NATIONAL R and D PRIORITIES DELPHI ASSEMBLY

Philippine International Convention Center

October 5, 2010

ENGR. MARIO G. MONTEJO

Former DOST Secretary

CAVITE STATE UNIVERSITY

SEAMEO SEARCA

SOCIO-ECONOMIC AND ENVIRONMENTAL ASSESSMENT OF A MICROCONTROLLER-BASED COFFEE ROASTING MACHINE: IMPLICATIONS FOR MARKET POTENTIAL AND TECHNOLOGY COMMERCIALIZATION

RUEL M. MOJICA
ASEAN Engineer
Professor of Agricultural Engineering

Date/Time: **March 8, 2017**/9:00 - 11:00 AM
Venue: **S.M. Rolle Hall**, CvSU, Indang, Cavite

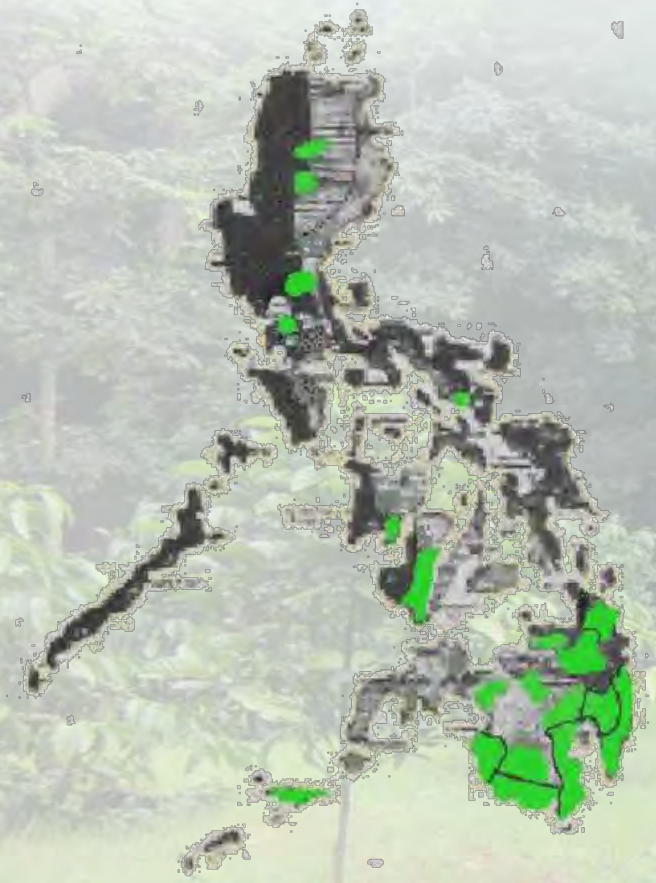
World Coffee Situationer

MAP: COFFEE PRODUCING COUNTRIES

- Second to oil in terms of trading value;
- 2 out of 3 people in the world drink coffee;
- Global consumption is 2.5 B cups/day;
- Grown in 70 countries in the world, 60 of which are exporters;
- Average world production (last 5 years) – **117 million bags green beans;**
- Provides livelihood for some 100 million coffee farming families around the world.

SOURCE:
International Coffee Organization (2012)

Philippine Coffee Situationer



- Average green bean - 450 kg/ha/year
- Average production - 30, 000 MT (green beans)
- Estimated annual consumption - 100,000 MT (green beans)
- To meet supply deficit , the country imports around 45,000 MT of coffee beans which accounts to around 70 million pesos a year
- Declining yields and conversion of coffee plantation to other commercial crops resulted to decreased area planted

SOURCE:
Department of Agriculture - Bureau of Agricultural Statistics (2014)

Role of Women in the Coffee Industry

INTERNATIONAL WOMEN'S COFFEE ALLIANCE
Promoting Possibilities
IWCA

- A global network of women in coffee that advocates for the reduction of barriers for these women in coffee producing countries by providing access to resources.
- To "empower women in the international coffee community to achieve meaningful and sustainable lives; and to encourage and recognize the participation of women in all aspects of the coffee industry,"

