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Production, Utilization and Trade of Environmentally Preferable Products in the Philippines

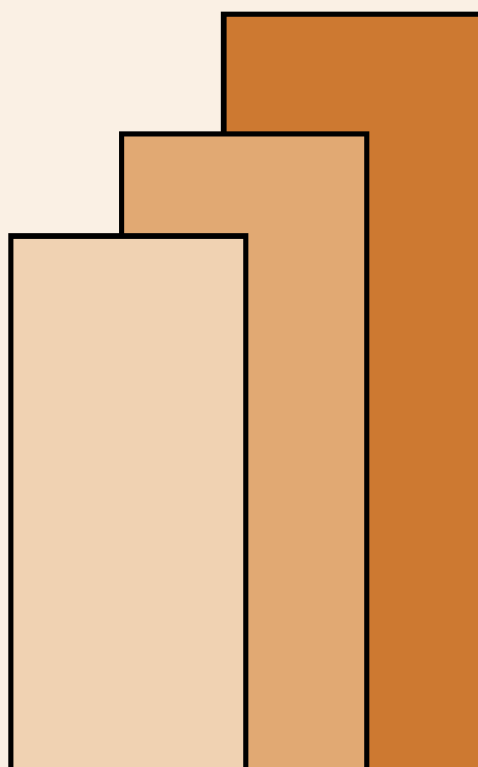
*Danilo C. Israel, Frances Myra C. Trabajo
and Corazon M. Nayve*

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**PRODUCTION, UTILIZATION AND TRADE OF ENVIRONMENTALLY
PREFERABLE PRODUCTS IN THE PHILIPPINES^a**

by

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**FINAL REPORT
(April 1995)**

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ABSTRACT

In the context of sustainable development, environmentally preferable products (EPPs) are desirable because they leave no unwelcome impacts on natural resources and environment. For a developing country like the Philippines, the potential benefits from EPP development are many. EPP production and utilization will help relieve the pressure on environmental resources, expand the international market for local products, and allow the utilization of indigenous technologies, among others.

The general objective of the study is to identify and generate a listing of EPPs which can be produced, utilized and traded by the Philippines. In particular, the study solicits information useful in the promotion of the production, consumption and international trade of EPPs. Moreover, it suggests some policy options which can be implemented for the full development of EPPs in the country.

The primary sources of data are the personal interviews conducted on researchers involved in the development of EPPs while the secondary sources of data are the published and unpublished literature on EPPs.

The study defines EPPs as products whose production and/or use have important natural resource and environmental advantages over substitute products. Based on this definition, a total of 37 EPPs were identified: 21 are agriculture-based, three are forestry-based, three are fisheries-based, six are industry-based and four are based on other products. The major observations in the study of development and production of EPPs in the Philippines are the following:

- a) Several EPPs are already produced and more can be produced in the country;
- b) Some of the technologies employed in the production of EPPs were locally developed while others were improvisation of technologies originally developed abroad;
- c) Many of the EPPs are still in the development stage although some are already sold commercial; most appear to be highly profitable ventures if operated on a commercial basis; and
- d) Commercialized EPPs are, in general, sold only in the domestic market but most have strong potential in both domestic and export markets.

The study found that although several EPPs can be produced, consumed and traded by the Philippines, the full development of EPPs is hindered by several problems. Among these are: the lack of financial support for technical research in EPPs; inadequate supply of major material inputs for full-scale production; lack of capital for expansion; lack of markets; lack of knowledge and experience in

the export business; and lack of government support for product promotion and technology dissemination.

To address the aforementioned problems, the study suggests the following policy actions: a) increase in government funding for EPP research as well as the involvement of private sector and international donor organizations; b) improvement of rural transportation systems and facilities to allow an adequate supply of material inputs; c) promotion of environmental consciousness in general and the utilization of EPPs in particular among the populace; d) provision of concessional credit to selected EPP ventures at least at the outset of operations; e) provision of special treatment and inducement to future exporters; and f) additional funding and streamlining of operations in government agencies in order to promote technology dissemination and the products themselves.

The study also identifies some gaps on EPPs research which can be addressed in the future. First, due largely to time and resource limitations, several other EPPs, especially those developed by the private sector, have not been covered by this study. It is suggested that an effort must be done to document other EPPs and expand the product listing of the current work.

Another gap in the current work, being a primarily review effort, is its treatment of some aspects in EPP development in a less intensive and in-depth way. For the benefit of potential EPP investors and other interested parties, a study that looks into the technical aspects of EPP development in detail should be carried out. Moreover, another study which concentrates on possible international markets for particular EPPs is welcomed.

In conclusion, although EPPs are relatively new in the Philippines, their usefulness as a means of attaining the twin goal of NRE protection and economic development cannot be ignored. Thus, the development of EPPs must be pursued with vigor and purpose by the government.

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I

INTRODUCTION

The alarming dangers caused by the degradation of the natural resources and environment heighten the need for effective mechanisms which can halt the overexploitation of these resources. In recent years, the search for these mechanisms has intensified worldwide and has spread beyond the traditional natural resource and environment (NRE) sector into the general product market area. In particular, calls have been made for a ban in the production and utilization of products which are hazardous to the environment and to the development of substitute goods which have environmentally preferable qualities. This desire for change comes from several sectors including consumer groups, international trade groups and environment organizations (Rath and Herbert-Copley 1993).

The rationale for preferring environmentally preferable products (EPPs) over environmentally adverse products is readily apparent. In the context of sustainable development, EPPs are desirable because they leave little or no unwelcome impacts on the NRE base. EPPs also require less resource and environmental inputs in their production hence the society savings. Moreover, the consumption of EPPs generate lower levels of pollutive wastes, thus reducing health costs to individuals and environmental costs to society.

For a developing country like the Philippines, the benefits from the development of EPPs are clear. Because of the country's resource-dependent economy, the NRE sector has been paying a stiff price for development over the years. At the least, the production and utilization of EPPs will help relieve pressure on the overburdened NRE sector.

Another advantage in producing EPPs is the possibility for local products to find their way into the international market. This result is expected because, other things the same, EPPs are likely to be more acceptable abroad over time vis-a-vis substitute products, given the growing aversion of foreign markets toward NRE-adverse products.

Yet another advantage is the utilization of indigenous technologies and material inputs which will result from the production and utilization of EPPs. At present, many of the locally developed technologies, specifically those which are EPP related, remain untapped. The promotion of the production and utilization of EPPs in both domestic and foreign markets will pave the way for an intensive application of local EPP technologies and the use of local resources as input.

While the development of EPPs is an attractive option for the Philippines to take, minimal research have been done to document EPPs which can be produced by developing countries. In the Philippines, for instance, a study which identifies and lists all

EPPs that can be commercially produced, utilized and traded is yet to be undertaken. This dearth in research limits the understanding of the public in general and potential investors in particular on EPPs, and explains the current disregard for EPPs as a means of achieving both the goals of NRE protection and economic growth at the same time.

II OBJECTIVES AND ORGANIZATION OF THE STUDY

Objectives of the Study

In general, this study aims to identify and list current and potential EPPs which can be commercially produced, utilized and traded by the Philippines. Its specific objectives are:

- a. to identify present or potential products with superior qualities in terms of NRE conservation and protection;
- b. to identify present substitutes for these products and compare their environmental and other positive attributes to the substitutes;
- c. to assess the potentials and problems associated to the commercial production, utilization and international trade of these products; and
- d. to present policy recommendations that will address the problems related to production, consumption, trade and general promotion of these products.

Organization of the Study

The rest of the paper is organized as follows. The sources and methods for collecting data, the limitations of the data and related concerns are explained in Chapter 3. Chapter 4 examines individual EPPs including their general profile, production, utilization, NRE qualities, substitutes and international markets. Chapter 5, on the other hand, discusses the different problems associated with the full development of EPPs and the policies recommended to address these problems. Finally, Chapter 6 provides the conclusions including the summary and identification of areas for future research.

III DATA AND LIMITATIONS

Sources and Methods of Collecting Data

Both primary and secondary data are used in the study. The sources of primary data are the personal interviews with different individuals engaged in EPPs production while the sources of secondary data are the published and unpublished literature and statistical indices. In some cases, the available literature were used only as supplementary sources. In other cases, i.e. when the interview did not generate sufficient data, the literature served as the main source of data and information.

In the actual gathering of data, researchers and institutions which developed the EPPs were identified through discussions with key informants including university researchers, Department of Science and Technology (DOST) researchers and personnel, industry leaders and other informants. The EPP developers identified were selected as respondents of the interview.

Aside from libraries of universities and government agencies, the EPP developers themselves furnished a number of literature, mostly unpublished, on EPPs which were used in the study. The names of developer-institutions and the EPPs they developed are listed in Appendix B.

The individual EPP developers were given questionnaires and interviewed by a member of the study team based on the schedule of the respondents. In a few instances where the product developer was not available at all, another institute personnel knowledgeable about the product was selected as replacement. The list of people actually interviewed is given in Appendix C.

The survey questionnaire was designed to collect a variety of information on the EPPs such as their general profile, production, consumption, NRE qualities, substitutes and international market (a sample copy of the questionnaire is provided in Appendix D). Opinions of respondents on the problems and possible solutions as well as their perceptions on the role of the government and the policies to be pursued for the development of EPP were solicited.

Aside from the respondents, ideas on the policies that must be pursued for the development of EPPs were solicited from some key informants which include researchers and people in the government and industry. The project steering committee members of this study, who likewise provided their policy suggestions are listed in Appendix E.

Data Limitations

Major problems were encountered during the data gathering stage which limited the scope and coverage of this study. First, due to time constraint and the unavailability or noncooperation of some respondents, the study does not cover all present and potential EPPs in the Philippines but only those with sufficient information generated from the survey and existing literature. However, the study team is confident that the EPPs covered already represent a substantial part of the total EPPs in the country.

Second, not all of the information on the EPPs was provided by respondents. In some instances, respondents opted not to respond to many of the questions in the questionnaire leading to incomplete descriptions of some of the included EPPs. As much as possible, however, effort was made to diminish the gap in information by using published literature.

Based on discussions with some of the respondents, the study team gathered that the main reason respondents tend to withhold information is to maintain secrecy in some aspects of the EPPs they developed (e.g. technology, production economics, market, etc.). Yet another reason for the respondents' hesitance to provide information is the tentative nature, like technology, of the EPPs in the development stage. Lastly, some of the question were beyond their scope of work.

To mitigate the problem of inadequate information, technical editors were involved in the write-up of the study report. The technical editors were selected from developer-institutions which have the most numbers of EPPs covered in the study. Copies of the preliminary draft were given to each of the four technical editors from BIOTECH, FPRDI, FNRI and ITDI, whose comments were then considered in the final report.

Definitions

EPPs are defined as products whose production and/or utilization have important NRE advantages over substitute products. The term "environmental advantages" implies environmental protection and/or natural resource conservation.

IV ENVIRONMENTALLY PREFERABLE PRODUCTS

EPPs were categorized according to the source of major materials used in their production: agriculture-based, forestry-based, fisheries-based, industry-based and other products. The discussion starts with the general description of the product then followed by a description of their production, utilization, environmental and other positive qualities, product substitutes and international market. At the end of the chapter is an overall review of the production, utilization and trade of EPPs. All tables related to the products, except the summary table, are provided in Appendix A.

Agriculture-Based Products

Compost fungus activator (CFA) and compost from rapid composting technology

General profile

Rapid composting is a technology that hastens the decomposition of agricultural and other wastes for use as organic fertilizer. Basic and applied research on the technology has been conducted by the Institute of Biological Sciences of the University of the Philippines at Los Baños (IBS-UPLB), Laguna in collaboration with the Institute of Environmental Science and Management (IESAM) of the same university and the Department of Science and Technology (DOST).

The compost fungus activator (CFA) and compost are products of rapid composting technology, both are now sold locally under the National Program on Rapid Composting and Use of Compost as Fertilizer launched in 1990. The same program is coordinated by the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) and implemented by the Department of Agriculture (DA) and DOST in different regions of the country.

The data and information were taken from Cuevas (1994a and 1994b), Inciong (1991), PCCARD (undated nos. 1 and 2) and the interview of Dijon.

Production structure

Material inputs. The material inputs in the production of both CFA and compost are available locally. These include sawdust, chopped wood such as *baging ilog*, *ipil-ipil* or *hagonoy* and coconut water, and *Trichoderma harzianum*, an active cellulose-decomposing

fungus, for CFA production and agricultural wastes such as rice straws, grasses, animal manure and any nitrogen-rich crop residues for compost production. Other major inputs for CFA and compost production such as the fungus *T. harzianum* can be acquired from IBS-UPLB and the Regional Production and Coordinating Centers (RPCCs).

Production technology for CFA. The production technology for CFA is locally developed by the IBS-UPLB.

The two main steps in CFA production are: the preparation of the mycelial mats where the *Trichoderma harzianum* used as CFA is initially contained and cultured; and the preparation of the carrier where the CFA is later transferred and allowed to grow. To prepare the carrier, wood such as *baging ilog*, *ipil-ipil* or *hagonoy* are chopped one centimeter long then mixed with sawdust at a ratio of one part wood to three parts sawdust. The mixture is afterwards moistened with acidified water for a 50 to 60 percent moisture content and then packed in polypropylene bags at one kilo per bag. The bagged carrier is then sterilized for 45 minutes at 15 pounds per square inch (psi) or steamed for 1-1/2 to 3 hours if an improvised sterilizer is used. Finally, the heated carrier is left to cool for about 1 to 1-1/2 hours.

To produce the mycelial mats, coconut water is first filtered through a fine marked cloth, then distributed in small bottles up to 20 to 30 milliliters only. The bottles are sterilized for 20 minutes at 15 psi or 45 minutes if an improvised sterilizer is used. The bottles are later on inoculated with *Trichoderma harzianum* which are allowed to grow for five to seven days. Afterwards, every 10 to 15 mycelial mats are aseptically retrieved from the bottles and transferred to every single carrier. The mats and carriers are mixed and the bags are sealed with a rubber band. The *Trichoderma harzianum* are left to grow for another five to seven days inside the sealed bags to produce a ready-to-use CFA.

Production Technology for Compost. The technology for compost production was also developed locally, by the IBS-UPLB.

To produce compost, rice straws and similar agricultural wastes are gathered preferably right after a rain to maximize water moisture content (If rice straws are gathered dry, they must be soaked in water from six to 12 hours). The rice straws are then piled in alternater layers with CFA and animal manure in the compost pen. For every ton of rice straw, 10 to 20 kilograms (kg) of CFAs and 300 to 500 kg animal manure or any nitrogen-rich crop residues are needed. Alternate layering is repeated until all the materials are piled up in the compost pen. The pile is then covered and sprayed with water at least once a week or whenever needed.

Within a month, the volume of pile in the pen will be reduced to 30 percent of the original level and the temperature of the pile will cool down. The ripe compost has no foul odor and is brown to

almost black in color. By this time, the compost is ready to use as fertilizer. In storing compost, it is air-dried first, then sieved using a wire mesh and finally placed inside sacks with plastic lining.

The two rapid composting production processes described are labor-intensive, especially compost production. The activities are manually executed employing only simple tools and equipment, such as sterilizer and stove for the production of CFA, and weighing scale, buggy cart, shovel and metal fork for the production of compost. However, mechanization of the technology is possible with additional equipment such as mixer, sieve, conveyor and drier.

Production capacity

Available data on the production capacity of CFA and compost at the industry level were taken from the Program's accomplishment report as of December 1993. About 145,586 kg of CFA were produced by the different Mass Production Centers (MPCs) while about 538,058 bags at 50 kg per bag of compost were produced by different Compost Production Units (CPUs) in 1993.

On plant basis, PCARRD estimated a yearly plant production capacity of 10,000 kg of CFA and 2,190 bags of compost.

At present, the Program plans to expand the plant capacity of the different production centers of CFA and compost in the country. In addition, it is contemplating on the gradual mechanization of production centers.

Production economics

While available data on the economics of CFA production are insufficient to allow a thorough financial analysis, CFA production is nevertheless perceived as a profitable commercial operation. PCCARD estimated that the current net income from CFA production amounts to ₱16,930 per plant, assuming that 10,000 kg of CFA are produced and sold per year at the price of ₱7.50 to ₱12.00 per kg.

A preliminary financial analysis was done by PCARRD to determine the viability of compost production as a commercial venture. Fixed capital investment for a compost plant is about ₱95,000 at 1994 prices, this covers the construction of a building and the purchase of tools and equipment. The fixed assets were assumed to depreciate on a straight line basis. The expected life span of the building is 20 years and that of the tools and equipment is 10 years. The cost of land in a rural area is considered to be minimal, hence, the cost valuation is assumed to be zero.

It was estimated that the construction and operation of the compost plant requires a loan of ₱2,000,000 payable in three years with an interest of 13 percent a year.

It is assumed that one operational cycle in the production of compost takes two months to complete, thus, there are six

production cycles a year. The variable cost of production includes costs of direct materials, direct labor and other expenses. Variable costs for the first year of operation is estimated at ₱114,130.

Meanwhile, total costs of operating the compost plant in the first year of operation is ₱146,630 including variable cost, depreciation and interest cost.

With a per-cycle production of 365 bags at 50 kg per bag, a total production of 2,190 bags of compost is reached per year. At ₱100 per bag, total sales in the first year of operations is ₱219,000.

The projected income statement for five years of operation, assuming a 10 percent annual growth rate in both costs and returns, shows that the compost plant will have net profits yearly. Net profit will be ₱72,370 in the first year and by the fifth year, net profits will be twice as much at ₱147,040.

Finally, profitability indicators show that the compost plant will have an internal rate of return of 34 percent; net present value of ₱33,888; benefit-cost ratio of 1.84; and a payback period of two to three years. Moreover, indicators show that the operation is profitable and allows the operators to recoup their investment in a relatively short period of time.

Utilization

As already mentioned, CFA is used to hasten the decomposition of agricultural waste materials in order to produce compost. Compost, on the other hand, is used as an organic fertilizer in rice farming as well in the production of vegetables, ornamental plants, fruit trees and other agricultural products.

The marketing of CFA and compost by the Program is usually coursed through cooperatives and nongovernment organizations (NGOs) in the countryside. These groups distribute the products directly to endusers including rice farmers, vegetable farmers, ornamental plant growers and fruit growers.

To promote CFA and compost products, campaigns to educate the users on the good attributes of the products has been undertaken by the Program over the years. Activities for CFA and compost promotion are mostly done through print media, radio broadcasting, fora discussions, trainings and field demonstrations.

Environmental and other positive qualities

Compost and CFA production has environmentally preferable qualities. First, their production utilizes indigenous materials, thus resulting in the productive use of local resources and saving of foreign exchange due to nonimportation.

Second, the use of agricultural products and other waste materials as major inputs is an environmental gain as these wastes

would have been otherwise dumped or burned, causing air and water pollution and waste disposal problems.

Third, the use of compost as organic fertilizer in agriculture decreases the consumption of inorganic fertilizers, which may be harmful to the health of farmers as well as to the farm environment in general.

Aside from the more obvious environmental advantages, compost as fertilizer brings production-related advantages. For instance, compost has a high nutritive and fertilizing content. It serves as a buffer to changes in soil acidity; improves soil tilth, aeration and water holding capacity; and provides humus or organic matter. These advantages cannot be gained from inorganic fertilizers.

Finally, the financial impact of compost utilization to farmers is substantial. It is estimated that utilization of compost increases farm yield by 10 to 20 percent per hectare per cropping by replacing as much as 50 to 75 percent of chemical fertilizer requirement of crops. On the other hand, the use of compost will improve employment in the farm economy and reduce foreign exchange spending on imported fertilizers.

Product substitutes

In general, other fertilizers are substitutes for compost. A look at the production and sales of fertilizers in recent years shows that while production on average has been growing annually, sales on the average has been fluctuating. The fluctuating sales may be an indication of a shift favoring the use of compost and other nonmanufactured fertilizers in some years. The large absolute sales, however, imply that fertilizers remain an important feature in agriculture.

International market

Since both CFA and compost are not exported at present, the international trade situation of fertilizers will provide some indication for a potential foreign market for these products. Exports of fertilizers in both volume and value by the Philippines have been large and growing annually at a healthy rate showing that fertilizers from the Philippines are already acceptable in the international market. This also suggests that compost and its related product CFA may also have a potential foreign market which can be exploited, assuming they can compete in terms of quality, price and availability of product.

While Philippine imports of fertilizers in volume and value have been growing at a lower rate than exports, imports have been larger than exports in absolute terms. Thus, the country has been continuously experiencing deficits or negative net exports in the international trade of fertilizers. The large importation of fertilizers means that the country is a big market for foreign made fertilizers. Hence, there is a large existing market to exploit in

terms of substituting foreign fertilizers with locally produced ones, including compost.

Slow-release type potassium silicate fertilizer from rice husk and dolomitic limestone (slow-release fertilizer)

General profile

Research and development on slow-release type potassium fertilizer from rice husk and dolomitic limestone mixture, or slow-release fertilizer, started in 1984 at the Industrial Technology Development Institute (ITDI), a line agency of DOST. Research and Development activities were initially funded by a grant from the International Transfer for Industrial Technology (ITIT) program of Japan. Since 1993 until the present, the product is still undergoing testing and evaluation.

The sources of information for this discussion are ITDI (undated) and the interview of Dominguez.

Production structure

Material inputs. The major material inputs in the production of slow-release fertilizer are available locally, which are rice husk and dolomitic limestone. Rice husk is a source of silicon dioxide while dolomitic limestone is a source of calcium and magnesium.

Other material inputs necessary in the production are also available locally. These include potassium carbonate (a source of potassium oxide), molasses (used as binder and sawdust (used as a heat sustaining material)).

Production technology. The production of slow-release fertilizer uses imported technology.

First, rice husks and dolomitic limestones are pulverized separately then mixed thoroughly with potassium carbonate, molasses and sawdust after which the mixture is passed through an extruder and granulated in a granulator. The granulated mixture is allowed to dry before subjecting it to heat in an internal heat type fluidized bed reactor with sawdust as the heat source.

The production process for slow-release fertilizer is capital-intensive because it requires production machinery and equipment that are expensive and costly to maintain.

Production capacity

The development of slow-release fertilizer is still in the testing and evaluation stage. There are no estimates available yet on the production capacity of a hypothetical plant producing such product.

Production economics

A full financial analysis for a hypothetical commercial plant producing slow-release fertilizer has yet to be conducted. For a production level of 100 kg, however, the estimated variable costs of production using the continuous method of calcination at 1993 prices reaches up to ₱1,366.40, exclusive of labor costs. Material inputs account for 78 percent of the cost while power cost accounts for 32 percent.

Utilization

Slow-release fertilizer can be utilized as low-cost fertilizer substitute. It has a unique characteristic of controlled nutrient release which leads to sustained fertilization without danger of fertilizer burns. The fertilizer is specially recommended for the culture of rice, corn, onion, tomato, lowland *gabi* and other short-term crops.

