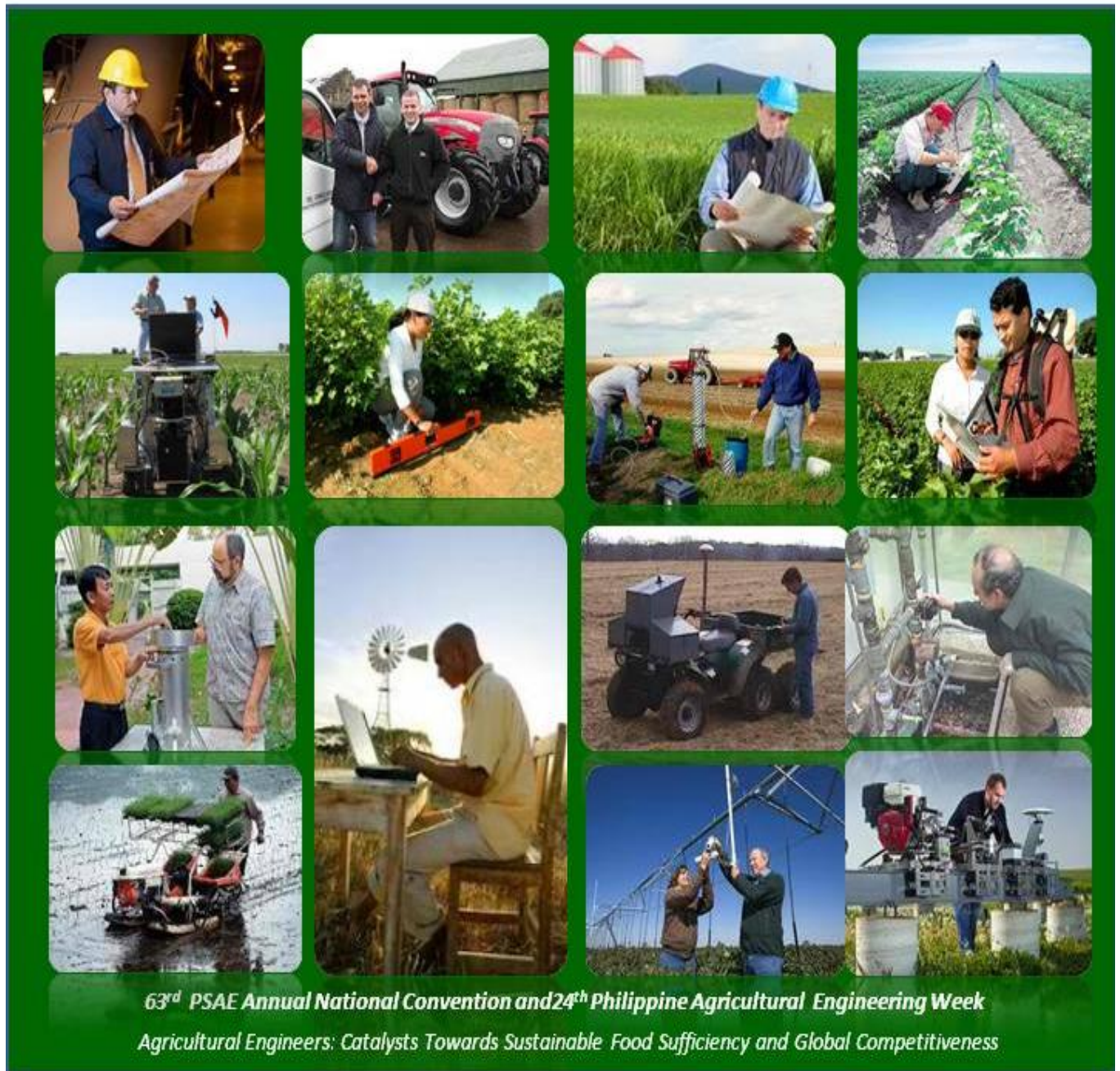


TECHNICAL AND POSTER PAPERS ABSTRACTS



*63rd PSAE Annual National Convention and 24th Philippine Agricultural Engineering Week
Agricultural Engineers: Catalysts Towards Sustainable Food Sufficiency and Global Competitiveness*



**Philippine Society of
Agricultural Engineers**

April 22-26, 2013
Cagayan State University, Andrew Campus
Caritan, Tuguegarao City, Cagayan

TECHNICAL AND POSTER PAPERS ABSTRACTS

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Technical and Poster Paper Committee
63rd PSAE Annual National Convention and
24th Philippine Agricultural Engineering Week
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AGRONOMIC AND YIELD RESPONSE OF RICE-BASED HYBRID CORN WITH EMPHASIS ON DIFFERENT SOIL MOISTURE REGIMES

by

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ABSTRACT

A study generally aims to develop water use efficient technologies for hybrid yellow corn as rice-based dry season crop in Ilocos was conducted at PhilRice Batac experimental area from February to May 2009. The study specifically aims: 1) To determine the effect of irrigation based on different soil moisture regimes on the growth and yield of hybrid yellow corn (BIOSeed 9698), 2) To determine the water productivity of the different soil moisture regimes on hybrid yellow corn, and 3) To reduce cost of irrigation and increase income.

The different treatments which were laid out in randomized complete block design (RCBD) with three replications were as follows: 1) Maintain the available soil moisture (ASM) at 95% and above, 2) Irrigate when the ASM dropped to 70-80%, 3) Irrigate when the ASM dropped to 45-55%, 4) Irrigate when the ASM dropped to 20-30%, and 5) Farmer's practice (conventional furrow irrigation every 3 weeks). Soil moisture content was monitored using a probe instrument. Amount of irrigation was based on the amount of moisture depleted. Recommended cultural practices for crop care and maintenance were observed.

Results showed that plant height, yield, cob length, cob diameter and water productivity were significantly affected by the different soil moisture regimes. At maturity stage, taller plants were observed from plots maintained with 90% and above ASM regime at 180.3 cm but comparable with those plants irrigated when the ASM dropped to 70-80%, 45-55% and farmer's practice with values 176.7 cm, 174.6 cm and 174.7 cm, respectively. The shortest plants were observed from plants irrigated when the ASM dropped to 20-30% at 171.4 cm.

Maintaining the ASM above 45% produced comparable yields at a range of 6.1-6.8 t/ha while significant decreased in yield was observed when the ASM dropped to 20-30%. Likewise, the yield obtained from the farmer's practice (5.62 t/ha) was comparable with those obtained from plots where 45% and above ASM were maintained. Also, plants irrigated when the ASM dropped to 20-30% gave significant decreased in the cob length and diameter.

Plants maintained with ASM above 95% gave the highest water productivity of 4.79 kg/m³ but comparable with that obtained from plots irrigated when the ASM dropped to 70-80% at 4.01 kg/m³. The plots under the farmer's practice and irrigated when the ASM dropped to 20-30% showed the least water productivities of 2.72 and 2.38 kg/m³, respectively.

The farmer's practice was applied with the highest volume of water (2,063 m³/ha) while the plants irrigated when the ASM dropped to 20-30% was applied the least (1,174 m³/ha). The plants maintained with ASM at 95% and above, irrigated when the ASM dropped to: 70-80% and 45-55% gave water savings of 30.64, 23.22 and 22.83%, respectively, over the farmer's practice.

Highest gross and net income per hectare were obtained from plants irrigated when the ASM maintained at 95% and above amounting to Php25,476 followed by that obtained from plants irrigated when the ASM dropped to 70-80% amounting to Php19,046. A negative income was penalized from plants irrigated when the ASM dropped to 20-30% while the farmer's practice produced a low net income of Php5,010.

Partial budget analysis also showed that plants maintained with 95% ASM and above were superior over the farmer's practice as revealed by a positive income of Php20,466/ha. Likewise, those plants irrigated when the ASM dropped to 70-80% and 45-55% over the farmers practice gave favorable income of Php14,036 and Php11,350, respectively. However, the farmer's practice was more superior than plants irrigated when the ASM dropped to 20-30%.

APPROPRIATE SOIL CONSERVATION TECHNIQUE FOR INCREASED LAND PRODUCTIVITY AND INCOME IN THE UPLANDS

by

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ABSTRACT

A study aimed to improve crop diversification and intensification through conservation farming in the upland was conducted in Pudtol, Apayao during WS 2011 to DS 2012. The experimental area was flat to rolling. The study specifically aimed: a) To improve the cropping pattern in the uplands for increase production; b) To improve the awareness of upland farmers on soil conservation management for rice in the uplands, and c) To increase income of upland rice farmers. Two treatments were evaluated namely: (1) Intervention model - Contour farming with alley cropping: WS - rice as alley crop with pigeon pea + pineapple + ginger as hedge rows and DS - cowpea as alley crop with pigeon pea + pineapple + cassava as hedge rows, and (2) Farmers' practice - rice relayed with pineapple. In the second season, the intervention model was expanded in a more steep (43% slope) adjacent area of 1,544 m². Kakawate (*Gliricida*

sepium) was used as hedgerow. A total of 1,250 cuttings of kakawate were planted in a double row. At the intervention model, the net income derived from NSIC Rc192, despite the prolonged drought at vegetative stage, was ₱4,850.00/ha. Additional net income was obtained from cassava and cowpea of ₱20,817.00 and ₱ 8,972.00 per hectare, respectively. While the farmers' practice net income from Palawan traditional rice variety was ₱2,420.25. The relay pineapple crop is still standing and will be harvested after 24 months from planting.

RECIRCULATING AQUAPONIC SYSTEM USING NILE TILAPIA (*Oreochromis niloticus*) AND FRESHWATER PRAWN (*Macrobrachium rosenbergii*) POLY CULTURE AND THE PRODUCTIVITY OF SELECTED LEAFY VEGETABLES

by

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ABSTRACT

A study on the productivity of lettuce (*Lactuca sativa* variety Black-seeded Simpson), Chinese cabbage (*Brassica rapa pekinensis* variety Rubicon) and pac choi (*Brassica rapa* variety Black Summer) in a recirculating aquaponics system using Nile tilapia (*Oreochromis niloticus*) and freshwater prawn (*Macrobrachium rosenbergii*) polyculture was conducted in a controlled environment. The system was effectively designed by following the "one-pump rule" having the culture water lifted by a 40-watt submersible pump from the 200-L bio-filtration tank, the lowest portion, to the 250-L fish tank, the highest portion, allowing the flow of water by gravity along the 2.44 m x 4.88 m raceway and the over-sized return pipes in a closed loop. Hydroponically germinated seedlings in rockwool received foliar fertilizer daily for 12 days and were transplanted on the rafts at 15-cm spacing 30 days after stocking 22 kg of mixed-sex tilapia in the fish tank and 295 prawns in the raceway with 20-cm water depth to permit rafts to float. Fish were fed ad libitum with commercial feeds while excess feeds entered the raceway for the prawn to scavenge. Environmental conditions were maintained and water quality parameters were monitored in a compromise between the ideal requirements of fish, prawn and vegetables including the beneficial bacteria throughout the 108-day culture period. Two sets of data for vegetables and one for tilapia and prawn were gathered after the two 35-day growing seasons of vegetables. Another similar system without prawn was installed as control and received the same cultural management from where similar data were gathered.