Source: www.borgenmagazine.com

COFFEE INDUSTRY

PRODUCTION

PROCESSING

MARKETING

PRIMARY

- Drying (Sun)

SECONDARY

- Milling
- ROASTING
- Grinding
- Packaging

PROBLEMS

TOTAL PRODUCTION

BIG COMPANIES

- dictate the price at the cheapest rate
- farmers are bonded with big companies

Nestlé

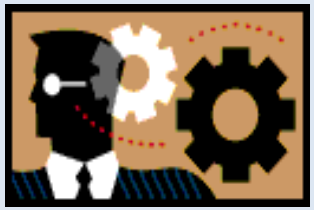
STARBUCKS COFFEE

GENERAL MILLING CORPORATION

90-95% = 5-10%

SOURCE: Kamagsasaka-Ka (2009)

R & D INNOVATION



- Cost effective
- Efficient
- Locally-made

OUTCOME

INCREASED FARMERS' INCOME

INCREASED LIVELIHOOD OPPORTUNITIES

INCREASED MECHANIZATION LEVEL FOR COFFEE

Objective

General

- to assess the socio-economic and environmental performance of the microcontroller-based coffee roasting machine developed for small-scale roasting operation.

Objective

Specific

1. identify the coffee farmers' criteria for selecting roasting machines;
2. assess their level of awareness and willingness to adopt roasting technology;
3. assess the economic viability of the machine and its effects on the income of farmers and processors;

Objective

Specific

4. determine the environmental impact of the machine; and
5. assess the market potential of the developed technology.

Methodology

MACHINE DEVELOPMENT & PILOTING

MACHINE DEVELOPMENT

FIELD EVALUATION

DEVELOPMENT OF FINAL PROTOTYPE

SOCIO-ECONOMIC & ENVIRONMENTAL ASSESSMENT

FIELD TESTING

FARMERS' PERCEPTION AND ACCEPTABILITY

ECONOMIC ASSESSMENT

ENVIRONMENTAL IMPACT ASSESSMENT

ASSESSMENT OF MARKET POTENTIAL

MACHINE COMMERCIAL-IZATION

BRANDING

IP APPLICATION

DEVELOPMENT OF IEC MATERIALS

LAUNCHING AND PROMOTION

SALES AND MARKETING

Farmers' Perception

Characteristic	Frequency	Relative Frequency (%)
1. Awareness about mechanical roaster for coffee and other crops		
Not aware	27	90.00
Slightly aware	3	10.00
Very much aware	0	0.00
2. Previous experiences with roaster for coffee and other crops		
None	29	96.67
Little experience	1	3.33
Much experience	0	0.00
3. Ownership of coffee machineries and equipment		
Coffee maker	7	23.33
Machine not available	23	76.67
4. Necessity of having a roasting machine for coffee		
Not needed	2	6.67
Necessary	23	76.67
Very necessary	5	16.67

Farmers' Perception

Characteristic	Frequency	Relative Frequency (%)
5. Can be used for other crops aside from coffee		
Not important	0	0.00
Important	25	83.33
Very important	5	16.67
6. Scale of roasting		
Small	26	86.67
Medium	4	13.33
Large	0	0.00
7. With microcontroller		
Not important	7	23.33
Important	23	176.67
Very important	0	0.00

Farmers' Perception

Characteristic	Frequency	Relative Frequency (%)
8. Output capacity		
5 kgs and below	6	20.00
6 – 10 kgs	15	50.00
11 – 15 kgs	5	16.67
16 kgs and above	4	13.33
9. Power source		
Biomass	6	20.00
LPG	10	33.33
Electricity	14	46.67

Farmers' Perception

Characteristic	Frequency	Relative Frequency (%)
10. Cost of machine (pesos)		
5,000 and below	11	36.67
5,001 – 10,000	8	26.67
10,001 – 15,000	7	23.33
15,001 – 20,000	2	6.67
20,001 and above	2	6.67
11. Materials		
Stainless steel	18	60.00
G.I. sheet	7	23.33
Stainless/G.I. sheet	5	16.67