Since the product is still in its development stage, there are no data on the actual market utilization of the product. However, the target users of the product are farmers and others engaged in the agriculture and agribusiness industries.

Environmental and other positive qualities

There are some positive environmental qualities related to the production and utilization of the slow-release fertilizer. The process utilizes two waste materials, sawdust as heat source, and rice husk. The use of sawdust substitutes for electricity consumption or coal whose production processes are highly pollutive.

On the other hand, the environmental qualities are as follows: first, the use of slow-release fertilizer lowers the danger of fertilizer burns to the person applying the fertilizer; and second, the product substitutes for standard fertilizers whose production processes and utilization have negative environmental effects.

Aside from the environmental aspects, the use of slow-release fertilizer have positive implication in terms of farm productivity. First, the fertilizer does not cause any damage to plant or crop even at high concentration. Second, it has a high utilization rate which benefits crops since nutrients are dissolved slowly and not easily washed away by flowing water.

As to the other benefits, the contribution to the farm economy of slow-release fertilizer is similar to that of compost use. It will promote income and employment in the countryside and reduce dependence on imported fertilizers.

Product substitute

The slow-release fertilizer is a substitute for traditional fertilizers sold in the market. The market situation for fertilizers is already discussed in the discussion on CFA and

compost production.

International market

Since the production of slow-release fertilizer is still in its development stage, there is no export data available. Thus, the foreign market for the substitute is relevant in this case. The international market for fertilizers in general is discussed in the section on CFA and compost production.

Azolla

General Profile

Azolla is a tiny aquatic fern that grows in rice paddies and other watery areas. It is rich in organic nitrogen because of its symbiotic relationship with the *Anabaena azoellae*, a blue-green algae which lives inside azolla leaves and fixes nitrogen from the air. Due to its high nitrogen content, azolla is called the all-around farm nutrient.

In 1982, UPLB and DA launched the National Azolla Action Program (NAAP). The program conducts research and development and promotes the use of azolla. One breakthrough is the production of azolla from spores. This method is seen as a better alternative to the traditional vegetative means of reproduction because it insures the continued survival of azollas in areas where water is lacking.

Although azolla produced through vegetative means have been used in rice culture by some farmers already, producing azolla from spores are not yet done extensively by farmers. At present, NAAP

is conducting technology-transfer activities although the technology of azolla from spores is not yet practiced at the commercial level.

The source of information in this discussion is NAAP (1990 and undated).

Production structure

Material inputs. The material inputs for producing azolla from spores are fresh azolla as inoculum, superphosphate for keeping the level of phosphorus and carbofuran granules for controlling insect pests in the pond.

A sporulation pond of about 250 square meters (sq m) is needed for production. The pond must be close to the source of running water and surrounded by a dike that is high enough to keep about 5 to 7 centimeters high of pond water. Also, another pond of about 20 square meter area for vegetative propagation and a pit is required.

Production Technology. The production technology for producing azolla spores is developed locally.

To produce azolla from spores, 50 kg of fresh azolla is placed in the sporulation pond. This quantity will eventually produce 200 grams (g) of fresh azolla per square meter area.

Care and maintenance of the sporulation pond is observed at all times. The pond is always flooded with water and kept at five to seven centimeters (cm) high. Carbofuran granules are added to the pond water to control insect pests. The recommended application is 0.5 to one kg active ingredient per hectare every two weeks. The pond is partially shaded by planting upward, straight-growing, wide-leaved, aquatic plants like *gabi* around its borders to protect azolla from too much heat. Also, phosphorus level is adequately kept at a certain level by applying superphosphate at a rate of 8.3 grams per square meter every 12 days.

The azolla plants are then allowed to multiply until they become too crowded in the pond, thus preventing further reproduction. When unable to reproduce, mature azolla plants start to produce spores. Mature azollas are usually bigger, sturdy looking and yellowish or brownish at the center of their fronds and leaves.

Harvesting of mature azolla plants starts a week after about 70 percent of all plants in the pond have produced spores. Only two-thirds of the azolla mat is harvested to allow the plants to multiply until spore reproduction starts again, that is, assuming all conditions are favorable. After three weeks, two-thirds of the azolla mat is harvested again. Thereafter, the azolla mat can be harvested after every three weeks.

During the summer and rainy season, the harvested azolla mat are placed in a three by five by 1/2 meter well-drained pit to decay for two weeks (during summer) and one month (during rainy season). Then the decomposed azolla are collected from the pit and dried through exposure to sun and air for 24 hours.

The dried azolla is passed through a coarse screen and the particles that pass through are immersed in water and soaked overnight. Particles that float are azolla spores while those that sink are azolla compost. The azolla spores are sun-dried for 24 hours and passed through a fine screen about 0.5 millimeter. These dried spores are then packed, sealed and labeled either in plastic bags, coin envelopes or glass jars. The sealed dried spores are then used for the next round of azolla production.

The above-described production process is labor-intensive because most of the steps are done manually. There are presently no available fabricated machines to do the processes, especially the preparation, care and maintenance of the sporulation pond, and harvesting of azollas.

Production capacity

The production of azolla from spores is in the technology-transfer stage and not yet commercialized. Thus, statistics on production capacity of azolla is not available.

Production economics

The production economics of azolla production from spores is not analyzed in any literature neither in the NAAP materials. Thus, the financial profitability of azolla production from spores is not analyzed and presented here.

Utilization

Azolla is used mainly as an organic nitrogen fertilizer in the production of crops, especially rice. In this regard, azolla can either be applied as green manure or compost. In addition to its use as fertilizer, however, the azolla plant can also be useful as a weed suppressant, mosquito control agent or water purifier. The target clientele for the product are farmers, especially those who are into rice culture.

Environmental and other positive qualities

There are many environmental qualities in the production and use of azolla in the farm. First, the production of azolla is devoid of chemical processes common in the production of inorganic and other fertilizers which produce pollutive wastes. Second, the use of azolla as a fertilizer decreases the use of other fertilizers having pollutive properties. Third, the employment of azolla as a suppressor of the growth of weeds and the mosquito population reduces the use of chemical herbicides and insecticides which can pollute the environment and damage man's health.

Finally, the use of the plant as water purifier lessens water pollution since it absorbs pollutants in the water such as nitrates, phosphates and heavy metals.

In addition to its being a fertilizer, azolla is environmentally preferred to inorganic fertilizers in particular because its continuous application does not deplete the soil of its essential nutrients but rather increases soil productivity. As an organic fertilizer, azolla supplies more nutrients due to its humus or organic matter.

Beyond the mentioned environmental advantages, the use of azolla raises the incomes of farmers because it will reduce production costs in terms of fertilization, weed and insect control. Its production can also become a separate profitable activity in the farm, adding employment opportunities to the local population.

Product substitute

The substitutes for azolla are other organic and inorganic fertilizers. Because of its other functions, it also substitutes

for chemical herbicides and insecticides. The market situation for fertilizers was already discussed in the section on CFA and compost production. Because the use of azolla as weed and insect control agent is secondary only to its primary use as fertilizer, the market for herbicides and pesticides are not discussed in this section.

International market

In the absence of exportation of azolla, the international trade for fertilizers will provide some indication of the potential foreign market for azolla. This market was already discussed in the previous section on CFA and compost production.

Lysine

General profile

Lysine is an essential amino acid which can be produced from the carbohydrates of agricultural and industrial by-products. The technology for the local production of lysine was developed by the National Institutes of Biotechnology and Applied Microbiology (BIOTECH) at the University of the Philippines in Los Baños, Laguna (UPLB). The four types of locally produced lysine are the lysine feed concentrate, animal feed grade, chemical grade, and United States Pharmacopeia (USP) grade.

Research and development efforts on local lysine production were initiated in 1984 through funds provided by the BIOTECH, UPLB and the Philippine Council for Industry and Energy Research and Development (PCIERD). The production of local lysine is now ready for commercialized application.

The sources of data and information for the discussion below are Pham (1994) and the interview of Pham and Ramirez.

Production structure

Material inputs. The material inputs used in the production of lysine include sugarcane or coconut water enriched with molasses; soybean-protein hydrolyzate, a nutrient source; yeast extract; corn steep liquor; potassium hydrophosphate; and magnesium sulphate. Except for the last two materials, the rest are available locally.

Production technology. The original technology for local lysine production was derived from a foreign source. A locally refined version of the technology which use indigenous inputs was developed to replace imported lysine.

There is no available detailed description of the processes involved in local lysine production. In summary, the steps are the building up of seed or inoculum fermentation, isolation of product, drying, and packaging.

For inoculum fermentation, the equipment used are: shaker,

autoclave, laminar flow hood, 10-liter and 500-liter fermentor and feed pump. For the isolation of cells, the equipment utilized are the 20,000-liter fermentor, centrifuge and feed pump while for the isolation of lysine, ion exchange resin (three columns), three feed pumps and neutralization tank are employed. For the drying process and packaging, spray dryer, weighing scale and sealing machine are utilized. The rest of the equipment are the spectrophotometer, pH meter and analytical balance are also used in production.

Because of the numerous equipment required, the production of lysine is clearly a capital-intensive process.

Production capacity

Lysine is not yet commercially produced, thus, there is no data on production capacity at the industry level. At the plant level, annual production was estimated at 1,000 tons or one million kilograms.

Production economics

A financial analysis for lysine production, particularly the monochloride animal feed grade from sugarcane juice, was conducted by BIOTECH. At 1991 prices, the investment requirement for a plant capacity of 1,000 tons is ₱134.41 million. This amount is broken down into expenses on fixed capital and working capital. The expenses on equipment alone amount to ₱74.57 million.

The total annual cost of production amounts to ₱52.60 million which includes direct production costs, fixed charges, overhead costs and general expenses. At an annual production rate of 1,000 tons per year of animal feed grade and a selling price of ₱95.40 per kilogram, the net profit is ₱72.6 million.

The internal rate of return for lysine production ranges from 35 to 40 percent. Therefore, while lysine operation requires large capital outlay, it leads to a high net profit and is a worthy investment.

Utilization

Lysine is widely used as a supplement or additive to enrich food products and animal or composite feeds. In addition, lysine is useful for pharmaceutical purposes.

There is no local commercial production of lysine at present but BIOTECH is searching for interested investors to finance its commercial production plans. The establishment of a production plant for local lysine will benefit the following industries: animal and livestock, feed milling, food, pharmaceutical and aquaculture.

Environmental and other positive qualities

A major environmental advantage in local lysine production is the utilization of agricultural by-products or waste materials as

fermentation substrates. For example, coconut water which is waste material of the coconut industry can be used as starting material or substrate in lysine production.

Another environmental quality of local lysine production is that its processes produce no toxic or harmful wastes. Moreover, based on bioassay and physico-chemical tests, locally produced lysine is toxin-free and is thus not harmful to human health.

Aside from its environmental attributes, the production of local lysine has economic advantages as well. First, the establishment of a local lysine production plant ensures product availability and reduces importation. Second, it provides employment opportunities, investment and joint ventures between companies with access to the supply of raw materials and those involved in the formulation and distribution of food, feed and pharmaceuticals. Third, it helps provide a basis for biotechnology industries to produce other high value products such as amino acids, enzymes and the like.

Product substitute

Local lysine is a substitute for imported lysine. Available data indicate that from 1988 to 1990, the country has not imported lysine except in 1991 and 1992. Both volume and value of imports had grown substantially between these two years. Thus, there is now a local market for imported lysine which local lysine can exploit, assuming that it is competitive in terms of price, quality as well as product availability.

International market

As mentioned, locally produced lysine is not yet commercially produced, much less exported. Thus, the product is not yet known to the international market. Although no data can be presented at this time, lysine, however, is widely used internationally. Hence, if the locally produced lysine can meet stiff international standards, it should have a potential market to exploit, at least in the long-term.

Handmade paper from rice straw

General profile

Handmade paper from rice straw is a product developed by the Forest Products Research and Development Institute (FPRDI), a line agency of the DOST. Research and development activities in the production of handmade paper commenced in the late seventies using DOST funds. In 1986, the technology was fully developed and the product was commercialized locally. At present, handmade paper from rice straw is also exported.

The data and information presented in the discussion below come from PCCARD (1982), PNB (1991) and FPRDI (1989 and 1994) and the interview of Frialde.

Production structure

Material inputs. The major material input used for the production of handmade paper is rice straw, an agricultural waste which is available in abundance locally. The other inputs which are also available in the domestic market are sodium hydroxide, sodium or calcium hypochlorite and paper additives such as rosin size, starch and alum (aluminum sulfate or tawas). Rosin size is used to prevent liquid penetration and make paper smooth, alum to enhance cohesion of the fibers and starch to bind fibers together.

Production Technology. The original technology for handmade paper from rice straw is of foreign origin but was adapted and modified by FPRDI. The production processes involved in the manufacture of handmade paper from rice straw are pulping, bleaching, and sheet forming or papermaking.

The pulping process involves the boiling of rice stalks in two percent sodium hydroxide solution, with a liquor to material ratio of 10:1, for about two hours until the stalks become soft. The stalks are drained right after boiling and transferred into a screen-bottom box. Then, the stalks are thoroughly washed with water at least three times and pounded with a wooden mallet. After pounding, the pulp is screened by under high water pressure using a double-decked screen box.

Bleaching of the pulp may either be a single or multi-stage procedure. In any case, the pulp is bleached for 15 minutes at temperatures of 35 to 45 degrees centigrade using a two percent sodium hypochlorite bleach solution. Also, consistency of 10 percent liquor to material ratio is maintained. After every bleaching, the pulp is thoroughly washed with water.

During sheet forming or papermaking, the bleached pulp is transferred to the paper vat and water is added (for thin paper, more water is added and for thick paper, less water is added). Paper additives such as rosin size, starch and alum are added to the pulp and the mixed substance is stirred continuously. Then, the mixture is laid on a dry and flat surface. Finally, the mixture is pressed down with a rolling pin or pressed to form the sheet.

The process of handmade papermaking from rice straw is labor-intensive as most of the work are manually done. Also, traditional handmade papermaking equipment are employed. These include the heater, cauldron or drum cooker, mortar and pestle, *bolo*, paper vat, mould, deckle, double-decked screen box, wooden mallet, and press.

Production capacity

At present, if all plants are fully utilized, the estimated maximum capacity of the industry is about 50,000 sheets a month or 600,000 sheets a year. However, plants are actually underutilized and produce at a rate below 50 percent of the estimated capacity. There is no available estimate of how much an average commercial plant produces annually.

Based on interview, it is expected that plant utilization will improve in the coming years. Moreover, it was gathered that some of the plant owners are planning to expand their plant size and capacity in the future.

Production economics

The FPRDI has preliminarily assessed the financial viability of putting up a plant producing handmade paper from rice straw which operates for three years. The plant is assumed to produce at 50 percent capacity during the first year, 70 percent capacity in the second year and 100 percent capacity in the third year.

The initial investment requirement for the plant is estimated at ₱198,682 in 1993 prices. This amount includes fixed investment on building, furnitures, fixtures and tools, and equipment excluding land. It also covers working capital for the first four months of operation as well as pre-investment expense which is 10 percent of fixed investment.

The estimated total cost of production of the plant is assumed to include operating costs, depreciation and interest rates. Operating costs cover factory, administrative and marketing costs. During the first year of operation, total cost is ₱345,412. By the third year, total cost has increased to ₱503,555.

Since the feasibility study on the product is still being updated, income statement and profitability indicators are not available yet.

Utilization

The handmade paper made from rice straw is creamy white and is thus suitable for making special paper products such as stationeries, greetings cards, calling cards and other paper items. In addition, it is also suited for making gift boxes and christmas decors. At present, an estimated 80 percent of total output is sold at the domestic market while the remaining 20 percent is exported.

Environmental and other positive qualities

The production of handmade paper is environmentally friendly since it utilizes rice straw, a waste material from rice production, which may otherwise cause waste disposal or pollution problem in the countryside. Although rice straws are sometimes used as organic fertilizer or animal feed, the bulk is usually

burned or left to rot.

Another environmental quality of handmade paper products is that it is produced manually with little mechanical processes involved. Thus, production does not result in the discharge of effluents which can pollute water and soil.

A third advantage of handmade paper production is that it does not involve the use of harmful chemicals, therefore, workers are not exposed to chemical-related health risks.

Other than the mentioned environmental gains, the product is a cottage industry in the countryside. Since the production process can be done manually, it helps to promote rural employment especially among women and children and, in effect, raises the incomes of farm families.

Product substitutes

Imported handmade paper and paperboard are the substitutes for handmade paper made from rice straw. The demand and supply situation of product substitutes are not known due to the unavailability of industry studies on them. Records show, however, that there have been importation of handmade paper and paperboard by the Philippines, except in 1989 and 1990, which indicate the presence of a domestic market for imported handmade paper and paperboard which local producers of handmade paper made from rice straw can exploit.

International trade

The Philippines only commenced exporting handmade paper and paperboard in 1992 with low volume and value of exports. Therefore, the international market for handmade paper appears to be weak at present. But it is heartening to note that the export of handmade paper and paperboard has finally arrived after many years in the country, an indication of brighter things ahead for the industry.

Hollow blocks made of rice hull ash cement

General profile

The rice hull ash cement (RHAC) is a building material which is a comparatively cheaper substitute for portland cement. The RHAC technology was developed by the FPRDI in the 80s using its own funds.

Research and development on RHAC found it to be a good and economical material in the production of hollow blocks. Pilot testing of the RHAC hollow blocks was jointly undertaken by FPRDI and a private firm in Calauan, Laguna. Since 1991, the RHAC hollow blocks has been commercially produced.

The sources of data and information for this discussion are FPRDI (1990) and Laxamana (1984) and the interview of Laxamana.

Production structure

Material inputs. The production of RHAC only needs rice hull as material input. On the other hand, materials needed for the production of RHAC hollow blocks are RHAC, portland cement, palanas soil, and volcanic cinder or sand. All these materials are locally available but they must be in sufficient volumes for the commercialization of RHAC hollow blocks to be possible.

Production Technology. The technology for RHAC production was developed abroad. The production processes are as follows. First, rice hulls are burned into ashes in an incinerator, a step which takes three to four hours. Then, the incinerator is allowed to cool overnight. In the morning, the ashes are unloaded through the bottom chamber of the incinerator and placed in a polyethylene bag or sack.

The next step in RHAC production is the grinding of rice ashes. The ashes in the sack or bag are poured into the ball mill grinder and grinded for about 30 minutes. The purpose of grinding is necessary to convert the coarse ash into the desired fineness. Once grinded, the product is now known as RHAC and is ready to use as a material input in the manufacture of hollow blocks.

In the fabrication of hollow blocks using RHAC, the procedures followed are similar to standard hollow block production. Forty kg of RHAC, 40 kg of portland cement, 0.42 cubic meter of palanas soil and 0.064 cubic meter of volcanic cinder or sand are mixed using enough water. The mixture is poured into the hollow block machine to produce hollow blocks. All in all, 180 pieces of eight by 16 inches hollow blocks can be produced from the mixture.

The production process is both labor and capital-intensive.

Production capacity

There are no available secondary literature which provided data on the total industry production of RHAC as well as RHAC hollow blocks. At the plant level, the rate of production is estimated at about 240 pieces of hollow blocks per day. Based on a 288-working-day-year, the expected yearly plant production is 69,120 pieces of hollow blocks.

Production economics

A financial analysis was done by FPRDI to assess the viability of RHAC hollow block production. At 1991 prices, the initial investment requirement for a plant is ₱118,061 which covers fixed investment on land, building and machinery, working capital and pre-operating expenses.

The plant is assumed to operate at 75 percent capacity during the first year of operation and 100 percent capacity thereafter. The projected annual costs for a six year operation shows a total cost of ₱128,157 in the first year. By the sixth year, total costs is about twice as much at ₱233,054. Selling price per unit in year

one is ₦3.20 while cost per unit is ₦2.45 indicating a net profit per unit of ₦0.75. In year six, selling price is ₦4.40 while cost is ₦4.40 indicating a net gain of ₦1.03.

The projected income statement shows that the plant is a profitable operation in its six years of operation. Profit less production costs, interest and tax is ₦20,731 for the first year. By the sixth year, profits has risen to ₦98,722.

Finally, the profitability indicators for the plant show a return of investment of 61 percent, an internal rate of return of 30.32 percent and a payback period of three years, all suggesting a highly profitable venture in RHAC hollow block production.

Utilization

RHAC is an inexpensive binding material which can substitute about 50 percent of cement in the production of commercial hollow blocks. RHAC hollow blocks, in turn, are inexpensive construction materials which can meet low budget construction, such as housing for the poor segment of society. The strength property of RHAC hollow block is also comparable to that of pure concrete hollow block.

The product is already commercially produced although distributed only in the local market with the small-scale construction industry as one of its buyers.

Environmental and other positive qualities

The production of RHAC uses the waste material rice hull which only poses a serious pollution and disposal problem if it accumulates in large volumes. The productive use of this agricultural waste material is both an environmental and economic boon to the countryside.

Socially, the relatively lower price of the RHAC hollow blocks will benefit the people, especially the less privileged, who may want to spend less for their housing and other construction needs. On the whole, the economy will benefit with additional employment in the countryside and, hopefully, less importation of portland cement.

Product substitute

Portland cement is the main substitute for RHAC. On the other hand, hollow blocks made from pure portland cement is the competitor of RHAC hollow block.

The domestic production of cement has been increasing annually from 1988 to 1992. Moreover, import of portland cement is on the rise in recent years. This means that there is a strong domestic market for cement which RHAC production can exploit. Given the declining incomes of the general population, the cheaper and waste-based RHAC should corner a good share of the cement market in the years ahead.

International market

Since RHAC is not yet exported, a look into the foreign trade of its substitute, portland cement, will provide an indication of the potential international market for RHAC. Exports of portland cement in recent years have been sporadic especially in 1989 and 1991. Also, there has been a substantial decrease in the absolute levels of exports between the said two years. Based on this, it can be implied that the international potential of RHAC may also be weak. However, the environmental qualities of RHAC are positive assets which should make the product become acceptable, especially in environmentally conscious societies.

Coconut coir dust cation exchange resin

General profile

Coconut coir dust cation exchange resin is a potential heavy metal scavenger used for water treatment. FPRDI has developed the product using its own funds and plans to conduct pilot-scale production of the product soon.

The data and information presented in this discussion come solely from the interview of Romana since no literature on the product is available.

Production structure

Material inputs. The material inputs in the production of coconut coir dust cation exchange resin are locally available. These materials include coconut coir dust, formaldehyde, and sulfuric acid. Coconut coir dust is a waste material from the extraction of coir fiber from coconut husk necessary for upholstery.

