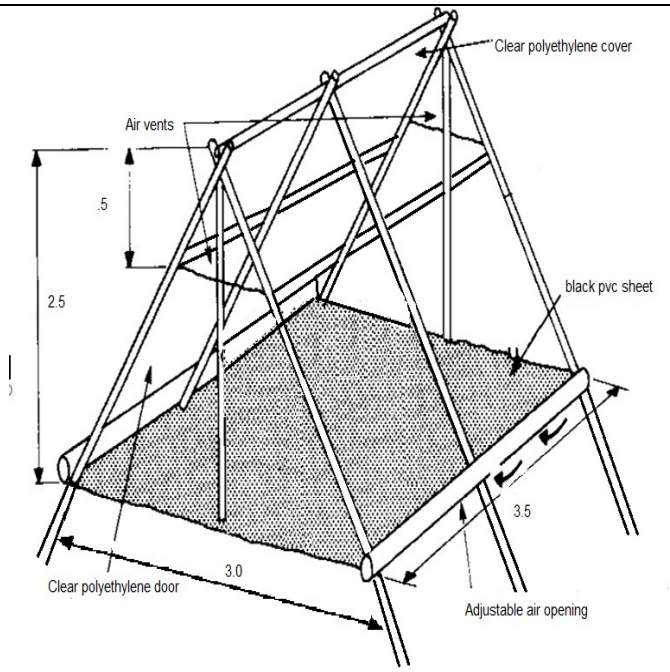
PROJECT PROPOSAL

I. PROJECT PROFILE	
A. Title of the Project	Development, Performance Evaluation and Utilization of Tiger Grass Postharvest Technologies in Romblon
B. Proponent	Romblon State University, Office of the Research Director
C. Project Cooperators	Tiger Grass Processors in the Marigondon Norte, San Andres, Romblon
D. Project Duration	1 year project implementation 2 years monitoring of outcomes
E. Total Project Cost	**PhP 916,450.00** DOST MIMAROPA - PhP 712,050 RSU – PhP 204,400.00
II. PROJECT PROPOSAL	
A. Rationale	The million peso tiger grass industry in Romblon is in need of technologies to aid in processing the commodity. A package of postharvest technologies will be developed for drying, pollen removing and for designing a green broom. The technologies will aid the processing industry workers lighten their jobs. Previous studies on tiger grass processing industries identified the need for technologies that will help the processors in drying the flowers, removing the pollens and improve the softbroom designs. Harvesting of tiger grass starts November and ends in May. Farmers rely on the sunlight and the pavement for drying and problems occur during intermittent rains. If not properly dried, tiger grass becomes infested with fungus that discolors the inflorescence and result to low price in the market. The farmer therefore resort to selling their harvests to accumulators who have the storage facility and the means to hire persons to dry the tiger grass. To address these problems, bamboo connectors will be used as a potential alternative for the conventional construction materials in putting up a solar dryer. The immediate resource in the rural areas, simplicity and economics of construction are among the numerous factors to consider in utilizing bamboo. The stakeholders, farmers and other interested party may benefit from the utilization of the product because of its economic value and efficiency. The existing pollen remover designed by DMMSU and RSU were seldom used by the farmers due to its bulk, weight and power requirement. Some units delivered to the communities were shared but farmers do not like the idea of bringing their harvests to the centers due to distance and terrain issues. The high cost of the ownership prevents the individual farmers from owning a unit of pollen removing machine. Thus, there is a need to develop a machine that is easy to operate, portable and cheap that even small-time farmers can avail. It has been reported that the farmers opted to sell their produce rather than processing them because of the tedious task of removing pollens. Likewise, the existing pollen remover machine is beyond the means