The two systems provided favorable water quality for tilapia, prawn and nitrifying bacteria with average dissolved oxygen of 5.6 ppm at 98 per cent saturation and 21°C temperature. A pH of

7.1–7.5 was established and total dissolved solids of 250–390 ppm were produced in the system with prawns while 7.4–7.7 pH and 220–350 ppm of total dissolved solids in the control. However, the low concentration of nutrients at high pH, which was far below the crop requirement, triggered the vegetables to exhibit nutrient deficiencies. Results uncovered that the stocking density of tilapia and the ratio of the aquaculture to the hydroponic components were inappropriate which limited the system to accumulate and increase the concentration of nutrients thereby causing chlorosis and necrosis among the vegetables and lessened the yield. Nonetheless, the system with prawns has higher nutrient content that vegetables demonstrated significantly better growth and yield than in the control which disclosed that integrating prawns helped stabilize and diversify the system thus improving yield. Among the three vegetables, pac choi had the highest growth and yield, followed by Chinese cabbage and lettuce. Tilapia also has higher gain in weight and better feed conversion ratio in the system with prawns. Prawns, likewise, has 6.42 g weight gain and 71 per cent survival rate. It was also confirmed that stocking density and component ratio were critical factors in designing aquaponic system.

**ASSESSING THE IMPACT OF RAINFALL REGIMES AND CROP MANAGEMENT PRACTICES
TO SURFACE RUN-OFF AND SOIL EROSION IN AGRICULTURAL WATERSHED USING
SIMULATION MODEL: A DECISION SUPPORT TOOL IN CONSERVATION
PLANNING FOR SUSTAINABLE UPLAND AGRICULTURE**

by

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ABSTRACT

The impact of rainfall regimes and crop management practices in the rainfed uplands of Northern Philippines was examined. Primary goal of the study is to evaluate the performance and adaptability of the Water Erosion Prediction Project (WEPP) model in estimating the rate of soil erosion and run-off under upland rice cultivation.

The research involves establishment of automatic weather station and erosion plots with three conservation management as treatments.

Analysis was undertaken to characterize rainfall events in terms of amount, intensity, duration and frequency in relation to erosion data. Comparison of actual and simulated data and sensitivity analysis of scenarios for different types of rainfall, slope, and conservation practices were made.

Validation result demonstrated statistical acceptability of the WEPP model. Actual and simulated data indicated that 50 percent soil loss is reduced when contour planting with hedgerow are practice. The rate of sedimentation is linearly affected by increasing slopes and length, such that, the rate of soil removal ranges 1.2 - 48.46 t ha⁻¹ across treatments at 10-50 percent slope and 10-40 m slope length.

The model can be used to develop decision support tools for conservation, optimization and utilization of farm resources in agricultural watershed units to improved productivity of upland areas in sustainable way.

**ASSESSMENT OF POTENTIAL PRODUCTION AND YIELD GAP ANALYSIS OF PEANUT IN
CAGAYAN RIVER BASIN: A CASE OF DSSAT MODELING APPLICATION
FOR CLIMATE CHANGE ADAPTATION**

by

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ABSTRACT

This study was aimed to determine yield potential and production constraints of peanut crop in Cagayan Valley through the use of Decision Support System for Agrotechnology Transfer (DSSAT) simulation modeling; analyze yield gaps between simulated and actual yield levels and to provide decision support to further optimize peanut production.

The simulation results using CSM-CROPGRO sub-model of DSSAT showed highest yield potential of peanut is 2267 kg/ha when planted in October 15 under rainfed condition. Under non-stressed conditions in the dry season, the yield potential of peanut is 4805 kg/ha planted in December 15.

There exists a large gap between actual and potential yield under rainfed condition. From 10 years of yield data, gap between farmer's yield compared to rainfed potential ranges from 153 kg/ha to 2116 kg/ha. Low rates of nitrogen application and pests and diseases were the main factors causing yield gaps of peanut. The program also captured the effect of prolonged drought in the last quarter of 2009 which resulted to underestimated yield result and the effect of warm weather in 2004 resulting to lowering of potential yield by 50%.

Yield potential for peanut limited only by temperature and solar radiation and no-water and nutrient stress, ranged from 3274 to 4805 kg/ha for six planting dates (October 1, October 15,

November 1, November 15, December 1, December 15) in the dry season. The highest yield potential was found for the December 15 planting date due to moderate temperature and a moderate level of radiation. Compared to rainfed farming, the yield reduction of peanut caused by water limitation ranges from 10% to 1041% of potential yield. Regional analysis of peanut yields showed that central eastern part is more productive area for rainfed conditions during the dry season, whereas southern part including Quirino and Ifugao is more suitable to produce peanut during the wet season due to cooler temperature.

COMMUNITY-BASED INTEGRATION OF WATER HARVESTING, CONSERVATION AND MANAGEMENT TECHNOLOGIES

by

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ABSTRACT

Water harvesting and adoption of water conservation and management techniques such as conservation tillage, mulching, and etc. can contribute to resolving the problems to water scarcity amidst climatic variability. The existing water harvesting structure and practices in the rural community of Pias Sur, Currimaog, Ilocos Norte were documented. Soil and water conservation technologies for rainfed farms were verified on on-farm level. Farmers in the area were involved in adaptive research using their farms as experimental areas.

During 2011-2012 WS, three tillage treatments (zero-ZT, minimum-MT and conventional-CT) were demonstrated showcasing different conservation tillage and water management techniques. Also, six varieties (NSIC Rc9, NSIC Rc222, NSIC Rc192, PSB Rc14, PSB Rc68 and PSB Rc98) were evaluated on-farm during 2011 WS. Two water management (alternate wetting and drying and conventional irrigation) were also tried and demonstrated during 2012 WS, with NSIC Rc192 as test variety since it was highly preferred by farmers during the previous season.

For both seasons, rice grain yield was not significantly affected by tillage, variety and water management. During 2011 WS, mean grain yield across tillage treatments and varieties was 3.32 t/ha. PSB Rc14 under ZT obtained the highest yield (3.74) with the same variety having the lowest yield (2.90) under MT. During 2012 WS, mean grain yield across tillage and water was 3.5 t/ha. NSIC Rc192 under ZT and AWD obtained the highest yield of 3.6 and 3.5 t/ha, respectively.

This study demonstrated alternatives to conventional farming practices, therefore, providing better options to farmers under rice-based rainfed ecosystem. Conservation tillage can be a good alternative to conventional tillage since it requires less input (water in particular during crop establishment) without sacrificing rice yield.

INCREASING WATER PRODUCTIVITY AND INCOME FROM BITTERGOURD THROUGH REGULATED DEFICIT IRRIGATION (RDI) TECHNIQUE

by

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ABSTRACT

The study aimed to assess the yield, income and the quality of fruits of bitter gourd through regulated deficit irrigation (RDI). Drip irrigation system was used to implement RDI technique using the concept of water balance. During the period September 2011-March 2012, RDI technique was tested with bitter gourd in farmers' field using: (1) full irrigation (FI) based on daily ET estimates, (2) 15% deficit from FI, (3) 30% deficit from FI, and (4) Conventional furrow irrigation (CFI) method. The treatments were laid out in randomized complete block design (RCBD) with 3 replications.

Result showed that highest water productivity was recorded from 15% deficit irrigation (18.2 kg/m³) but comparable with FI (17.9 kg/m³) while the lowest was from the CFI method (8.7 kg/m³). Highest net income was obtained from FI while the lowest was from 30% deficit irrigation. Partial budget analysis also showed that the technique of FI using RDI was the most profitable. Likewise, fully irrigated bitter gourd produced higher yield than 15 and 30% water deficits (1,577 kg as against 1,339 and 1,246 kg/1,000 m², respectively). The used of RDI technique gave higher water productivity of 20-22 kg/m³ than the CFI method of 7.7 kg/m³. FI also gave higher income than subjecting the crop to 15 and 30% water deficits. Also, RDI technique saved water by as much as 49.7 to 60.1% compared with the CFI method.

MODELING THE FATE AND TRANSPORT OF PESTICIDE IN AN IRRIGATED RICE AREA

by

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ABSTRACT

For fast, effective and economical assessment and continuous monitoring of the level of concentration of pesticide in an irrigated rice area, the development and use of a model play a very important role.

The study aimed to assess the extent of pesticide contamination of water in the paddy field and drainage channel and develop a model that can be used to determine the fate and transport of pesticide in an irrigated rice area. Three - 144 sq. m. experimental paddy plots planted with MS 16 variety of rice and applied with Lambda cyhalothrin insecticide was used in the study. A computer based transport model was developed that will be used to simulate the concentration of pesticide residue in the ponded water and drainage channel in an irrigated rice area by mathematically tracking the total mass of chemical residues from the loading point to the drainage stream in terms of mass balance. Results of simulation of the model revealed that concentration of Lambda cyhalothrin insecticide applied in the paddy field diminished at the rate of 42.38% on the first day, 90.64% on the second day, 98.26% on the third day, 99.10% on the fourth day and almost nil on the fifth day. As indicated by the correlation analysis and test of significance between the observed and predicted data, the model can accurately simulate the actual pesticide concentration in the ponded and drainage water of an irrigated rice area. The study recommends the enhancement of the model by taking into consideration the advection process in the drainage stream and linking of the model to other available models by either using the input/output of the model as an input/output to the other model or vice versa.

PRODUCTIVE CAPACITY ANALYSIS OF LAKESIDE AREAS IN BATO, CAMARINES SUR AND ALBAY

by

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ABSTRACT

The Organic Agriculture-Based Social Enterprise Project is envisioned as a major opportunity for providing alternative and sustainable means to reduce malnutrition among children and improve the productive capacities of households and communities in the program areas of Intervida, a Spanish Non-Government Organization. This is also in response to attaining the region's development commitments relative to food security, environmental integrity and education. To come up with sound prescriptions, it is essential to understand the project beneficiaries' productive capacities in the context of organic agriculture.

The study was conducted to assess the productive capacity of the Bato cluster namely: Cawacagan, San Juan, Salvacion and Buluang in Bato, Camarines Sur and Buga, Libon Albay, as proposed Organic Agriculture-Based Social Enterprise (OABSE) program area and generate livelihood management options. Participatory rapid appraisal (PRA) in combination with on-site focus group discussions (FGD), interviews and participatory workshops with core groups and key informants (KI) in each barangay were conducted as the major data gathering and data consolidating tools. Primary data were taken through observations and interviews of beneficiaries. Lake water characteristics were determined through secondary data and soil quality was determined through actual analyses. Secondary data were taken from key informants from the community, and LGUs, NGOs, GOs and other sources. Sustainable livelihood assessment was used to determine the level of access of people to livelihood assets (human, physical, natural, social and financial) and socio-ecological systems assessment were used to determine the level of sustainability of the area in terms of management of resources, community resiliency and social enterprise development.

The distinct ecosystems of Bato Cluster are classified as upland, middle, lowland/flatlands and lake. Generally, the area is highly vulnerable to risks (floods, landslide, soil erosion, typhoon, dependence to chemical inputs and various pests). All barangays have high access to social capital but poor access to human, financial, natural and physical capital. They also have low level of sustainability in terms of sustainable management of natural resources, community resiliency and social enterprise development.

To build organic agriculture based livelihoods and resilient communities, development options and research and extension support are directed towards a) strengthening of the natural resource-base to increase supply of local production inputs; b) promotion of sustainable production systems and livelihood; Improvement of physical capital through provision of

adequate support services and infrastructure; and development of local organizations, partnership and linkages.

INCREASING RICE YIELD AND PRODUCTIVITY THROUGH THE PROMOTION OF SMALL SCALE IRRIGATION SYSTEM (SSIS) AND INTEGRATED CROP MANAGEMENT (ICM) IN RAINFED AREAS

by

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ABSTRACT

Rice production in rainfed areas contributes about one-fourth of the country's overall rice production. Productivity remains low mainly due to moisture limitation which delays planting and causes stress during the crop growth stages.

Farmer Field Schools (FFS) implemented by the local government agricultural technicians (ATs) has always been for farmers in irrigated rice production areas, less in rainfed areas, and never developed for Small Scale Irrigation System (SSIS).