Production technology. The basic technology for coconut coir dust cation exchange resin is foreign in origin although it was adapted and improved by FPRDI. To produce the product, coconut coir dust is treated with formaldehyde and sulfuric acid through heating. The treated coir dust is then washed with water and dried. The production process is labor-intensive.

Production capacity

Since the pilot-scale production of coconut coir dust cation exchange resin still has to be done, no industry data on its production capacity is available. The estimated production capacity per year at the plant level, however, is 264,000 kg.

Production economics

The FPRDI conducted preliminary analysis of the financial

viability of putting up a pilot-scale plant for coconut coir dust cation exchange resin. The estimated investment requirement is ₱2.837 million, broken down into fixed investment, working capital, pre-operating and contingency expenses.

The production cost, on the other hand, is ₱8.021 million broken down into operating costs in terms of raw materials, manpower needs, utilities and maintenance, and depreciation costs.

At a production capacity of 264,000 kg of output per year and priced at ₱38.00 per kg in 1994, sales in the first year is ₱10.032 million. Total sales less production cost yields a net return of ₱2.01 million.

Lastly, the rate of return from the pilot plant is high at 70.86 percent while the payback period is one year and three months, indicating that it is a profitable business operation that recoups investment in a relatively short time.

Utilization

Coconut coir-dust cation exchange resin can either be used in water treatment or in the removal and recovery of heavy metals from industrial waste water. The potential users of this product are manufacturing establishments like lead battery manufacturing firms and leather tannery firms. In addition, the product is likewise useful in the treatment of gold mine tailings.

Environmental and other positive qualities

The first positive environmental advantage in the production of coconut coir dust cation exchange resin is its use of coconut waste materials from the extraction of coir fiber from coconut husk. The productive use of these waste materials solves yet another waste disposal and pollution problem.

The second positive environmental advantage of the product is its usefulness in the removal and recovery of heavy metals from industrial waste water. Untreated industrial waste water causes water pollution that threatens streams, rivers, lakes and other waterways. The utilization of the locally produced coconut coir dust cation exchange resin as a treatment material helps in preventing water pollution.

The production of coconut coir dust cation exchange resin will promote rural economy by raising the income of coconut producers who will supply the major material input of the product and also expected to alleviate rural unemployment.

Product substitute

Imported synthetic cation/anion exchange resin is a substitute for coconut coir dust cation exchange resin. The country imported ion exchange resins in 1988 and 1989 but stopped doing so thereafter. The exodus of the domestic market for resins can be taken to mean that a potential domestic market for coconut coir

dust cation exchange resin is weak at present.

International market

Coconut coir dust cation exchange resin is currently not exported as well as its substitute, ion exchange resins. Thus, the foreign market for the product is likewise weak.

Soy tempe flour

General profile

Soy tempe flour is flour produced from fresh tempe, a popular Indonesian soybean product fermented with an edible mold called *Rhizopus oligosporus*. Soy tempe flour has been developed by the Food and Nutrition Research Institute (FNRI), a line agency of the DOST. Research and development work on the product started in 1990 with funding from the United Nations University. At present, the product is ready for commercialization.

The sources of data and information for this discussion are Molano et al. (1993), FNRI (1993) and Karta (1990) and the interview of Molano.

Production structure

Material inputs. The material inputs in the production of soy tempe flour are local soybeans and starter for the mold *Rhizopus oligosporus*. The mold is imported from Indonesia but can be prepared locally by semi-pure culture.

Production technology. The technology for soy tempe flour production has been adapted from Indonesia. Soy tempe is a popular low-cost substitute for meat in Indonesia which can be fried, stewed, grilled or steamed to suit a variety of recipes. Among these recipes are tempe sweet and sour, tempe cream of potato soup and deep-fried tempe chips.

FNRI has recognized the potential of soy tempe as another form of protein source. However, soy tempe in its original form may be difficult to introduce in the Philippines due to peculiarities in the food tastes of Filipinos. Thus, FNRI has marketed soy tempe in the form of soy tempe flour.

There are three main processes in the production of soy tempe flour: the preparation of starter, preparation of fresh tempe and production of soy tempe flour from fresh tempe.

To prepare the starter, 200 grams of rice is half-cooked in 300 milliliters of water for 30 minutes, then steamed for 30 minutes and allowed to cool down. The cooked rice is inoculated with 2 grams of inoculum of *Rhizopus oligosporus* and incubated at room temperature for three days. The inoculated rice is then dried

at 55 degrees centigrade down to a five percent moisture, milled and diluted at a ratio of 1 part inoculum and two parts rice flour.

To prepare fresh tempe, soybeans are boiled for 30 minutes, drained, cooled down and soaked in water from 20 to 22 hours. Soaked soybeans are then dehulled and surface-dried until moisture content is reduced to 60 percent. The partially dried soybeans are inoculated (two grams of inoculum to one kg of dried soybeans) and packed in 0.002 millimeters (mm) thick polyethylene plastic bags with holes of 0.60 mm diameter and 1.3 centimeter (cm) apart. The inoculated soybeans are then incubated at room temperature for 36 hours. The resulting fermented tempe is fully covered with the white mycelia of the starter, is compact and the aroma resembles that of a fresh mushroom.

To prepare soy tempe flour from fresh soy tempe, the fresh tempes are first sliced to 1/2 by 1/2 by two cm and steam-blanching for 10 minutes. Steamed tempe are drained, allowed to cool down and then dried at 65 to 70 degrees centigrade until only 5 percent moisture content is left. Dried tempe are then allowed to cool down before they are milled at 60 mesh fineness.

The production processes described above are labor-intensive since they are done manually. In addition, skills are needed, especially in preparing the fresh tempe, which has to be carried out in a hygienic environment.

Production capacity

Since soy tempe flour will not be commercialized yet, data on production at industry level are not available. It is estimated, however, that a commercial plant can produce 34,200 kg of soy tempe flour annually.

Production economics

The FNRI has provided some initial estimates of the costs and returns involved in putting up a commercial plant that produces 34,200 kg of soy tempe flour a year. At 1994 prices, the initial investment requirement for the plant totals ₱815,210 which is broken down into expenses on land and building, production equipment, office equipment, transport vehicle, working capital, pre-operating and contingency expenses. It is assumed that 60 percent of the investment requirement will be loaned from a commercial bank with a 17 percent interest rate payable in 5 years.

For the first year of operation, total cost of production is estimated at ₱1,408,755 which is broken down into costs of direct materials, direct labor and overhead. Gross income during the first year of operation adds up to ₱2,372,260 while net income after deduction of interest and taxes amounts to ₱380,312.

Profitability indicators show that the plant has a return on investment of 46.70 percent and a payback period of 2 years. The

venture is, therefore, highly profitable and allows the recovery of investment over a relatively short period of time.

Utilization

Soy tempe flour is a highly nutritious food source which can be used as a protein fortifier for weaning food mixtures and bakery products such as cookies, doughnuts, polvoron and hot cakes. The target clientele are producers of bread and flour-based products.

Environmental and other positive qualities

The production of soy tempe flour is environmentally friendly because it leaves very little waste. The only waste materials generated are the hulls of soybeans, which can be recycled either as organic fertilizer or animal feed and the slightly acidic water where soy beans were soaked, which can be easily neutralized with any weak base before disposal.

Other positive qualities of soy tempe flour is its being an excellent alternative source of protein and its high nutrient content. Moreover, it can also help fill in the supply of flour whenever traditional flour run out of supply, thus, cushioning the market.

Product substitute

Soy tempe flour can substitute for the traditional edible flour particularly those in the cereal flour group. Data on the domestic production of traditional flour are not available. On the other hand, the increasing imports by the Philippines of cereal flour means that a portion of the local market has not been met by local production. This implies that, at present, there is still room for soy tempe flour in the market to satisfy unmet local flour demand.

International market

Soy tempe flour is not yet commercially produced, thus, data on its export is not available. However, it has been estimated that in the year 2010, total tempe flour consumption in Asian developing countries alone will reach about 470,800 metric tons. This signifies a large international market for soy tempe flour in the coming years.

The international market potential of Philippine produced soy tempe flour can be gauged from the performance of its substitute. Exports of cereal flour grew substantially during the last five years, indicating the acceptability of locally produced flour in the international market. If soy tempe flour can establish itself as a viable substitute for cereal flour, then it can possibly capture a share of the export market in the coming years.

Squash flour

General profile

Squash flour is a flour substitute produced from the squash vegetable. The technology for squash flour production was developed by FNRI in 1989 using its own funds. The production of squash flour is now ready for commercialization.

The sources of data and information used for the discussion below are Molano et al. (1989) and the interview of Molano.

Production structure

Material inputs. The major material input in squash flour production are matured squash fruits which are locally abundant. The other input is sodium metabisulfite which is used to prevent browning reaction and thus, lengthen the shelf life of the product. The second input is imported.

Production Technology. The processes involved in squash flour production are simple. First, ripe squash fruit is weighed and washed, cut into segments and deseeded, then peeled and sliced about two mm thick. The slices are partially dried, steam blanched for 10 minutes, and dried down to a final moisture of five percent. Finally, the dried slices are pulverized to 60 mesh fineness and packed in polypropylene plastic bags.

Production of squash flour is labor-intensive and does not require sophisticated machines and processing techniques. Also, the machines needed for production are already available in the local market.

Production capacity

There is no data on industry production because squash flour still has to be commercialized although the annual production capacity of a plant is estimated at 9,336 kg.

Production Economics

A preliminary analysis of the financial viability of squash flour production was prepared by FNRI. The initial investment requirement for a plant producing squash flour at 1992 prices is ₱774,783. Investments include land and building improvement, equipment, working capital, pre-operating expenses and contingency expenses. It is assumed that 60 percent of the investment requirement will be borrowed from a commercial bank at an interest rate of 17 percent and payable in five years.

The production costs of a plant in one year of operation can run up to ₱1,251,321 including those spent on direct materials, direct labor and production overhead.

Based on an annual production volume of 9,336 kg of squash flour and a price of ₱236.58 per kilogram, gross sales is ₱2,208,708 with a net income of ₱353,350 after production costs,

interest and tax have been deducted.

Finally, financial indicators prove the high profitability of flour squash production, with a return on investment of 45.61 percent and a payback period of 2.2 years.

Utilization

Like cereal flours and soy tempe flour, the squash flour is used in the production of bread and other bakery products. It is highly nutritious and contains 4.4 g of protein, 191 calories of energy and 5,860 micrograms of beta-carotene per 100 gram sample. Its target clientele are bakeries.

Environmental and other positive qualities

In contrast to the production of traditional cereal flours, the production of squash flour is very manual, thus resulting in less pollutive effluents. The product has likewise found another use for squash which might rot and be wasted if not disposed of in the market. Squash flour production, therefore, is a good alternative processing technique for vegetables in order to minimize postharvest losses. Production of squash flour will likewise increase the income of squash growers.

Product substitute

Like soy tempe flour, squash flour can substitute for commercially available flour, particularly in the cereal flour group. Because of lack of industry data, cereal flour production and sales are not discussed here. The imports of cereal flour was already discussed in soy tempe flour in the preceding section.

International market

The discussion for the international market potential of squash flour is similar to that of the soy tempe flour in the preceding section.

Rice mongo curls

General profile

The production of rice mongo curls, a snack food made of rice and mungbeans, has been developed by FNRI since 1983. The research and development of the product was funded by the Institute while commercial production, initiated in 1984, was financed by the Kilusang Kabuhayan at Kaunlaran (KKK) Program. Unfortunately, production was halted a few years later mainly due to lack of financial resources for plant operations and lack of market for the product. At present, rice-mongo curls are not sold commercially although there are efforts to reintroduce the product to potential investors.

The sources of data and information for this discussion are FNRI (1991) and Cilindro et al. (1983) and the interview of Cabagbag.

Production structure

Material inputs. The material inputs for rice mongo curls production are rice, mungbeans, skimmed milk, food color, flavors, and vegetable oil. Except for skimmed milk which is imported, all material inputs can be bought in the local market.

Production technology. The production technology for rice-mongo curls is developed locally.

First, rice and mungbeans are grounded separately to 20 mesh size grits. Then, seventy parts of rice grits, 25 parts of mungbean grits and 5 parts skimmed milk are thoroughly mixed in a rotary mixer. Sufficient amount of water is added to adjust moisture content to approximately 16 percent. The mixture is passed through a preheated extruder cooker to obtain puffed extrudates which are then dried in an oven or forced draft dryer until they become crispy. The crisp curls are then placed in a rotary mixer for additional vegetable oil and a coating of food flavor. Afterwards, they are packed in polypropylene bags.

Production of rice-mongo curls is labor-intensive and suitable as a small-scale industry. The production process does not require sophisticated equipment and techniques. Furthermore, the equipment needed are locally manufactured.

Production capacity

Current data on the industry's production capacity are not available as well as on plant level.

Production economics

The financial feasibility of operating a plant producing rice-mongo curls was undertaken by FNRI. At 1991 prices, the investment requirement for such an operation is ₱1,648,303. Investment covers land and building improvement, equipment, working capital for three months of operation, pre-operating expenses and contingency expenses. Of the total requirement, 60 percent can be loaned at an interest of 14 percent, payable annually within five years.

The total annual costs of production of the rice-mongo curls plant is ₱3,831,917. This is broken down into expenses on direct materials, direct labor and production overhead. Based on an annual production volume of 3.74 million packs and a price of ₱1.53 per pack, gross sales is ₱5.605 million while the net income after tax is ₱898,472.

The return on investment of the plant is estimated at 54.51 percent while payback period is 1.8 years which means that the plant is highly profitable and investment can be recovered in only

a short time.

Utilization

Rice-mongo curls are nutritious snack foods rich in protein. It has high nutritional value because it is a wholly cereal-based food product. The product is ideal as a small-scale industry in rice and mongo producing regions in the country. Target consumers are avid snack eaters and schoolchildren.

Environmental and other positive qualities

The production of rice mongo curls have two environmentally preferable qualities. First, the product does not contain any chemical additive, common in other snack items, and is thus perfectly harmless to consumers. Second, production is simple and does not involve mechanical processes which might result in pollutive wastes.

Being a suitable small-scale industry, the production of rice-mongo curls can be an economic boon to the countryside. It will raise rural income, especially among rice and mongo farmers, as well as employment level.

Product substitute

Any snack item available in the market, especially curls and chips, is a substitute for rice-mongo curls. At present, no data on the production of substitutes are available. On the other hand, the Philippines has been importing potato snack products and biscuits in high volumes. This means that there is a portion of the local market for snack products which cannot be met by local production, opening the way for other products like rice-mongo curls to enter as substitutes into the market.

International market

Since rice-mongo curls are not commercially sold in the domestic or international market, a way of assessing its export potential is to look at the trade performance of its substitutes. The Philippines have started exporting potato snack products in 1992 and biscuits in the last five years except 1990. The export figures indicate that snack products produced locally are already acceptable to foreign consumers and that rice-mongo curls, being a snack substitute, has a potential export market as well. Net exports have been positive in recent years indicating the high potential of local snack foods abroad.

High fiber mango drink

General profile

High fiber mango drink is a refreshing fruit drink fortified

with vitamin C developed by the FNRI. Research and development activities on the product are undertaken using institute funds. At present, the product is still in the development stage.

The sources of data and information are FNRI (1994) and the interview of Molano.

Production structure

Material inputs. The inputs for the production of the high fiber mango drink are fresh ripe mango fruits, nata de coco, sugar, and Food and Drugs Authority (FDA)-approved additives. Except for the additives, the inputs are available locally.

Production technology. The technology for high fiber mango drink production is locally developed. The production process is described below.

First, nata de coco puree is mixed with mango pulp puree. The additives are then added to the mixture. Afterwards, the mixture is poured into 500 ml general purpose glass bottles, which are sterilized for 15 minutes at 85 degrees centigrade in a double boiler. Finally, the bottles are labeled and sealed with metal caps.

The production of high fiber mango drink is labor-intensive but utilizes simple equipment only.

Production capacity

Because the product is still in the development stage, there is still no industry at present. It is estimated, however, that a commercial plant will produce about 300,000 pieces of 500-ml bottles per year.

Production economics

The FNRI conducted a financial analysis of the production of high fiber mango drink to assess its profitability as a commercial enterprise. The investment requirement, broken down into land and building improvement, equipment, working capital, pre-operating expenses and contingency expenses, at 1994 prices is ₱2.02 million. Sixty percent of the amount is loaned at an interest rate of 17 percent and payable annually within five years.

The total annual production cost of the commercial operation is ₱5.7 million. Direct material cost is 70 percent of the total production cost, production overhead is 27 percent and direct labor is 3 percent. With an annual production rate of 300,000 pieces of 500-ml bottles, gross sales is ₱8.2 million and net income after tax is ₱1.3 million.

The return on investment of the production operation is 65.45 percent with a payback period of 1.5 years. Therefore, high fiber mango drink production is a highly profitable venture that allows the investor a short time to recoup his investment.

Utilization

The high fiber mango drink will help solve the vitamin C deficiency in the country based on FNRI estimates that the mango drink can supplement one-third of the daily vitamin C requirement. The target clientele is the whole population, especially those who are vitamin C deficient.

Environmental and other positive qualities

The production of high fiber mango drink optimizes the use of indigenous materials while minimizing postharvest losses of the mango fruit, currently estimated to be 50 percent of harvest. The production process is simple and does not result in a lot of residues that can pollute the environment.

Beyond these environmental advantages, drinking mango juice is healthful because of its vitamin C content. Production will also raise income and employment level not only among producers but also mango growers, coconut producers and nata de coco manufacturers.

Product substitute

Substitutes for high fiber mango drink are other fruit juice drinks made from orange, grapefruit, pineapple, tomato, and others. The country has been importing fruit juices at significant levels since 1988 which implies the presence of a large local market for fruit juices. This market can be exploited by high fiber mango drink producers if they can prove their product's competitiveness in terms of price, quality and availability.

International market

Since high fiber mango drink is not yet commercially produced, it might help to take a look at the foreign market of its substitutes as the gauge for its own potential as a tradable commodity. From 1988 to 1992, the country has been exporting fruit juices at a high rate which may mean that locally produced fruit drinks are already known to foreign consumers. In effect, the potential for export of mango drink is also large assuming that the product meets stiff international standards.

Banana peel vinegar

General profile

Banana peel vinegar is developed by the Home Resources Management Section, Special Services Division of the Agricultural Training Institute (ATI), DA, using its own funds. At present, it is already being commercially produced on a backyard scale, mostly by homemakers. The product is not yet exported.

The sources of data and information are PNB (1991) and the interview of Jimenez.

Production structure

Material inputs. The inputs needed in banana peel vinegar making are locally available like the peels of banana of the cooking varieties, sugar, and water.

Production technology. The production technology for banana peel vinegar is local in origin and is patterned after the technology for producing other vinegars such as coco and palm vinegar.

To produce banana peel vinegar, banana peels are first thoroughly washed and cut into squares which are then placed in a jar with a mixture of sugar and water. The jar is then covered with a clean cloth to allow alcoholic fermentation to occur. The mixture is stirred at times until banana peels are submerged and the froth which formed above the mixture is removed.

After four weeks, when the fermentation process is completed, the mixture is drained to extract the vinegar. The vinegar is then stored in clean bottles. In order to maintain the acidity level of the vinegar, it must be pasteurized. There are two ways to do this. One is to put the bottles of vinegar in a casserole with water and heated at 65 degrees centigrade for about 20 minutes. The other is to place the vinegar in an enamel casserole then subjected to heat at the same temperature and length of time. All in all, three bottles of vinegar can be produced from one cup of banana peels, four cups of water and one-half cup of sugar.

As a small-scale business venture, banana peel vinegar making is labor-intensive and requires simple production equipment only.

Production capacity

A study which analyzes the banana peel vinegar industry has yet to be done. Thus, at present, data on production performance in both industry and plant level are not available.

Production economics

A financial analysis of banana peel vinegar production is not available based on both literature and the interview with ATI. Nevertheless, banana peel vinegar making is a venture which requires low initial capital because of inexpensive equipment and raw materials needed in the backyard scale production. At present, it is estimated that the production cost for three bottles of banana peel vinegar produced is ₱1.30 and the selling price per bottle is ₱3.50. This indicates that a commercial production is highly profitable.

Utilization

Banana peel vinegar, like ordinary table vinegar, is used as condiment or seasoning in different dishes. Since its production requires low investment, many homemakers and other backyard operators have ventured into this small-scale business whose main

clientele are usually neighbors as well as buyers from nearby places.

Environmental and other positive qualities

Three qualities of banana peel vinegar production which make it environmentally preferable are: a) the utilization of banana peel as input makes good use of an abundant agricultural waste; b) the reuse of production waste materials, i.e., banana peels, either as supplementary feeds for animals like hogs, or as organic fertilizer, result in no pollutive discharges; and c) the safeness of the product in food because it has no chemical content which is detrimental to human health.

Banana peel vinegar production will raise employment level and income of the rural poor as well as increase returns from the small-scale banana industry in the countryside.

Product substitute

The substitutes for banana peel vinegar are those made from coco, palm, sugarcane and other. Information on the domestic production of these products are not available, however, the country's vinegar import has been declining in both value and volume. This may mean that local vinegar brands have become competitive and popular in the local market and have become substitutions for imported ones. In turn, this suggests that banana peel vinegar should have a ready domestic market, assuming it is competitive with other local vinegar brands in terms of price, quality and availability.

International market

The Philippines has been exporting vinegar from 1988 to 1992 and both the volume and value of exports have been growing at a healthy rate annually. Therefore, locally produced vinegars are already used by foreign consumers. If banana peel vinegar will prove to be an internationally viable substitute to other vinegar brands, then it will be a potential exportable commodity in the future.

Sodium silicate from rice husk

General profile

A study on the production of sodium silicate from rice husks was undertaken in 1989-1990 at ITDI under a joint financial funding assistance with the Philippine Council for Industry and Energy Research and Development (PCIERD). Since then, succeeding studies have been conducted under a project financed by the Japan International Cooperation Agency (JICA). The product is still in the development stage.

The sources of information are PCIERD-ITDI (1991) and the interview of Pigao.

Production structure

Material inputs. The material inputs required for producing sodium silicate are rice hull ash and sodium hydroxide. Both material inputs are available locally, the rice hull ash is obtained by burning rice husks in a furnace or incinerator.

Production Technology. The original technology for the production of sodium silicate from rice husks was developed in Japan. This was refined and adapted for local use. The local technology is described in the succeeding paragraphs.

Rice husks are burned under controlled time and temperature conditions in a furnace or incinerator. The ash produced is then pulverized and mixed with sodium hydroxide and heated under pressure for one hour. After that, the nonreactant residue is filtered out and the solution is brought down to the desired concentration level.

Production of sodium silicate from rice husks is both labor and capital-intensive since it requires careful handling of material inputs by manual labor as well as expensive production equipment such as the furnace or incinerator and pulverizer.

Production capacity

As mentioned, the local technology for the production of sodium silicate from rice husks is still in its development stage. Thus, production at the commercial level has not been done yet and data on the production capacity at plant level are also unavailable.