Description of the Coffee Roasting Machine

Significant Features

- 10-kg capacity
- Automatic control
- 220V single phase
- Cost-effective
- Innovative
- Efficient

Social Acceptability

CRITERIA	LEVEL OF ACCEPTABILITY		
	Low	Moderate	High
1. Easiness of operation	13.33	16.67	70
2. Compatibility with farmers' needs	0	8	92
3. Compatibility with farmers' field condition	10	30	60
4. Visibility of result	0	27	73
5. Cost of roaster (P150,000/unit)	21.67	71.67	6.67
6. General acceptability	3.33	83.33	13.33

Economic Benefits

ITEM	VALUE
Initial Investment Cost	PhP 485,000
Fixed Cost /yr	PhP 126,585
Variable Cost /yr	PhP 96,000
Total Operating Cost/yr	PhP 222,585
Annual Gross Income	PhP 432,000
Annual Net Income	PhP 203,983
Payback Period	3.01 years
Break-Even Point	14,333 kg/year
Net Present Value	PhP 793,847.61
Benefit Cost Ratio	1.94

Additional Income to Coffee Farmers

A. Income based on the existing practice of the coffee farmers (selling produce in raw form)

Volume of dried berries : 400 kg/ha

Selling price : PhP 400/can

(1 can = 10 kg)

Income from selling of dried berries : **PhP 16,000/ha**

Additional Income to Coffee Farmers

B. *Income Using the Roasting Machine*

Volume of dried berries	: 400 kg/ha
Volume of green (pulped) beans (70% of dried beans)	: 280 kg
Volume of roasted beans (60% of green beans)	: 168 kg
Cost of pulping (Php 7/kg)	: PhP 2,800
Cost of roasting (PhP 12/kg)	: PhP 3,360
Total Added Cost	: PhP 6,160
Income from selling of roasted beans (PhP 300/kg)	: PhP 50,400
Net Income	**: PhP 44,240**

Additional Income to Coffee Farmers

C. Additional Income from Roasting

Per hectare : PhP 44,240 – PhP 16,000
: **PhP 28,240.00**

Per kg of dried berries roasted : PhP 70.6

Environmental Impact of the Technology

Comparison of fuel consumption from different sources and corresponding CO_2 emission (per 10kg batch).

ITEM	TYPE OF FUEL FOR ROASTER		
	KEROSENE	LPG	ELECTRICITY
Fuel Consumption	1.3 li	1 kg	0.3292kW-hr
Heating Value	35.2MJ/li	47.31MJ/kg	2.5 Kw-hr
Total Energy	45.76 MJ	47.31 MJ	4.50 MJ
Unit Emission	2.531kg $CO2_{eq}$/li	2.985kg $CO2_{eq}$/kg	0.5610 kg $CO2_{eq}$/kW-hr
Total Emission Savings in CO_2 emission/batch	3.289kg $CO2_{eq}$ 3.10433 kg $CO2_{eq}$	2.985kg $CO2_{eq}$ 2.80033 kg $CO2_{eq}$	0.18467 kg $CO2_{eq}$ not applicable

Sources: Mojica R. MS Thesis (Design, Construction and Evaluation of A Batch-Type Coffee Roaster for Small-Scale Roasting, 2003) and Intergovernmental Panel on Climate Change (IPCC) Guidelines for national Greenhouse Gas Inventories: Volume 3. Greenhouse Gas Inventory Manual

Environmental Impact of the Technology

Total emission avoided if electricity is used to roast Cavite coffee production and total national production per year using 2012 data.

