منظمة الأغذية والزراعة للأمم المتحدة | 联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Agricultura y la Alimentación

COMMITTEE ON COMMODITY PROBLEMS

JOINT MEETING OF THE FOURTH SESSION OF THE SUB-GROUP ON BANANAS AND THE FIFTH SESSION OF THE SUB-GROUP ON TROPICAL FRUITS

Rome, 9 – 11 December 2009

FAST-TRACK PROJECT PROPOSAL FOR SUBMISSION TO THE COMMON FUND FOR COMMODITIES: UTILIZATION OF AGRICULTURAL RESIDUES (PINEAPPLE AND BANANA) FOR INDUSTRIAL APPLICATIONS

1. Project Title:	**Utilization of Fruit Agricultural Residues (Pineapple and Banana) for Industrial Applications**
2. Duration:	Six months (06 months)
3. Participants:	**-** FEPAF – Foundation for Study and Research in Agriculture and Forestry (PEA)
Co-Participants	**-** Tech Easy Composites Ltd., Brazil
	- Resmapel Ltd., Brazil
4. Nature of the Project:	Establishing the potential for Pineapple and Banana Fibres in Industrial Applications

5. The Objectives and Rationale of the Study:

The project will establish at the pilot level the technical and economic viability of the production of composite materials, special papers, chemical feedstocks (bromelin enzyme) and fabrics from pineapple and banana fibres. Currently, the leaves from pineapple and the leaf sheath from banana are treated in most instances as a waste product, and the commercial potential for utilizing these residues in a host of applications is not widely known and remains untapped.

Realising the commercial viability of these fibres will present a host of benefits to rural communities, fostering their economic development, as well as having benefits to society at large:

- **Food Security:** Since food crops are involved, improving productivity of these commodities to meet fibre demand will have a positive impact on food security.

- **Strong LDC and Poverty Alleviation Focus**: Least Developed Countries have a global production share of about 11 and 5 percent for banana and pineapple, respectively. While seemingly small, the extraction of fibres from these fruits to meet industrial market demand will have an enormous potential for income generation.

- **Adding Value and Product Diversification**: The potential to add value to fruit crops by utilizing residues is evident. At the moment these products are widely treated as waste, and are valued at zero accordingly. Moreover, a diversified product base brings with it advantages in countering commodity dependency, managing export price risk and the risk of declining output markets.

- **Value Chain Development**: The development of new value added products and opening of new market niches are expected to have a positive impact in the pineapple and banana value chain. These initiatives are expected to bring about greater commercialization of the crop, through which there will be better coordination and delivery of value chains, and the prospect of more equitable distribution of income accruing to producers,

- **Pro-environment**: As natural fibres, they are a renewable and sustainable resource, and their utilization in industrial applications at the expense of synthetic fibres in the bio-economy will yield huge benefits to the environment.

- **South-to-South Co-operation**: The countries where the pilot will be located, Philippines and the Brazil, will strongly collaborate with one another for the benefit of other developing countries.

A main objective of project would be to pilot low-cost, easily transferable technology to developing countries where these crops are mostly produced, especially LDCs. The ultimate beneficiaries will be poor small producers and rural communities who depend on fruit crops for employment and income, especially in least developed countries as well as the environment and sustainable agricultural systems.

6. Background:

Materials and their technical attributes are critical when it comes to product development. From their correct choice it can result in either success or failure in product development. Materials can be classified by their properties, namely chemical and physical characteristics, or by the functionality which is introduced to the product.

6.1. Pineapple

Pineapple is also known as piña, pinha, abacaxi, ananas, etc. It is native to South America but nowadays cultivated in many tropical areas around the world, including Thailand, Brazil, Indonesia, Philippines, Costa Rica and India. Most of its production is sold as fresh fruit, marmalade, confectionary, juice, frozen and dried products. Brazil has a long tradition in pineapple and is the world largest producer after Thailand, with 2.7 million of tons of fruits and 72 000 ha. The fruit is also important in the Philippines, grown on 54 000 ha of land yielding an annual crop of over 2 million tones.