Production economics

A complete financial analysis of a commercial operation for sodium silicate from rice husks has yet to be made. Preliminary data, however, indicate that variable costs including material and energy costs, excluding labor costs, at 1991 prices was ₱35.81 for producing 9 kg of sodium silicate for silica gel production and ₱46.75 for producing 10.08 kg of sodium silicate for detergent production.

Utilization

Sodium silicate can be used as a component in both bar soap and powdered detergent. Other potential uses of the product are: as adhesive for corrugated boxes; starting material in the preparation of silica gel; bonding agent in ceramics and refractories; and anti-corrosion agent in water lines and tanks. The target clientele for the product includes producers of soap, paper packaging, pharmaceutical, chemical, ceramics and refractories and metal products.

Environmental and other positive qualities

The production of sodium silicate from rice husks is environmentally preferable because it uses rice husks, an agricultural waste produced in huge volumes by rice mills. The productive use of the husks reduces waste disposal problem. The production of sodium silicate from rice husks likewise raises the incomes of people in the rice industry through the sale of byproducts which otherwise have no economic significance.

Product substitute

Sodium silicate from rice husks is a substitute for imported sodium silicate. The imports of sodium silicate has been rising yearly at a healthy rate which means that locally produced sodium silicate from rice husks has a potential domestic market to exploit as long as the product can be competitive vis-a-vis imported sodium silicate.

International market

The country has not been exporting sodium silicate for several years implying that locally produced sodium silicate is still unknown in the international market. Therefore, the foreign market potential for sodium silicate from rice husk is weak in the short-run.

Silica gel from rice husk

General profile

The production of silica gel from rice husks is another technology developed by the PCIERD-ITDI project which has been likewise working on the technology for the production of sodium silicate from rice husks. At present, the technology for sodium silica gel from rice husks is undergoing refinement process under JICA funding.

The sources of information are PCIERD-ITDI (1991) and the interview of Pigao.

Production structure

Material inputs. In the production of silica gel from rice husks, the inputs are sodium silicate from rice husks and sulfuric acid which are locally available.

Production Technology. The technology for silica gel production from rice husks is foreign in origin. Modifications were done by ITDI to come up with a local technology as described below.

First, sodium silicate from rice husks is added to sulfuric acid which has cooled down resulting in a gel-like substance.

Water and sodium sulfate are extracted from by heating the gel-like substance at 70 to 95 degrees centigrade. The liquid is afterwards decanted and the dried solid mixture of glassy silica gel, silicon dioxide powder and sodium sulfate is passed through a sieve to obtain the silica gel. The gel is washed with water and filtered using a vacuum pump or basket centrifuge. Finally, it is dried at 110 degrees centigrade and activated at 190 degrees centigrade.

The above production process is both labor and capital-intensive since it requires careful manual handling of material inputs as well as the use of expensive production equipment.

Production capacity

Since the silica gel technology is still in the development stage, there are no data on commercial production nor of the production capacity at plant level at present.

Production economics

A full financial analysis of commercial silica gel from rice husks production has yet to be done. However, at 1991 prices, the estimated variable costs for the production of one kg of silica gel from rice husks, inclusive of material and energy costs and exclusive of labor, is ₦72.51.

Utilization

Silica gel from rice husks can be used as a desiccant in the pharmaceutical and chemical products. In addition, the product can be used in the drying and refining of industrial gases, recovery of inorganic solvent, as carrier in the production of petroleum cracking catalysts, and as raw material for the production of zeolites. The target clientele are the pharmaceutical and chemical industries.

Environmental and other positive qualities

Silica gel production utilizes sodium silicate from rice husks as its major material input. Thus, it solves yet another waste disposal problem and raises both income and employment levels in the rice industry at the same time.

Product substitute

Silica gel from rice husks is a potential substitute for the silica gel already available in the market. The domestic consumption of silica gel is not known although the importation of silica gel has been declining in the past years, probably because the locally produced gel has captured part of the market of imported gel. This indicates that there is a domestic market for silica gel which the local gel made from rice husks can take advantage of if it is competitive enough.

International market

In recent years, the volume and value of the country's silica gel exports have been relatively lower than imports but have been growing yearly at a fast rate. Thus, domestically produced silica gel is already familiar in the foreign market, which suggests that if silica gel from rice husks can be competitive at the international level, it may have a strong potential as an export commodity.

Synephrine from calamansi wastes

General profile

Synephrine is an adrenergic drug. The technology which uses calamansi wastes in the production of this drug has been developed by ITDI since 1991 using Institute funds. The technology is currently in the development stage.

The data and information in this discussion are solely from the interview of Briones.

Production structure

Material inputs. The material inputs in the production of synephrine from calamansi wastes are resins (for ion-exchange chromatography), acids, bases and calamansi wastes. Calamansi is a lemon which grows locally. Its peels, pulp and seeds are the wastes of processing industries. All the material inputs are locally available.

Production technology. The process for the production of synephrine from calamansi wastes is adapted from a foreign technology. The local technology is still being developed in the laboratory, thus, a description of the production process in detail is not available. In summary, the steps include the following: extraction of the product with water by distillation set-up; filtration by using Buchner funnel with vacuum pump; column chromatography; concentration through the evaporator; thin-layer chromatography using thin-layer chromatography plates; and crystallization.

The use of several equipment makes the production capital-intensive. Because of the highly technical nature of the production steps, skilled labor is required.

Production capacity

Since production of synephrine from calamansi wastes is still being developed, estimates of the production capacity at plant level are not available yet.

Production economics

A financial feasibility analysis of a commercial production

operation has not been done yet while preliminary data on the costs of production are not available.

Utilization

Synephrine from calamansi wastes is an adrenergic drug used as heart stimulant, as vasoconstrictor in controlling skin hemorrhages and as muscle relaxant in bronchial asthma. The target users of the product are people with the mentioned ailments.

Environmental and other positive qualities

One of the environmental qualities of synephrine production is the utilization of calamansi wastes. Thus, the technology solves the waste disposal problem of agro-industrial processing plants. Another positive quality is that the product is safe because of its natural ingredients. Moreover, the product increases the income of the calamansi processing sector as well as the calamansi growers.

Product substitute

Synephrine from calamansi wastes is a potential substitute for epinephrine, a drug product which has synthetic chemicals in its formulation.

International market

Data on the international trade of the product synephrine or epinephrine are not available.

Coco-diesel fuel

General profile

The technology for the production of coco-diesel fuel from coconut oil, to be used in internal combustion engines, has been developed by ITDI using its own funds. The technology is still in the development stage.

The data and information used in the following discussion are from de la Paz (1983) and ITDI (1993).

Production structure

Material inputs. The major material inputs in the production of coco-diesel fuel are ordinary diesel fuel and purified coconut oil. Coconut oil can be extracted either from matured, whole coconut or from dried coconut meat or *copra*. These material inputs are locally available.

Production technology. The manufacture of coco-diesel fuel is foreign in origin. The processes involved are as follows. First, the coconut oil is dehydrated then mixed with ordinary fuel at a ratio of five to 30 percent volume of coconut oil to 70 to 95 percent volume of ordinary diesel fuel. The mixture is afterwards

filtered and polished by making it pass through super fine filters and then tested if it meets the standard specification for coco-diesel. If the fuel does not meet the standard specification, the ratio between coconut diesel and fuel content of the mixture is adjusted. Quality test is repeated until the standard is met and once it does, the fuel product is stored. The whole production process is labor-intensive.

Production capacity

There is no data on the production capacity in both industry and plant level since coco-diesel fuel is not yet commercially produced.

Production economics

A full financial analysis of a commercial production operation is not available as well as simple cost and return estimates of production.

Utilization

Coco-diesel fuel is highly suitable for internal combustion engines and its production will target the owners of diesel engine cars and vehicles as well as other users of diesel fuel.

Environmental and other positive qualities

Coco-diesel fuel is environmentally preferred because of its lower diesel fuel content, which leads to less air pollutants emitted from cars and other machines and equipment using diesel fuel.

Coco-diesel fuel production will also increase the demand for coconut oil and raise the price of copra. Thus, it will raise incomes in the coconut industry.

Product substitute

Coco-diesel can be a substitute for diesel fuel. There is no available data on diesel fuel production in the country. However, in general, the production of petroleum products in the country has been declining and has since stopped in 1992. On the other hand, the country has been importing diesel fuel at substantial levels which have been gradually increasing every year. Thus, if coco-diesel fuel can be competitive, it may have a strong domestic market potential as substitute for imported diesel fuel.

International market

The Philippines exported diesel fuel in 1988 and 1989 but stopped doing so after the second year. It appears, therefore, that the potential for coco-diesel fuel in the international market, at least in the short-term, is weak.

Agricultural fibers as textile raw materials

General profile

Fibers, natural or man-made, are important raw materials in textile production. Among the natural fibers are the agricultural type, of which cotton is the most widely used worldwide. In the Philippines, however, cotton production has been constrained by limited suitable land and adverse climatic conditions. As a result, the bulk of cotton requirements of the textile industry of the country is imported.

The Philippine Textile Research Institute (PTRI) identified in 1974 some plants as potential sources of fibers in the production of textiles. Among these are banana, abaca, pineapple, and maguey which are produced in abundance in the country. Over the years, research and development on these plant fibers have continued although at present, none of these plant fibers has been produced on a commercial scale.

The data and information used come from the joint SERFDI and UP-ISSI study (1994) and the interview of de Guzman.

Production structure

Material inputs. Banana trunks are used in the manufacture of banana fiber. These are found in abundance in the countryside with approximately 330,540 hectares of land all over the country planted to bananas.

The abaca trunk is the raw material needed in the manufacture abaca fiber. Like bananas, abaca is grown on a large-scale since this has been one of the country's traditional exports.

Pineapple leaves are the raw materials for pineapple fiber. The pineapple plant is produced abundantly since the country is home to some large pineapple plantations.

Finally, fiber is obtained from maguey leaves. At present, maguey can be sourced from Cebu, Bohol and the Ilocos provinces.

Production technology. Production of fiber and textiles from trunks or leaves of plants begins with decortication, the process of removing pulpy material from the trunks or leaves either by handstripping or using a decortivating machine.

After decortication, there are four main processes involved are: fiber pretreatment; spinning; weaving; and fabric finishing.

Fiber pretreatment involves conversion of the decorticated fiber into spinnable form via a series of chemical and mechanical treatments.

Spinning involves conversion of the pretreated fiber strands into a single yarn to the desired fineness and twist. This is done by blending the pretreated fiber strand with polyester staple fiber through a series of mechanical processes.

Weaving involves the interlacing of warp and weft yarns to

form the greige fabric. The warp yarns are yarns running lengthwise in a woven fabric while the weft yarns run from selvage to selvage or at right angles to the warp.

Finally, finishing of the fabric involves the improvement of the appearance, smoothness, handle and performance of the greige fabric thru the application of appropriate finishing processes.

The technology for producing textiles from natural fibers such as *abaca*, banana, pineapple and maguey is a combination of local and foreign technology. The technology for fiber pretreatment is being developed by PTRI. The technology for spinning, weaving and fabric finishing is foreign like what is used in conventional textile production.

The technology for textile production using natural fibers is capital-intensive. The equipment needed include the decorticating machine, carding machine, intersecting gill, roving frame, spindle, weaving machine and fabric finishing machines.

The processes of decortication, weaving and dyeing of the natural-based fabric, however, can be labor-intensive assuming that machines and equipment used in these processes are replaced with manual labor.

Production capacity

Textiles from natural fibers are produced on a research and development basis only. At present, the PTRI is not properly equipped to produce textile materials on a commercial scale. Likewise, the textile industry has not produced any textile material using agricultural fibers.

Production economics

The PTRI gave a rough preliminary estimate of initial capital investment at P5 million for an agricultural fiber-based commercial production of textile. A sizable portion of this investment goes to the pre-treatment plant. The PTRI estimated the cost of their pre-treatment plant at late 1970s price at P125,000.

Given that the use of agricultural fibers for textile production is still in the research and development stage, a full financial evaluation of a commercial production operation is not available yet. The PTRI, however, estimated that the production of textile using agricultural fiber costs P302.00 per kg in 1990, greater than the production cost of textiles using the traditional material cotton. Thus, it appears as of present, that the use of agricultural fibers in textile production is more costly than the use of cotton.

Utilization

Textiles made from garments, sacks, suiting materials, industrial fabric, household linens and upholstery materials. The use also extends to some industrial application including

construction.

The PTRI promotes the use of garments produced from textiles made from agricultural fibers by featuring the garments in fashion shows, product exhibits, newsletters and magazines. Since local technology is not yet established, promotion is focused mainly on finished products and not on the textiles made from agricultural fibers themselves.

Environmental and other positive qualities

The environment-friendly attributes of textile made from natural fibers are the use of agricultural waste materials such as banana trunks and pineapple leaves, and the substitution of chemical-based fibers with natural fibers produced with little pollutive wastes.

There is a major potential economic benefit in processing textiles out of natural fibers. In 1992, the country spent about US\$640 million in order to import conventional textile materials,

mainly cotton, polyester and other natural and synthetic fibers. If the country successfully commercializes the production of agricultural fibers, there will be less need for importing fiber materials, thus the country is able to save much needed foreign exchange.

Product substitutes

Conventional textile materials such as natural fibers like cotton, flax, ramie, wool and synthetic fibers (polyester, nylon, rayon, etc.) are the substitutes for agricultural fibers. However, in textile production, substituting one fabric with another is not appropriate. This is because each fabric has its own characteristic and possesses desirable qualities suited for specific uses. However, it was reported that the PTRI has been able to duplicate the minimum physical attributes of a conventional cotton fabric in agricultural fibers.

International market

The potential export market for agricultural fiber-based textiles includes the United States, Europe, Japan and Asian countries. These countries are traditional markets for textile and garment exports of the Philippines. Thus, assuming that textiles made from agricultural fibers can eventually compete in terms of price and quality, then there is a potentially very large market waiting for these products.

Tobacco waste as molluscide

General profile

Tobacco waste can be used as a toxicant which can eliminate the major pest in rice culture, the golden or miracle snail locally known as *kuhol*. The use of tobacco waste as snail control agent was discovered by scientists at the National Tobacco Administration-Main Research Center (NTA-MRC) in the northern town of Batac, Ilocos Norte. The technology has already been tried by some local rice farmers.

The sources of information is based on the interview of Castro.

Production structure

Material inputs. The main material input in the production of the tobacco waste molluscide are mainly the top leaves of tobacco plant left unharvested in the field and tobacco leaves which turn into waste and fail quality control test.

Production technology. Producing molluscide from tobacco waste involves a very simple step: dried tobacco wastes are chopped into pieces and used directly on paddies one day after transplanting the rice plants. About 200 kg of chopped tobacco wastes is adequate for every hectare of paddy.

The technology for producing this molluscide is locally developed. It is labor-intensive and does not involve any mechanical processes.

Production capacity and sales

As mentioned, the use of tobacco wastes as molluscide has been tried by rice farmers. However, the extent of their use is not known.

Production economics

There are no data on the production of molluscide from the wastes of tobacco. Given that it uses wasted leaves only as input and is labor-intensive, the product is not likely to be cheaper than manufactured insecticides and molluscides.

It is also estimated that use of this product by rice farmers instead of commercial molluscides will generate about P420.00 of added income per hectare per cropping.

Utilization

Tobacco wastes as molluscide controls the infestation of ricefields by *kuhol*, a voracious snail which feeds on young rice plants. It is estimated that about 130,946 hectares of ricelands are now infested by the snail. Thus, the target users of the molluscide from tobacco wastes are the lowland rice farmers, in

both irrigated and rainfed areas.

Environmental and other positive qualities

The production of molluscicide from tobacco wastes does not produce pollutive effluents. The product is biodegradable and harmless in contrast to those sold in the market which can damage both environment and the health of rice farmers.

The use of tobacco wastes as molluscicides will give employment and extra income to people in the tobacco and rice industries as well as save foreign exchange when they are substituted for imported insecticides.

Product substitute

Molluscicide from tobacco wastes is a substitute for molluscicides and insecticides, mostly imported, presently used in the control of *kuhol*.

International market

It is not known whether *kuhol* infestation is a problem common in other rice producing countries. If it is, there may be potential for this product to be exported. If not, then the product will be useful to our local farmers only.

Particleboard from tobacco stalks

General profile

Production of particleboard from agricultural wastes will also be discussed in a section on woodwool cement board. The waste material used in that type of particleboard is *ipil-ipil*. On the other hand, this particleboard is made of tobacco stalk.

The particleboard from tobacco stalk has been developed by the NTA. It was shown to be profitable and had passed quality standards. However, available data did not state if particleboard from tobacco stalk is produced commercially at present.

The source of information for this discussion is Castro et al. (1994).

Production structure

Material inputs. As stated, the main input in the production of this particle board is tobacco stalk, a waste material which is left or thrown out after the tobacco leaves are harvested. Tobacco plantations are abundant in the Ilocos region.

The other material is urea formaldehyde resin which is used as an adhesive material.

Production technology. There are six main processes involved in the manufacture of particle board from tobacco stalks. These are

stalk collection and preparation, preparation of adhesives, spraying and tumbling, mat forming, hot pressing and conditioning and trimming.

In stalk collection and preparation, tobacco stalks are cut down after the last priming and are dried in the field for three weeks before they are hauled for processing. The dried stalks are cleaned, chopped into 20 to 40 mm pieces and oven-dried to reduce moisture content to four percent.

In the second process, the preparation of urea formaldehyde is based on the predetermined dimension, density and resin content level of the finished board. On the other hand, in the spraying and tumbling process, adhesive is sprayed on the stalk particles inside a tumbling box using a spray gun.

Mat forming follows. The particles are removed from the tumbling box, distributed and levelled evenly by hand, layer by layer, on the stainless caul. The caul has a removable wooden frame to hold the particles.

After mat forming, the mats are placed under a hydraulic hot press. Once this is done, the boards are finally taken out for conditioning and trimming. They are stacked in the open air for not less than five days in order to allow complete curing and polymerization of the resin adhesive. Then, they are trimmed down to desired sizes.

Producing particle boards from tobacco stalk is labor-intensive even though capital equipment, namely, spray gun and hydraulic hot press are utilized.

Production capacity

There is no available data on the industry capacity of particle board production from tobacco stalks. However, it is estimated that an individual farmer can produce 50 pieces of standard boards from the wastes of a one-hectare tobacco plantation.

Production economics

There is no detailed financial profile for the manufacture of particleboard from tobacco stalks. Available data suggests, however, that a tobacco farmer with an average-sized farm can earn ₱3,000.00 from such a production. This estimate is based on a selling price of ₱600.00 per piece of particle board and a 10 percent raw material cost.

Utilization

Like other particleboards produced from other wastes, particleboard from tobacco stalks can be used as walls and ceilings in low-cost housing. It can also be used as panels and decors.

Environmental and other positive qualities

One environmental advantage of producing particleboards from tobacco stalks is the use of waste materials which helps in the conservation of wood that is commonly used as particleboard materials. This is also true for other waste-based particleboard production.

Tobacco farmers will benefit through additional income and employment. Likewise, members of low income groups will benefit more in terms of lower housing construction cost.

Product substitutes

Like other waste-based particleboards, particleboards from tobacco stalk can replace conventional wood-based particleboards in the construction of walls, ceilings, decorative panel or dividers.

International market

The international market potential for particleboard from tobacco stalk will not differ much from that of other boards such as the woodwool cement board.

Mykovam-1

General profile

BIOTECH has been developing biofertilizers that can be used to grow various crops. One of these is Mykovam-1, a soil-based biofertilizer in a powdered form, which contains a mixture of spores, infected roots and propagules of three endomycorrhizal fungi that promotes survival, growth and yield of plants.

Research on Mykovam-1 began in 1988 using institute funds. In three years, the product has been produced commercially by BIOTECH. There are available written materials in the form of brochures and papers and handouts which explain the production of Mykovam-1.

The source of information in this discussion is the interview of Zonate.

Production structure

Material inputs. There are four basic material inputs in the fabrication of Mykovam-1: soil, sand, grass and mycorrhizal spores. All these can be found locally. Grass and mycorrhizal spores can be obtained from the mycorrhizal laboratory of BIOTECH.

Production technology. The technology used in the manufacture of Mykovam-1 is entirely developed by BIOTECH.

To produce the fertilizer, soil and sand are collected and sterilized for about eight hours in an oven. Afterwards, they are placed in plastic cups and then planted with grass and mycorrhizal spores. The cups are kept inside a screenhouse for four months.

The roots and soil are harvested after four months and then

tested for consistency of physical properties. If it passes quality control, they are then packed in one kg plastic bags for storage and distribution.

Producing Mykovam-1 is very labor-intensive although it involves only one major equipment, the plastic sealer.

Production capacity

BIOTECH is currently the only producer of Mykovam-1. In 1994, the actual output was estimated at five tons but the maximum capacity of BIOTECH is nine tons. This year, BIOTECH plans to produce 18 tons of Mykovam-1 and from 1997 to 1999, it plans to produce about 25 tons a year.

Production economics

According to BIOTECH, production cost per unit of Mykovam-1 is ₱10.00 per bag. The current selling price per bag is about ₱25, therefore, a profit of ₱15 per bag. On the other hand, the initial capital investment needed is ₱10,000.00 including investment in a plastic sealer. Sales of BIOTECH from Mykovam-1 amounted to ₱16,560.00 last year. This year, the institute projects an increase of sales to ₱20,000.00.

Utilization

Mykovam-1 is a biofertilizer which can be used to grow a host of agricultural crops and fruit and reforestation trees. Its application extends to upland rice, corn, tomato, peanut, mungbean, eggplant and other agricultural crops. It can also be used on fruit trees like papaya, guava, guyabano and citrus and reforestation trees like narra, acacia mangium, falcata, mahogany, yemane and others.

Environmental and other positive qualities

Mykovam-1 is an environmentally friendly product because its production does not involve any chemical and other environmentally adverse inputs. Its major raw materials are soil, sand, and mycorrhizal spores which are all natural substances.

In addition, the use of Mykovam-1 enhances the natural growth of plants. Therefore, it raises income in farming through increased yield.

Product substitute

Currently, conventional fertilizers can be used in place of Mykovam-1. Many of these fertilizers, however, specifically the chemical fertilizers, have adverse impacts on human health and the environment.

International market

Mykovam-1 is currently marketed domestically but BIOTECH soon

plans to export the product to Asian countries such as Indonesia and other agriculture-based economies. The export potentials of Mykovam-1 is similar to that of other biofertilizers already discussed in this report (see discussion on slow-release fertilizer).

Multi-crop solar dryer

General profile

The multi-crop solar dryer is a simple dryer developed by NTA for flue-curing tobacco and drying other crops. The dryer was designed in response to high fuel cost for flue-curing and the scarcity of fuelwood. It was designed particularly for local farmers who can construct it using locally available materials at a cost comparable to the conventional domestic barn.

