ECA/FSSDD/S&T/98/1j/R

S&T RESEARCH/INNOVATION IN ZAMBIA

Prof. C. J. Chetsanga. (Updated) 1998

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Country: **ZAMBIA**

Project Title: **Rhizobium Inoculum Production**

Background Information:

The secret to successful agricultural activities for crop growth is the supply of adequate nutrients to the soil. The role of Rhizobium strains in fixing nitrogen at the roots of legumes is to enrich the soil with nitrates for plant growth. It has been long appreciated that legume inoculants could be used as biological fertilisers for promoting plant growth. Food legumes such as beans and soybeans are good candidates for this application.

The basic strategy in this approach is the introduction of legume inoculants into the soil so as to increase the efficiency of nitrogen fixation.

Innovation Process/Success of the Work:

The Zambian Department of Agriculture & Water Development established the Inoculum Production Facility at the Mt Makulu Research Station in Chilanga in 1984. The facility grew rapidly in its programme of promoting the application of legume derived biofertilisers.

They successfully inoculated considerable hectarage of soybean fields. They used Bradyrhizobium strains as the inoculant feedstock. They set up two bioreactors in 1991 at the Inoculum Production Facility to facilitate the production of larger quantities of broth cultures of the organisms.

From this production facility, they went into extension of inoculants and inoculation techniques among farmers. For the distribution of inoculants, they used 250 gm packets of inocula. During the 1991-92 production season, they supplied some 75,000 packets largely to soybean farming sites. In addition to the Bradyrhizobium strains, they also worked with legume inoculants of other nitrogen fixing bacteria.

Starting with carefully planned experimental work on developing legume inoculants, the scientists at the Inoculum Production Facility demonstrated the efficacy of the use of these inocula in functioning as biofertilizers. They were subsequently able to scale up the Rhizobium production to factory quantities which they were then able to market.

Major Progress Achieved:

The project has provided the much needed legume inoculants for soybean farmers. They are widening the scope of their work by using other types of nitrogen fixing bacteria that populate the nodules of leguminous plants.

The work at the Inoculum Production Facility in Chilanga has shown that with good foresight and experimental acumen, it is possible to provide a technical intervention that can introduce a new approach to cultivar growth and management.

The use of legume inoculants as biofertilizers has the unique advantage that the feedstock never gets used up as it is a live fertiliser. More work is required in order to fully develop and

promote a wider use of biofertilisers.

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Collaborating Institution: None indicated

Funding Sources: Government of Zambia

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Country: **ZAMBIA**

Project Title: **Production of Wine from Indigenous Fruits**

Background Information:

While African villages have had well established traditional technologies for fermenting grain to make opaque beer, the culture did not include the fermentation of fruit to make wine. The drinking of wine did thus not become part of rural culture.

There is an increasing proportion of urban dwellers who have developed a taste for wine. In European cultures, it is the grape that has traditionally been used for making wine, although other types of fruit are used to varying extents. Wine is a beverage of great commercial value.

The appreciation of the commercial value of wine has motivated food scientists in the food Technology Research Unit (FTRU) of the National Council of Scientific Research (NCSR) in Zambia to carry out a research and development (R&D) project on making wine from indigenous fruit. This was a good strategy as there are more quantities of local fruit than grapes in the country. The exercise was one of adding value to local fruit and deriving more commercial value out of such fruit. The fruit is picked during peak season from the forest where it grows in a natural wild environment.

Innovation Process/Success of the Work:

The project focused on masuku fruit (Uapaca kirkiana). One starts with fruit of a certain weight. The process starts with the extraction of the fruit mash which is diluted with varying amounts of water in order to determine the optimum dilution. It has been found essential to filter the mash before inoculation with yeast to start the fermentation process. An investigation of optimum fermentation conditions, amount of sugar to be added, etc is necessary.

Those who have worked with other types of fruit have found that it is necessary to first use a fruit crusher to get access to the mash inside. The mash is diluted with water, pressed and filtered to get the starting juice. This juice is inoculated with yeast to initiate fermentation.

The FTRU wine making project resulted in a wine on which sensory evaluation has established that it has a delightful flavour. The sensory evaluation also found the masuku wine to have acceptable aroma and bouquet.

The making of wine requires relatively simple equipment which many people who do cottage industry wine-making find adequate. The equipment includes a fruit crusher or homogenizer, presser weighing balance, mixing jar, filter cloth, wooden spoon for stirring and a fermentation metal or plastic tank. These are initial investments which many people can afford to purchase. They can be used in making most types of wine.