ITEM	CAVITE	PHILIPPINES
Annual coffee production, MT	7,085.95	88,943.00
Volume of fuel needed		
Kerosene, li	921,173.50	11,562,590.00
LPG, kg	708,595.00	8,894,300.00
Electricity, kW-hr	233,269.48	2,928,003.60
Avoided emission kg $CO2_{eq}$		
Kerosene	2,288,411.63	28,724,193.08
LPG	2,072,077.98	26,008,768.32
Electricity	Not applicable	Not applicable

Market Prospects

- Cavite production = 7,085.95 MT
- 30kg/hr or 240kg/day @ 8hr operation/day
- 164 units

- Sultan Kudarat = 23,000 MT
- 526 units

Market Prospects

List of prospective buyers of the coffee roaster.

NAME	AGENCY/ADDRESS	CONTACT NOS./ EMAIL
1. Ms. Georgina Hernandez	Bukidnon	geo_ann18@yahoo.com
2. Mr. Peter John Balais	Tabuk, Kalinga Apayao	asguard52782@yahoo.com
3. Mr. John Michael Bantolina	Manila	jmbantolina@yahoo.com
4. Mr. Khan Mayor	USA	zagalawa.v10346@gmail.com
5. Ms. Merle Basco	Alaminos, Laguna	merlebasco@yahoo.com
6. Mr. Bing J. Jaleco	Consultant, USAID	bingjaleco@gmail.com +63920 9028482
7. Ms. Sharon Sarol	Program Manager Lagawe Coffee Blends	sarol_sharon@yahoo.com (074) 382025 09064790004
8. Mr. Edward Tobing	Gingoog City Misamis Oriental	lutong878@yahoo.co.nz
9. Ms. Ana Blardony Araneta	Manila	hq.greta@gmail.com +63917 5500060
10. Mr. Mike Carroll	Businessman Northwest Indiana, USA	mikec.t25@att.net

Market Prospects

List of prospective buyers of the coffee roaster.

NAME	AGENCY/ADDRESS	CONTACT NOS./ EMAIL
11. Mr. Barry Phillips	Director, Global Warmth, Aurora Province	globalwarmth@gmail.com
12. Ms. Lyle Myers	Businesswoman Bislig, Mindanao	lyleluvzme@yahoo.com
13. Ms. Pinky L. Nepumoceno	Businesswoman Brgy. Kalubkob, Silang Cavite	pinky_laysa@yahoo.com
14. Mr. Philo Chua	Businessman Manila	philochua@hotmail.com 0922 4315650
15. Mr. Fred Bacher	USA	fbacherl@san.rr.com
16. Mr. Roberto Francisco	Businessman Imus, Cavite	robertof@globenet.com.ph
17. Mr. Pepot Fortich	Businessman Cagayan de Oro City	+63917 7071240
18. Engr. Manuel Alagcan	Ministry of Agriculture Fiji Islands	(679) 3477044

Brand Name

- **Trade Mark** and **Trade Name** application were already published
- Application Nos. 4/2012/00013597 & 4/2012/00013598

Patent

Intellectual Property Center, 28 Upper McKinley Rd.
McKinley Hill Town Center, Fort Bonifacio, Taguig City 1634, Philippines
Tel. No. 238-6300 Website: http://www.ipophil.gov.ph e-mail: mail@ipophil.gov.ph
Publication Date August 13, 2013

ERRATUM

The following mark was inadvertently included in the 12 March 2013 TM Journal. The mark should not have been included in the list of allowed marks for opposition since the mark was still pending at that time.

Application No:	4/2012/00013515
Mark:	
Filing date:	06/11/2012
Applicant(s):	RUEL M. MOJICA [PH] and VIRGILIO F. LANZUELA [PH]
Address:	PUROK II, KAYTAMBONG, INDANG, Cavite, 4122, Philippines and 23 MAREMIL SUBD. LANDAYAN, SAN PEDRO, Laguna, Philippines
Translation:	NONE
Disclaimer:	NONE
Priority claim(s):	NONE
Goods / Services:	Class 42: TECHNOLOGICAL/MECHANICAL RESEARCH DESIGN RELATING TO ROASTING COFFEE.
Published:	12/03/2013 Journal: 13-02-04

- **Patent documents** were already submitted to the IPO of the Philippines (Application No. 4/2012/00013597)