In 2009, the Philippine Government requested assistance from the European Union (EU) under its Food Facility Programme to develop the capacity of the government to alleviate food security among poor farmers in rainfed areas. The resulting project has the overall objective to enhance food security of rain-fed rice farming communities to buffer the effects of volatile food prices in the Philippines, and a specific objective to increase production of rice (and other crops) by rainfed farmers through the promotion of small scale irrigation systems (SSIS) and other production technology. The project targeted those farmers who were resident tillers, whether or not they were formal land owners, willing to participate in project technology development and capacity building activities, and establish SSIS.

About 6,000 hectares were covered by the project from the original FAO sites to the expansion sites in Regions 1 and 3 (2010 – 2012). The participatory technology demonstrations (PTDs) allowed for the adaptation of the Palay Check (for irrigated areas) in the rainfed areas. Based on the results of the PTDs, applicable technologies were put together based on the key management areas of the *PalayCheck* System. A total of 1350 units of different SSIS (engine and pump set) were distributed to the farmer recipients with 50:50 scheme for the two years implementation of the project.

SOIL EROSION MODELING FOR A MICROWATERSHED

by

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ABSTRACT

The objective of this study was to develop a soil erosion model for a microwatershed. The selected watershed area was 2.64 hectares under forest area with plantation crops. Soil erosion factors identified were precipitation, stone cover, soil physical properties, height of vegetation, slope steepness and ground cover. From this mechanism, values of permanent interception, soil cohesion, erosive rainfall intensity, evapotranspiration and infiltration was established.

Composition of precipitation, evapotranspiration, infiltration and surface runoff was the water balance basis for the model structure developed. Soil erosion equation (RMMF) model by Morgan was modified. Secondary equation, the kinetic energy of leaf drainage (KE(LD)) was replaced with the kinetic energy equation. Event surface runoff from the original equation of the model was enhanced; it was applied based on the water balance equation ($R_s = P - ET - F$). Stone cover factor was added to the equation of energy because it has an effect to the raindrop impact.

The new model was calibrated and validated by comparing the observed and adjusted soil erosion values for the selected rainfall-runoff event of May to September, 2012. Analysis of data sets used in the calibration of the model yielded calibration equation of Adjusted $Dt = 0.456 * Dt - 0.878$. Data sets during the calibration had correlation coefficient of 90.30%, root mean square error (RMSE) of 27.5 % and coefficient of determination was 81.5%.

Calibration equation was included in the model to come up with the final equation that determined total soil erosion rate. In the validation of final model, adjusted detachment rate and the observed value posted 97.9% correlation with root mean square error of 56%.

The model could be used as prediction measure in the design and construction of channel structures as well as soil and water conservation practices that may reduce soil erosion.

SUB-SURFACE WATER RUN-OFF HARVESTING

by

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Water remains the most limiting constraint in agriculture in the semi-arid areas such as the Ilocos. The intensive pumping of groundwater is becoming a problem, both in terms of economics and the negative effects to the environment. Groundwater becomes deeper and pumping becomes more difficult and expensive. In arid and semi-arid areas, one important source of water is subsurface runoff in dried-up river beds.

This study aimed to establish a subsurface runoff water harvesting system, characterize the runoff rate and develop a nomogram in designing a subsurface collection system for a given farm area. The system will likewise demonstrate the feasibility of the technology to the farmers.

The Quiaoit River in Batac, Ilocos Norte was tapped for this study. The river usually dries up during the months of March until June where crops are still in need of irrigation. A subsurface water harvesting structure made up of reinforced concrete pipes was laid six feet below the river bed to impound the subsurface runoff flow along the river. It has a capacity of 2.9m³.

The subsurface flow of the river was initially characterized. Daily pumping tests data were gathered as soon as surface water subsides. An electric water pump with an average operating discharge of 4.32 liters per second (lps) was used. The average subsurface recharge rate into the structure is 1.67 lps. Subsurface flow only enters at one end of the structure with an exposed surface area of 0.79m². Through resource inventory, the river could yield as much as 9.82 lps.

The subsurface runoff of the Quiaoit River has high potential in sustaining the water requirement even during the dry months. However due to the early onset of rainy season in 2012, the data gathered are still insufficient to develop a decision guide (nomogram) in designing a subsurface water harvesting system for a given farm area. Pumping tests data will still be gathered in order to fully characterize the river.

WATER-SAVING OPTIONS FOR TRADITIONAL RICE PRODUCTION: SOIL WATER TENSION AND IRRIGATION SCHEDULING FOR DRY-SEEDED RICE AND HYBRID MAIZE PRODUCTION

by

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ABSTRACT

Almost half of the world's population depends on rice. In most parts of the world, rice is grown on flooded fields, typically requiring about 1300 to 1500 mm of water per crop. However, supply of irrigation water is diminishing because of competing demand. Innovations are needed to produce sufficient rice with more efficient use of water. The study was conducted during the dry seasons of 2011 and 2012 at the International Rice Research Institute in Los Banos, Laguna to monitor water dynamics and use for dry-seeded rice and maize production. Rice was established by direct dry seeding and grown without soil submergence in a 3-hectare field, while maize was grown in another 3-hectare field nearby. Both fields were equipped with overhead sprinkler irrigation and eddy covariance systems. Irrigation scheduling was based on soil water tension and crop evapotranspiration (ET_c), estimated from weather data and crop factors. Irrigation was applied when soil water tension exceeded 10 kPa at 15-cm depth for rice and when it surpassed 50 kPa at 40-cm depth for maize. For each crop, each irrigation was about 5 to 10 mm higher than ET_c minus rainfall from the previous irrigation period. Irrigation water input for rice was 646 mm in 2011 and 553 mm in 2012; while the input for maize was 368 mm in 2011 and 260 mm in 2012. Average irrigation water productivity (WP₁) for two seasons was 0.9 kg m⁻³ for rice and 3.0 kg m⁻³ for maize. Total water input (irrigation + effective rainfall) for rice was 830 mm in 2011 and 836 mm in 2012; for maize, it was 538 mm in 2011 and 544 in 2012. Total water input productivity (WP_{1+R}) for the 2 years averaged 0.6 kg m⁻³ for rice and 1.7 kg m⁻³ for maize. Total water input productivity for maize was lower in 2012 due to the lower yield caused by soil waterlogging arising from higher rainfall. Rice, on the other hand, took advantage of the rain to maintain yield with less irrigation water, leading to higher WP₁ (0.96 kg m⁻³) in 2012. Less use of irrigation in 2012 for both crops was also attributed to improved water management by real-time soil moisture monitoring. Growing rice with less water and diversification using other crops such as maize are viable options to improve water productivity.

OPTIMIZED USE OF WATER FROM A WINDPUMP FOR HIGH-VALUE CROPS THROUGH A DRIP IRRIGATION SYSTEM

by

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ABSTRACT

Although the windmill has been used for water pumping for many centuries, its development and application is limited due to the high investment cost. Using windmill instead of diesel engine to drive a water pump reduces dependence on fossil fuel and provides opportunities for mitigating greenhouse gas emission. Thus, this study was conducted to optimize the use of water from a windpump coupled to a drip irrigation system. Moreover, the performance of the windpump-drip irrigation system was also evaluated based on technical and economic feasibility. In this study conducted in Gerona, Tarlac, water from the windmill combined with suction pump ("Jetmatic" pump) and piston pump was applied to vegetable crops through a drip irrigation system with total area of 0.18 ha. Results showed that average daily discharge of the windpump was $9.2 \text{ m}^3 \text{ day}^{-1}$ (24 hours) at 1.6 m s^{-1} daily wind speed. It varied from 0.7 at 1.6 m s^{-1} to $22.1 \text{ m}^3 \text{ day}^{-1}$ at 2.7 m s^{-1} . Functional relationship between daily wind speed and discharge of suction pump was defined by the regression equation: $q_s = 6.6433 \cdot V - 3.4436$, where q_s is discharge and V is daily wind speed, with $R^2 = 0.09069$. Overall efficiency of the windmill-suction pump system varied from 23.1 to 6.1% corresponding to wind speed of 1.7 to 4.3 m s^{-1} , respectively. With total available water supply from the windpump system and rainfall of $17.1 \text{ m}^3 \text{ day}^{-1}$, optimum service area of the system would be 0.81 ha, 0.95 ha, 0.65 ha, and 0.32 ha for tomato, eggplant, onion, and rice crops, respectively. Assuming that windpump system is fully subsidized, maximum net income would be PhP291,615.72 per year if tomato is planted at three crops per year an area of 0.81 ha. Economic analysis showed that with three tomato crop per year, annual net income would be PhP38,960.00. The financial rate of return was 19%, with a payback period of nine (9) years. Thus, the investment for the windpump-drip irrigation system would be feasible only for high-value crops.

YIELD PERFORMANCE OF RICE AS INFLUENCED BY LAND PREPARATION DURATION AND LEVELNESS OF THE FIELD

by

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ABSTRACT

Land preparation is one of the most important processes in rice production. A well-prepared land provides a soil condition favourable for good management of water, nutrient and weeds. Current recommendation in wet land preparation requires 3- 4 weeks to complete plowing, harrowing and levelling the soil. With limited supply of irrigation water, and labour source in the field, some farmers tend to cut short the duration of preparing their land to save water and labour. In this study, we evaluated different duration of wet land preparation and degree of final levelling the soil, to assess their effects on the grain yield and weed density in the rice fields. Field experiments were set up in a split-plot in RCBD with land preparation duration (7d, 14d, 21d) and degree of levelness of the soil (well-levelled and not-so- levelled) as the treatments during the 2012 wet (WS) and dry seasons (DS) in PhilRice-Central Experiment Station. Results showed that there were no significant effects of the treatments on the grain yield and yield components of rice in both seasons. Grain yields varied from 6.5-7.8 t ha⁻¹ (DS) and 4.8-5.2 t ha⁻¹ (WS) with 14d and 7 d obtained the highest, respectively. In DS, weed density was significantly influenced by duration of land preparation and the degree of levelling the soil. At shortest duration (7d) under not-so- levelled soil, weed density was highest and 14 d under well-levelled soils, weed density was the lowest at 15 DAT. In WS, there was no effect of the treatments on the weed density in the field. The study concludes that conventional land preparation (3-4 wks) can be shortened to 1 - 2 weeks duration of preparing the soil with comparable or higher grain yield and lesser weed density in the field under a well-levelled soil.

ADAPTATION OF THE KOREA'S RIDING-TYPE SEEDER IN RICE SEED PRODUCTION

by

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ABSTRACT

In the Philippines, there are two crop establishment methods in rice production: transplanting and direct seeding. Direct seeding is becoming popular among rice farmers due to savings in labor cost. It is done by broadcasting the seeds manually into the field, but nowadays some farmers are using the drum seeder. The drum seeder is manually pulled, and the seeds are seeded in rows at the soil surface. The seeding rate could be adjusted from 40 kg/ha - 80 kg/ha, thus reducing the seed requirement by 50% because farmers used seeding rates of 150 kg/ha - 200 kg/ha.

Rice farming in the country in general is not fully mechanized. The level of agricultural mechanization in the country is 1.68 hp/ha compared to Japan with 7.0, and South Korea with 4.0 hp/ha. Thus, there is a need for Philippine agriculture to be modernized, farming operations should be mechanized and integrated into the rice production system to increase rice productivity and efficiency.

The Korea's riding-type seeder was introduced here in the Philippines through the KOPIA project to promote direct seeding practices as well as reduced labor and production cost in the production of rice. The Korea's seeder composed of 8 rows with spacing of 25cm and 30 cm between rows and 15 cm between hills. It has a built-in canalet for every four rows with field capacity of 100 min/ha. The seeding rate could be adjusted from 10 kg/ha- 100 kg/ha. The seeds are placed in the surface and slightly covered with soil.