Research and development on the multi-crop solar dryer started in the early 1980s and was completed in 1988 using institute funds. It was then packaged for commercialization in 1992 through funds sourced from the ASEAN-Canada Project on Solar Energy in Drying Processes. It appears from the literature, however, that the product has not been actually commercialized at present.

The sources of information in this discussion are Castro et al. and NTA, both are undated.

Production structure

Material inputs. Inputs in the production of the multi-crop solar dryer include the following: for foundation and footing include portland cement, rebar and tie-wire; for structure and heating system, tanguile-rough, G.I sheets, angle bar, lawanit, nails and hinges; for collector glazing and painting, polyethylene sheet, enamel paint and paint thinner; for drying trays, welded wire, aluminum screen, tanguile, and nails; and for the expandable materials, welding rod, hacksaw blade and paint brush.

Majority of the materials required can be found locally. In the operation of the multi-crop solar dryer system, the main fuel is solar energy which is adequate during the hot months of summer. However, fuelwood is used as a supplement when there is inadequate solar energy.

Production technology. The finer aspects of the construction of the multi-crop solar dryer is discussed in detail in Castro et al. (undated). The standard dryer measures about 3.72 by 6.00 meters at the base and 2.00 by 6.00 meters at the top with the overall height of 3.95 meters. Its roof and walls are made of corrugated galvanized iron sheets painted in black and provided with polyethylene plastic glazing which serve as solar energy collectors. The walls face the east-west direction.

The essence of operation of the multi-crop solar dryer is its passive greenhouse effect. The roofs and east and west walls collect solar energy. The structure is air-tight to minimize heat losses from infiltration while the gravel bed act as storage medium.

The multi-crop solar dryer operates as follows. Solar energy that strikes the black walls and roof through the plastic glazing is absorbed through radiation and convection. Some of the stored energy in the gravel bed, on roof and walls will be used when the amount of solar energy required to dry crops is not enough. An aluminum reflector absorbs additional heat whose angle is adjusted every hour in reference to the sun. The plastic glazing can be either of single layer continuous, single layer panelized or double layer panelized form.

Production capacity

The multi-crop solar dryer has an estimated maximum capacity of curing a total volume of about 46.8 cubic meters of crop leaves. Aside from tobacco leaves, the dryer can be used in drying crops such as corn, garlic and soybeans among others. However, there is no data available indicating the number of multi-crop solar dryers produced so far.

Production economics

The multi-crop solar dryer is adapted to the know-how and investment capacity of the farmer. It costs lower than a drying barn of the same capacity.

The total cost of materials in putting up a multi-crop solar dryer to accomodate the yield of a one-hectare farm is ₱66,052.00. On the other hand, the material cost for a corresponding conventional concrete barn is ₱76,644.00. This difference represents a ₱10,592.00 savings in material costs. In addition, the use of multi-crop solar dryer saves up to 50 percent of fuelwood consumption compared to the conventional dryer.

The NTA did not provide data on the profitability of using the multi-crop solar dryer in curing tobacco and other crops. However, based on fuel savings alone, a farmer could save up to ₱6,000 per hectare in his operations. This savings is expected to increase as fuelwood becomes more scarce and costly.

Moreover, the multi-crop solar dryer has a year round application as it can be used in drying other crops when tobacco is not in season. Investment in multi-crop solar dryer is fully maximized since tobacco curing is done during summer months when solar energy is at its peak.

Utilization

Although it is designed mainly in flue-curing tobacco, the multi-crop solar dryer can also be used for drying crops such as

tobacco, garlic, corn and soybeans.

Environmental and other positive qualities

The multi-crop solar dryer is environmentally preferable and economically advantageous over other conventional type of dryer. It saves on fuelwood by as much as 50 percent and maximizes the use of solar energy. With the growing scarcity of fuelwood due to rapid depletion of forests, the multi-crop solar dryer contributes to the conservation of wood resources.

The product also lessens pollution from the burning of fuelwood since it minimizes use of fuelwood and maximizes the use of solar energy.

The multi-crop solar dryer is economically advantageous over other dryers because of lower material costs required in its setting-up as well as lower operating costs.

Product substitutes

There are three general types of dryers which can substitute for the multi-crop solar dryer. The first type is the traditional concrete barn which is fuelwood-intensive. The second type is direct exposure to sunlight while the third type uses electricity or liquified petroleum gas as energy source.

International market

The product is not yet actually commercialized at present and is thus not exported. However, there is a high potential for the dryer to be sold in agriculture-based third world countries where wood fuel is usually scarce and oil fuel is even more scarce. Assuming that the multi-crop solar dryer can be competitive in terms of price and performance, farmers in third world countries should consider the product in drying their crops.

Forestry-Based Products

Charcoal briquette

General profile

The technology used in the production of charcoal briquette from agro-forestry waste products has been developed by FPRDI-DOST since 1956. The funding for research and development was provided

solely by the Institute. At present, the product is already commercially produced and sold domestically.

The sources of data and information for the discussion below are FPRDI (1992) and Today (1994).

Production structure

Material inputs. Charcoal briquettes are charcoal fines produced through the traditional charcoal making process and using suitable binders. Charcoal fines come from agroforest wastes such as coconut husk, coffee bean hull and coconut shell. Suitable binders can be corn starch, sweet potato starch, corn grits, clay, coal tar or molasses. All these inputs are available locally.

Production technology. The technology of briquetting started in Germany in the early 1900s and later disseminated to other countries in Europe.

In the Philippines, charcoal briquetting started with the use of imported briquetting equipment. Recently, however, FPRDI has designed and constructed a set of charcoal briquetting equipment to suit the specifications of small-scale manufacturers. This set of equipment, with a production capacity of 2 tons of briquette per eight-hour operation, is composed of a crusher, a charcoal-binder mixer, a briquettor, and a briquette dryer.

The processes involved are material preparation, binder preparation, mixing operation, briquetting and drying.

In material preparation, charcoal fines are produced by crushing lump of charcoals with a hammermill or any other crusher and screened through a 40-mesh metal strainer. The screening process separates the soil and other contaminants from the fines and results in uniform particle sizes.

The binder is then prepared by cooking the cassava flour or any substitute using the right amount of water, in order to form a glutenous substance, ranges from 35 to 65 percent of the weight of charcoal fines. On the other hand, the total amount of binder to be produced is about six percent of the weight of the charcoal fines.

In the mixing process, a proportionate amount of charcoal fines and binder is poured into the charcoal-binder mixer. Every particle of the charcoal fines should be coated with a film of binder to enhance adhesion and produce uniform quality briquettes.

In producing the briquette, the mixture from the previous process is molded into briquettes by employing a mechanized briquettor. In this step, the mixture is dropped directly on rotating iron molds which transform the mixture into uniform-sized briquettes.

Finally, the briquettes are placed in trays and loaded in carts for drying in a furnace-type briquette tunnel dryer. For eight hours, about two tons of briquette can be dried in the tunnel dryer.

The whole production process is both labor and capital-intensive since skilled labor as well as expensive fabricated machines are needed.

Production capacity

Data on industry production capacity is not available. It is estimated, however, that a plant can produce about 480 metric tons of briquettes a year.

Production economics

A financial analysis conducted by FPRDI to evaluate the profitability of charcoal briquette production shows that the amount of investment needed to put up a briquette plant is ₱500,000 based on 1992 prices. The amount covers the purchase of equipment, construction of the factory building and a working capital for three months.

The total cost of production of the charcoal briquette plant for a year of operation is ₱1,111,933 broken down into expenses on direct materials, direct labor and overhead. On the other hand, gross sales at a production level of 480 metric tons is ₱1,680,000 while net profit before taxes is ₱496,067.

Lastly, profitability indicators show a very high return on investment at 113.61 percent and a payback period of nine months. Therefore, charcoal briquette operation is a highly profitable venture which allows the investor to recoup his investment in a very short period of time.

Utilization

Charcoal briquette can be used as fuel in outdoor cooking. Furthermore, it is considered a cheaper and more efficient alternative in brooding chicks. Its target clientele is the general population.

Environmental and other positive qualities

Charcoal briquetting uses agroforestry wastes such as coconut husks, coffee bean hulls and coconut shell as inputs, thereby reducing the problem of waste disposal (or pollution in case the wastes are burned). Since it is a substitute for wood fuel, its use prevents further denudation of the few remaining forests. Moreover, as a substitute for other oil-based household fuels like liquified petroleum gas, it lessens pollution caused by the industrial production of such fuels.

Product substitute

The substitutes for charcoal briquettes are the traditional charcoals made of wood and coconut shell. However, producing charcoal from wood contributes to the rapid depletion of forest resources. Charcoal from coconut shell, on the other hand, easily burns out as it is thin and porous. Moreover, it is filthy to handle and gets easily crushed during transport. Thus, charcoal briquette is a better substitute than these two traditional charcoals.

Over the years, the Philippines has been producing wood charcoal at a substantial and increasing rate which implies an increasing demand for charcoal as an alternative source of energy. While the Philippines did not import coconut shell, it has been importing wood charcoal and charcoal briquettes. These data indicate that there is an existing market for briquettes in the domestic market, which local production of charcoal briquettes can exploit.

International market

Although charcoal briquettes are sold domestically, they are not yet exported. It may be useful to look at the trade performance of its competitors to assess its international potential. In the last five years, the country's export of coconut shell charcoal has increased, export of wood charcoal has decreased while there has been no export of briquettes. Thus, there is an international market for charcoals from the Philippines, which can be a potential market for charcoal briquettes as well if the product meets international standards.

Woodwool cement board

General profile

The woodwool cement board (WWCB) is a cheap but durable construction material made of woodwool and bonded by ordinary portland cement. Research and development work on WWCB was started in the early eighties by the FPRDI using its own funds. By 1986, commercial production started. At present, the product is sold domestically but not exported.

Data and information presented in this discussion come from FPRDI (1990) and Commendador (undated) and the interview of Pablo.

Production structure

Material inputs. To produce WWCB, mostly local materials are needed such as shredded wood like *ipil-ipil*, agriwastes or wood wastes, portland cement, and technical grade calcium chloride accelerator, a mineral additive.

The agrowaste materials to be utilized may include bagasse from sugarcane, corn stalks, coco coir fiber, bamboo wastes, rattan wastes, or any other fibrous materials.

Production technology. The original technology for WWCB production comes from Europe. The technology may vary from country to country according to the kind of raw materials used. Production technology for WWCB can be either labor or capital-intensive, a small-scale production using simple manufacturing tools or large-scale production using mechanized manufacturing processes.

Whichever, WWCB production involves the following steps:

cutting, debarking and shredding, soaking, drying, mixing, spreading and mat forming, pressing and clamping, curing and conditioning, and trimming and storing.

Initially, logs, branches and slabs are cut into billets and debarked using a sharp bolo or axe. The debarked billets are converted into woodwool through a shredder or woodwool-making machine. In case of the giant *ipil-ipil*, shredding usually results in 70 percent recovery.

Next, the shredded materials are soaked in water for two days to dissolve carbohydrates which may cause termite attack or chemical substances which can inhibit bonding with cement. The woodwool is fully submerged in water which is replaced every day.

After soaking, the materials are spread on a cement floor for drying under the shade or sun. The drying process takes about one or two days depending on the thickness of the spread and the climatic condition.

In the mixing process, all the necessary materials are loaded into the mixer in the proportion of 45 percent woodwool, 55 percent portland cement and accelerator, which is two percent of the weight of cement. The materials are mixed from two to three minutes or until the shredded wood materials are thoroughly coated with cement.

The cement-coated materials are then taken out of the mixer and molded to form a mat. The forming box is a detachable rectangular wooden frame placed over a plywood caul plate smeared with used oil (to prevent the mixture from sticking to the plate during the initial curing period). As soon as the mat is formed, the mold is detached from the caul plate, then stacked one over the other in batches of 10 to 20 depending on the board thickness.

Next to molding, pressing and clamping follow. The filled molds are piled and compressed by jacks placed against a cross beam and left under pressure for 24 hours. Each jack exerts a pressure of about five kg per square cm. To control the board thickness, wooden stoppers---the size of which corresponds to the actual thickness of the finished boards---are placed between caul plates. The pressure is maintained by clamping or bolting the stack for 24 hours which is the required time for the initial setting and hardening of cement.

Twenty-four hours after clamping, the boards are then piled vertically in a dry place and set aside for three to four weeks for curing and conditioning.

Finally, the boards are trimmed to the desired size using a portable carbide-tipped circular saw then stacked horizontally in an adequately shaded area. The boards are now ready to use as construction materials.

Production capacity

Because of limited supply at present, commercially produced

WWCBs do not pass the market but go directly to the users. Moreover, there are only six established commercial plants producing WWCBs. These plants can meet the requirement of only 1,234 housing units---or 2,468 units at doubled capacity---yearly. In the near future, however, with the addition of a newly proposed production-oriented project, it is expected that industry capacity will be able to meet the needs of 2,661 housing units---5,322 units at doubled capacity---per year.

Currently, it is estimated that a plant can produce about 43,800 pieces of boards per year.

Production economics

Preliminary estimates in the financial feasibility of a WWCB plant were provided by the FPRDI. The total investment for such a plant at 1990 prices amounts to ₱2,188,159. This amount is broken down into expenses on fixed investment and working capital.

The annual cost of production amounts to ₱1,715,591 for direct materials, direct labor and overhead expenses. On the other hand, sales amount to ₱2,847,000 based on a production volume of 43,800 pieces of boards priced at ₱65 a piece. Thus, net returns is ₱643,684. The profit margin is 22.61 percent, return on investment is 29.42 percent, and payback period is three years and three months. These indicate that the operation is a profitable investment.

Utilization

WWCB is a versatile construction material that can be used either as a sheathing in timber-framed construction or as substitute for cement hollow block. It is as a cheaper substitute for plywood in the construction of house ceilings and walls.

WWCB is designed to meet the housing needs of the lower income segment of the population. The current low industry production is still far from reaching its maximum potential. It is expected, however, that in the future, production and utilization levels of the product will increase as awareness of its merits as a construction material also increases.

At present, an intensive promotional campaign for the product is being undertaken by FPRDI through product exhibits including display of model houses. In 1987, FPRDI built two WWCB model houses for display, one at the FPRDI compound in Los Baños and the other at the National Housing Authority (NHA) in Quezon City.

Environmental and other positive qualities

The production of WWCB utilizes a wide variety of indigenous wood and agroforest waste materials which otherwise could have caused waste disposal and pollution problems. There are also less pollutive effects since the main material inputs are organic

matter. Moreover, dust or any waste particle generated in the production process are also utilized as material inputs. The product itself is not toxic since no chemical is added to it, in contrast to composite panels such as plywood and particleboard which require expensive and imported resin binders. Finally, as a substitute for wood construction materials, WWCB will lessen deforestation and degradation of forest resources.

There are also general advantages of WWCB: a) The product utilizes simple machines, tools and equipment in its production; b) it has lower production cost and lower market price compared to its substitutes; and c) the product is weather-proof, fire-proof, and resistant to fungus and termite attack.

Product substitute

Tiles, concrete hollow blocks, plywood, particleboard and other similar building materials are the substitutes for WWCB. Some tables show decreasing production of these substitutes over the years. The imports of veneers, plywood, other woods as well as fiberboard have been rising yearly from 1987 to 1992 indicating that there is a strong domestic market for construction materials similar to WWCB in function. It follows, therefore, that WWCB has a strong local market potential as well, especially since it has a highly competitive market price among its many favorable qualities.

International market

WWCB is not yet exported at present. The export of its substitutes such as veneers, plywood and other wood has been fast declining from 1988 to 1992. This is likely brought about by the growing campaign to preserve the remaining forests in the country. The decreasing exports may also mean that WWCB has some export potential as it can fill in the void caused by the decreasing exportation of the substitute products.

Coconut timber

General profile

Coconut timber is a wood product from the coconut tree (*Cocos nucifera*), a common agricultural tree in the country. To harness the full potential of the coconut tree as an alternative source of wood building materials, studies on the utilization of coconut timber have been conducted by the Philippine Coconut Authority (PCA), FPRDI and the Technology Resource Center Foundation Inc. (TRCFI). Funding for research was provided by the Food and Agriculture Organization and the United Nations Development Programme (FAO/UNDP). Coconut timber is already commercialized across the country.

The data and information for this discussion are taken from a

report of The Committee for Forestry (1985).

Production structure

Material inputs. Coconut timber is obtained from the lower trunk portion of unproductive mature coconut trees. Coconut trees, which become unproductive upon reaching 60 years or more, are felled for timber purposes as well as to accommodate new trees.

Production technology. The original source of technology for coconut timber production is foreign. The steps involved in the production of coconut timber are harvesting and logging of coconut trunk, sawmilling, drying, and secondary processing.

Harvesting and logging of coconut trunk involves felling, skidding, loading and transporting the log. Felling of the coconut tree is considered the most critical stage in logging operations. It is done either through the manual method using an ax or a two man-saw, or through the mechanical method using a chainsaw. The first is suitable for small-scale operation while the second is for large-scale operation.

After felling, the trees are skidded toward the landing area using a fabricated towing bar mounted to the rear-hydraulic arms of a tractor. The felled trees are then cut into lengths and classified according to uses (e.g., sawn timber, fence posts, power poles, and charcoal or wood fuel). These classified logs are then loaded in flat-bed trucks then transported.

Sawmilling is the process of sawing the logs into lumber. Three activities under this step are headsawing, resawing, and sorting and grading.

Drying is the process of reducing the moisture content of the coconut lumber. It is done either by natural or artificial method depending on the purpose for which lumber will be used. Natural method refers to a simple air drying process while the artificial method refers to the kiln drying process where the lumber is placed in an enclosed chamber and subjected to properly controlled conditions.

Lastly, secondary processing involves machining and finishing. Machining involves the cutting of wood into various shapes and sizes to improve surface quality and aesthetic value of the wood. On the other hand, finishing, involves the application of transparent or semi-transparent liquid coatings to preserve and accentuate the natural grain, color or figure of the wood. Finishes like paints, stains, sealers, clear lacquers can be applied either by brush or spray gun.

Production capacity

There are no data available on the actual production capacity of the coconut timber industry. However, it is projected that six million cubic meters of coconut wood will eventually be available annually from the felling of unproductive and old trees.

On a plant-level basis, it is estimated that a commercial sawmill operation can produce 30,000 board feet of rough coconut lumber per month.

Production Economics

A financial analysis involving an actual sawmill operation producing 30,000 board feet is available. At 1985 prices, the log acquisition cost of the sawmill per log was ₱18.28 and total acquisition cost for 1,200 logs was ₱21,942. On the other hand, manufacturing costs incurred in the conversion of logs into rough lumber was ₱1.38 per board foot or ₱41,604 for all the 30,000 board feet of lumber produced.

At a selling price of ₱2.20 per board foot, monthly gross sales was ₱66,000. Net income over costs was ₱12,930. The return on investment was 25 percent.

Utilization

Coconut timber is used in the construction of low-cost housing and other structures. It is suitable for housing components such as trusses, purlins, walls, joist, door, window frames, jalousies and others. In addition, it can likewise serve as posts provided it is properly treated.

Coconut timber can also be utilized in the manufacture of furniture, novelty products, and other handicrafts. Among the furnitures which have been produced from coconut timber include a dining set, chairs and sofa, office furniture, and classroom chairs.

Given these facts, the target clients for coconut timber are the industries using wood including construction, furniture and handicraft industries.

Environmental and other positive qualities

Using the coconut timber has several environmental advantages. First, studies showed that coconut timber can compare to narra, yakal and other hardwoods in quality. Thus, the use of coconut timber as replacement for these hardwoods will help in the conservation and protection of the remaining forest areas in the country.

Second, coconut timber is produced from unproductive and old coconut trees which can otherwise obstruct the growth of younger coconut trees and other plants. Thus, their last use allows wider space for other trees and plants to grow.

Third, the coconut timber industry produces shaved off waste materials which can be used as irewood or as inputs in other industries such as furniture and handicraft making. The coconut timber industry, therefore, produces little useless by-products.

Aside from these environmental aspects, coconut timber is also

cheaper than its substitutes and thus, provides available dwelling units for the economically deprived segment of the society. Moreover, coconut timber production will raise the employment and income opportunities in both the coconut and timber industries.

Product substitute

Coconut timber is a substitute material for other wood and concrete construction materials. As mentioned, it is a cheap alternative for hardwood. The discussion on the production and importation of product substitutes follows that of woodwool cement board.

International market

The discussion on the export of product substitutes also follows that of woodwool cement board.

Fisheries-Based Products

Seaweed tablet as natural source of iodine

General profile

Seaweed tablet is a natural source of iodine. It is a product which has been developed by ITDI since 1993 using its own funds. At present, the product is ready for a pilot-scale production.

The data and information used in this discussion are taken from the interview of Briones.

Production structure

Material inputs. Brown seaweeds (*Sargassum sp.*), binders, and excipients are the material inputs used in the production of seaweed tablet. Brown seaweeds are locally available while the rest of the inputs are imported.

Production technology. The production technology of seaweed tablet is locally developed. The processes are as follows. First, fresh seaweeds are thoroughly dried in a cabinet drier and then grounded to powder form using a wiley mill. After that, a mixture is formulated by mixing seaweed powder with binders and excipients such as starch, cellulose and polyethylene glycol. Then, the mixture is compressed into tablet form using the tableting machine. Finally, the tablets are packed for storage.

The production process is labor-intensive since the collection and preparation of material inputs are all done manually. However, it is also capital-intensive because equipment such as the cabinet drier, wiley mill and tableting machine are employed.

Production capacity

Although seaweed tablet is ready for pilot-scale production, it has not been commercially produced yet. Thus, there is no data on production capacity, both at industry and plant-level.

Production economics

No study or information are available on the financial feasibility of seaweed tablet production.

Utilization

Seaweed tablet as a natural source of iodine can be used for the treatment of goiter and maintenance of the thyroid gland. The target clientele of the product therefore are people suffering from goiter.

Environmental and other positive qualities

The product is environment-friendly because it uses indigenous materials such as seaweeds, which are beneficial to the marine ecosystem and environment. In addition, the production process itself is simple and does not result in pollutive wastes as against the manufacture of other medicinal products which can result in chemical discharges.

The product is a cheap and natural source of iodine. Its commercialization will help boost the demand for seaweeds and raise incomes in the seaweed industry.

Product substitute

Seaweed tablet is a substitute for kelp pills and traditional iodine tablets now available in the market. Unluckily, there is no available data on the production and consumption of the substitutes in the country. Also, there is no data on the import of these substitutes. It is believed, however, that given the prevalence of goiter cases, especially in rural areas, the potential local market for seaweed tablet is large.