Launching of Bravura Coffee Roasting Machine

KAPIHAN 2012

Cavite State University

June 28, 2012

Television Features

- "*Mag-Agri Tayo*"
  PTV Channel 4
  July 14, 2012

- *"Ating Alamin"*
  PTV Channel 4
  Ka Gerry Geronimo

Press Releases

- **Manila Bulletin**
  July 12, 2012


THE EXPONENT OF PHILIPPINE PROGRESS
SINCE 1900
MANILA BULLETIN
THE PHILIPPINES' LEADING NATIONAL NEWSPAPER
STUDENTS & CAMPUSES
SCHOOLS COLLEGES UNIVERSITIES
"Building a Brighter Future"
CaVSU Unveils Redesigned Coffee Blender

- **Global Coffee Review**
  October 2012


LASTWORD
Roaster for farmers
A COFFEE ROASTER FOR FARMERS: LETTING PRODUCERS IN ON THE VALUE CHAIN
DR RUEL M. MOJICA believes his latest academic work is set to change the livelihoods of Filipino coffee farmers.
In his previous studies on the coffee chain, Mojica, an agricultural engineer at Cavite State University (CaVSU) in the Philippines, came across the information that the roasting process adds significant value to coffee. As such, he came up with a plan to put that additional revenue into the farmers' hands.
Mojica notes that farmers in the coffee capital of Indang, like most coffee farmers the world over, only sell their beans in raw form. As part of his latest dissertation work, Mojica, wanted to develop a microcontroller-based machine that small-scale coffee farmers could use to roast their own produce then sell at a higher price. He worked for months alongside coffee farmers in the region of Indang to assess a coffee roaster that would best suit their needs.
"I used a participatory approach in the design of the machine where coffee farmers played an important role," Mojica says. The farmers gave their input into the design of the machine, on factors such as capacity levels and cost restrictions.
"They wanted a low cost machine that was locally manufactured...The engagement of the farmers within the coffee business was crucial," Mojica says, adding that the additional income should help boost the development of the local coffee industry.
The Philippines have a long history of coffee farming and was once considered one of the leading coffee-producing nations during the 19th Century. Today, the Philippines produce 30,000 tons of coffee a year, according to the Philippine Coffee Board.
Still a traditional profession, Mojica says the coffee farming industry could be made even more profitable for growers. He notes that farmers in the Philippines are mostly small
Mojica says that the microcontroller device he installed in the roaster is certainly the standout feature. "It automatically controls the operation of

- BAR Chronicles, *Tuklasin Natin*, PIA

Product Exhibition

8th Agriculture and Fisheries Technology Forum and Product Exhibition

August 9 – 12, 2012, SM Megamall, Mandaluyong City

Distribution of IEC Materials

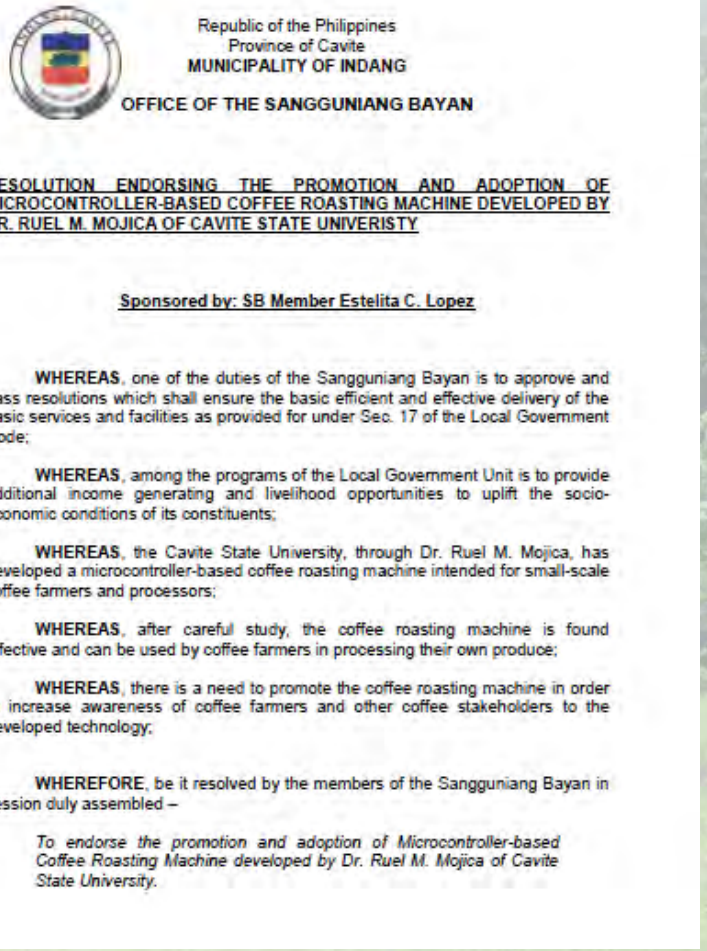
- Hundreds of brochures/posters were distributed