The seeder was adapted for establishment in rice seed production using foundation and registered seeds at seeding rates of 10, 20, 30, and 40 kg/ha. The established trials at PhilRice area and seed grower cooperator were monitored by the seed inspector from NSQCS. Seed samples from the harvested crop were taken by the seed inspector and seed testing and analysis was done at NSQCS.

Based on the result of seed analysis by NSQCS, the seed samples passed the seed certification standard of registered and certified seeds. Thus, the Korea's seeder could be recommended to be used as method of establishment in rice seed production. The protocol developed in using the Korea's seeder should be followed by the seed grower to meet the standard in field inspection.

DESIGN AND DEVELOPMENT OF MINI CORN MILL

by

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ABSTRACT

In support to the government's program on the promotion of white corn as food staple, the Agricultural Mechanization Development Program of the Institute of Agricultural Engineering, CEAT, UPLB has funded the development of a farm level (mini) corn mill that is mobile, easy operate and maintain, has higher milling capacity relative to its size, and can be fabricated by small machine shops.

The corn mill is a portable machine which consists of the main milling assembly (degermer), grit mill and polisher, oscillating screen and centrifugal fan. It is adaptable to electric motor or single cylinder engine. The design of the mill component was based on the commercial model of the pin mill because of its ease of operation, potential for local manufacturing, low power requirement and comparably high capacity per unit horsepower. The milling capacity ranges from 50 to 150 kg/hr for products ranging from very fine to coarse grind, respectively. The power consumption ranges from 1.38 to 4 kW for milling coarse to very fine grind, respectively. The corn mill is also provided with centrifugal type suction fan to separate impurities from the grits.

DESIGN EVALUATION OF A TWO-WHEEL TRACTOR USING THE ANTHROPOMETRIC PROFILE OF MALE FARMERS IN RIZAL, PHILIPPINES

by

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ABSTRACT

A survey intended to develop an anthropometric profile of male farmers in the agricultural municipalities of Rizal, Philippines was conducted. Thirty eight (38) different physical body dimensions that have direct bearing on agricultural machine design are collected from 81 respondents with ages ranging from 25 to 65 years old. Some of the measured dimensions are integrated in the design evaluation of a commercially available two-wheel tractor (SHUHE

brand). Results of the analysis showed that the handle to handle distance, handle diameter, and distances of the steering, clutch, and gear shift levers from the handle are at the recommended range. However, the handle height with recommended range of 81.73 to 96.90 cm, the handle length with recommended range of 136.63 to 143.13 cm, and the distance of the operator's foot to the two-wheel tractor's implement with a recommended value of not lower than 35.73 cm needs some adjustment to accommodate 90% of the respondents. With proper fitting of the dimensions of the two-wheel tractor to its operator, musculoskeletal disorders can be prevented, thus, resulting to more efficient in terms of labor inputs and more productive in terms of results.

DEVELOPMENT OF A VILLAGE-LEVEL COMBINED OIL PALM DIGESTER AND SCREW PRESSER

by

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ABSTRACT

The village-level combined oil palm digester and screw presser was designed and fabricated. The performance of the digester was tested and evaluated using three factors and three responses while the attached screw presser was evaluated using two factors and two responses. Determination of physical and mechanical properties of oil palm fruit was conducted to aid in the design process.

Three factors varied over 3 levels were considered on the design of the digester, namely: revolution of the central rotating shaft, spikes population and feeding rate. Based on the result of the evaluation of the digester, a screw was attached to the digester and evaluated based on the revolution of the shaft and the pressure applied.

The result of the study shows that the digestion is best operated with a shaft revolution of 100 rpm, a feeding rate of 16 kg per minute and a spike population of 8 beating arms per set. The screw press attached to the digester also shows a significant increase in the oil yield. A 12-hp water cooled diesel engine was able to deliver the required power requirement for the process.

DEVELOPMENT OF AN IMPROVED PANDAN (*Pandanus simplex* Merr.) LEAF FLATEENER (Part 1)

by

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ABSTRACT

Pandan is one of the plants producing leaf fibers. The leaves are being utilized to meet domestic needs and to support occupations such as farming or fishing by the rural and local population. Weaving is part of the country's cultural heritage. With the global concern over the proliferation of non-biodegradable packaging, one of the pandan weaved products known as bayong exhibits a potential for income and employment generation in the Philippines. The government, through the DTI, is on the forefront of promoting bayong and came up with the Bayong Development Project. The project sees bayong as the focus of a sustainable livelihood program with the two-fold benefits of boosting the economy and diminishing ecological imbalance. The DTI, in 2009, projected an annual domestic demand for bayong to Php1.3B. In spite of these, the technologies in processing pandan have not been improved through time. Promotion and adoption of mechanical input was still not evident. To address this gap, this study focused on the development of an improved pandan (*pandanus simplex* Merr.) leaf flattener locally known as *ilohan*.

This study aimed to develop an improved pandan leaf flattener using participatory approach. A structured test instrument was developed to gather necessary data and information as one of the bases of the machine design. The end-users present practices and design preferences were collected and were carefully considered in the development. The *ilohan* was evaluated. Several existing machines that exhibit the same operating principles of the *ilohan* were visited, tested and evaluated. The data collected from the end-users, the evaluation result of the *ilohan*, and the operating principle of the evaluated machines were combined to come up with a holistic design of an improved pandan leaf flattener. The developed Pandan Flattener's overall dimensions were: 500 mm x 625 mm x 1200 mm with an operational peripheral speed of 0.33 m/s. It has a throughput capacity of 83.48 kg/hr compared to 15.65 kg/hr only of the *ilohan*.

DEVELOPMENT OF A VILLAGE-SCALE PLANT SHREDDING MACHINE

by

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ABSTRACT

To hasten the decomposition of organic materials for organic fertilizer purposes, plant substrates have to be shredded into smaller sizes. Hence, a plant shredder is necessary.

This study was aimed at developing a plant shredding machine which is suited for village-scale use. Several design criteria such as: portability, affordability, efficiency and versatility were considered. A shredding machine known as “Plant Power Shredder (PPS)” was developed using locally available materials. The machine is 1.5 m L × 1.05 m W × 1.10 m H, weighs 150 kg and cost 75,000 PhP (inclusive of 7 Hp Diesel engine). It is mounted in an angular bar framing fitted with 2 free-wheeling wheels to be pulled by a hand-tractor. The prototype used combination of shear and impact forces, which is achieved by the combination of radially mounted blades and hammer members.

Comparative evaluation of PPS with two other plant shredders at VSU were conducted, such as the RUMVD35000-16 and RUMVD35000-14 in terms of capacity, efficiency, fuel consumption, power-output ratio, sizes of shredded materials, percent decomposition of shredded output, and break-even cost of each machine. These were evaluated in shredding rice straw (RC 216), kakawate leaves and branches, and dried coconut husk at three replications.

Among the three shredders, PPS has the highest machine efficiency of 95.71 %, lowest cost of fuel consumed of Php 57.17/hr and Php 0.15/kg, highest power to output ratio of 0.014 hp/kg, and lowest break even cost of Php 0.68/kg. RU 14 has the highest capacity of 471.90 kg/hr and has the greatest percentage of short-size shredded material of 70.94 %.

ESTABLISHMENT OF REACH ENVELOPE OF CALABARZON MALE FARMERS FOR AGRICULTURAL MACHINE DESIGN

by

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ABSTRACT

Efficiency of work done can be optimized with properly designing machines. Most of the agricultural machines used by Filipino farmers are not ergonomically fit for the workspace. This study aimed to establish the sitting position reach envelope of CALABARZON male farmers from an existing anthropometric data. Reach Analysis Program and Fuzzy Logic Method were used in determining the desired results. It was determined that the minimum, average and maximum reaches without flexion are 63.8 cm, 69.6 cm and 75.4 cm respectively. Comfortable degrees of arm flexions were identified using Figure 13 from ASAE Distinguished Lecture Series: Tractor Design, to verify the region of comfortable reach envelope. A qualitative survey was conducted to validate the area of comfortable reach envelope using Reed's representation of workspace to identify the target regions. A two-dimensional representation of the workspace was generated for the analysis of the comfortable areas for the computed reach envelope. Both right and left hand was analyzed and revealed that the most comfortable reach envelope region is from 38.6 cm to 62.7 cm between 30 degrees to 90 degrees reckoned sideward reach position. The gathered results are recommended to be used for standardization of the placement of controls in agricultural machines.

DESIGN AND DEVELOPMENT OF A GRANULATOR FOR A MORE EFFICIENT DRYING OF CASSAVA

by

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ABSTRACT

A cassava granulator appropriate for village-level application was designed and developed to assist farmers in their processing activities. It is powered by a ¾ hp electric motor but can be readily converted into an engine-driven unit. The said machine can be used either in the preparation of local delicacies like cassava cake or to produce flour which is the main objective

for the design. The granulator was developed to reduce the size of the cassava to hasten the drying process prior to pulverization. A drying curve was developed and was determined that a granule size range of 6.35 to 12.70 mm dried faster as compared to granule size of less than 6.35 mm and more than 12.70 mm. With this data, the developed machine's performance was optimized by varying the different machine operating parameters like the drum speed, clearance of the grate or sieve and the combination of both parameters. Result of the study showed that the optimum rotational speed of the drum should be 908.91 rpm with a grate or sieve size of 25.40 mm to achieve a capacity of 1,005.39 kg/hr. With this setting, it is assured that the output granule size will be in the target range.

EVALUATION OF A LOCAL TWO-WHEEL TRACTOR POWERED BY DIESEL ENGINE WITH DIFFERENT POWER RATINGS

by

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ABSTRACT

The most common machine used by farmer operators in land preparation operation is the local two-wheel tractor. However, issues on maneuverability, balance and control were identified in its utilization making the man-machine system less efficient. One of the major factors that affect its efficiency is the weight (power rating) of the prime mover attached to the machine. Hence, a technical performance evaluation of the IRRI PT-5 Power Tiller using air-cooled diesel engines with different power ratings was conducted to know the effect of the different power ratings in performing plowing operation. The two-wheel tractor was attached with a single-bottom, 18-cm moldboard plow. Plowing was done at plow depth of 10-12 cm with an average traveling speed of 2kph. The field performance evaluation was conducted using engine power ratings of 3.73kW, 5.22kW and 7.46kW and the machine was evaluated in terms of its field efficiency, fuel consumption, drawbar power and specific fuel consumption. The ease or difficulty in terms of maneuverability, balance and control using the machine were also evaluated by the farmer operator after performing plowing operation.

Results showed that the highest field efficiency of 87.77% was obtained using the 7.46kW engine. The field efficiency increases with increasing power ratings. Moreover, fuel consumption and drawbar power also increases as the power rating of the engine increases. The highest SFC of 1,065 g/kw-hr was obtained using the 5.22kW engine while the lowest SFC of 918 g/kw-hr was obtained using the 3.73kW engine. In terms of maneuverability and balance, the farmer operator preferred the smaller power rating as prime mover because of ease of operation. On the other hand, all power ratings were rated moderate in terms of control of the machine.