The fibres obtained from the leaves have the following characteristics:

- Very hygroscopic
- High cellulose content
- Low microfibrilar angle
- Fibre bundle strength decrease by 50% when wet
- Yarn strength increase of about 50% when wet
- Difficulties in dye penetration due to high coarseness

The leaves are a major waste of pineapple cultivation, including fibrous and non fibrous residues. The fibrous residues represent about 54.3% by weight. Pineapple waste from leaf and crown will be studied as a reinforcement for composite applications, cellulose, pulp and paper and fabrics.

6.2. Banana

Banana is the common name for the herbaceous plants of the genus Musa and for the fruit they produce. They are native to the tropical region of Southeast Asia, but today are cultivated widely throughout the tropics. India, China, Philippines, Brazil and Ecuador are the biggest producers in the world in that order. In Brazil and the Philippines, banana is grown on 515 000 and 437 000 hectares, respectively, producing a crop of well over 7 million tones in each country.

The “pseudo” trunk is the source of the fibres from the banana plants. The pseudo stem is a bundle of huge leaf stems wrapped around a soft central corm. Initially the leaves develop in a circular pattern around a central growing region and emerge as a shoot from the underground corm. Eventually these leaves mature as overlapping leaf sheaths, made up of the leaf base and the petiole that supports the blade. The banana fibres are produced from these leaf sheaths are extracted mechanically in most cases, since the pseudo stem is cut after the banana fruit harvesting to allow the sprout to grow. From these pseudo stems it is possible to extract several types of fibres, each one with a particular characteristic. The pseudo stem is constituted of three layers: the external, where the mechanical bundles are found. These mechanical bundles are

unique in a sense that they are responsible for sustaining the plant, sometimes up to four meters in height. These fibres are among the longest and strongest of the hard fibres group after abaca.

Again, banana residues will be studied as a reinforcing material for composite applications, cellulose, pulp and paper and fabrics.

7. Outputs and Main Activities:

a) To develop and establish methodologies to convert agricultural residues from banana and pineapple into industrial products: fabrics, cellulose, feedstock, pulp and paper and composites;

b) To construct a data base comparing the intrinsic properties of banana and pineapple with the other competitive natural fibres and synthetic fibres

c) Production of low-cost composite specimens and testing based on the results of tensile, flexural resistance, surface hardness, impact test, heat deflection temperature (HDT); and pulp and paper and fabrics testing.

d) Production of low-cost demonstration materials including clothing, paper, and composites.

e) Feasibility study in transferring and replicating fibre technology in other developing countries, particularly LDCs.

Output: A survey of state of the art of natural fibre based composites and special papers incorporating market studies aimed at determining opportunities for both fibres. The results from the pilot plant trials will be used as a reference point for marketing.

Activity 7.1. State of the Art of the Component

- Review of the technical literature of ongoing studies and results of previous experiences and current initiatives around the world in the application of natural fibres for composites
- Assess the technologies for producing composites from other natural fibres and synthetics; and
- Review global experiences, past and present, on cellulose and pulp and paper markets, including specialty papers.

Activity 7.2. Laboratory Evaluation and Pilot Plant

- Performance of laboratory and pilot trials in the premises of private companies for both natural fibres based on the following applications: chemicals (nitrocellulose), cellulose, paper, fabrics and composites focusing on the adjustment of technical parameters.

Activity 7.3. Technology Development and Market Penetration

- Establishing cost and price parameters of the pilot value chain for industrial products
- Technology development and potential market openings for composite prototypes and demonstration for fabrics and papers - compare the technical performance of pineapple and banana fibres, in cooperation with the requirements of targeted consumers, including market trials.

Activity 7.4. Feasibility of Replicating Results to LDCs

- Analyse banana and pineapple value chains in LDCs with a view to transferring fibre initiatives to them.

Activity 7.5. Final Report and Technology Transfer

- Prepare a consolidated report of the results to be presented in the final dissemination workshop.