POSTER

BROCHURES

Trainings and Consultations

Support from LGU



Republic of the Philippines
Province of Cavite
MUNICIPALITY OF INDANG

OFFICE OF THE SANGGUNIANG BAYAN

RESOLUTION ENDORSING THE PROMOTION AND ADOPTION OF MICROCONTROLLER-BASED COFFEE ROASTING MACHINE DEVELOPED BY DR. RUEL M. MOJICA OF CAVITE STATE UNIVERISTY

Sponsored by: SB Member Estelita C. Lopez

WHEREAS, one of the duties of the Sangguniang Bayan is to approve and pass resolutions which shall ensure the basic efficient and effective delivery of the basic services and facilities as provided for under Sec. 17 of the Local Government Code;

WHEREAS, among the programs of the Local Government Unit is to provide additional income generating and livelihood opportunities to uplift the socio-economic conditions of its constituents;

WHEREAS, the Cavite State University, through Dr. Ruel M. Mojica, has developed a microcontroller-based coffee roasting machine intended for small-scale coffee farmers and processors;

WHEREAS, after careful study, the coffee roasting machine is found effective and can be used by coffee farmers in processing their own produce;

WHEREAS, there is a need to promote the coffee roasting machine in order to increase awareness of coffee farmers and other coffee stakeholders to the developed technology;

WHEREFORE, be it resolved by the members of the Sangguniang Bayan in session duly assembled –

To endorse the promotion and adoption of Microcontroller-based Coffee Roasting Machine developed by Dr. Ruel M. Mojica of Cavite State University.

- Hon. Estelita C. Lopez sponsored a resolution to promote the use of Bravura Coffee Roasting Machine in the Municipality of Indang and other nearby towns of Cavite and to increase awareness of the general public to the developed technology.