MODELING A MOBILE ANTHROPOMORPHIC ROBOT FOR AUTOMATING FARM ROW OPERATIONS

by

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ABSTRACT

The inverse kinematics model of a three-wheeled mobile, autonomous, six-jointed anthropomorphic robot aimed to automate the labor-intensive and health-hazardous row operations in farm plots is presented in this paper. The mobile component of the robot uses two differentially-driven wheels and an idle wheel located at the rear end for balancing purposes. The anthropomorphic component of the robot is composed of six revolute joints aimed to automate several row-based farm plot operations such as seeding, watering, plant monitoring, and precision applying of fertilizers, herbicides and insecticides. The mobile component can simulate several routes along the farm plots of any realistic dimensions, while the anthropomorphic component can trace several trajectories to simulate row-based actions, such as spot-seeding along a straight plot. There is a need to model the actions (routes and trajectories) of the robot so that its physical design parameters and performance can be optimized, without the need to conduct the usual costly cycle of trial-and-error prototyping, laboratory testing, field evaluation, and redesign. This costly cycle, practiced by almost all local fabricators, is one among the major reasons why most of the current locally manufactured machines for mechanizing agricultural operations have less-optimal design and field performance, especially when compared to similar machines manufactured abroad that were optimized with the aid of models. Similarly, the effort to automate the laborious and hazardous farm plot operations with the aid of robotics also requires the need for optimizing the robot's physical parameters using computer-based models. These models can aid designers in customizing the set of physical dimensions of the robot, as well as the robot's routes and trajectories, that are optimally suited for most farm plot operations.

DESIGN, FABRICATION AND PERFORMANCE EVALUATION OF A MOBILE ENGINE-DRIVEN PNEUMATIC PADDY COLLECTOR

by

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ABSTRACT

A simple mobile engine- driven pneumatic paddy collector made of locally available materials using local manufacturing technology was designed, fabricated, and tested for collecting and bagging of paddy dried on concrete pavement. The pneumatic paddy collector had the following major components: radial flat bladed type centrifugal fan, power transmission system, bagging area, frame and the conveyance system.

Results showed significant differences on the collecting capacity, noise level, and fuel consumption when rotational speed of the air mover shaft was varied. Other parameters such as collecting efficiency, air velocity, augmented cracked grain percentage, and germination rate were not significantly affected by varying rotational speed of the air mover shaft.

The pneumatic paddy collector had a collecting efficiency of 99.33 % with a collecting capacity of 2685.00 kg/h at maximum rotational speed of centrifugal fan shaft of about 4200 rpm.

The machine entailed an investment cost of P 62,829.25. The break-even weight of paddy was 510,606.75 kg/yr at a collecting cost of 0.11 P/kg of paddy. Utilizing the machine for 400 hours per year generated an income of P 23,887.73. The projected time needed to recover cost of the machine based on 2685 kg/h collecting capacity was 2.63 year.

EVALUATION OF QUICK COVERING MACHINE FOR GRAIN DRYING PAVEMENT

by

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ABSTRACT

In sundrying the quality of the grains are greatly reduced when paddy grains were caught by the rain unsacked and unstored resulting to reduced profit. The objectives of this study were to design and fabricate a quick covering machine for grain drying pavement; to test and evaluate the operating characteristics of the machine according to its deployment speed, recovery speed, deployment time, recovery time, power consumption, aesthetics of laminated sack; and to conduct partial budget and cost curve analysis.

The machine was able to cover the grains in a 12.8 m x 22.5 m grain drying pavement at an average time of 17.13 s. It consumed 0.53 W-hr for the deployment and recovery of the cover.

The machine entailed an investment cost of \$1,344.40 and an annual cost charge of \$647.32. Moreover, the savings per year using the quick covering machine was \$101.83.

PROTOTYPE DESIGN & DEVELOPMENT OF RE-ADJUSTABLE MULTIPLE-DIBBLER ERGONOMIC TOOL (RAMDE TOOL) FOR TRAY-BASED SEEDLING PRODUCTION OF HIGH VALUE CROPS

by

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ABSTRACT

A prototype unit of a re-adjustable multiple-dibbler ergonomic tool (RaMdE Tool) was designed and developed for tray-based seedling production of high value crops. It was locally-fabricated using commonly-used shop tools, equipments and materials available over-the-counter. Parts of the prototype tool are grip handle, shank, tool bar, dibbler teeth, wing nut and hexagonal double nut.

Theoretical and effective dibbling time per tray of the prototype tool is significantly different from the farmers practice at 28.2 seconds and 34.1 seconds, respectively. Dibbling Capacity significantly increased to 109 trays/hour from 15.7 trays/hr with the farmers' practice. Device Efficiency is 82.7%. The reduction in dibbling time did not significantly affect dibbling quality. Using RaMdE Tool is a very light physical activity with a mean score of 9.25 by Borg's Rating of Perceived Exertion (RPE) Scale. The prototype is considered to be "good" designed tool with Mean Score of 87.2 using the Checklists for the Ergonomic Evaluation of Hand Tools.

The investment of P 560.00 for a unit of RaMdE Tool yields a net benefit of P 1,008.80 per growing season. Man-hour required to complete the dibbling operation for a 5 hectare tobacco seedling growing module is reduced to 6.65 man- hours from 46.17 man- hours using the usual farmers' practice. A contract laborer using RaMdE Tool earns P 218.00/hr at 109 dibbled trays per hour and incremental income of additional P 37,320.00 for 25 working days per growing season. The computed payback period under this scheme is 19 man-hours (2.4 Man-Days).

PERFORMANCE OF LOCALLY FABRICATED 6-TON FLAT BED DRYERS IN THE PHILIPPINES

by

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ABSTRACT

AMTEC has conducted the testing and evaluation of locally manufactured 6-ton flat bed dryers available and distributed around the country using PAES 202:2000². Initial weight of samples ranges from 2,082 kg to 6,049 kg with moisture content of 20.1% to 31%. Air drying temperature used ranges from 40 °C to 57 °C. After the testing process with final sample moisture content of 9.6% to 18.4%, results showed that the dryers tested have rice hull consumption rate of 19 kg/h to 50.2 kg/h and engine fuel consumption rate of 0.8 to 2.87 L/h. The drying and drying system efficiencies results to ranges of 49% to 86.5% and 32% to 82%, respectively. Heating system efficiency varies from 42% to 95% with heat utilization of 2,707 to 4727 kJ/kg moisture content removed. Furthermore, actual drying time was measured to be from 5 h to 15.8 h with 382 to 782 kg/h drying capacity and 0.88 %/h to 2.18 %/h moisture content reduction rate. Moreover, moisture content variation and moisture gradient from top to bottom layers of grains were computed to be $\pm 0.28\%$ to $\pm 4.46\%$ and 0.9% to 11.4%, respectively.

In these performance test outcomes, 85% and 31% of the dryers reached the minimum requirements specified in PAES 201:2000³ on heating system and drying efficiencies,

respectively. Likewise, only 38% of the dryers resulted to be below the maximum allowable moisture content gradient. These results were mostly attributed to the blower efficiency, and the skills and techniques employed by the dryer operators. Based on all of these findings, recommendations on further development of dryer design on blower configuration, materials used, capacity, flexibility, and usability of the machine to the intended user are essential. In addition, there is also a necessity for the retooling and retraining of operators and re-evaluation of the distribution scheme used.

ADAPTATION OF THE VIETNAMESE REVERSIBLE AIRFLOW FLATBED DRYER IN THE PHILIPPINES

by

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ABSTRACT

A flatbed dryer with a reversible airflow was introduced in the Philippines through a collaborative project between Nong Lam University of Vietnam and the Philippine Rice Research Institute. In this design, airflow is reversed at some point during the drying period to achieve uniform drying without mixing the grain.

A 10-ton capacity dryer which served as pilot unit was constructed to evaluate its performance and adaptability under Philippine conditions. Appropriate and locally available materials were used in the construction of the pilot unit. Less than one percent (1%) moisture gradient along the depth and across the drying bin was achieved during the performance testing. The drying rate was 1% moisture reduction per hour.

Eight-ton capacity dryers were then constructed at PhilRice stations (CES, Isabela, Negros, Agusan, CMU and Midsayap) that served as pilot units for technology promotion. A study was conducted to compare the reversible airflow flatbed dryer with the conventional flatbed dryer. The parameters verified, compared, and assessed were: (1) drying; (2) quality of dried grains; and (3) economic analysis of using the dryers. The performance evaluation was conducted in three drying batches of newly harvested rice seeds.

Based on T-test of parameters, the performance of the reversible airflow flatbed dryer was not significantly different from that of the conventional flatbed dryer. However, the mean germination rate obtained with the reversible airflow dryer was 91.5% (which met the Philippine Standards for germination rate of 85%) while that of the conventional flatbed dryer was 79.9%.

Both dryers could be promoted on large scale since the drying cost using the reversible dryer (PhP0.74 per kg) and conventional flatbed dryer (PhP0.68) are lower than of the prevailing mechanical drying cost of PhP1.13 per kg. The reversible airflow and the conventional flatbed dryers have payback periods of 2.5 years and 1.7 years, respectively. The break-even points were 53.0 and 43 batches/yr for the reversible airflow and conventional flatbed dryer, respectively.

EFFECTS OF VARYING AIR TEMPERATURES IN THE POLISHING COMPONENT OF SINGLE-PASS MILL ON THE MILLING YIELD AND QUALITY

by

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ABSTRACT

The air temperature in the polishing component of a Single-Pass Rice Mill (Satake) was kept varied by improving the milling system. An air duct connecting the 1-hp Aircon to the polishing component was made. The effect of varying air temperatures (full, $\frac{3}{4}$ full, $\frac{1}{2}$ full adjustment, No Aircon or Control) in the polishing component of the Single-Pass Mill on the milling recovery of paddy, a Philippine inbred rice variety, was investigated. Results showed that the milling recovery of the paddy subjected to the $\frac{3}{4}$ full Aircon thermostart adjustment that gave the highest milling recovery of 67.62 % while that of the No Aircon (Control) was the lowest (66.27 %), hence, an increase of 1.35 % in milling recovery. This means that for every 1-ton paddy milled, 135 kg of milled rice would be saved when using the Rice Mill-Aircon set-up at $\frac{3}{4}$ full Aircon adjustment. The temperature of the polishing component at $\frac{3}{4}$ full Aircon adjustment was 33 °C while that of the Control (No Aircon) was 45 °C. This study on determining temperature effects in the polishing component of the Satake Single-Pass Mill serves as guide to millers and processors in the production of more and better quality rice.

EFFECTS OF VARIOUS CONDITIONS DURING POSTHARVEST OPERATIONS ON THE LOSS OF AROMA IN RICE

by

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ABSTRACT

Aromatic rice has become popular and continues to command higher price than ordinary rice because of its distinctive pleasant scent that makes it special. The effects of various conditions during drying, storage and milling on the aroma level and concentrations of the principal aroma compound, 2-acetyl-1-pyrroline (2AP) of the Philippine aromatic rice, Maligaya Special 6 (MS 6), was investigated. Sensory evaluation revealed no significant variations on the aroma of the raw and cooked milled rice samples obtained from the different drying air temperatures (35, 45 and 55 °C) and storage temperatures (ambient at 27, 15°C). However, the aroma levels of milled rice samples (65% recovery) were higher than the brown rice samples (75% recovery). There were also no significant variations in the 2AP concentrations determined through gas chromatograph-flame ionization detector (GC-FID) among the rice samples obtained from the various drying air and storage temperatures, and milling degree. The cold storage did not significantly minimize the loss of aroma in rice during storage. The amount of 2AP in rice, however, decreased with storage time. There was a rapid loss of 2AP during the first five weeks but later slowed down until it did not change anymore indicating the presence of starch bound 2AP. Around 63–67% of total 2AP was lost in brown and milled rice of MS 6 paddy kept at ambient.

COMPARATIVE EVALUATION OF DIFFERENT PROCESSING SYSTEMS IN THE PRODUCTION OF CEREAL-LIKE GRAINS FROM CASSAVA

by

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ABSTRACT

This study was conducted to develop cereal-like grains using cassava through different processing systems; compare the different processing systems in producing grains from cassava in terms of the physical characteristics of the products, and the processes involved; and identify the simplest and most feasible process in producing cassava grains.