	of the farmers to afford. Disruptive technology is defined as one that displaces an established technology and shakes up the industry or a ground-breaking product that creates a completely new industry (Rouse 2016). This is the kind of technology that will be explored by this project because traditional broom have persisted through time without innovation in terms of design and packaging.
B. Project Description	The research will come up with innovative postharvest technologies for drying tiger grass inflorescences, pollen removing and redesigning of soft brooms using waste materials and will have handles that are refillable, sleek and may be folded for easy transport. It will also include an appropriate packaging for the product. These technologies will undergo testing and evaluation across parameters that will vouch for their efficiency as compared to the prevailing postharvest practices and methods of the commodity.
C. Objectives	The general objective of this research is to develop innovative postharvest technologies for tiger grass industry in Romblon and test their efficiency and feasibility. Specifically, it intends to: 1. Develop and test the performance of a tiger grass dryer using bamboo connectors. 2. Develop and test the performance of a compact and DC operated tiger grass pollen remover 3. Develop a “disruptive” broom design and test its quality and market performance 4. Empower tiger grass farmers to harvest, dry, clean and store their tiger grass and command a premium price to their produce 5. Value addition will be at the hands of farmers as they convert the tiger grass into brooms that they could bring to the market themselves. 6. Provide appropriate P&L to the product to give value and price. 7. Increase farmer’s productivity 8. Generate DOST 6PS for research project (product, people, partnership, protection, publication and policy)
D. Methodology	**<u>Component 1: Development and Test Performance of Tiger Grass Dryer using Bamboo Connectors</u>**



Note: Modification from the existing miniature shall be made by using bamboo connectors with additional features of horizontals across the frames and additional layers of drying mediums, adjustment in coverage area and the height of the drying mediums.

Research will be conducted in Marigondon Norte, San Andres, Romblon by the Agricultural Engineering Department of the College of Engineering and Technology to at least three tiger grass processors.

The Conceive, Design, Implement and Operate (CDIO) framework will be used in the development of the technology. Existing literatures on drying facilities related to tiger grass will be reviewed along with the procedure for performance testing. The drying facility will be developed considering the suggestions from literature especially on the utilization of bamboo connectors. The implementation phase will be conducted carefully following the design.

Below is the working Equation for Drying.

Drying Capacity

Cd = (Wi/Td)
Cd – drying capacity, kg/hr
Wi – initial weight of the material, kg
Td – drying time in hr
da

da

Final Weight of Dried Material

Wf = (Wi(100-Mci))/((100-Mcr))
Efficiency
Wf – final weight of dried material, kg
Wi – initial weight of material, kg
Wci – initial moisture content, %
KJ/hr
Wcf – final moisture content, %
KJ/hr

Heat Supplied to the Dryer

Qsd =(60 (h2-h1)AR)/γ

Qsd – heat supplied to the dryer
H2 – enthalpy of drying air,KJ/kg

H1 – enthalpy of ambient air, KJ/kg

AR – airflow rate, m3/min
γ – specific volume, m3/kg da

Heat System

ξhs = (Qsd)100/Qaf
ξhs – heating system efficiency, %
Qsd –heat supplied to the dryer,

Qaf – heat available in the fuel,

Moisture Reduction per Hour

MRR = (wi-wr)/Td

MRR = moisture reduction rate kg/hour
Wi – initial weight of material, kg
Wf – final weight, kg
Td – drying time in hr

Heat Utilization

ξhu = (Qsd x Td / MR)100

HU – heat utilization, KJ/kg
Qsd – heat supplied to the dryer, KJ/hr
Td – drying time, hr
MR – amount of moisture removed, kg

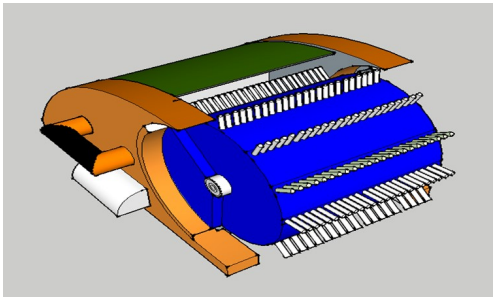
Heat Utilization Efficiency

ξhu = (THU x 100)/Qsd

ξhu – heat utilization efficiency, %
THU –total heat utilized, KJ/hr
Qsd – heat supplied to the dryer, KJ/hr

Tests of the dryer using bamboo connectors will be made at the College's testing laboratory. Simulated dead loads and wind loads will also be made for frame analysis of the structures. The connectors will likewise be tested in actual construction work of structures it will be intended for. A research paper will be developed for purposes of presentation in scientific or professional gathering, local, regional, national and even international. Patent for the technology and construction method would be other outputs of the research.