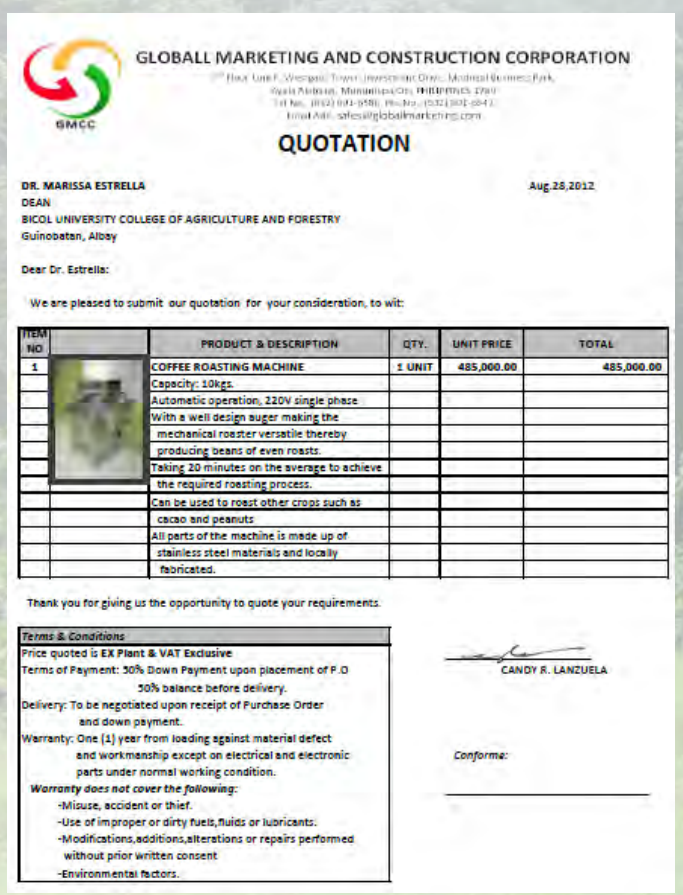
Private Sector Partnership

GMCC
GLOBALL MARKETING & CONSTRUCTION CORP.

- Our networking and collaboration with Rollmaster Machinery and Services Corp. and Globall Marketing and Construction Services Corp. has led to the commercialization of Bravura Coffee Roasting Machine

Sales and Marketing

☞ 2 units were already sold



GLOBALL MARKETING AND CONSTRUCTION CORPORATION

GMCC

QUOTATION

DR. MARISSA ESTRELLA — Aug.28,2012
DEAN
BICOL UNIVERSITY COLLEGE OF AGRICULTURE AND FORESTRY
Guinobatan, Albay

Dear Dr. Estrella:

We are pleased to submit our quotation for your consideration, to wit:

ITEM NO		PRODUCT & DESCRIPTION	QTY.	UNIT PRICE	TOTAL
1		COFFEE ROASTING MACHINE	1 UNIT	485,000.00	485,000.00
		Capacity: 10kgs.			
		Autometic operation, 220V single phase			
		With a well design auger making the			
		mechanical roaster versatile thereby			
		producing beans of even roasts.			
		Taking 20 minutes on the average to achieve			
		the required roasting process.			
		Can be used to roast other crops such as			
		cacao and peanuts			
		All parts of the machine is made up of			
		stainless steel materials and locally			
		fabricated.			

Thank you for giving us the opportunity to quote your requirements.

Terms & Conditions
Price quoted is **EX Plant & VAT Exclusive**
Terms of Payment: 50% Down Payment upon placement of P.O
50% balance before delivery.
Delivery: To be negotiated upon receipt of Purchase Order and down payment.
Warranty: One (1) year from loading against material defect and workmanship except on electrical and electronic parts under normal working condition.
Warranty does not cover the following:
-Misuse, accident or thief.
-Use of improper or dirty fuels,fluids or lubricants.
-Modifications,additions,alterations or repairs performed without prior written consent
-Environmental factors.

CANDY R. LANZUELA

Conforme:

- **10-kg capacity**

  Bicol State University
  Guinobatan, Albay

- **5-kg capacity**

  LGU – Gen. Emilio Aguinaldo
  Cavite

☞ 6 additional units – under negotiation

Impact to Farmers and Coffee Industry

- The development of the microcontroller-based roasting machine could **provide income generating opportunities to small-scale farmers/coffee processors**.

- The **coffee farmers can process/roast their own coffee** either individually or thru the cooperative and sell their processed coffee at a better price rather than selling the raw coffee beans.

Impact to Farmers and Coffee Industry

- Farmers can now **demand better price** for their product.
- The **developed roasting technology is a sure way of helping the country's ailing coffee industry** and since coffee is dollar earner, it will mean **more dollars for the country**.

Project Planning

The team during the inception meeting on 4 October 2011 at the NCRDEC Conference Hall, Cavite State University.

Project proponents during the meeting with the staff of Nanodevice Technologies, Inc. (prospective partner of the project).

Consultation with Partners

Dr. Ruel M. Mojica inspects the on-going fabrication of coffee roasting machine at Rollmaster Machinery and Industrial Services, Corp. at San Pedro, Laguna on 6 January 2012.