The different processing systems tested were: (1) grinding of steamed and dried cassava slices; (2) grinding of steamed and dried cassava chips; (3) extruding and drying of steamed cassava slices; and (4) extruding and drying of steamed cassava grates. Cereal-like grains produced from different processing systems were evaluated based on their physical characteristics which include moisture content, bulk density, diameter size and number of grains.

The results based on the analysis of variance showed that the physical characteristics of cereal-like grains were significantly affected by the different processing systems at $P \leq 0.05$. However, the Tukey's method for multiple comparisons of treatment means showed that the physical characteristics of cereal-like grains produced from grinding of steamed and dried slices (system 1), and from grinding of steamed and dried chips (system 2) were not significantly different. However, these data for systems 1 and 2 were generally significantly higher than that for system 3 (extruding and drying of steamed cassava slices), and for system 4 (extruding and drying of cassava grates).

Among the different processing systems, the simplest and most economical process in producing cereal-like grains from cassava is through extruding and drying of steamed cassava slices with production cost of ₱26.23 per kilogram.

DRYING AND STORAGE CHARACTERISTICS OF GOLDEN APPLE SNAIL (*Pomacea* spp.)

by

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ABSTRACT

Drying and storage characteristics of golden apple snail (GAS) as a non-conventional and alternative food, fertilizer and feedstuff were established in this study. Physical and thermal properties of GAS whole meat, crushed meal, ground dried meat, and ground dried meal including physical dimensions, shrinkage, 1000 particle weight, bulk density, angle of repose, angle of friction, specific heat, thermal conductivity, and thermal diffusivity, were likewise experimentally determined at several moisture levels.

Empirical and semi-empirical models for drying GAS whole meat and crushed meal were developed using the Response Surface Analysis considering the effect of air temperature, air

velocity, and loading capacity on final moisture content, drying rate, rehydration ratio, crude protein content, aroma, color, dryness, brittleness, and the overall acceptability. The optimum drying conditions were determined at 97°C, 0.31m/s, and 11.5 kg/m² for whole meat and 94°C, 0.3m/s, and 12 kg/m² for crushed meal. The modified Page equation best described the thin-layer drying of whole meat and crushed meal. Results of the physico-chemical and microbiological analyses for the processed dried GAS whole meat and crushed meat have met the specification standards as prescribed for commercially dried food and/or feedstuff in the country.

Moisture sorption isotherm models that best describe both the desorption and adsorption paths of whole meat, crushed meal, ground meat and ground meal were developed at 4, 18, 28 and 60°C with relative humidity ranging from 18 to 94%. An hysteresis effect was observed for GAS whole meat and crushed meal. The phenomenon of caking was observed at when the moisture content reaches 25% and 9% moisture content, dry basis, for ground meat and ground meal, respectively. *Bacillus* sp. and *Aspergillus* sp. were the identified dominant microorganisms causing early spoilage on the storage of fresh whole meat and crushed meal.

Results of the study can be used in the design of process equipment particularly on GAS drying, storage and handling. Moreover, these results can serve as sound bases in developing the standard protocol for golden apple snail processing into food, feed, and fertilizer material.

FLEXIBLE PLASTIC SHEETS AS HERMETIC COLLAPSIBLE STRUCTURE FOR SILAGE MAKING

by

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ABSTRACT

A comparative study between silage produced from conventional bunker silo and the SilBag™, made of reinforced flexible polyvinyl chloride, was done. Three units of SilBag™ were used to compare the quality of silage with three replicates of bunker silos. The quality of silage was evaluated based on its chemical, physical, and sensory properties, including palatability using pan method. Results showed that there were no significant differences in percent dry matter, protein, ash, and acid detergent fiber content, except for neutral detergent fiber at day 21, of the silages produced at different sampling periods. The pH level of silage from the SilBag™ remained at 4.57 as opposed to 6.48 pH level in the bunker silage. Lactic acid content of the silage in the SilBag™ was significantly higher. It was also observed that the color and aroma of

the resulting silage from the SilBag™ is better, which is indicative of good silage quality. SilBag™ silage was highly comparable to the palatability of fresh grass.

OPTIMIZATION OF HOT WATER TREATMENT OF CASSAVA (*Manihot esculenta*) TUBER TO MINIMIZE DETERIORATION

by

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ABSTRACT

A hot water treatment was used to minimize deterioration of cassava tubers. An experimental design of two-level full factorial that resulted into six runs was chosen to get an optimal value for the treatment. Water temperature having the values of 40°C, 50°C and 60°C together with submersion time of 40min, 45min and 50min was used as independent parameter. A five day ambient storage for the samples was done after each treatment. The physiological and microbial deterioration were analyzed and verified afterwards. Results showed that at higher temperature the vascular streaking can be prevented but the potential for gelatinization is present. In line with this the treatments having the highest temperature used which is 60°C were more prone to the development of microbial decay. At 10% level of significance the dimensionless cassava temperature (DCT) and vascular streaking at 15% transverse cut were significant while the optimal actual values obtained were 45°C and 40min.

EX-ANTE ANALYSIS FOR THE DEVELOPMENT OF BROWN RICE JUST IN TIME HULLING TECHNOLOGY

by

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ABSTRACT

The potential of brown rice just in time hulling technology (JITHT) has been analyzed through qualitative and quantitative research using 174 respondents among current brown rice consumers, retailers and millers in different areas of the country. The process and findings that

emerged in this research has helped resolved management decision and marketing research problems (i) of whether PHilMech shall proceed in the development of household type brown rice huller; and (ii) if there are potential buyers, and what shall be the technical features of the proposed JIHT to become acceptable to the target users.

This research has successfully established basic technical specifications and financial parameters that will lead to the viable operation of the proposed JIHT. Given the current low level of household consumption of 2.80 kg/wk, the proposed JIHT is highly feasible at the consumer's level if the capacity shall be 12kg/hr and at selling price of Php8,500 per unit. Likewise, the proposed JIHT could well fit the business operations and requirements of 'regular rice retailers' given a capacity of 104kg/hr and a selling price of Php18,500 per unit. This group of rice retailers is basically those stores in the ordinary market that packaged brown rice as healthy or organic rice

Using Probit regression analysis, the research has also established the socio-economic factors that may influence the potential adoption of the proposed technology both at the consumers' and retailers' levels.

The development and the eventual commercialization of the proposed JIHT shall be aggressively pursued by the government to promote wider adoption of brown rice in the country. This policy program and direction shall be embraced by the government as one of the enabling mechanisms to collectively achieve and sustain food-self sufficiency in the country in the future.

STANDARDS ON POULTRY DRESSING/SLAUGHTERING PLANT

by

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ABSTRACT

With the increasing demands on higher quality and safe poultry products in the country, standardization of the equipment and structures involved in it is in place. AMTEC recently conducted the development of technical standards for poultry dressing/slaughterhouse equipment and dressing/slaughtering structures.

Ten (10) technical standards (specifications and methods of test) for poultry dressing/slaughtering equipment involving stunner, scalding, defeathering machine, chilling

tank, and overhead rail system and two (2) standards on poultry dressing/slaughtering structures for small and large-scale were developed. Standards for equipment composed of requirements such as manufacturing, installation and performance as well as the methods of test for each equipment. On the other hand, standards for structures consist of lighting, water, plumbing, drainage, electrical, and structural and functional requirements and complete floor plans. These standards specify the minimum requirements for the performance of the equipment and design of the poultry dressing/slaughtering structure.

VIS-NIR SPECTROSCOPY – A RADICAL TECHNOLOGY FOR PHILIPPINE AGRICULTURE

by

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ABSTRACT

Visible-near infrared spectroscopy is a rapid, non-destructive and safe technology for compositional analysis of materials. Although this has been in limited use in the animal feed sector in the Philippines for routine analysis, its use to other applications had never been fully realized. The technology is based on the principles of interaction between light and matter that provides basis for calibration development. To define the system, specific light sources must have sufficient spectral quality coupled to a specific spectrometer of appropriate spectral sensitivity. By using chemometric analysis, prediction models are developed for the target constituents. The technology can be used for food and feed analysis, nutrient management of crops, and on-line or at-line quality measurement of bio-chemical processes. Some examples are non-destructive measurement of protein and moisture contents in corn and soybean, and assessment of nutrient status of rice crop.

PERSONAL AND INSTITUTIONAL CORRELATES OF POSTHARVEST TECHNOLOGY ADOPTION IN BICOL REGION

by

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ABSTRACT

The study aimed to determine the personal and institutional factors related to the adoption of postharvest processing technologies developed by state universities and colleges (SUCs) in Bicol from 2005-2011. Answers to the following questions were sought: 1) What are the demographic characteristics of farmers? 2) What are the postharvest processing technologies developed and disseminated by SUCs to farmers? 3) What is the status of technology adoption of postharvest technologies along the following aspects: social acceptability, technical consideration, economic feasibility and environmental management? 4) Are the demographic and institutional factors related to the technology adoption of farmers? 5) What is the extent of technical assistance given to farmers by SUCs? 6) Are there significant differences in the level of technology adoption among the different aspects across sites? and 7) What are the constraints/problems and benefits derived by the farmers from the postharvest processing technology being disseminated by SUCs?

The descriptive-evaluative correlative research design was used in the study. Survey forms, interviews and focused group discussion (FGD) were employed for the collection of data.

Major findings of the study were: 1) Majority (57.1%) of the technology users are in their most productive stage (31-40 years), predominantly female (72.6%), married, high school graduates and with household size ranging from 4-6 persons. (2) Post-harvest processing technologies adopted by the farmer-respondents are essential oil extractor (CBSUA), corn husk processing (CNCS), pili pulp processing (SSC), abaca fiber stripper (CSC) and multi-crop extractor (BU). (3) Status of technology adoption along social acceptability is high with 84.5% of them highly satisfied; along technical consideration, all respondents indicated they were provided technical assistance by SUC's and other agencies and they were able to produce quality products and by-products that were sold to established markets, exhibits, trade fairs and fora; along economic feasibility, 87% of the adopters indicated that the technologies were affordable, appropriate and very useful; and along environmental concerns, majority (83%) of them practiced environmental management. (4) Test of relationship between some factors and technology adoption resulted to significant relationship of marital status ($X^2=83$), frequency of visits of change agents ($X^2=49.86$), and adequacy of trainings and seminars ($X^2 = 49.86$). (5) Extent of technical assistance by SUCs to farmers is high due to constant visit (3-4 times a year) of the R & E agents of SUCs and capability building activities given to the technology adopters. (6) Significant differences were obtained in the level of technology adoption along social

acceptability ($X^2= 36.07$); technical consideration ($X^2= 25.27$); and environmental management ($X^{2\text{comp}}=57.74$).

The constraints/problems of the technology were :1) Insufficient raw materials to meet the demand, lack of technical know-how, lack of capital, demand for the products are not met, high cost of equipment, and high interest rate on borrowed capital. The benefits include: increase in farmers' income, satisfaction of postharvest technologies through effective, R & E programs on the dissemination of technologies appropriate to their needs, individually or as a group.

The following conclusions were made: 1) Respondents have younger family with increasing basic needs of the family and therefore must look for other income generating activities; (2) The post harvest technologies are confined only to a very limited number of users whose products can be processed by the available technology; (3) The postharvest technologies are affordable, cost-effective, easy to operate, efficient and environment-friendly; (4) Marital status, frequency of visits of technical personnel and upgrading of capabilities of technology adopters are possible determinants of technology adoption; (5) Technical assistance of SUC's through visits and capability of technology adopters is high; (6) There are significant differences in technology adoption among the aspects of social acceptability, technical consideration and environmental management; and 7) The main problem is inadequacy of raw materials for processing to meet market demands while the major benefit is increase in the household income and generation of revenue for the municipality once a processing industry is established.