The Zambian project shows that there is scope for experimenting with wine- making from other fruits in the region. The FTRU can propagate this technology by running training workshops on wine making for both local and regional participants. The project can assist many people in establishing cottage industries devoted to wine making on a commercial basis.

The important strategy is to choose the wild fruits that are abundant in a given area. Producing wine from wild tropical fruit has an untapped economic potential. Using such fruit in this way prevents the frequent waste of fruit during the peak season because there is no use to which it can be put if harvested.

Major Progress Achieved:

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Country: **ZAMBIA**

Project Title: **Developing of Beverage Production Technology**

Background Information:

The lack of appropriate technology has often led to missed opportunities in African countries. The food processing opportunities provided by the wide variety of tropical fruits during the peak season in Zambia had in the past not been productively exploited.

The scientists in the Food Technology Research Unit (FTRU) of the National Council for Scientific Research (NCSR) of Zambia recognised the opportunity lost from not processing the fruit that was always rotting in large amounts during the peak seasons.

Innovation Process/Success of the Work:

The Food Technology Research Unit (FTRU) of the NCSR has developed the technology of processing a wide variety of fruits to make beverages. The fruits used for these applications include mango, guava, pineapple, orange and lemon. The beverages that have been developed have formed the basis for a number of commercial activities. A number of examples will be cited below.

After FTRU developed the procedure for making mango juice, the technology was transferred to the Zambia Horticultural Products Limited (ZAMHORT) who are now commercially exploiting the technology. ZAMHORT has set up a system of collecting ripe mangoes from rural areas during the peak season and use them for making the juice which is marketed in grocery stores.

The FTRU developed a procedure for making carbonated soft drinks from fruit. The fruits used included orange, guava, lemon and pineapple. The technical know-how for producing these carbonated soft drinks was transferred to the Copperbelt Bottling Company, Zambia. This was followed by subsequent work leading to the production of guava nectar and a tomato cocktail juice whose commercial exploitation was also transferred to the Copperbelt Bottling Company.

Major Progress Achieved:

These different research results produced by the FTRU have contributed to a notable technological capability for Zambia in the beverages field. They contributed to employment creation and reduced dependence on soft drink importation.

These projects helped in establishing small scale industries that used locally produced fruits as feedstock. The development of the soft drinks manufacturing expertise required a lot of R & D effort on the part of NCSR scientists.

The achievements of this laboratory at NCSR shows that when appropriate capacity building is executed, it is possible to establish an industrial base in a target area using local human and raw material resources. The laboratory was instrumental in assisting with the

establishment of several beverage processing industrial plants providing employment opportunities to the country.

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Country: **ZAMBIA**

Project Title: **Solar Dryer for Dehydrating Local Vegetables**

Background Information:

A major constraint to food security is the issue of post harvest storage of food materials in rural areas. The common approach to food preservation is by either canning or refrigeration/freezing.. In these modes of storage, the food is pre-treated so as to reduce its bulkiness. The problem of bulkiness particularly relates to fresh uncooked leaf vegetables.

Both canning and refrigeration/freezing require expensive electrical energy during the processing and/or storage of food material. Vegetables can be preserved in a dehydrated state. The dehydration can be effected by means of solar irradiation. Solar drying provides a suitable convenience in non-electrified regions of a country.. This drying has been achieved at the Food Technology Research Unit (FTRU) of the National Council for Scientific Research (NCSR). Zambia. They have designed a solar dryer that is relatively easy to use for achieving complete dehydration of vegetables in a short period of time. The cost-effectiveness of using a solar dryer is that the solar energy used is free of charge.

Innovation Process/Success of the Work:

There are a number of designs used in making solar dryers. The important feature is that the device should have a wide surface that is capable of receiving incident sunlight and radiating it towards the atmosphere. The heat radiating surface can vary in area size as long as adequate provisions are made to ensure that the heat radiated is somehow concentrated and not wastefully dissipated.

1. Open Surface Solar Dryer

At the FTRU of NCSR, they have found out that one can achieve satisfactory drying of vegetables with a dryer whose sunlight receiving surface has good reflective properties so that the heat from incident solar radiation can be beamed at the vegetables suspend above the reflecting surface. The system can be refined so that the sun approaches the reflecting surface at an angle whereby it is not screened off by the vegetable sample to be dried.