Dr. Ruel M. Mojica (rightmost) together with the staff from DOST and NCRDEC, during the team's ocular visit at Mariñas Technologies, Inc. fabrication shop on 27 January 2012 at Pila, Laguna.

Machine Fabrication

Dr. Ruel M. Mojica explains the changes to be made on the auger of the coffee roasting machine.

The initial output of Rollmaster Machinery and Industrial Services, Corp. in San Pedro, Laguna.

Partner Fabricators

Standing from left: Mr. Jaape Vandersleish and Ms. Coreen Lizarres (officials from CIMPLEWIDE, Inc., prospective buyer of the machine), Dr. Ruel M. Mojica, Dr. Mary Jane D. Tepora, and Mr. Virgilio F. Lanzuela pose with the coffee roasting machine fabricated by Rollmaster Machinery and Industrial Services, Corp. during the team's visit to the fabricator shop on 11 February 2012 at San Pedro, Laguna.

Drs. Ruel M. Mojica and Mary Jane D. Tepora inspect the coffee roasting machine fabricated by Mariñas Technologies Inc., during the team's visit on 11 February 2012 at Pila, Laguna.

Coordination with Coffee Farmers

Ms. Annalyn Encarnacion (AE Thesis Student) coordinates the conduct of field evaluation of coffee roasting machine with Ms. Adelaida Poblete, MAO of Silang, Cavite.

Coffee growers and processors of Silang, Cavite during the demonstrative orientation on the use of coffee roasting machine.

Field Evaluation

Field evaluation at Silang, Cavite.

Final output (roasted coffee) of the developed coffee roasting machine.

Farmers' Assessment

Conduct of farmers' assessment on coffee roasting machine at Silang, Cavite.

Conduct of farmers' assessment on coffee roasting machine at Amadeo, Cavite.

Development of Final Prototype

Dr. Mojica discusses with Mr. V. Lanzuela the features of the final model of the coffee roasting machine.

The final model of the coffee roasting machine.

Technology Promotion

Product promotion at Maragondon, Cavite on April 3, 2012.

Product promotion at Amadeo, Cavite on April 16, 2012.

Technology Promotion

Product promotion at Gen. Emilio Aguinaldo, Cavite on April 17, 2012.

Product promotion at Mendez, Cavite on April 19, 2012.

Technology Promotion

Product promotion with the participants of Tanim Kalikasan, Inc. Lakbay Aral held on April 24, 2012 at the NCRDEC, CvSU, Indang, Cavite.

Product promotion with the members of Tuba, Benguet Coffee Growers Association during its Lakbay Aral on May 24, 2012 at the Cavite State University.

Technology Promotion

Product promotion with the staff of Laguna Provincial Agriculturist Office during its tour on May 25, 2012 at the NCRDEC, CvSU, Indang, Cavite.

Product promotion with the participants of Skills Training on Coffee Production from Romblon Electric Cooperative (ROMELCO) on May 25, 2012 at the NCRDEC, CvSU, Indang, Cavite.

Prospective Clients

Meeting with Mr. Erwin C. Meer of Tateoka Company (prospective buyer of the machine) and Ms. Candy Lanzuela of Globall Marketing and Construction Corp. at the NCRDEC, Cavite State University.

Engr. Manuel M. Alagcan, Senior Engineer and Head of Agricultural Engineering Unit, Koronivia Research Station, Ministry of Agriculture, Forestry and Fisheries, Department of Agriculture, Nausori, Fiji Islands inspects the Bravura Coffee Roasting Machine. They are planning to import the machine for their small-scale roasting operation in Fiji Islands.

With all these efforts, a great hope has been created in the hearts of thousands of small-scale coffee farmers. The fire behind this faith should therefore be kept alive to continuously empower the hopes of the Philippine coffee industry.

SMALL-SCALE COFFEE FARMERS

Acknowledgements

Cavite State University

Department of Agriculture
Bureau of Agricultural Research (DA-BAR)

Southeast Asian Regional Center for
Graduate Study and Research in Agriculture

MARAMING SALAMAT PO!