USE OF THE DIFFERENT BLENDS OF *JATROPHA CURCAS* BIODIESEL AS FUEL FOR THE PERFORMANCE EVALUATION OF A FOUR-WHEEL TRACTOR

by

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ABSTRACT

This study aimed to determine the effects of using different blends of *Jatropha curcas* biodiesel as fuel on the performance of a four-wheel tractor. Unblended (Blend 0), five percent (5%) blend (Blend 5), ten percent (10%) blend (Blend 10), and fifteen percent (15%) blend (Blend 15) of biodiesel were used during the tests. At varying speed and load, the drawbar power (DBP), specific fuel consumption (SFC), operating forward speed and wheel slippage of the tractor were measured. Response surface regression was used to analyze the response at 90% and 95% levels of confidence. Further, a multiple range test was conducted to verify the significant

difference of the blends from each other. Results showed that Blend 5 has the highest DBP produced. On the average, Blend 5 has also the closest performance to the performance of the commercial diesel fuel, Blend 0. Statistical analyses also proved that for most of the test runs, there are no significant differences among the DBP generated by the different fuels. Statistical analyses further showed that for most of the tests, there are no significant differences between the SFC of the Blend 0 and the SFC of the blended biodiesel.

PROMOTION OF PHILMECH BIOMASS-FED FURNACE RETROFITTED TO MECHANICAL DRYERS

by

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ABSTRACT

With the aggressive promotion of hybrid rice in the country, production level is expected to increase. On the other hand, the effect of global warming and climate change gave rise to unpredictable weather conditions like heavy downpour and flooding. With these situations, the problem in drying harvested paddy becomes more acute if not properly addressed. Increasing the utilization rates of mechanical dryers (recirculating batch-type) by retrofitting them with biomass furnaces would be a logical solution to the problem, as this would lower drying cost and eventually, entice more farmers to use mechanical dryers. Along with this, PHilMech has developed an indirect-fired biomass furnace utilizing rice hull and other biomass materials as alternative fuel.

To cushion the effect of the rising cost of fuel, reduce the cost and lossess of drying operation and encourage utilization of mechanical dryers, PHilMech implemented the project entitled "Promotion of Biomass Furnace Retrofitted to Mechanical Dryers". The project established strategic pilot technology demonstration sites nationwide to showcase the benefits of the retrofitting system that would eventually boost the utilization of mechanical drying facilities which are underutilized due to high drying cost. These serve as demonstration and showcase centers for interested adopters and manufacturers of the technology.

Establishment of techno-demo sites was done in partnership with DA-RFUs and organized farmer groups (cooperative/organization), LGUs as cooperators and licensed manufacturers. The PHilMech biomass furnace was retrofitted to the recirculating batch-type mechanical dryer of identified cooperators and seasonal utilization level were monitored and documented for a period of two years.

Generally, data collected reveal significant increase in mechanical dryer utilization (number of bags dried) and decrease in drying fee collected (peso per bag). Utilization level of the mechanical dryer tripled in terms of number of bags dried attributed to the decrease in drying fee collected by almost 50 percent. Also, findings shows that the sustained utilization of biomass fed furnace is hinged on the collaborative efforts of both public and private entities.

DEVELOPMENT OF SINAG: A SOLAR-ASSISTED EGG INCUBATION SYSTEM

by

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ABSTRACT

This study describes the development of SINAG: a solar assisted egg incubation system. The term SINAG is an acronym for Solar INCubation for AGricultural applications, which in Filipino means sun's ray; implying its utilization of solar energy. The study is an attempt to provide the poultry industry with an appropriate technology that is suited for small to medium scale production. A SINAG egg incubator prototype was designed and fabricated. The main strategies implemented in the SINAG system to enhance energy efficiency were solar assisted heating of the incubation space and intermittent operation of the ventilation device. The study revealed that 72.6% of electrical energy could be conserved by using the SINAG system. If the SINAG prototype was used for *balut* production, payback period for initial investment is just 10.5 month and annual income would be 3.3 times compared with the income from a conventional system.

Response surface methodology was used to characterize the SINAG system using a Box and Behnken Design. Response variables were electrical energy consumption and evaporation of water in the incubator. Parameters used in the modeling work were incubator temperature setting, tank water temperature and ventilation port opening. Mathematical models that were generated by the statistical software, Design Expert[®], had a good fit and were validated and was found to be 94% and 98% accurate for predicting electrical energy consumption and evaporation of water, respectively. Numerical optimization revealed the ideal region of operation for SINAG for incubating duck eggs was at 0% ventilation port opening, incubator temperature setting of 37.5-38°C and tank water temperature of 47.5-60°C.

The SINAG system promotes energy efficiency, utilizes a renewable energy resource, and can also be considered an environmentally sound technology. This study presents tremendous potential for adoption not just for *balut* production but also for the entire poultry industry.

ANALYSIS OF ENERGY CONSUMPTION AND PROPOSING ENERGY REDUCTION MEASURES: A CASE OF SELECTED FISHPONDS IN CANDABA, PAMPANGA

by

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ABSTRACT

The paper discusses the identified water movement practices into and out of selected fishponds in Candaba and their corresponding energy requirements in terms of liquid fuel (diesel) consumption is evaluated.

At first, with the aid of Google-based satellite photo and actual ocular visits, the author grouped the fishponds into three(3) with reference from the Arayat-Apalit control dike. Group A is the majority grouping, consisting of the fishponds within the three(3) barangays outside the Arayat-Apalit Control Dike. Group B, as the middle group, consisting of the fishponds within one(1) barangay only but inside the control dike. The last group which is Group C consists of fishponds within the two(2) barangays which are also inside the control dike but about one kilometer away from the control dike. Secondly, an analytic diagram of the fishpond was prepared to facilitate the analysis of water volume into and out of the fishpond for the computation of energy use. Lastly, only one representative fishpond operator from each group was taken and its mode of water movement was analyzed with the associated diesel fuel consumption.

The results showed that 1) the groupings have unique situations in relation to the delta irrigation network, affecting primarily the nature of energy consumption, and 2) the water movement practices in each grouping were different which reflect the variation in their energy requirements. Group C showed the highest energy requirement, revealing intensive use of diesel fuel for water pumping into and out of the fishpond. As a way of addressing the situation in Group C, the introduction of alternative energy such as biomass gasifier (BMG) is suggested as an attractive option to reduce commercial diesel energy consumption.

ENERGY PERFORMANCE OF AGRICULTURAL MACHINES IN THE PHILIPPINES

by

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ABSTRACT

AMTEC has tested about two thousand agricultural machines. From the test results, the data which relate to the energy performance of engines, water pumps, threshers, flat bed dryers and blowers were analyzed. The general trend showed that many engines perform poorly. Self-priming water pumps were comparatively inefficient than non-self-priming pumps. Capacities of threshers were poorly correlated with engine size and design optimization is being recommended. Performance of flat-bed dryers were found to be very much affected by operator skills. All blowers tested in the laboratory showed low power performance efficiencies.

AMTEC performs tests and evaluation of agricultural machines for procurement using government loans and grants. The test results data can be construed as representative of the energy performance of the machines found in the Philippine farms.

MATCHING AND PERFORMANCE EVALUATION OF ELECTRIC GENERATING SYSTEM FOR A PUMP-AS-TURBINE MICRO-HYDRO SET UP

by

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ABSTRACT

A 900-W alternating current (AC) generator and a 35-A automotive alternator were matched and tested at different pressure and load settings with a 75mm x 75mm non-self priming pump-as-turbine (PAT). The performance of the system was evaluated through their electrical power output and efficiency.

Performance curves of AC generator at 4000 rpm and 3800 rpm generally shows that as the speed increases, voltage, electrical power and efficiency increase while current decreases. The maximum power obtained by the AC generator during the actual run was 515 W that is way below the calibrated value of 846 W. The set up with pulley combination of 254 mm (PAT) and 50.8 mm (AC generator) have the highest electrical power output.

No general trend was observed in terms of electrical power and system efficiency on performance curves of alternator test at different pressure settings. The percent difference of the maximum power obtained from actual and calibration test of alternator ranges from 0.5% to 67.5%. Relatively high percent difference could be observed at lower pressure settings. If belt slippage could be reduced, the maximum power obtained by the alternator during calibration test could be obtained in the alternator-PAT test set up.

DESIGN MODIFICATION AND OPTIMIZATION OF LOW HEAD MICROHYDRO SYSTEM FOR ELECTRICITY GENERATION

by

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ABSTRACT

One of the most used renewable energy source in electricity generation is water. The system of a low head microhydro system to be installed on irrigation canal for electricity generation was analyzed in this study. Two factors are incorporated: the draft tube and speed ratio. The maximum power is generated by the combination of modified draft tube and speed ratio of 3:8 (86.9W). The most efficient system is the combination of the original draft tube and speed ratio of 3:8 (31.7%). The optimum power is produced by the design with original draft tube at speed ratio 3:8. The microhydro system costs Php 95,362.33. Almost half of the cost, Php 45,774.33, was spent for the labor cost that includes skilled labor and requires specialized equipment. Php 49,588.00 was spent for the materials, which is mostly for black iron sheet. The cost can be further reduced if fabrication of components is through mass production. It is recommended that the test rig design is further improved with the incorporation of a control system for the charging circuit. Field testing the microhydro system is also encouraged in order to know the actual performance of the system.

RETROFITTING OF GASOLINE ENGINE TO RUN ON HYDROUS ETHANOL FOR WATER PUMPING APPLICATIONS

by

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ABSTRACT

The possibility of running retrofitted engines with hydrous ethanol without mixing gasoline was examined. A 3.5hp Robin and a 16hp Briggs and Stratton engines were retrofitted to run on different concentrations of hydrous ethanol. Problems usually encountered in researches with ethanol fuel were avoided by bypassing the carburetor, thus directly injecting fuel into the combustion chamber and replacing the parts that are not compatible with ethanol. The carburetor, however, was not removed to allow the engine to be used with either gasoline or hydrous ethanol fuel.

The retrofitted engines were able to run on 85%, 90%, and 95% ethanol fuel. The engines were coupled to water pumps and the flow rates were tested using the weir method. The discharge of the pump was measured when the engine was run on gasoline, 85% ethanol, 90% ethanol, and 95% ethanol. No gasoline-ethanol mixture was used in the study.

DESIGN, FABRICATION, AND EVALUATION OF PROTOTYPE SOLAR-POWERED STILL FOR BIO-ETHANOL PRODUCTION

by

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ABSTRACT

A solar still is a simple device for distilling water which uses heat of the sun to drive evaporation and ambient air to cool a condenser film. These simple yet effective basic principles of solar water distillation can be replicated in the distillation of bio-ethanol from fermented solution. The results of economic analysis of solar distillation system by Vorayos *et.al* appear to be

economical compared to the conventional distillation system using fuel oil as heat source. Likewise, solar distillation of ethanol with vacuum conducted by Rajvanshi shows that the efficiency of the distillation unit for distilling 40% ethanol is about 13% and compares extremely favorably as compared to 2-3% obtained from existing fossil fuel fired ethanol distillation plants.

With an objective to distill bio-ethanol in simple way, a solar-powered still prototype was designed, fabricated and evaluated in terms of ethanol recovery and efficiency. It is batch-type solar distillation system which consists mainly of flat-plate solar collector for heating the solution and a still with domed-type head that facilitates evaporation-condensation process. The assembly of these two main components made-up the solar-powered still prototype for bio-ethanol production. Initial distillation of fermented solutions with varied chemical and physical properties, which includes clarity, viscosity and purity, was imposed in the performance evaluation.