2. Greenhouse Solar Dryer

There are several permutations to the design of solar dryers. Some operate like greenhouse dryers whose translucent roofs are heated by solar radiation. The heat that builds up inside this greenhouse dryer will dry the vegetables.

3. Solar Tunnel Dryer

Another approach uses solar tunnel dryers. Here the vegetables are suspended in a tunnel through which sun heated air is propelled by a fan. If the system is being operated in a non-electrified part of a country, the fan can be powered by a photovoltaic energy device.

Major Progress Achieved:

The importance of solar dryers in rural areas is that they can be used for preserving food in areas not serviced by the national electric grid. The researchers in Zambia are continuing to work on improving the effetiveness of the efficiency of the solar dryers. The drying capacity can be in the range of 50-100 kg.day and can be increased to about 500 kg/day, depending on the size of the dryer as well as solar radiation intensity.

With improved optimisation, the dryers can be applicable to fruit dehydration. These are important developments that can enable rural people to overcome the limitations of living in non-electrified areas of the country.

The open surface solar dryer is the least expensive one. It has been adopted for use in many rural areas. We were not able to get an estimate of the number in operation in the rural areas

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Country: **ZAMBIA**

Project Title: **Maize Research**

Background Information:

Maize is the primary staple food crop for Zambia. Zambia has a rapidly growing population. over 50% of which is now living in cities. This segment of the population is no longer involved in producing food from the land. They rely on buying food produced by fewer people.

For such a system to be sustainable it is essential that the few people who produce food. be able to meet the food needs of the ever growing Zambian population. The research programme chosen to enhance food production was to develop high yielding maize hybrids. The research work was done at Mount Makulu Research Station under the Ministry of Agriculture and Water Development.

Innovation Process/Success of the Work:

As a starting point. the programme set out to collect and screen local and foreign varieties of maize to determine their suitability for the Zambian environmental conditions. They chose the Zimbabwe SR52 maize hybrid as the starting material. and used it to develop hybrid maize varieties with the desired characteristics that included early maturing. drought tolerance and streak resistance. Part of the task was to be able to produce enough seed maize for the farming community.

They produced several hybrid maize varieties which were best suited to growing in certain agro-ecological zones of Zambia :

Zone	Rainfall	Maize Hybrid
I	High (over 1000 mm)	SR 52 and MM 752 or MM 606 and MMV 600
II	Intermediate (800-1000 mm)	MM 752 and SR 52 or MM 601 and MM 604
III	Low (Below 800 mm)	MM 504 and MMV 400

This is continuing research work which requires a periodic screening of each hybrid for

both purity and stability of yield levels.

The maize hybrid development programme in Zambia has been quite successful. The initial achievement was the development of hybrid MM 752 from the SR52. Hybrid MM 752 was better suited to the Zambian environment and provided a yield increase of 20% above SR52.

The table given above shows the maize hybrids that have now been released. It is the Zambia Seed Company (Zamseed) that carries out maize seed bulking through its contracts with the members of the Zambia Seed Producers' Association (ZSPA). Members of ZSPA grow certified maize seed on pre-determined hectarages (approx. 5,000 hectares per year) each year.

This is how the production of maize seed has been commercialised in Zambia. The Seed Control & Certification Institute (SCCI) provides the required quality control oversight, under authority of the Agricultural (Seeds) Act CAP 352.

In this process OECD regulations are followed in seed certification.

The release of the new and improved maize hybrids has changed maize production for the better. The availability of early and late maturing maize varieties has introduced an important element of flexibility in planting time which is determined by how early or late the rainy season actually starts during a given year.

Major Progress Achieved:

The maize hybrids that have resulted from this maize improvement project have greatly improved maize yields. The seed supply network encompassing Zamseed and ZSPA has been effective in assuring the supply of maize seed. The pricing of the seed has remained rather reasonable in that it is ensuring the market survival of the members of ZSPA as well as Zamseed. A critical examination of the functioning of the system shows that Zambia has established a viable system for the production and marketing of maize seed.

A successful food security programme requires provision for high maize production as well as the availability of adequate planting material (maize seed). The Zambian maize programme has sought to meet these requirements with considerable degrees of success. There is a quality control and certification system provided by the Seed Control and Certification Institute.