Component 2: Compact and DC-Operated Tiger Grass Pollen Remover



This research will be conducted at the Romblon State University, Main Campus at the Metal and Woodworking school factory of the College of Engineering and Technology.

The pollen remover will be an automatic, portable and DC operated intended for Tiger grass producers of San Andres, Romblon.

The frame or body of the Automatic Tiger grass pollen remover will be made of plywood for the ease of transport and to reduce the cost of the machine to be affordable.

The pollen remover cylinder assembly has holes where the nylon is inserted at a specified spacing.

The motor that will be used is a 24V, 2700 rpm, 14 amperes maximum, and 250 watts, with a DC motor controller to drive the cylinder at a specifically required speed. The power from the DC motor will then be transmitted by a chain drive and two chainrings (36

and 16 teeth)

The system will use a 24-Volt battery with a capacity of 64AH (Ampere-hour) which is more than enough to power up the machine. For the better battery capacity of the machine, the converter charger that can fully recharge the battery in just 2 hours will be used.
The efficiency of the machine is determined based on the number of stalks finished over the specific time. The number of damaged stalks in that specific time will also be recorded.

To optimize the machine, the proponents will use the Bex-Behnken Design. It is an independent quadratic design in that it does not contain an embedded factorial or fractional factorial design. In this design, the treatment combinations are at the midpoints of edges of the process space and the center. These designs are rotatable (or near rotatable) and require 3 levels of each factor.

The selected independent variables/factor are:

1. The Rotation of the cylinder in Revolution per Minute (A)
2. The size of the Nylon to be used (B); and
3. The spacing among the nylons in the Cylinder Assembly (C).
   The Design Expert Statistical Software will be used to generate the number of runs/experiment.
   The Response (dependent) Variable to be optimized will be the Efficiency of the machine.

Factor	Name/Unit	Low Level	Middle Level	High Level
A	RPM	-	-	-
B	# of Nylon	-	-	-
C	Millimeter	-	-	-

The machine will be tested based on the following standards:
PNS/PAES 103:2000 Agricultural Machinery – Method of Sampling
PNS/PAES 138:2004 Agricultural Machinery – Guidelines on After Sales Service
PNS/PAES 263:2015 Agricultural Machinery – Multipurpose Thresher – Methods of Test.

Component 3: Disruptive Broom Design

The development research will be conducted at Romblon State University. Development will follow the CIDT framework.

Conceptualization will involve looking for solution to the existing condition of the tiger grass industry players. Ideation will be based on the appropriate design that would best fit the perceived problem of marginalization in the industry. Ideation will also be made in line with the desire to make farmers increase their productivity by maximizing potential of their product by actually doing the processing and value addition themselves. Ideation will also consider the value that the product will give to consumers in terms of addressing issues met by consumers in using brooms. Development of the broom will be made at the College of Engineering and Technology. The development process will follow what had been ideated. The

<table>
<tr><td></td><td>development will not only entail the product but also the process of making into reality the blueprint made during ideation. The processes involved will be designed so as to create the broom that would have standard content and properties. The product must be amenable to optimal packaging and shipping and must create the maximum profit to producers. New materials that were not usually used but are cheap and readily available will be introduced in the product. Moreover, the product will utilize materials that will reduce the total carbon footprint of the broom and may also possibly reduce the same carbon footprint for other industries. The prototype broom will be tested to determine its mechanical property. A simple contraption will be made for the test in the absence of a Universal Testing Machine.