8. Estimated Total Cost:

The estimated cost for the project is USD 210 000, of which USD120 000 from a CFC grant, USD 60 000 from counterparts contributions and USD 10 000 from co-financing. The required budget will include the non financial counterparts from the universities and the private companies involved in the project, including salaries, equipments, facilities, etc. The budget requested from the CFC is broken-down as follows:

Table 01. CFC Budget items by activities

ITEM	TOTAL COSTS (USD)
State of the Art Study survey and enzyme isolation	20 000
Development of a specific decortication machine, with liquid recovery	20 000
Polymeric matrix trials	30 000
Pulp and paper trials	10 000
Fabric production	10 000
Field trips – Brazil to Philippines and vice versa	20 000
Study on market penetration and replication of the technology to other countries (including LDCs)	10 000
TOTAL BUDGET	120 000

Table 02. Summary Project Cost by Category by Expenditure ('000 USD)

Category	*Total Cost*	CFC GRANT	Tech Easy Composites Ltd.	Resmapel	UNESP
I. Vehicles, Machines and Equipments	86 000	40 000		10 000	36 000
II. Civil Works	15 000	10 000	5 000		
III. Materials and Suppliers	15 000	10 000	5 000		
IV. Personnel	54 000	20 000		10 000	24 000
V. Technical Assistance and Consultancy	20 000	20 000			
VI. Duty Travel	20 000	20 000			
TOTAL	210 000	120 000	10 000	20 000	60 000

Chronogram

The project will be implemented over six months, by which time a better understanding of the technical and commercial viability of banana and pineapple fibres in industrial applications will be known.

Table 3. Chronogram listed by activities

B. ACTIVITIES	Bi Months 1	Bi Months 2	Bi Months 3
Literature survey about pineapple and banana fibres, especially characteristics (chemical and physical) and processing			
Field trips to collect fibres (banana and pineapple) samples from several varieties			
Composites development, pulp and paper production, fabrics production and chemical characterization			
Writing reports and Seminar with representatives from other countries			

9. Finance sought from the Fund: USD 120 000 plus in-kind contributions from participating institutions and other stakeholders

10. Mode of Financing: Grant

11. Co-Financing: USD 10 000: Tech Easy Composites Ltd (www.techeasy.com.br - Brazil)

12. Mode of Co-Financing: in-kind and grant.

13. Counterparts Non-Financing Contribution:

UNESP – USD 60 000

Resmapel – USD 20 000

14. Project Executing Agency: FEPAF – Foundation for Study and Research for Agriculture and Forestry (www.fepaf.org.br), a foundation linked to UNESP – Sao Paulo State University. This Foundation has more than 400 projects under development in agricultural, forestry and environmental fields.

15. Supervisory Body: FAO – Intergovernmental Groups on Hard Fibres and Banana and Tropical Fruits

16. Estimated Starting Date: March 2010

17. Technical Expertise: The experts from UNESP have a long experience dealing with composites made of natural fibres, with several books and chapters of books published on the subject, under the author's name of Leão, A. The PEA will be the university foundation FEPAF, from Brazil. The other partners are one Brazilian company (Tech Easy), responsible for the resins and blending. The Universities involved will act as the agents responsible for technology transfer through scientific meetings and exhibitions. **The processes and products developed in the present project will be protected by the** policy of the Fund with respect to intellectual property rights (IPR). Aiming to assure such conditions, the results will be the object of a public patent or a so-called "defensive patent" in favour of the CFC, considering the proportions of the co-financiers of the project.

The CFC has the right to publish the project outputs and results in any forum or publication. The PEA also assumes a compromise that all related publications and studies related to the project will carry full acknowledgement for CFC funding and CFC's name, address and logo will be appropriately displayed on published material. If such studies are not reviewed by CFC before distribution, a disclaimer will be included. Furthermore, the processes and products will be freely available to LDCs and at a cost to other developing country members of the Fund.