1

VENUE: AKOSUA MANSA CHOP BAR, KUMASI

Weight of pestle	=	11.8kg
Major diameter of mushroom	=	190mm
Minor diameter of mushroom	=	165mm
Weight of Plantain + Pan before pounding	=	1.8kg
Weight of Pan	=	1.2kg
Therefore weight of plantain before pounding	=	0.6kg
Time spent in pounding plantain	=	1min.28sec.
Weight of plantain after pounding	=	0.6kg
Weight of cassava + Pan before pounding	=	5.4kg
Therefore Weight of cassava before pounding	=	4.2kg
Weight of cassava + Pan after pounding	=	5.4kg
Therefore Weight of cassava after pounding	=	4.2kg
Time spent before stirring cassava	=	2min.10sec.
Total time spent in pounding cassava	=	5min.10sec.

APPENDIX 3

FUFU POUNDER (JAPANESE MODEL)

General Observations

It has been observed that the successful pounding by the Japanese fufu machine is dependent on the following factors:

i. That the moisture content of the cooked food stuff is kept right at the initial stages.

ii. That during the period of pounding the temperature of the foodstuff is kept constant

iii. That the pounding blade angles are designed such that the foodstuff is always kept pumped upwards in the bowl.

iv. That the relative differences in the weight/density of the foodstuff assist in turning the material around until a noddle is formed.

A very significant feature of the Japanese machine is that it has less moving parts which are easily removable for thorough cleaning of the machine.

In the traditional or indigenous pounding technique it is observed that successful pounding of the material depends on either pounding such foodstuff as yam hot but for cassava and plantain best results are achieved when pounded cold.

APPENDIX 4

INDIVIDUAL UNEDITED COMMENTS - JAPANESE YAM POUNDER

Type of Food Stuff	Yam	Plantain	Cassava	Cassava and Plantain
Technical Data Pounding Time	Weight 425gm Net Loss 88gm Total Weight 513gm 4 mins.	660gm 46gm 1006gm Difficult	1383 271gm 1654 5min-Difficult	1391 571 1964 10 min but difficult
Observation	Successful	Unsuccessful	Unsuccessful	Unsuccessful
Individual Comments by Mr Francis K Forson, Lecturer, UST	Texture is very smooth and elastic. However it appears to be a little bit hard than the usual fufu. It requires some amount of water to bring it to the standard fufu texture	It is hard a little bit as compared to the yam. There are too many pebbles in it i.e. it is not very smooth	The texture lost its elasticity and plasticity. It is no near fufu and has lot of lumps in it.	This fufu is soft and has a lot of humps. It is not very plastic as compared to the normal fufu.
Mr Kwaw Anaman, Lecturer, UST	Specimen was a little bit short of fufu. The texture was one between mashed yam and full-blown fufu	Texture not up to standard, too many pebbles	Texture not up to standard of fufu and has too many pebbles	Poor texture of fufu with too many pebbles

Dr L E Ansong, Lecturer, UST	An addition of little more water will make the texture softer for people who prefer fufu softer	The plantain pounded hot did not have the require texture. It felt like plantain that has lost its elasticity. After mashing on the finger tips it gained plasticity		
Mr A O Anakwa, Lecturer, UST	The texture is hot (warm) condition is very good.a It looks a real form of fufu. Try pounding with the input material temperature lower.	Does not look like normal fufu and has many pebbles	Does not look like normal land has many pebbles.	Lost plasticity and has many pebbles. Texture is too soft
Mr G E Afari, Research Fellow UST	Texture is good enough. Looks almost the normal fufu	Not very good texture when pounded hot. Try a lower temperature	Too many pebbles produced with soft texture	Not like fufu texture at all

Miss Theresa Akowuah, Secretary UST	The texture after sometime will be OK to be served but it need some water to make it a bit soft.	I feel it will be good for serving together with cassava	I feel it will be good for serving if combined with little plantain	
Mr Edwin Adjei, Senior Technician, UST	Texture is almost the real used in many homes. It is OK	Texture is quite OK but not as sticky as expected		
Mr S A Sowah, Senior Technician, UST	Pounded yam is OK. It seems there is no difference to the local one	Does not look like fufu. It is too soft with many pebbles.		
Mr Budu-Diabene, Technician, UST	The texture is very good. The temperature at which it was pounded was too much so the possibility of breaking down is high	Not much like plantain fufu. It has not much plasticity in it	Disappointing texture. Too many large lumps.	