International market

There are no data available on the exportation of kelp pills and iodine tablets. Thus, it cannot be determined whether or not seaweed tablets have a strong international market potential. On the other hand, goiter remains a major disease in developing countries. It is thus expected that if seaweed table can compete internationally in terms of price and quality, it should have a good potential as an exportable product.

Seaweed noodle

General profile

Seaweed noodle is a nutritious food product prepared from a blend of bread flour, salt and puree. Research and development work on the product has been done by FNRI using its own funds. At present, the product is still in the development stage.

The sources of data and information in this discussion are FNRI (1992) and the interview of Tobias.

Production structure

Material inputs. The inputs in the production of seaweed noodles are available locally such as green seaweeds, bread flour and salt.

Production technology. The source of production technology of seaweed noodle is local. The processes involved in seaweed noodle production are simple and involve fabricated equipment which are locally available. Labor used in the noodle production may be unskilled.

To produce seaweed noodles, the seaweeds are first thoroughly washed and drained then blended with lye solution to produce the seaweed puree. The seaweed puree, bread flour and salt are thoroughly mixed, kneaded and formed into patties, then steamed and shaped or cut into flat noodles. Finally, the cut noodles are dried and packed.

Production capacity

Since the production of seaweed noodles is still in the development stage, data on production capacity in both industry and plant-level are not available.

Production economics

Preliminary estimates were done by FNRI to assess the financial feasibility of a commercial seaweed noodle operation. The investment requirement of such an operation at 1992 prices totals ₱932,233. This is broken down into expenses on land and building improvement, equipment, working capital for three months, pre-operating and contingency expenses. The financing scheme assumes that 60 percent of the investment requirement is loaned while 40 percent is to be shouldered by the producer. The loan has an interest rate of 17 percent, payable annually in five years.

The total annual production cost is ₱1,865,252 which is itemized into costs on direct materials, direct labor and production overhead. Gross sales, on the other hand, is ₱3,046,170 while net income after tax is ₱489,005.

The return on investment of the seaweed noodle operation is 52.46 percent while payback period is almost two years. Thus, the operation is highly profitable that allows the investor to

recoup his investment in a relatively short time.

Utilization

Seaweed noodles are found to be excellent sources of iodine and beta-carotene (Vitamin A). Thus, its consumption will improve the nutritional status of many Filipinos, especially pre-school children, who are found to have deficiency in iodine and vitamin A.

Seaweed noodles can be consumed like any noodles already available in the market and is likely to appeal to all noodle-loving consumers. It should be highly competitive because of its nutritive value. However, since it is still in the development stage, data on domestic utilization is not yet available at present.

Environmental and other positive qualities

There are two environmental advantages in the production of seaweed noodles. First, its production does not involve chemical or likely to produce pollutive wastes as the inputs are only seaweed puree mixed with flour and salt.

Second, the use of seaweed puree as an input promotes an aquaculture product, the seaweed, whose production is considered to enhance the aquatic environment. Compared to aquaculture practices like fishpond culture which can produce significant water pollution, seaweed farming contributes to the marine ecosystem by being a source of food for many marine organisms.

Seaweed noodles provide iodine and vitamin A. Moreover, its production can be a source of additional income and employment not only for its producers but also for the whole seaweed farming industry.

Product substitute

Seaweed noodles can be a substitute for all kinds of noodles and similar foods now commercially available in the market such as macaroni, spaghetti, lasagna, *miki*, *misua*, *sotanghon* and others. Data on the domestic production of these products are not available.

The Philippines' total imports of noodles have been growing over the years. This means that there is a strong potential domestic market for seaweed noodles as long as it is competitive with other products and attractive nutrition-wise to consumers.

International market

Since seaweed noodles are not yet commercialized, the trade performance of its substitutes will help provide an indication of its potential in the international market. Over the years, the country has been exporting noodles in substantial quantities although exports are declining lately.

The high level of exports is an indication that locally made noodles now has a niche in foreign markets although its decline may imply falling international competitiveness of local noodles. As long as seaweed noodles is competitive, however, the data appear to indicate that the product has some potential as an exportable product.

Shrimp powder fortifier

General profile

Shrimp powder fortifier is a product used for food flavoring. It has been developed by the FNRI using its own fund. Although research and development work on the product started in 1990, the product is still in its development stage.

The data and information in this discussion come from the interview of Lainez.

Production structure

Material input. The major material input in the production of shrimp powder fortifier are shrimp heads, wastes from the processing of shrimp in headless form which are usually for export.

Production technology. The technology for producing shrimp powder fortifier is locally developed. It is also simple. First, shrimp heads free of centilage are boiled for 25 minutes at four kilos per batch. The boiled material is then dried in an oven drier for about 79 hours. Finally, it is grinded and pulverized into powder form. A lot of manual labor is required in the process, thus, production is labor-intensive.

Production capacity

Since the product is still in its development stage, there is no available data on the industry capacity. It is estimated that at plant level, production may reach about 7,500 kg per year.

Production economics

Preliminary estimates were provided by the FNRI on the financial viability of shrimp powder fortifier production. Investment requirement for the plant is estimated at ₱474,210 at 1993 prices. This amount covers expenses on land and building improvement, equipment, working capital, pre-operating expenses and contingency expenses. Of the total amount, 40 percent is equity while 60 percent is loaned at an interest rate of 17 percent per year and payable annually in five years.

Total production cost is estimated at ₱567,268 broken down into expenditures on direct materials, direct labor and production overhead. On the other hand, gross sales is ₱1,258,396 and net income after tax is ₱199,770.

The return on investment of the plant is 42.13 percent with a payback period of 2.4 years. Thus, the production of shrimp powder fortifier is profitable and enables the investor to recoup his investment in a relatively short time.

Utilization

Shrimp powder fortifier is rich in protein and therefore raises the level of protein intake. It can be used in soup or other food preparations as a source of nutrient and flavoring as well. It is estimated that shrimp powder fortifier has about 61 percent protein content per 100 gram. The target clientele is the whole population.

Environmental and other positive qualities

Production of shrimp powder fortifier is environment-friendly because it utilizes shrimp heads which are waste materials from shrimp processing and its production process does not include chemical processes which may produce other wastes.

Moreover, beyond environmental concerns, as a production activity vertically integrated with shrimp processing, shrimp powder production will raise income and employment not only in the shrimp processing sector but also in the aquaculture industry.

Product substitute

Substitutes for the shrimp powder fortifier are bouillon cubes and other food flavoring products. The data on production of these substitutes are not available. However, the Philippines has been importing large volumes of bouillon and the level has been increasing at very high rates yearly. This means that the domestic market for bouillon is very strong and which the shrimp powder fortifier product can exploit assuming it is competitive vis a vis its substitutes.

International market

The country has not exported bouillon in recent years. Thus, locally produced food seasoning products may not be readily accepted in international markets. The potential for exporting a new product like shrimp powder fortifier is thus not very promising in the near future.

Industry-Based Products

Cement additive from waste pulping liquor

General profile

Cement additive from waste pulping liquor is a potential set retarder developed by FPRDI in 1993 using its own funds. Pilot-testing of the product will be done in 1995.

The data and information for this discussion come from the interview of Romana.

Production structure

Material input. The sulfite waste liquor from pulp mills is the only input used in the production of cement additive. This is available locally from local commercial pulp mills.

Production technology. The technology for producing cement additive from waste pulping liquor is adapted from a foreign source. There is no available detailed description of the technology.

In brief, however, waste liquor obtained from the commercial pulping of abaca is concentrated using steam-heated glass evaporator. The concentrated waste liquor is then ready for utilization as concrete additive. In the production process, the basic equipment employed are the boiler and evaporator.

Production capacity

Since the technology has not been commercialized yet, no industry exists at present. It is estimated that at plant-level, a production capacity of 1.8 million liters of cement additive is possible.

Production economics

A feasibility study on the viability of producing cement additive from waste pulping liquor is still ongoing. However, preliminary figures indicate that a production capacity of 1.8 million liters a year will require an initial investment of ₱9.51 million at 1994 prices. This amount will be spent on production equipment and installation and building.

The total production cost is estimated at ₱10.008 million. This amount consists of 76.70 percent fixed costs and 23.30 percent variable costs.

Utilization

Cement additive from waste pulping liquor can be used as a set retarder in the preparation of ready-mix concrete such as hollow blocks. The potential end-users of this product are manufacturers of ready-mix concrete, bricks, ceramics and charcoal briquettes.

Environmental and other positive qualities

The production of cement additive from waste pulping liquor is environmentally preferred because it uses waste from the manufacture of abaca pulp for paper. The wastes are major pollutants produced by local pulping mills industry produce, which are otherwise discharged to nearby lakes and rivers.

Another environmental attribute of the product is that the concentration process of waste liquor from pulping mills is done in a closed system, thus, no waste materials are produced in the production process.

The use of wastes should be a boon to the pulp mills which can now earn money from their waste products instead of spending on them in terms of waste disposal.

Product substitute

Cement additive produced from spent liquor can substitute for imported commercial cement additives. However, data on imports of these additives are not available.

International market

Data on the exports of existing product substitutes for the cement additive from waste pulping liquor are also not available. Thus, it could not be identified whether the product has a potential in the international market or not.

Hemosep-WC (*Pasteurella* vaccine)

General profile

Hemosep-WC (Whole Cell), also known as *Pasteurella* Vaccine, is a vaccine that protects against Hemorrhagic Septicemia (HS), the dreaded cattle and carabao disease. The vaccine was developed by BIOTECH with joint funding from PCARRD and Biologics Corporation which is a private firm. At present, the product is commercially produced on a large scale at the BIOTECH compound. The production and marketing of the product is handled by Biologics Corporation. The product is sold locally but not yet exported.

The sources of data and information for this discussion are Maslog (1991), Maslog et al. (1993) and BIOTECH (undated) and the interview of Maslog.

Production structure

Material inputs. The major material input in the production of Hemosep-WC is the isolated bacteria *Pasteurella multocida* which is locally available. Other inputs are imported such as sodium hydroxide, sodium chloride and formalin.

Production technology. The technology used in Hemosep-WC production is foreign in origin. To produce Hemosep-WC, a

lyophilized stock of a bacterial strain isolated from mice is inoculated in the blood agar plate and then in the brain heart infusion. The stock is then incubated for six hours at 37 degrees centigrade and vigorously shaken to attain the desired log phase of growth. Afterwards, the stock is retrieved and cultured in a large fermentor where growth factors are strictly regulated. The vaccines produced are then bottled and labelled for testing.

Following rigid quality control procedure, the vaccine has to be tested to ensure the least batch-to-batch variations. Moreover, further tests for purity, sterility, and potency are performed by the Bureau of Animal Industry (BAI).

Because the steps are mostly done manually, the production of Hemosep-WC is labor-intensive.

Production capacity

The maximum production capacity of the commercial operation of BIOTECH and Biologics Corporation is 1.2 million doses of Hemosep-WC yearly. For 1994, however, actual production is expected to be only 300,000 doses. Next year, production is targeted to reach 600,000 doses and by 1996, it should reach 900,000 doses. Beyond that, production is planned to reach one million doses yearly.

Production economics

A full financial analysis of the production of Hemosep-WC is not available. However, the initial investment for a commercial operation was roughly estimated to be ₱3 million at current prices. This amount covers expenses on production equipment, installation and building construction.

It is also estimated that the production cost per unit of the product is ₱1.00 per dose at current prices. Locally, the product sells at a price of ₱10.00 per dose.

Utilization

Hemosep-WC is a vaccine that is effective against Hemorrhagic Septicemia (HS). Other than this disease, it can be a vaccine against any form of pasteurellosis that affects cattle and carabao. The target clientele for the product, then, are the cattle industry and farmers with carabaos.

Environmental and other positive qualities

Hemosep-WC is environment-friendly because all the materials used in its production are biodegradable and do not have adverse effects such as allergic or anaphylactic reactions in the vaccinated animals. The use of the vaccine does not likewise result in disease transmission due to vaccination since the bacteria used in the vaccine is completely inactivated.

Aside from environmental advantages, the production of a local vaccine to cure diseases of cattle and carabao will be a big

contribution to the development of the livestock and farming sectors.

Product substitute

Imported vaccines such as sera and other vaccines for poultry and livestock are the substitutes for Hemosep-WC. Over the years, the country's import of sera and other vaccines has been increasing at a very fast rate. This indicates that the local market for vaccines including Hemosep-WC is rapidly growing.

International market

In recent years, the country has not been exporting vaccines, including Hemosep-WC. However, the product has great potential in the international market, especially in Southeast Asia where the occurrence of the HS disease in cattle and carabao is common.

Bio-N

General profile

Bio-N, a biological nitrogen fixer used as a source of nitrogen for rice and corn through the process of biological nitrogen fixation was developed by BIOTECH in 1990. Research and development of the product was conducted using funds from DA-BAR, PCARRD, and the Institute itself. At present, the product is commercially produced.

The sources of data and information presented are BIOTECH (undated) and the interview of Torres.

Production structure

Material inputs. FROM or Bio-N production, pulverized top soil, charcoal, inorganic chemicals and cultures of nitrogen fixing bacteria are needed. Except for inorganic chemicals, the material inputs are locally available.

Production technology. The production technology of Bio-N is of foreign in origin but was modified by BIOTECH.

To produce Bio-N, the nitrogen fixing bacteria are cultured and maintained in the laboratory under an aseptic condition. The bacteria is then inoculated into the medium and allowed to grow from four to five days. After that, the liquid inoculant is dispensed into the carrier using a sterile syringe and an autopipetting machine for faster and accurate measurements. The carriers are packed in polypropylene bags and subjected to high temperatures from about one hour to three consecutive days. The product is afterwards ready to use.

There are several laboratory equipment and machineries needed in the production of Bio-N. These include the laminar flowhood, shaker, steam sterilizer and autoclave, grinder, mixer, pulverizer,

sealer, auto-weighing machine, and auto-pipetting machine. The production process is, therefore, capital-intensive although the process itself involves simple and easy steps.

Production capacity

At present, with the existing equipment of BIOTECH, the actual annual production capacity is 1,500 packets of Bio-N. However, it is estimated that if all necessary equipment are available, maximum capacity of one million packets per year is possible.

Production Economics

There is no available information on the financial feasibility and economics of Bio-N production. Nonetheless, it is known that at present, the product is sold at ₱20.00 per packet in the local market.

Utilization

Bio-N is a nitrogen-fixing inoculant for rice and corn. It is used to improve root development and sustain nitrogen requirement of rice and corn plants. BIOTECH is the sole distributor of the product and its target market are rice and corn farmers.

Environmental and other positive qualities

Bio-N is environment-friendly, first, because its production has no pollutive effluents in contrast to other fertilizers. Second, the microorganisms in the product are nitrogen-fixers, non-pathogenic and have the ability to supply some of the nitrogen requirement of crops which improve the quality and productivity of the soil. Third, the utilization of Bio-N reduces the dependency of crops on inorganic fertilizer, thereby minimizing the adverse effects of fertilizers on the farm environment.

As an alternative source of nitrogen fixers, the product will help promote productivity in the farm, especially among rice and corn farmers.

Product substitute

Other biological nitrogen fixers available in the market today are product substitutes for Bio-N. Unfortunately, data on the production and importation of these products are not available.

International market

The data on exportation of biological nitrogen fixers are likewise not available. Therefore, the export potential of Bio-N cannot be assessed here.

Nitro-Plus

General profile

Nitro-Plus, a biological nitrogen fixer specifically for legumes, is a seed inoculant containing a broth culture of rhizobia (a bacteria that live within the root nodules of leguminous plant like mungbean, peanut, and soybean) mixed with a suitable carrier. The technology for Nitro-Plus production was developed by the Department of Soil Science at UPLB and mainly financed by UPLB and PCARRD. BIOTECH, also at UPLB, started producing the product on a commercial scale in 1981.

The data and information presented in this discussion come from the interview of Santos.

Production structure

Material input. The material input needed in the production of Nitro-Plus is the culture medium containing the rhizobia and charcoal. This input is available locally.

Production technology. To produce Nitro Plus using a foreign technology, the culture medium with the rhizobia and the inoculant carrier are separately prepared. the culture medium with the rhizobia is then placed in the inoculant carrier and incubated for two weeks. The produced legume inoculants are then tested for quality and distributed to end-users.

The equipment used in the production of nitro-plus are hammer mill, vibration mill, blender, bagging machine, sealing machine, steam sterilizer, autosyringe, water distilling apparatus, and a 100-liter fermentor. These equipment make the production of nitro-plus capital-intensive.

Production capacity

Currently, BIOTECH produces 1,600 kg of Nitro-Plus per year. For 1995, the projected volume of output is placed at 2,000 kg. If the plant at BIOTECH is fully used, the production capacity per year is 73 tons of inoculant.

Production economics

A preliminary financial analysis of commercial production of Nitro-Plus is available. The investment requirement is estimated at ₱8.7 million at 1991 prices. This amount is broken down into expenses on land, building, machinery, vehicles, start-up costs and working capital. Of the investment, 95 percent is loaned at 20 percent interest rate for 10 years with a grace period of one year.

The total cost of production per year is ₱3.64 million. Two-thirds of this amount is fixed cost and one-third accounts for variable cost. Annual sales is ₱10 million while net profit is ₱4.7 million.

Profitability indicators were computed based on the projected cash flow statement. Production of Nitro-Plus has an internal rate of return of 48.9 percent and a payback period of two years. Thus, while the operation has a very high investment requirement and is capital-intensive, it is highly profitable and allows the investor to recoup his investment in only a short time.

Utilization

Nitro-Plus is an inoculant used as nitrogen fertilizer for legumes and can be applied only on soils which are neither acidic or basic. The product has a shelf-life of six to eight months. At present, it is still produced just for the local market and target consumers include small-scale farmers planting legumes and corporations producing legumes.

Nitro-Plus is promoted through farmer meetings by BIOTECH through a film showing which explains the importance as well as the appropriate use of the product. Also, samples and brochures of the product are distributed to the farmers for an effective transfer of technology.

Local distribution centers for the product are at present nonexistent. BIOTECH is the only source of the product, thus limiting product marketing and exposure.

Environmental and other positive qualities

The production of Nitro-Plus is environment-friendly because rhizobia, the starter material or bacteria used in the inoculation, is nonpathogenic. This bacteria has been widely used abroad because it has no adverse effects on both human health and the environment.

Second, using Nitro-Plus as fertilizer is environmentally safe because it does not result in groundwater pollution which, on the other hand, is a likely possibility from the excessive use of inorganic nitrogen fertilizers.

Product substitute

The product is a substitute for chemical nitrogen fertilizer and other biological nitrogen-fixers. However, data on the present domestic production of these products are not available. Data on fertilizers in general are shown in a previous section.

International market

Since Nitro-Plus is not yet exported, the export market for its substitute may provide indication of its potential. The needed information, however, is not available. Export performance of fertilizers in general is discussed in a previous section. It appears that Nitro-Plus has some potential in foreign markets given the acceptability of locally produced fertilizers in these markets.

Mycogroe

General profile

Mycogroe is a bio-inoculant developed by the UP College of Forestry and BIOTECH, which funded the research and development of the product. At present, Mycogroe is commercially produced and sold locally. The production of Mycogroe is being done by the Los Baños Biotechnology Corporation in collaboration with BIOTECH.

The sources of data and information in this discussion are de la Cruz et al. (1991) and the interview of Navarro.

Production structure

Material inputs. The inputs used to produce Mycogroe are soil carrier and spores of mycorrhiza. These materials are available locally.

Production Technology. The technology for Mycogroe production is foreign. There is no detailed description of the production process, however, a brief summary follows. To produce Mycogroe, basidiospores of mycorrhizal fungi are mixed with the soil carrier. The mixture is processed afterwards using a tableting machine and then packed for storage and distribution. Producing Mycogroe is labor-intensive.

Production capacity

Although Mycogroe is now commercialized, there are still no available data on the production capacity in both industry and plant-level.

Production economics

There are no data on the financial analysis or simple production economics of a Mycogroe production. Since the product is commercialized, however, its production is assumed to be a profitable one.

Utilization

Mycogroe is used as bio-inoculant for the rapid establishment of tree species used for reforestation, such as pine, eucalyptus, *Casuarina* (agoho) and *Dipterocarps*. The product contains spores of the fungus ectomycorrhiza. The clientele of the product are tree breeders, tree plantation owners and administrators of the country's reforestation program.

Environmental and other positive qualities

Mycogroe is environmentally preferred because, as inoculant, it does not contain chemicals which can be harmful to both host plant and soil. In addition, the ectomycorrhiza contains a naturally occurring fungi which have beneficial effects on the roots of the host plant. The beneficial effects include: enhanced

intake of water and nutrients from the soil; improved survival rates of plant seedlings in the field; decreased incidence of pathogenic root infections; improved soil structure and mineral recycling; and increased plant growth rate.

Mycogroe is easy to apply and substantially cheaper than chemical fertilizers. For instance, it is estimated that the use of the product instead of chemical fertilizer in reforestation reduces expenses by 27 percent. Moreover, Mycogroe can replace 60 to 85 percent of the fertilizer requirements of most plants based on the recommended rates.

As bio-inoculant for trees, the product should greatly help the reforestation program of the government and the private wood plantation industry.

Product substitute

Mycogroe is a substitute for chemical fertilizers. Although data on fertilizers in general are available (see section on rapid composting technology), specific data on the production, utilization and importation of chemical fertilizers are not available. It is assured, however, that there is a widespread utilization of chemical fertilizers in the country which means that there is a large potential market for mycogroe.

International market

It is not known if chemical fertilizers are exported by the Philippines. It can be safely assumed, however, that chemical fertilizers are still used widely, at least in developing countries. Thus, Mycogroe as an environmentally safe alternative to chemical fertilizers should have a strong international market potential assuming that it can meet stiff international standards.

Orchid hybrids through somatic cell-fusion

General profile

Research and development on the production of orchid hybrids through somatic cell-fusion was undertaken by BIOTECH in 1987 using institute and DOST funds. The technology is now fully developed and is now ready for commercial application.

The source of data and information for this discussion is the interview of Sajise.

Production structure

Material inputs. The necessary material inputs for orchid hybrid production through somatic cell-fusion are enzymes, organic and inorganic compounds, sugar, agar (which can be replaced by local gulaman) and orchids. Sugar and agar can be bought locally while the rest of the materials are imported from the United States

and Japan.

Production technology. The technology for orchid production through somatic cell-fusion is of foreign origin. The processes involved are: the establishment of the orchid's sterile culture and callus; isolation of protoplast with enzymes; regeneration or growing of plants under sterile condition for mass production; planting the orchids on a semi-sterile condition; and field testing of these plants before distribution. The different laboratory equipment employed are sterile laboratory facilities, autoclave, and laminar flowhood.

A step by step description of the specific technology for the production of orchid hybrids through somatic cell-fusion is not available and will not be described here. However, the technology is described as skill-intensive, one that requires a skilled production staff in order to produce the necessary orchid hybrids.