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Country: **ZAMBIA**

Project Title: **Telecommunications System for Health Workers**

Background Information:

As is the case with other countries in Africa. Zambia faces the problem of distributing information to different community groups in general. and affecting communication among medical professionals. The country has poor conventional telecommunications infrastructure with an average coverage of 7 telephones per 1000 people. Telephone calls are expensive and inefficient.

Mail service is slow and expensive. Transportation is inadequate and costly. Library services are unsatisfactory due to a shortage of books and other essential reading materials. Libraries are now unable to keep up with journal subscriptions.

This has created a serious problem for medical professionals who no longer get medical journals. The inability to access new medical information leaves an information gap that leaves medical professionals in both provincial and district medical centres greatly handicapped in their ability to keep abreast of developments in the medical profession. The need to fill this information gap let the University of Zambia to exploit the opportunity offered by Healthnet.

Innovation Process/Success of the Work:

Healthnet had been established internationally in 1989 as a joint USA-USSR organisation for facilitating communication among medical professionals. The launching of the Healthnet project was the initiative of the Computer Centre at the University of Zambia. Healthnet thus provided a cost-effective alternative instrument for procuring and disseminating medical information. Zambia was one of the first few countries in Southern Africa to install satellite for Healthnet applications.

The groundstation equipment consists of a fast personal computer (PC), a terminal node controller and an amateur radio transceiver to which a radio modem together with transmit and receive antennas are coupled. The total cost of a groundstation is about US$6,000.

By pocket radio technology, the groundstation is able to send information to a low-earth-orbiting satellite which acts as a mail box from which information is distributed to target organisations, such as medical centres.

The groundstation communicates directly with the satellite independent of the national telecommunications infrastructure, and is thus not affected by the problems of poor national infrastructure. The Healthnet project was licensed by the Zambian posts, telegraph and telecommunications (PTT) authority.

Major Progress Achieved:

The Zambian Healthnet distributes medical information by means of computer-to-computer e-mail through dial-up telephone lines. In addition to improved

administration of health services and inventorying of all supplies. Healthnet provides local and international interlinkage of medical and health professions specialists. In Lusaka, satellite-based e-mail messages are transmitted by modem to the University Teaching Hospital, Ministry of Health, WHO and UNICEF offices. Healthnet services also extend to Tropical Disease Research Centre (IDRC) in Ndola (300 Km away). The project has also facilitated the improvement of distance in-service training. The project succeeded because the University of Zambia had staff capable of operating the groundstation.

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Funding Sources: Satelife, University of Zambia and IDRC.

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Country: **ZAMBIA**

Project Title: **Fish in Zambia**

Background Information:

As a diet item. fish have traditionally been in short supply in Zambia. The country is not endowed with large inland bodies of water where fish can grow and multiply, hence the fish shortage.

This state of affairs existed until 1960 when the construction of Lake Kariba on the Zambezi River was completed. At that time Lake Kariba became the largest man-made lake in the World. The Tonga tribesmen who lived along the Zambezi River in that region were forced to move away as the huge lake began to fill up with water coming in from its catchment area in Angola and the Democratic Republic of Congo.

Lake Kariba is jointly owned by both Zambia and Zimbabwe. The two countries are separated by the Zambezi River along a stretch of 715 Km. They have jointly established the Zambezi River Authority. the dam wall has power plant that generates hydroelectricity for use by both Zambia and Zimbabwe.

Innovation Process/Success of the Work:

The filling of Lake Kariba with water killed large numbers of wild animals which had used this region as sanctuary. This deprived the Tongas of their traditional venison from wild game. The meat from wild game had served as a source of protein for them. They had also become good fishermen using dug out canoes on the Zambezi River. Government assisted some fishing co-operatives with funds to purchase the necessary equipment.

From the very beginning of the planning process to build Lake Kariba, it had been realised that the man-made lake would become a good fishing facility. Thus the lake was stocked with bream fish. tiger and kapenta fish as soon as there was enough water in it. There was, of course, an inflow of regular Zambezi River fish with the water from upriver.

There is a regular monitoring exercise by scientists in the region to ensure that the fish populations in the lake remain optimal. This is part of a resource management programme that is carried out to ensure that the fish supply to the communities using this resource remains sustainable.

The most prevalent commercial activity in Lake Kariba is bream and kapenta fishing, carried out using large nets. The fishermen operate in groups of 4 to 6 people who go out in boats at night. they use strong flash lights to attract fish to their boats where they become caught in the nets.