Once the “disruptive” design is developed, a simulated broom factory will be created so as to test the design in a “production line.” Brooms will be developed in a time and motion study and the study adopted in a school factory “production line” setting.
Furthermore, sweeping capability, portability, and design ergonomic impact will be tested.</td></tr>
<tr><td>E. Business Plan</td><td>These technologies will be an addition to the RSU-CET woodworking school factory or any taker, especially from the furniture industry for the frame, the rotating drum and the disrupted broom design. But before this would be spun off, intellectual property for the patent, utility model, industrial design (whichever will apply) will be made first. Spinning off will be governed by the technology transfer manual of the university if existing. Otherwise, the school factory will be utilizing the design and process for the benefit of the university. The researchers may be allowed to share profits from operations as defined by the IGP manual of the university.</td></tr>
<tr><td>F. Activity Schedule</td><td>The following timetable will be followed:

<table>
<tr><td rowspan="2">Activity</td><td>2020</td><td colspan="4">2021</td><td>2022</td><td>2023</td></tr>
<tr><td>3-4Q</td><td>1Q</td><td>2Q</td><td>3Q</td><td>4Q</td><td></td><td></td></tr>
<tr><td>Consultation and meeting</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project proposal preparation</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project proposal review</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Revision, approval and MOA signing</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fund release</td><td></td><td>X</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Procurement of equipment & supplies</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Implementation</td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Completion and report preparation</td><td></td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Liquidation</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
<tr><td>Report presentation</td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td></tr>
</table>

Monitoring and evaluation would be made by the PSTC so that the performance objectives and other deliverables will be attained.</td></tr>
</table>

<table>
<tr><td>G. Budget Breakdown</td><td>The following line-item-budget would be followed for the project:

<table>
<tr><th>ITEM</th><th>DOST-GIA
(P)</th><th>RSU
(P)</th></tr>
<tr><td>Personal Services
Honorarium for researchers (@P1400/day x 2 days/ week x 2 weeks/month x 12 months x 4 researchers)</td><td>134,400</td><td>134,400</td></tr>
<tr><td>MOOE
Travel
Representation, training & meeting
Transport Cost
Supplies & Materials
HD Heat gun (3.1T)
Vise riveter set (2.7T)
UV Plastic sheet roll (137T)
Metal tube & plates, 6 (18T)
Motor chain & drive, 6 (21T)
12V battery, 6 (18.6T)
P&L</td><td>
40,250
12,000
15,000
200,400

50,000</td><td>
60,000

10,000

</td></tr>
<tr><td>Equipment Outlay
1 unit MIG welding machine
1 unit SWAW with generator
1 unit Cut-off saw</td><td>
90,000
120,000
50,000</td><td>

</td></tr>
<tr><td>Existing equipment and facilities at the WSF</td><td></td><td>(2,200,000)</td></tr>
<tr><td>Total</td><td>712,050</td><td>204,400</td></tr>
</table>

The RSU counterpart would be travel of faculty to present the paper and office supplies for preparation of manuscript, reports and liquidation. It will also shoulder the honorarium of two other researchers because the project has three components.</td></tr>
<tr><td>H. Project Management</td><td>The project will be managed by the DOST PSTC Romblon. It will be implemented by the Office of the Vice President for Research, Extension and Development in cooperation with faculty from the RSU-CET. Financial matters will be handled by the RSU Administrative and Finance Services offices.</td></tr>
<tr><td>I. Expected Output</td><td>Products. The products that would come out from this research are tiger grass dryer using bamboo connectors, a compact and DC operated tiger grass pollen remover and a disruptive broom design.

People. One master’s degree graduate will be considered for this research. This will come from a faculty co-operator of this research. This will also open opportunities for farmers and processors to convert their produce into brooms that they could bring to the market themselves consequently leading to the creation of new jobs.

Places and partnerships. Partnerships with tiger grass processing industry sector will be made.

Publication. At least one paper for publication in a Scopus- indexed journal will be considered. Another knowledge product that could be copyrighted is the documented process for producing the bamboo</td></tr>
</table>

	laminates. *Protection.* An application for patent, utility model or industrial design, whichever is applicable, for the protection of intellectual property will be made. *Policy*. Once implemented and spun off, a policy for using tiger grass as a reforestation species for the national greening program will be lobbied in the local governance.
J. Monitoring and Evaluation	Monitoring and evaluation will be made by the DOST PSTC Romblon. Monitoring and evaluation will be centered on project deliverables as listed in the expected output.

Prepared by:

DR. EDDIE FETALVERO
RSU, Director for Research