Production capacity

The commercial application of the technology has yet to be undertaken, therefore, no data on production capacity at the industry level is available. It is estimated, however, that at unit level, a commercial operation using the technology can produce 10,000 orchid hybrid plants a year.

Production economics

No financial analysis has been done for a production operation involving purchases of plant facilities and equipment. However, it is estimated that if commercial production is done in partnership with an institute with the necessary laboratory facilities, the initial investment requirement will only include direct material cost equal to ₱50,000. Based on this and an estimated production capacity of about 10,000 plants, the production cost per plant is placed at ₱5.

Domestic price of the plant is about ₱500 per plant while if exported, the price is about \$20 per plant. The operation then is, obviously, a clear commercial success.

Utilization

The orchid hybrids through somatic cell-fusion technology is used only for the propagation of orchids. The potential user of the product is the cutflower industry.

Environmental and other positive qualities

Compared to other methods of orchid hybrids, the technology for orchid hybrid production through somatic cell-fusion is environment-friendly because the material inputs used are nontoxic and biodegradable, particularly the enzymes.

Although the production process involves burning of alcohol, the fume emitted is controlled by using fumehoods or an exhaust

system. The fume generated in the process is very tolerable or negligible.

Product substitute

There is a current production of mutant orchids through chemical utilization. However, these mutant orchids are found to be carcinogenic. Thus, orchid hybrids through somatic cell-fusion is environmentally superior to them. There is no data and information available on domestic production and importation of these product substitutes.

International market

The potential international market for the product cannot be assessed because data on the exportation, if any, of its product substitutes are not available.

Other Products

Bonded ash souvenir items

General profile

The eruption of Mount Pinatubo located in the province of Zambales in 1991 resulted in concentration of large masses of volcanic ashes or lahar in parts of Central Luzon. Research activities were done by ITDI on the possible productive use of lahar. The main goal was to generate lahar-related technologies

and products that can provide livelihood for the families affected by the eruption.

Studies indicate that a number of products can be produced out of lahar. Among these are bonded ash souvenir items, concrete hollow blocks (CHB), ceramic novelty wares, construction materials and glass artwares. Bonded ash souvenir items are already being commercialized at present.

Due to the large number of products which can be produced from lahar, it is not possible to describe each one of them. Only bonded ash souvenir items and ceramic glazes are covered in this report. The valuable information come from Bedia et al. (1991), Sunday Standard Magazine (1991), The Manila Chronicle (1991a and 1991b) and ITDI (1992).

Production structure

Material inputs. The major material inputs for the production of bonded ash souvenir items are volcanic ash, resin, and catalyst. Resin is used as binder while the catalyst hastens the hardening or

forming of the volcanic ash into the desired souvenir item model.

Production technology. The technology for the production of bonded ash souvenir items was locally developed. The main steps involve the preparation of a silicone rubber mold, preparation of plaster backing, preparation of volcanic ash, casting and finishing.

In preparing the silicone rubber mold, a modelling clay is shaped into the desired design. Then, a mixture of silicone rubber and five percent retainer is applied using a brush on the surface of the mold. After that, the mold is left to harden for four hours.

In plaster backing, plaster of paris is sprinkled into a container filled with water and then stirred slowly. The mixture is poured into the rubber mold and left for a few minutes to harden.

Volcanic ash is collected from the ground, dried and then passed through a screen at 60 to 80 mesh size.

Polyester and catalyst are then blended for a few minutes. Volcanic ash is added to the mixture and mixed thoroughly. Afterwards, the mixture is poured into the rubber mold, left to harden and artwares are then removed from the mold.

Finally, for newly-formed artwares to be more attractive, finishing is applied using lacquer paints and other coloring pigment.

All the mentioned steps involve a lot of manual labor, thus, the production of bonded ash souvenir items is labor-intensive.

Production capacity

In 1991, there were 17 production units in the Pinatubo affected areas which produced bonded ash souvenir items. No data on the volume of production was reported but total sales of the units was about ₱781,894. On a unit basis, as indicated below, a production unit is able to produce 20 pieces of souvenir items a day.

Production economics

A study on the financial analysis of a unit producing bonded ash souvenir items is not available. Based on preliminary data, the capital investment required for a unit is as low as ₱1,500. This amount includes rubber mold, unsaturated polyester, plaster of paris, and other necessary items. The production unit produces 20 pieces of souvenir items per day.

Utilization

Bonded ash souvenir items are marketed as novelty items. The target clientele is the general population.

Environmental and other positive qualities

The main environmental quality of bonded ash souvenir items is that the production uses volcanic ash which has no productive utilization and is an inconvenience to people in the lahar-affected areas of central Luzon.

Due to low capital needed to start an operation, the production of bonded ash souvenir item is within the capability of low-income families in the Pinatubo affected areas. Thus, it increases employment and income while lowering criminality at the same time due to a preoccupation that is financially rewarding.

Product substitute

The bonded ash souvenir items are substitutes for the souvenir and novelty items available in the market today. While no data are available on the domestic production and importation of souvenir items, it is expected that the local market for these products is large, given the well known propensity of Filipinos to give souvenir items to their loved ones during special occasions.

International market

There is also no data available on the exportation of souvenir items by the Philippines. However, many art products such as indoor decorative items have been exported by the country for years. It may mean that local artworks have a niche in foreign market which producers of bonded ash souvenir items can exploit.

Ceramic glazes made from lahar

General profile

Ceramic glazes made from lahar is another product developed by ITDI in reaction to unemployment caused by the Mt. Pinatubo eruption. Like bonded ash souvenir items, the development of the product is aimed at providing a source of livelihood to those people affected by the eruption. The product is now sold commercially by small-scale operators.

The information for this discussion is taken solely from the interview of Villostas.

Production structure

Material inputs. Ceramic glazes made from lahar are produced from locally available material inputs including volcanic ash, white lead, clay, silica and feldspar.

Production technology. Producing ceramic glazes made from lahar is simple. The steps include ball milling, screening, weighing, and mixing. Simple equipment fabricated by local manufacturers are used.

There is no available detailed description of the steps involved in the production of ceramic glazes made of lahar. The steps, however, are laborious and make the whole production process a labor-intensive activity.

Production capacity

There is available data on the production of ceramic glazes made from lahar at the industry level but none at the unit level.

Production economics

No information is available on the financial viability of an operation producing ceramic glazes made from lahar. However, it was reported that the investment requirement for such an operation is low. Since there are already small-scale operations existing at present, it is expected that production is profitable.

Utilization

Ceramic glazes made from lahar are useful in the production of artwares and dinnerwares. Therefore, the target clientele are the producers of these products.

Environmental and other positive qualities

The production of ceramic glazes made from lahar is environmentally preferable because it uses volcanic ash as input. It is also desirable because its production employs the victims of the Mt. Pinatubo eruption and helps in finding them a source of livelihood.

Product substitute

The product can substitute for any ceramic glazes used in the manufacture of artwares, dinnerwares and the like. There are no available data on the domestic production of ceramic glazes but the country has been importing glazed ceramic in the past years. Importation, however, is declining yearly. The reason for this may be the emergence of domestic substitutes. If this is so, then the local market looks rosy for the production of ceramic glazes made from lahar.

International market

The country has been exporting ceramic glazes at an increasing rate in recent years. This may mean that local ceramic glazes are already known in foreign markets. If ceramic glazes made from lahar is competitive in its price and meets international quality standards, it has a strong potential as an exportable commodity.

Derris root powder

General profile

Derris root powder can be used as a toxicant to eliminate the predators of fish and other marine animals cultured in fishponds. The product has been developed by PCAMRD. At present, it is in the technology development stage.

The sources of information are Guerrero et al. (1989 and 1990) and the interview of Villacorta.

Production structure

Material inputs. The main material input in the production of derris root powder is the root of the *Derris elliptica*, a plant locally known as *Tubli*. The plant has been analyzed to contain the fish toxicant rotenone.

Production technology. The process of *Derris* root powder production is simple. Dried roots of the *Tubli* plant are gathered and chopped two to three cm long. The pieces are then dried at about 60 degrees centigrade. After drying, they are grounded into powder form with a laboratory pulverizer and then passed through a sieve.

The technology for producing is locally developed and is also labor-intensive.

Production capacity

Since the technology for derris root powder production is still in the development stage, no data on its industry production capacity is available.

Production economics

The production economics of derris root powder production is also not known. However, given that it uses only roots as input and is labor-intensive, the product is expected to be cheaper vis a vis pesticides.

Utilization

Derris root powder has been developed to serve as a natural fish toxicant in the control competitors and predators of fish in fishponds. The application of fish toxicant is essential in the culture of marine animals in ponds to lower predation levels and, thus, increase harvest and income. Potential users of the product are business enterprises engaged in pond aquaculture.

Environmental and other positive qualities

One of the environmental attributes of Derris root powder as fish toxicant is that its production does not involve the use of

harmful synthetic chemicals. The product is also biodegradable and is not harmful to the user unlike other insecticides which can potentially damage the user as well as the water environment.

Since gathering Tubli root is laborious, production of the toxicant powder should provide employment and extra income in rural areas. As a replacement of imported fish toxicants, The product benefits the local aquaculture industry as well as save foreign exchange for the Philippine economy.

Product substitute

Derris root powder is a practical alternative for commercially available fish toxicants like insecticides and teaseed cake commonly used in fishponds. Both products are mostly imported.

International market

There is no available data on the export of pesticides. Thus, the international market potential for Derris root powder is not clear. On the other hand, widespread use of pesticides is common both in developing and developed countries. Hence, it is believed that the product has a potentially large foreign market assuming it can meet stiff international standards.

Lightweight aggregate (expanded clay) made of coal deposit overburden materials

General profile

The technology for the production of lightweight aggregate, also known as expanded clay, made of coal deposit overburden materials was developed in 1992 by ITDI and funded by the institute. The product is ready for pilot-scale production but is temporarily shelved due to lack of funds, specifically for the purchase of production equipment.

The sources of information for this discussion are ITDI (undated) and the interview of Cabillon.

Production structure

Material inputs. The materials needed in the production of lightweight aggregate are coal deposit overburden, waste materials from coal mining, and a local natural resin as a bloating agent.

Production technology. Due to lack of information, it is impossible to give a detailed description of the production process in the production of lightweight aggregate made of coal deposit overburden materials. In summary, the different steps involved are: the crushing the coal deposit overburden material inputs; extrusion or pelletizing with the addition of a bloating agent and using an extruder or pelletizer; and calcining at high temperature until

sintered using calcining kiln.

The manufacture of lightweight aggregate made of coal deposit overburden materials involves intensive labor in the handling and preparation of raw materials and requires costly production machinery and equipment. Thus, the process is both labor and capital-intensive.

Production capacity

There is no industry data for lightweight aggregate made of coal deposit overburden materials as the product has yet to be commercialized. There are also no available data on production capacity at plant-level.

Production economics

Preliminary data indicate that the initial investment required to operate a commercial plant for lightweight aggregates made of coal deposit overburden materials is roughly placed at ₱2 million at current prices. The amount covers production equipment (60 percent), building (30 percent) and installation (10 percent). Unfortunately, the production capacity of the plant and other important information are not known.

Utilization

Lightweight aggregate made of coal deposit overburden materials can be used in the manufacture of structural or load bearing products, nonbearing concrete masonry units, thermal and acoustic insulation and lightweight concrete slabs and structural lightweight concrete beams. The target clientele of the product is the construction industry.

Environmental and other positive qualities

The production of lightweight aggregates made of coal deposit overburden materials utilizes the waste materials from open pit coal mining operation. These coal deposit overburden materials are generated by the several hundred thousand to million tons before extraction can be made on an expose a coal-seam. At present, these coal deposit overburden materials are just left behind without any economic contribution and create a waste disposal problem. With this new technology developed by ITDI, these waste materials can be utilized as productive inputs of an industry and as a source of income and employment for people.

Product substitute

Lightweight aggregates made of coal deposit overburden materials can substitute for sand and gravel used in concrete mixtures and other lightweight aggregates, imported or locally produced. Over the years, the local production of sand and gravel has been increasing yearly. The Philippines has also been importing

sand and gravel and lightweight aggregates. These implies that there is a market for the substitutes of lightweight aggregates made of coal deposit overburden materials which future manufacturers of the product can exploit.

International market

The Philippines has been exporting lightweight aggregates over the years although the volume of exports has declined on the average every year. Locally produced lightweight aggregates, therefore, are already utilized by foreign users which implies, on the other hand, that there is potential for lightweight aggregates made of coal deposit overburden materials as an exportable commodity.

Summary of Characteristics of Environmentally Preferable Products

A short summary of the characteristics of 37 EPPs covered in the study is presented in Table 1. Of these total, 21 are agriculture-based, three are forestry-based, three are fisheries-based, six are industry-based and four are classified as other products.

Of the 37 EPPs, six were developed by FPRDI, six by FNRI, nine by ITDI, seven by BIOTECH, one by PCARRD, one by PCAMRD, one by NAAP, one by ATI, three by NTA, one by PTRI and one by PCA. The research and development of 31 of the products have been financed solely by local funds while those of six others were financed solely or partially using foreign funds. Also, the development of 17 of the EPPs were based on technologies which are originally developed locally while those of 20 others were based on improved or refined technologies which were originally developed in other countries.

Of the total EPPs, 11 are in the stage of product development, five are in pilot-testing, four are ready to be commercialized, 14 are sold domestically only and one is exported. The stage of development of three EPPs are not known at present. The products which are sold locally are the compost fungus activator and compost from rapid composting technology, handmade paper from rice straw, hollow block made from rice hull ash cement, banana peel vinegar, aid to organically grown products, charcoal briquette, woodwool cement board, coconut timber, Hemosep-WC, Bio-N, Nitro-Plus, Mycogroe, bonded ash souvenir items and ceramic glazes made from lahar. Of these products, only handmade paper from rice straw is currently exported.

The technologies for the production of 23 of the products can be described as labor-intensive while those for six others can be

Table 1. Summary of the Characteristics of Environmentally Preferable Products in the Philippines

Product Classification	FPRDI	FNRI	ITDI	BIOTECH	PCARRD	PCAMRD	NAAP	ATI	NTA	PTRI	PCA	Total
Agriculture-based	3	4	5	2	1	0	1	1	3	1	0	21
Forestry-based	2	0	0	0	0	0	0	0	0	0	1	3
Fishery-based	0	2	1	0	0	0	0	0	0	0	0	3
Industry-based	1	0	0	5	0	0	0	0	0	0	0	6
Other Products	0	0	3	0	0	1	0	0	0	0	0	4
All Products	6	6	9	7	1	1	1	1	3	1	1	37

Table 1. Summary of the Characteristics of Environmentally Preferable Products in the Philippines

Product Classification	Source of Research Funding			Source of Original Technology		Product Devt	Stage of Dev't			Commercialized		
	Local	Foreign	Both	Local	Foreign		Pilot Testing	To be com- mercialized		Domestic Only	Exported Also	Not Known
Agriculture- based	17	3	1	11	10	8	2	3		5	1	3
Forestry- based	2	1	0	0	3	0	0	0		3	0	0
Fishery- based	3	0	0	3	0	2	1	0		0	0	0
Industry- based	6	0	0	1	5	0	1	1		4	0	0
Other Products	3	0	1	2	2	1	1	0		2	0	0

Table 1. Summary of the Characteristics of Environmentally Preferable Products in the Philippines

Product Classification	Input Intensity			Waste User	Environmental Qualities	
	Capital Intensive	Labor Intensive	Both		Non-pollution generating prodn process	Non-pollutive in consumption
Agriculture-based	4	13	4	17	17	21
Forestry-based	0	0	3	3	2	3
Fishery-based	0	3	0	1	3	3
Industry-based	2	4	0	1	6	6
Other Products	0	3	1	2	4	4
All Products	6	23	8	24	32	37

characterized as capital-intensive. Eight products have production technologies which are both labor and capital-intensive. Of the 37 products, 24 use waste materials in production. All the EPPs can be utilized with no pollutive effects while 32 have nonpollutive production processes.

Almost all the products use locally available material inputs. Most of the products are commercially viable and appear to have strong market potential, both in the domestic and foreign markets.

In summary, the following are the observations on the EPPs produced in the Philippines:

- a) There are several EPPs which are already produced and has potential to be produced in the country.
- b) Several of these EPPs were developed by universities and government research and development institutions.
- c) Most of the funding for EPP development in public institutions come from government funds while only a small fraction comes from foreign sources.
- d) Some of the EPP technologies were locally developed while others were adapted from foreign technologies.
- e) Most EPP technologies are labor-intensive and use inputs which are locally available while only a few are capital-intensive.
- f) EPP technologies either use waste as inputs, have nonpollutive production process or utilization.
- g) Many of the EPPs are still in the development stage but some are already commercialized.
- h) Most of the EPPs appear to be highly profitable ventures if operated on a commercial basis.
- i) The commercialization of EPPs, in general, is done by government institutes which developed them or by private small-scale operators.
- j) Commercialized EPPs are mostly sold only in the domestic market.
- k) Most EPPs are commercially viable and have strong potential in both domestic and export markets.

V PROBLEMS AND POLICY FOR EPP DEVELOPMENT

Problems Associated with EPP Development

In this section, the problems related to the development and commercialization of EPPs are reviewed. The discussion follows the three classifications of EPPs: those that are in the development stage, those that are ready to be commercialized and those that are already commercially produced. The sources of information for the discussion is the interview with the developer-respondents and key industry informants.

Problems Associated with EPPs in the Development Stage

As shown in the previous chapter, although some EPPs are already produced and marketed, many others remain in the development stage due to problems which constrain the transformation of EPPs from laboratory products to market products. A major problem in the development of EPPs is the difficulty encountered by researcher-developers in perfecting technologies that will make production not only technically possible but also rewarding to potential investors. In some cases, the technical aspects of EPP production alone is already hard enough to perfect. Establishing the financial feasibility of these technologies is an even tougher task that requires years of continuous research and development before technology EPPs can be disseminated.

The success of technology development and refinement for EPPs depends largely on the availability of sufficient financial resources necessary to conduct the needed research and experiments. In the Philippines, inadequate financial support is a problem faced by EPP developers. More often than not, researchers and institutions working on EPP technologies are left to their own devices to scout for funds since the national government cannot meet the full financial needs of the research sector. Furthermore, scavenging for funds is made even more difficult by the stiff competition among researchers and institutions and the decreasing supply of funds for research over the years from nongovernment sources, both local and foreign.

The problem of insufficient funds for research appears acute, especially for EPPs whose technologies need to be developed using capital-intensive equipment available only from abroad. With the weak local economy and declining aid from developed countries, available foreign currency for the purchase of imported research equipment has fallen. The eventual effect of this is the unwanted postponement or termination of research on some capital-intensive

EPPs still in the development stage.

A second important problem facing the development of EPPs is that, in general, the country has no clear and conscious effort to develop EPPs. While the country has already started to understand the meaning of sustainable development, direct sectoral intervention, such as the imposition of command and control instruments in forestry and fishery, remain the popular approach employed by government to attain its NRE objectives. The product market has not been given serious consideration, so far, as a potential arena for addressing NRE problems. In turn, this lack of appreciation of the role that the product market can play reduces the importance of developing EPPs in the country.

In summary, there are big problems facing the research and development of EPPs. The major problem is the lack of funding support for EPP related research activities. Another is the government's lack of general appreciation of the role the product market plays as a potential major avenue for addressing the NRE problems facing the country.

Problems Associated with Ready to Commercialize EPPs

There are EPPs whose technical and financial feasibilities have been established already but whose commercialization is put on hold. The problems facing these EPPs are discussed below.

One major hindrance to the commercialization of EPPs is the unreliability in the supply of major inputs of production. In some cases, inputs may be in short supply literally because there is not enough of them around for commercial production. In other cases, they are in short supply due to inadequate transportation systems. Moreover, inputs may be available in enough volumes but the facilities necessary for their proper storage may be inadequate. Either way, the unreliable supply of inputs has discouraged investors from producing EPPs on a commercial scale.

The market for EPPs, or the lack of it, is another obstacle to commercialization. In general, EPPs are unknown to consumers compared to their traditional substitutes. Thus, they need to be introduced to the market. The large cost which may be needed to finance promotional programs for the development of markets for EPPs have discouraged investors from investing in EPPs.

A third problem is that some EPPs, especially those which are capital-intensive, requires large investment outlays. While some businessmen may have the ability to raise huge amounts of money for investment, great financial exposure on an untested and new product in the market may be too much of a business risk for many investors to take.

A fourth problem is that for some EPPs, especially capital-intensive ones, the tools, machines and equipment for production are not available locally but can be purchased only from abroad.

The prohibitive prices of these equipment may deter many investors from commercial production as the option of producing the equipment locally may be too costly if not technically unfeasible.

Finally, a factor constraining the commercialization of EPPs is the weak drive by the government to promote EPP technologies and disseminate them to the private sector. While there are government agencies mandated to promote indigenous technologies, including those on EPPs, the budgets of these agencies are minuscule relative to the task they are asked to perform. With low appropriations, agencies are forced to spend significant parts of their budgets for personnel compensation and maintenance expenses, with not much left for operations. Moreover, agencies are understaffed and personnel are underpaid, thus, causing morale problems among the staff.

In summary, there are many problems facing EPPs which are ready for commercialization. Among these are the unreliable supply of major production inputs, nonexistent or weak demand for EPPs in the market, high investment needed for EPP commercial operations, costly and imported production equipment and inadequate dissemination efforts by the government.

Problems Associated With Commercialized EPPs

A major problem in the commercialization of EPPs is the lack of sufficient funds for planned expansion. At present, production of EPPs is mostly done on a small-scale basis only, way below the maximum potential capacity of plants, due to the lack of capital available to the operators, be they private businessmen or government institutes. While some operators perceive the expansion of operations beyond the present scale as an attractive move, they do not have the required capital to do so. Moreover, borrowing money from banks and other institutional sources to undertake expansion is deemed unattractive as the interest and other conditionalities imposed by these sources can be prohibitive. The need for a low-interest capital by investors is especially acute where planned expansion of operation involve procurement of capital-intensive facilities and equipment.

Aside from capital, the unreliable supply of major production inputs---a problem already cited as common with ready to be commercialized EPPs---is also a constraint for already commercialized EPPs. In some cases, although the needed capital fund for expansion may actually be available, production is stuck at present levels due to limits in the supply of inputs. This problem is a major reason why some EPP ventures remain small-scale even after a long period of operation.

Another major problem faced by EPP investors is the present weak market demand for EPPs due to the lack of product recognition by potential buyers. As in the case of EPPs which are ready for commercialization, this could be reduced through intensive product

promotion. However, being small-scale businessmen, investors may not have the funds required for intensive promotional activities. Moreover, investors who avoid risks may be uncertain about the financial benefits that promotion will bring to their business.