Some of the fishermen operate in a system of co-operatives. Allowing for the turnover that occurs. it is estimated that each night an average of 140 Zambian fishermen carry out commercial fishing activities in Lake Kariba. They do not necessarily all go out fishing every night. It is estimated that the number of fish caught each night during the peak season exceeds 500,000 tonnes a year.

Major Progress Achieved:

Fishing activities have provided gainful employment for hundreds of Zambians who would otherwise be unemployed. A large number of people are employed in fish marketing and processing activities. Overall this resource has ended up assisting larger numbers of people that the numbers of the local tribesmen who were displaced by the lake. It is estimated that each year millions of people in Zambia benefit from Lake Kariba fishing outputs in one way or another.

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Country: **ZAMBIA**

Project Title: **High Protein Biscuits with Soya Bean Flour**

Background Information:

The main point in this case study is that S&T can enhance food security by modifying food materials to make them more nutritious.

Biscuits generally belong to the group of confectionery products. Such products are known for their high carbohydrate content. They are often eaten for their sweetness and are of limited nutritive value.

Many people in rural communities eat food substances that are rich in carbohydrates The staple food items are form grains or cereals that are largely composed of starch or carbohydrates. Thus the food intake in these communities is poor in proteins but rich in carbohydrates.

A project undertaken by the scientists at the Food Technology Laboratory of the National Council for Scientific Research (NCSR) in Zambia sought to enrich biscuits products in protein derived from Soya bean flour. the project took advantage of the high protein content of Soya beans. Such biscuits can be a good contributor to food security.

innovation Process/Success of the Work:

This research project undertook to make regular dough from wheat flour as a first step. This can be done from a mixture of shortening, sugar, vanilla, milk, egg, baking powder and flour. The protein content could be enhanced by the amount of Soya bean flour added to the mixture.

The mixture was kneaded to make the dough from which biscuits were baked. The proportion of Soya bean flour to wheat was varied to achieve a taste acceptable to the consumer. This entailed a lot of experimentation.

Major Progress Achieved:

The end result was the production of flavourful biscuits that are rich in protein. The biscuits can serve as a good source of protein for those consuming them. Children eating such biscuits can thus routinely benefit from a reasonable protein intake as the high protein content makes them nutritious. The technical know-how from this project has now been transferred to the Dairy Produce Board in Lusaka. Zambia.

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Country: **ZAMBIA**

Project Title: **Producing Biscuits with 40% Cassava Meal**

Background Information:

The traditional recipe for making biscuits includes wheat flour and other ingredients. It is this flour that makes up the major matrix of the biscuit.

The majority of the countries in the Southern Africa Developing Community (SADC) are not suited to wheat growth. they have to import the wheat that they use for baking biscuits at great cost in foreign currency.

On the other hand, cassava can be easily grown in these countries. Cassava is a hardy plant that can tolerate low soil fertility and limited amount of rainfall. Being able to make biscuits and other confectionery products from cassava is attractive as it offers society an alternative way of making biscuits using material from plants that are not negatively impacted by the vagaries of the weather.

Innovation Process/Success of the Work:

The need to reduce too great a dependency on imported wheat motivated the scientists at the Food Technology Research Unit of the National Council for Scientific Research (NCSR) to experiment with the use of cassava meal in making biscuits. The usual components of biscuits dough including baking powder, milk, shortening, sugar, egg and wheat flour were present.

Before kneading, decisions were made to mix the wheat flour and the cassava meal in varying proportions. By a process of progressive titration, they were able to design a biscuit which contained a maximum 40% of cassava meal and 60% wheat meal flour. The flavour of the biscuits was quite tasty and acceptable to the many stakeholders who formed the test group community.

Major Progress Achieved:

The Food Technology Laboratory has availed the technical know-how to PELS Limited, Lusaka for commercial exploitation. By making biscuits that contain 40% cassava meal, Zambia is able to reduce the amount of wheat flour that it needs to import for producing biscuits by 40%. This new technology has been transferred to PELS Limited, Lusaka for use in manufacturing cassava-based biscuits.

It has been estimated that the cost of the cassava-based biscuit has been reduced by 20%. The added manufacturing advantage is that the biscuit producer's foreign currency bill for importing wheat flour is reduced by 40%.

As biscuits are not staple food item in Zambia, the overall impact of this innovation on household budgets is of limited magnitude. The overall cost effects can only be appreciated in general terms as it was not possible to procure information on the amount of wheat that is imported for manufacturing biscuits.

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