The problem of a weak market for commercialized EPPs is made worse by the presence of substitutes in the market which are very well entrenched and recognized by consumers. Having been in the market for years, the EPP substitutes command a dominant share of sales. Breaking the hold in the market by the substitutes is a big undertaking faced by investors of commercialized EPPs, especially those who produce on a small-scale footing.

The control of the market by EPP substitutes is strengthened further by the lack of knowledge of buyers about the environmental attributes of different competing products. Although substitutes may be environmentally-adverse, consumers continue to patronize them either because they are not aware of their negative qualities or if they are, they do not care as long as the adverse effects on the environment caused by the use of the product do not directly affect them. Social and environmental irresponsibility on the part of buyers appear to be contributing factor to the continued appeal of environmentally adverse substitutes.

Still another factor which adds to the success of substitutes is the present low supply of EPPs in the market. For some EPPs, the demand is actually high but is not met by supply. Hence, many buyers, especially those who purchase frequently and in bulk, are discouraged to patronize EPPs and instead replace them with their substitutes whose supply can be relied on.

Finally, while supply may be a problem of some EPP businesses, others can actually produce as much as the market demands given a reasonable period of time. For these businesses, the concern at present is how to stimulate and expand sales. Some see exporting to foreign markets as an attractive avenue for market expansion.

Breaking into the foreign market, however, is a challenge for EPP ventures as the problems related to exportation are many. To mention a few, EPP investors in general are neophytes in their line of business and have no previous experience in exporting EPPs. To succeed in the export business, they need to establish first their own international marketing network.

A second problem related to exportation is that while there is a growing international trend favoring EPPs in general, the locally produced EPPs are unknown to foreign consumers. Thus, local EPPs must be extensively promoted in foreign markets first. Yet another problem is that for local EPPs to be acceptable, it must meet stiff international product standards in terms of market price, product quality and overall competitiveness.

In summary, the problems associated to commercialized EPPs relate to both supply and demand factors. Limitations in supply are caused by lack of capital for expansion and the unreliability

of production inputs. On the other hand, limitation in demand is caused by weak product recognition in the domestic market and the presence of established substitutes. Demand is further limited by the difficulty of EPP producers in breaking into the international market.

Policies for the Development of EPPs

This section discusses policy recommendations which may help solve the problems related to EPP development outlined in the preceding section. In the following presentation, policies are grouped based on the level of development of EPPs: those that are still in the development stage, those that are ready for commercialization and those that are commercialized at present. The policies discussed are based on the opinions of the interview respondents, key informants and the authors of the study.

Policies for EPPs in the Development Stage

Inadequate funding is not only a problem in EPP research but also in the whole Philippine research system. Historically, the share of the government budget allocated to research has been low (David, Ponce and Intal 1992). Calls have been made to raise this share to effect technology development but unfortunately, instead of improving, the situation has gone worse as funding for research continuously dropped.

At the risk of being redundant, the call for more government funding for research in general and EPP research in particular is repeated and argued here. As a matter of policy, the government must raise its allocation to the research sector which is the main foundation of the drive of the country towards industrialization. As explained, more funding for research can only result to greater benefits for the country over the long-term (Ibid).

If the government cannot embrace this policy, then at least it should help mitigate the problem of low research funding by actively pursuing outside sources of research funds, especially for EPP development. Other than the government, potential sources of research funds are the private sector and international donors. As a policy, the government must encourage business firms to provide research funds for the development of EPP technologies that they can potentially apply in the future. To motivate the private sector to contribute for R & D, the government must provide firms incentives, such as joint patentship for developed EPP technologies and tax breaks for EPP producing businesses.

To stimulate foreign research funding, EPP researchers must be assisted by the government in scouting for international funds for their research projects. Since EPPs help attain NRE goals, an area of much concern and popularity among international donor agencies, foreign funding for EPP projects may not be as difficult to raise as might be perceived. The government can assist researchers in this regard through a variety of activities such as: the provision of information on the international sources of funding and official government linkages with international donors interested in the funding of EPP research; promotion of interaction between local and

international researchers via government funded workshops and meetings; and the promotion of visits by officials of international donor organizations to observe local EPP research developments and other activities.

The problem of lack of a clear and conscious effort on the part of government to develop and promote EPPs as a means of attaining NRE goals must also be addressed. As a matter of policy, the production and consumption of EPPs must be encouraged while that of goods harmful to the environment must be discouraged. In research terms, this policy can be implemented by integrating EPP development into the mainstream of research in the NRE sector. Specifically, the government must emphasize EPP development as a solution to NRE problems as it does on direct sectoral interventions such as reforestation, proper solid waste disposal and similar programs.

Finally, to hasten the full development of EPP technologies, the EPP sector must be explicitly encouraged by the government to continue their good work. For instance, an award system must be activated by the government whereby inventors and developers are properly remunerated and recognized for their efforts. The award must be over and above what is now currently in place given the critical importance that EPPs play in the search for sustainable progress in the country.

Policies for Ready to Commercialize EPPs

The unreliability in the supply of major production inputs as a constraint to EPP commercialization has two sides to it. If inputs are constantly in short supply simply because there are not enough of them available, then technology research on the involved EPPs has to stop. Clearly, there is little sense in developing a technology that has no potential for commercial production because major inputs are not available. As a matter of policy, therefore, developer-institutes, especially those financed by the government, should assess the stock and supply of local inputs of a product before funding for research and development on the product is made available. This policy should also hold for EPPs whose major production inputs can only be acquired from abroad at economically prohibitive prices.

When production inputs are in short supply because of the lack of necessary transportation systems and support facilities, then the government must improve transport and support facilities, either by spending on them directly or by encouraging the private sector to spend on them.

Over the years, the improvement of transportation systems has been a government priority and in fact a large part of the budget yearly has gone into this purpose. However, the concentration of the effort has been on the improvement of urban road networks and

less on rural road networks where many of the small-scale EPP firms are located. The government must then emphasize the improvement of rural transportation networks, not only for EPP development but for rural growth as a whole.

To encourage the private sector to help in the improvement of transportation and support facilities, businesses engaged in EPPs may be assisted by the government through the provision of cheap credit, for instance, in buying transport vehicles and putting up storage facilities. The purchased vehicles and equipment will allow businesses to move the production inputs from their sources and store them in areas before production commences.

As to the problem of imported equipment which can be purchased only at very high prices, the government can do two things. First, it can lower the tariff imposed on equipment used in the production of EPPs so that the domestic prices of these can be lowered. Second, the government can encourage the growth of local producers of equipment so that local substitutes for imported equipment can be produced at lower costs. As a matter of policy, the government can do either or both to, at least, reduce the problem of costly imported equipment.

As already discussed, the problem of nonexistent markets for EPPs may have to be addressed only through good product promotion. If an EPP is a substitute for an existing product, then the market for this latter product is effectively the market for the EPP. The important job is to convince potential buyers of the merits of the EPP as an alternative to the substitute product.

On the other hand, the problem of poor dissemination efforts by the government is basically a problem about budget. Needless to say, more money must be afforded government agencies for them to be effective at their work. This is indispensable for the successful dissemination not only of EPPs but also for other locally developed products.

In line with product promotion and technology dissemination, streamlining and reorganizing units within and between agencies may be useful in addition to higher budgets for government agency operations. In particular, a unit within the Department of Trade and Industry and/or the Department of Science and Technology may be formed to perform the task of promoting and disseminating EPP products and technology. In this way, EPP development will be highlighted as a priority task of the government.

Finally, the problem of capitalization for an EPP commercial venture does not differ from the problem of capital to expand operations. This problem is addressed in the next section.

Policies for Commercially-Available EPPs

The lack of capital needed to start or expand operations is a common problem among Philippine business firms. This predicament

may be worse among EPP producers whose businesses have no previous strong record in terms of financial viability. Without record, it will be difficult for banks and other sources of funds to judge the commercial profitability of EPPs as a business which may lead to the rejection of loan applications of EPP investors or the provision of loans but only at very high interest rates.

For EPP businesses to prosper in the country, the government may have to take up, at least initially, part of the risk involved in the commercialization of EPPs. The government may set-up a special credit program designed to assist EPP firms in meeting the capital demand of their businesses. The credit program will have to be concessionary in nature, one that provides firms with enough expansion capital at easy terms of credit.

The solution to the input supply problem faced by EPP firms is similar to what was discussed in the previous section. As a policy, the government must give priority to the improvement of transportation systems and support facilities by spending on them directly or by encouraging private firms to invest on them through provision of easy credit.

Also as discussed in the previous section, the problem of weak local markets for EPPs can be addressed through intensive product promotion and consumer education. In this regard, the creation of that government unit proposed earlier to promote EPPs becomes even more imperative.

The problem of low or inconsistent supply of the EPPs in the market, which discourages buyer patronage, can be addressed by producing more EPPs or proper scheduling of the shipment of goods to specific outlets. Producing more, of course, depends on the ability to expand operations (already discussed in an earlier section). Supply can be made more consistent at firm level, given a fixed volume of output, by limiting the number of outlets to what is necessary and maintaining stock inventory. Fewer outlets insure that sufficient quantity of products is made available, thereby assuring buyers the availability of the product. On the other hand, stock inventory insures that sudden increases in the demand of the product, for example bulk buying, can be sufficiently met at a reasonably short period of time.

Finally, for the development of export markets for EPPs, a concerted effort by both the private sector and the government is necessary. Private trade organizations can be of great help to potential EPP exporters in the process of learning the nuances of export business. For its part, the government can encourage EPPs producers by providing them special treatment, initially at least. The special treatment may come in the form of export tax incentives and other inducements different from what has already been provided to other exporting firms.

General Policies for EPP Development

It is strongly argued that in general, the national government must vigorously play the leading role in the development of EPPs. This role must be in the form of tangible financial assistance to EPP developers including provision of cheap credits, tax incentives, infrastructure support, promotional support, export incentives and other subsidies to the EPP subsector.

With the rising popularity of free trade and the advent of free trade groupings, however, the provision of subsidies to any economic sector in the Philippines will certainly be viewed with skepticism by many at present. In particular, the granting of subsidies to EPP producers can be seen as a step backward to the old days when government was the main propping-up mechanism for favored but grossly inefficient and uncompetitive industries.

Granting subsidies, therefore, will be a bone of contention in EPP development for some time. The case for granting subsidies, on the other hand, is based as much on social as on economic reasons. First and foremost, the NRE sector of the country has been continuously penalized for a long time in the attainment of traditional economic development objectives. Thus, the state of well-being of the environment is slowly being eroded that its simple survival and that of the whole society which depends on it, is now at great risk. Worthy solutions to natural resource and environmental degradation, such as EPP promotion which justly deserves financial investments, must therefore take precedence over society's other less pressing priorities.

VI CONCLUSIONS

Summary

There is no denying that for the Philippines, the development of EPPs both for the local and export markets is a step in the right direction. The production and local consumption of EPPs, in lieu of environmentally-adverse substitutes, will alleviate the rapidly deteriorating state of the NRE sector of the country. On the other hand, the trade of EPPs in the international market, which is increasingly becoming environment conscious, is going to spur growth in an otherwise lagging economy.

This paper shows that there are EPPs already produced and consumed commercially in the Philippines and there are still others which are ready for commercialization or in the research stage. In general, however, locally produced EPPs are not yet introduced in international markets.

There are several major hindrances to the full development of EPPs in the Philippines. These are: the lack of financial support for technical research; inadequate supply of major material inputs for full-scale production; lack of capital for expansion; lack of knowledge and experience in the export business; and lack of government support for product promotion and technology dissemination.

Strong policies are needed to surmount the above problems and effect full development in the production, utilization and trade of EPPs in the country. The problem of research financing must be met by a serious effort on the part of the government that will also involve the private sector and international donor organizations in the funding for EPP research. The inadequate supply of material inputs may be solved with the government allocating more funds to be spent on rural transportation system or lent to the private sector to improve their transportation and storage facilities. The inadequacy of capital for expanded operation must be addressed through the provision of concessional credit to EPP businesses. The government may facilitate export market development by providing special treatment and inducement to would-be exporters in addition to what has already been given to other firms. Poor promotion and technology dissemination must be met via additional funding to agencies and streamlining of operations. Specifically, a unit in government agency or agencies must be set up to promote EPP products and disseminate EPP technology.

Areas for Future Research

This specific review of EPPs in the Philippines, obviously, has gaps which need to be filled. These gaps are discussed to point out possible areas for future research and continue the preliminary work already started in this report.

First, this current work is less comprehensive in terms of the number of products covered. Due to time and resource limitations, other EPPs, especially those developed by the private sector, have not been included in this study. A documentation of the EPPs not covered here can be undertaken in the future to expand the list of environment-friendly products developed and commercialized in the country.

The second shortcoming of the study is that it treats some aspects of EPP development in a less intensive and in-depth way. This is particularly true in the treatment of the technical aspects of EPP development. Thus, in the future, for the benefit of potential investors as well as other interested parties, a special review detailing the technical aspects of at least some of the products can be done, especially those EPPs which have the promise of becoming business winners. A more in-depth review will facilitate the wider use of EPP-based technologies in the country.

Other than the technical aspects, a more detailed study on the international market potential of EPPs which are ready for commercialization or are already commercialized domestically is in order. This is necessary so that investors who want to venture into EPP exportation will have a strong basis for decision making. A study which will look into particular countries and markets for specific EPPs will be most welcomed.

Finally, although EPPs are relatively new to the country, their usefulness as a means of attaining the twin goal of NRE protection and economic development cannot be ignored. Thus, the development of EPPs must be pursued with vigor and purpose by the government.

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APPENDIX A: List of Developer-Institutions and
Environmentally Preferable Products in the Philippines

1. Agricultural Training Institute (**ATI**)
ATI Bldg., Elliptical Rd., Quezon City, Philippines

Product:

a) Banana Peel Vinegar

2. Food and Nutrition Research Institute
Department of Science and Technology (**FNRI-DOST**)
Bicutan, Taguig, Metro Manila, Philippines

Products:

a) Soy Tempe Flour
b) Squash Flour
c) Rice-Mango Curls
d) High Fiber Mango Drink
e) Seaweed Noodles
f) Shrimp Powder Fortifier

3. Forest Products Research and Development Institute (**FPRDI**)
University of the Philippines at Los Baños
College, Laguna, Philippines

Products:

a) Handmade Paper from Rice Straw
b) Hollow Blocks made of Rice Hull Ash Cement
c) Coconut Coir Dust Cation Exchange Resin
d) Charcoal Briquette
e) Woodwool Cement Board
f) Cement Additive from Spent Liquor
g) Biomass Pyrolyzer

4. Industrial Technology Development Institute
Department of Science and Technology (**ITDI-DOST**)
Bicutan, Taguig, Metro Manila, Philippines

Products:

a) Slow-Release Type Potassium Silicate Fertilizer from Rice
Husk and Dolomitic Limestone (Slow-Release Fertilizer)
b) Sodium Silicate from Rice Husk
c) Silica Gel from Rice Husk
d) Synephrine from Calamansi Wastes
e) Coco-Diesel Fuel
f) Seaweed Tablet as Natural Source of Iodine

- g) Bonded Ash Souvenir Items
 - h) Ceramic Glazes Made of Lahar
 - i) Lightweight Aggregate (Expanded Clay) Made of Coal Deposit Overburden Materials
5. National Azolla Action Program (**NAAP**)
University of the Philippines at Los Baños
College, Laguna, Philippines
- Product:
- a) Azolla
6. National Institutes of Biotechnology and Applied Microbiology (**BIOTECH**)
University of the Philippines at Los Baños
College, Laguna, Philippines
- Products:
- a) Lysine
 - b) Hemosep-WC (Pasteurella Vaccine)
 - c) Bio-N
 - d) Nitro-Plus
 - e) Mycogroe
 - f) Orchid Hybrids Through Somatic Cell-Fusion
 - g) Bio-Organic Fertilizer
 - h) Mykovam-1
7. National Tobacco Administration-Main Research Center (**NTA-MRC**)
- Products:
- a) Tobacco Waste as Molluscide
 - b) Multi-Crop Solar Dryer
 - c) Particleboard from Tobacco Stalks
8. Philippine Coconut Authority (**PCA**)
- Product:
- a) Coconut Timber
9. Philippine Textile Research Institute (PTRI)
- Product:
- a) Agricultural Fibers as Textile Material
10. Philippine Council for Aquatic and Marine Research and Development (**PCAMRD**)
University of the Philippines at Los Baños

College, Laguna, Philippines

Product:

a) *Derris* Root Powder

11. Philippine Council for Agriculture, Forestry and Natural
Resources Research and Development (**PCARRD**)
University of the Philippines at Los Baños
College, Laguna, Philippines

Product:

a) Compost Fungus Activator (CFA) and Compost
from Rapid Composting Technology

APPENDIX B: Interview Respondents

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APPENDIX C: Interview Questionnaire

PRODUCTION, UTILIZATION AND TRADE OF ENVIRONMENTALLY PREFERABLE PRODUCTS IN THE PHILIPPINES

Respondent: _____ Position: _____
Institute : _____ Address : _____
Tel. No. : _____ Fax No.: _____
Interviewer: _____ Date of Interview: _____

I. GENERAL PROFILE OF THE PRODUCT

- 1) Name of Product: _____
- 2) [a] Name of Product Developer : _____
[b] Name of Institute Developer: _____
- 3) Development Stage of the Product: _____
- 4) For commercially available product:
[a] Year it was developed: _____
[b] How long was it developed? _____
[c] Year it was first commercially produced: _____
- 5) For on-going research product:
[a] Year research was started: _____
- 6) Sources of financing for Research and Development:
(Indicate percent share for each source.)

- 7) Are there any written materials regarding the product and its technology? If yes, please enumerate.

II. PRODUCTION STRUCTURE

1) Input Structure

a] Material Inputs

MATERIAL INPUTS

IMPORTED INPUTS
REPLACED

SOURCES OF INPUTS

b) Percentage of Material Inputs, by Source:

[a] Percent Local/Indigenous Materials: _____ %

[b] Percent Imported Materials : _____ %

2) Production Technology

a] Source of Technology:

[a] Local [b] Foreign [c] Both a & b

b] Description of the Production Process:
(Indicate equipment used in production.)

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper has a slight shadow on the right side, suggesting it's resting on a surface.

c] Is the production process labor-intensive or capital intensive? _____

3) Yearly Production Capacity and Sales (Industry)

a] Yearly Production

1 9 9 4		Projected				
Actual	Max.	1995	1996	1997	1998	1999

b] Yearly Sales

Actual	Projected				
1994	1995	1996	1997	1998	1999

c] Do you have any plans to expand the present plant size and capacity? _____
Please elaborate.

4) Production Economics

a] Estimated Initial Capital Investment: _____

b] Sources of Financing (Indicate percent share for each source.)

c] Fixed Assets

EQUIPMENT	QTY.	YEAR ACQUIRED	ACQUISITION COST	EXPECTED LIFETIME	MAINTENANCE COST
-----------	------	------------------	---------------------	----------------------	---------------------

d] Estimated Total Cost/Unit of Product: _____

e] Percent Share of Total Cost Per Unit:

Costs	% Share
Fixed Cost	
Variable Cost	
Material Inputs	_____
Labor	_____
Storage	_____
Marketing	_____
Others	

f] Estimated Market Price/Unit of Product

[a] What is the domestic selling price per unit of your product? _____

[b] If Exported, what is the international selling price per unit of your product?_____

g] Productivity Ratios

[a] Profit level per year	:	_____
[b] Return on Investment	:	_____
[c] Payback Period	:	_____
[d] Others (please specify):		_____

III. UTILIZATION

1) Product Usage:

a] Main Use of Product:

b] Secondary Uses of Product:

2) Domestic Market

Domestic Market	Present		Potential				
	1994	1995	1996	1997	1998	1999	
Volume							
Value							

3) Present Domestic Marketing Channel. Please elaborate.

4) Target Clientele

a] Present Consumers/End-Users:

b] Potential Consumers/End-Users:

5) Product Promotion/Advertising

a) Is the product advertised and promoted domestically?_____

b) If yes, how is it promoted product?

c] If no, do you have any plans to promote the product? Please elaborate.

6) If the product is not exported, do you plan to export your product in the near future? Please elaborate.

IV. ENVIRONMENTAL AND OTHER POSITIVE QUALITIES OF PRODUCT

1) Why is product environment-friendly? Please elaborate.

[illegible]

- 2) What are the other potential attributes of the product? Please elaborate.

V. PRODUCT SUBSTITUTES

- 1) Product Substitutes

a] Current Substitutes:

b] Potential Substitutes:

- 2) What is the present supply and demand situation for those substitutes? Please describe generally.

- 3) Why is your product considered environmentally superior to its substitutes?

V. EXPORT MARKET OF THE PRODUCT

- 1) If product is exported, how big is export market?

Export Market	Present		Potential				
	1994	1995	1996	1997	1998	1999	
Volume							
Value							

- 2) If product is exported, how big is export sales?

Export Sales	Present		Potential				
	1994	1995	1996	1997	1998	1999	
Volume							
Value							

- 3) Describe export marketing channel. Please elaborate.

- 4) Target Export Clientele

a] Present Export Consumers/End-Users:

b] Potential Export Consumers/End-Users:

5) Product International Promotion/Advertising

a] Is the product advertised and promoted internationally?_____

b] If yes, how is it promoted?

c] If no, are there plans to promote it internationally? Please elaborate.

VI. PROBLEMS AND POSSIBLE SOLUTIONS

1) Please state the major problems involved in the technology, development, production and marketing of the product. For each type of problem, what do you think are the possible solutions?

a] Problem 1:

b] Problem 2:

c] Problem 3:

VII. GOVERNMENT ROLE AND POLICY RECOMMENDATIONS

1) What do you suggest should be the role of the government in the development of EPPs in terms of the following areas?

a] Production:

b] Utilization:

c] Exportation:

2) What general policies would you like to recommend for the promotion of your product in particular and EPPs in general?

- END -

APPENDIX D: Project Steering Committee Members

- 1) Mr. Sergio R. Ortiz-Luis, Jr.
President
Philippine Exporters Confederation, Inc. (PHILEXPORT)
Ground Floor, Southside
Philippine International Convention Center (PICC)
Roxas Boulevard, Manila

Tel. nos.: (632) 833-25-31 to 34
Fax no. : (632) 831-37-07/831-02-31
- 2) Ms. Araceli Maria Pinto-Mansor
Executive Director
Center for International Trade Expositions
and Missions (CITEM)
International Trade Center
Roxas Boulevard corner Sen. Gil Puyat Avenue
Pasay City, Metro Manila

Tel. nos.: 831-22-01 (trunkline)
831-23-82 or 832-39-56
- 3) Mr. Mario Feranil
Director for Research
Philippine Institute for Development Studies (PIDS)
NEDA sa Makati Building, 106 Amorsolo Street
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Tel. no.: 893-7819
- 4) Dr. Ponciano S. Intal, Jr.
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