At pure solution (water is the only other component of the solution) the prototype distilled 65.4%v/v of ethanol with purity of 63%v/v from 39%v/v. The efficiency of distillation with this condition of distillate is 41.8%. With unclear solutions, a lower concentration of ethanol was obtained however the distillates became clear and has viscosity like of water. This improved condition of distillates will simplify further separation of ethanol

Analysis of the results implies that distillation efficiency of the prototype tends to increase as the composition of solution to be distilled improves. Further evaluation for the performance of the prototype in complete separation of ethanol contain by the solution is recommended. Improvements that will raise ethanol distillation rate will be addressed in the future studies.

SOLAR DRYING: THE SECRET TO FUTURE SUCCESS OF SMALL-SCALE BAMBOO INDUSTRY IN THE PHILIPPINES

by

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ABSTRACT

There is a need to strengthen the bamboo furniture industry in the Philippines in terms of its postharvest engineering aspect. With a great demand from the local and global market, the Philippines have not been able to make its name nor become a strong pillar in this industry. This study is a descriptive research of the small-scale bamboo furniture business in the Philippines. It employs a comparison between the method done by small-scale furniture makers and the

proposed post harvest technique and use of a solar dryer in the drying method of bamboo as tested by the researcher. This study covered the whole process of bamboo furniture making from the post harvest techniques to designing and marketing in order to achieve the desired and good quality product. This study provides the answer as to why the typical bamboo furniture sold in the local market is prone to shrinkage and has a poor quality plus prone to insect attack. Since the bamboo is not dried properly or does not achieve the right amount of moisture level which is 10% or below, the bamboo furniture cannot be considered and exported in terms of the standards in the global market. The result of the research shows the need to make use of a solar dryer in the drying process of a bamboo before undergoing the furniture making process itself. The condition in ordinary sun drying method can only reduce the moisture level of the bamboo by 15 to 20 percent. This is the situation of small scale bamboo entrepreneurs who are not using solar dryer. Their bamboo materials having still 15 to 20 percent moisture level tend to undergo shrinkage, resulting into cracking of connecting joints in their finished bamboo furniture products.

ADSORPTION OF ERIOCHROME BLACK T (EBT) DYE USING ACTIVATED CARBON FROM WASTE RICE HULLS

by

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ABSTRACT

The increasing problem of vast amount of wastes from industrial, agricultural and domestic emitted in the environment is a by-product of rapid technology advancement. This inevitable development coupled with unavoidable production of waste has spurred increasing effort to manage and dispose waste in an environmentally friendly manner. Dyes are extensively used in textile, paper and leather industries. Wastewater effluents from these industries are mostly contaminated with different synthetic dyes that cause major water pollution. Thus, its removal from effluents is an important environmental concern. In this study, batch experiments were done to determine the efficiency of rice hull activated carbon in the removal of Eriochrome Black T (EBT) dye. The effects of initial dye concentration, adsorbent dose and pH on the percent removal of EBT were investigated. Results show that the EBT removal increases with the increase in adsorbent dose, and the decrease in initial dye concentration and pH. The optimum parameter conditions identified are 95 ppm initial dye concentration, 2.0 g adsorbent dose and a pH of 2. Among the isotherm models used, the Freundlich isotherm exhibited the

best fit for the isotherm studies which implies that the adsorption of EBT dye onto rice hull activated carbon is heterogeneous.

ALTERNATIVE BIOMASS FURNACE WALL MATERIAL FROM BIOMASS FURNACE REFUSE

by

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ABSTRACT

The use of agricultural wastes for the production of material is now gaining wider attention because of its availability, low cost, and considerable disposal problem that needs to be addressed. As part of our Agency's growing concern in the reduction of environmental wastes problem and by adding value of wastes generated in postharvest handling and processing, refuse from biomass furnace, mostly carbonized rice husk (CRH) produced during drying of grains in flatbed dryers were compounded with cement and utilized as wall of the combustion chamber of a biomass furnace. Varying ratio of CRH-cement from 1:4 to 1:8 by volume were prepared and cured in an ambient condition for 7, 14 and 28 days. Properties such as density, porosity, compressive strength and thermal shock resistance of each sample composition were characterized and determined. Result shows that compressive strength increased with increasing cement content and curing time. All the samples prepared are highly porous materials which ensure low thermal conductivity and minimal heat loss as a good measure of insulating quality of a biomass furnace. All the sample compositions exceeded 30 cycles without any crack when subjected to thermal shock resistant cycles of heating and cooling using a firing temperature of 1000°C in an electric muffle furnace. Actual construction of direct-fired biomass furnace using the developed material was also done and attached to flatbed dryer for custom drying services. The low cost, environment-friendly developed biomass furnace wall material has been utilized for several drying seasons and still being used and functional up to this time.

BIOCHAR PRODUCTION WITH HEAT RECOVERY: CHALLENGES AND PROSPECTS FOR CLIMATE SMART AGRICULTURE

by

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ABSTRACT

The use of biochar from rice hull (carbonized rice hull) is becoming popular among the Filipino rice farmers particularly those practicing an integrated system of farming called *Palayamanan*. Under this system of farming, carbonized rice hulls are widely used as soil conditioner or as main ingredient in the production of organic fertilizers. Some farmers are also using them as animal beddings to absorb urine and fresh manure in poultry and livestock, while eliminating foul odor. The saturated biochar are then collected and applied into the soil as organic fertilizer for vegetables and other crops.

To further enhance the system of producing biochar, PhilRice developed a continuous-type rice hull (CTRH) carbonizer that operates by natural draft. Occupying a space of 0.8m x 0.8m with body height of 1.5 m, the carbonizer is capable of processing rice hull into biochar at a rate of 21 to 36 kg/h with biochar recovery of 37 to 40%. It is easy to ignite (3 min maximum using at most 100 mL kerosene), with almost smokeless emission, and allows the recovery of the generated heat for some practical applications in the farm. Aside from rice hull, it is also capable of processing other agricultural wastes such as, but not limited to, rice straw, coconut husks, corn cobs, dried leaves and twigs.

Results of experiments conducted to evaluate the carbonizer's potential as heat source for various farming applications using the recovered heat from the chimney walls showed that, at air flow rates of 805-883 m³/h, the ambient air temperature was raised from 28-37°C to 102-140°C. This shows that the carbonizer can potentially be used as furnace for mechanical dryers. Since the heated air is clean (not contaminated with the flue gas emission), it can also be used to dry food and herbal products as well as in heating poultry houses.

Using another heat recovery attachment, the carbonizer was successfully used for high volume cooking. Water boiling test recorded a 30-min boiling time for 32 liters of water. Using the same heat recovery attachment, essential oils were also successfully extracted from lemon grass and eucalyptus leaves. Current efforts are geared towards providing control for temperature so that it can be used for special applications like baking, bio-oil production, and others.

The cogeneration of biochar and heat for farming applications will help provide farmers with added opportunities for increasing their productivity and income while reducing their carbon

footprints. Among other things, it would enable them to save on fertilizer costs through the use of biochar and biochar-based products while earning additional income from products that are processed using the generated heat. Follow up experiments are currently being done to further verify these findings under actual working conditions.

DESIGN, FABRICATION OF A BIOFERMENTING MACHINE ON A VILLAGE LEVEL

by

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ABSTRACT

This research study was conducted to design a biofermentor for treating biologically convertible matter by contacting same with Spirulina, a microalga deposited and immobilized on support carriers. The apparatus is made up of a bioreactor chamber, sludge and collecting chamber and a wastewater conveyor.

Piggery slops, bagasse, chicken manure and fresh cow manure was mixed with a solution of food grade chemicals, the medium was prepared by stirring – in waste matter into the water.

Spirulina was cultured in the bioreactor to produce a protein biomass and at the same time absorb, degrade and convert the biologically convertible matter.

The physico – chemical quality of wastewater before and after undergoing treatment inside the biofermentor were analyzed and evaluated.

Based on the result of the physico – chemical analyses the wastewater became odorless, less turbid, and the color gradually changed from brownish to yellow - deep green teeming with Spirulina growth. The concentration of potassium/nitrogen ion concentration was increased while sodium ion concentration was decreased. There was a marked increase on the biomass yield of Spirulina together with its biochemical composition.

CONTINUOUS FLOW RICE HULL GASIFIER: HEAT SOURCE ALTERNATIVE FOR MECHANICAL DRYING OF PALAY

by

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ABSTRACT

High drying loss can be attributed to inadequate drying facilities or less efficient drying systems but normally efficient systems involve a higher investment cost. The Philippine Rice Postproduction Consortium (PRPC) has developed a 6-ton/batch recirculating dryer design for paddy using a diesel-fired burner. However, since 2004 when the dryer was initially operated, the price of diesel fuel has increased remarkably which resulted to its reduced utilization.

To reduce drying operational cost, a 60-cm diameter continuous flow rice husk gasifier based on the Central Philippine University (CPU)-Center for Rice Husk Energy Technology (CRHET) model was constructed, improved and tested. It uses ricehull as heat source by gasification process. Recent trials showed adequacy of the gasifier to provide heating requirements for a 6-ton capacity dryer. Rice hull consumption is at 40 kilogram per hour. Plenum temperature was measured as high as 100°C but the drying temperature maintained during drying operation was 70°C. With minor refinements, this shall be a potential heat source alternative for mechanical paddy drying operation.

DEVELOPMENT OF BIOMASS FURNACE BY-PRODUCTS BASED FUEL BRIQUETTES

by

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ABSTRACT

One of the most pressing issues that are currently facing the Philippines and other developing countries is the capability to have an affordable, dependable and renewable energy source. Historically, the Philippines has been heavily dependent on imported oil for its energy needs. With the rising costs of fossil fuel energy coupled with the increasing population of the country, the pressure of harvesting alternative fuel options grow bigger every day.

The PHilMech rice hull-fed furnace system was developed to solve the problems of high cost of heating fuel such as oil, kerosene, LPG, and other fossil-based fuels, burned and or dumped biomass wastes (rice hull and corn cob) in open fields. The developed furnace system does not only provide heat for mechanical dryer but also produce carbonized rice hulls as by-products. However, these carbonized materials have no deliberate and immediate use, which led to problem in residue disposal and hence creating environment al hazard to the people in the community near the drying centers. Converting the carbonized material into a densified form, also known as briquettes, will help in solving these problems.

Biomass furnace by-products based briquettes showed potential as fuel on a low requiring energy consumption due to its good flame, calorific value, shattering indices test, tumbling test, durability and thermal efficiency.

DESIGN, FABRICATION, TESTING AND EVALUATION OF A CONTINUOUS-FLOW RICE HUSK GASIFIER FOR BAKERY OVEN

by

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ABSTRACT

The study was centered on the design, fabrication, testing, evaluation and determination of the economic viability of a Continuous-Flow Rice Husk Gasifier for Bakery Oven (CFRHGBO). The gasifier was designed to cater the energy demand used in small-retail bakery.

Design calculations were done after the criteria were identified followed by design drawing preparation. Fabrication of the device was performed following the design plan. The gasifier and oven were fabricated by component and then assembled by fitting all the components into one operating system as indicated in the design plan. Consumer product testing was done to determine the difference in the overall adaptability of the salt bread baked in CFRHGBO and LPG-fired oven.

The designed gasifier is 2,150 mm high and 400 mm in diameter. It was made of galvanized pipes, metal sheets and round bars. The oven is 1,295 mm long, 1,295 mm wide and 1570 mm high and was made of metal sheet plates, round bars and galvanized iron pipes. The whole CFRHGBO system has; start-up time of 9.43 min, loading time of 26.3 min, unloading time of 51.18 min, preheat time of 16.87 min, baking time of 34.31 min, energy input rate of 24,311.11 kcal/hr, preheat energy of 6,949.54 kcal, idle energy of 6,762.79 kcal, baking energy of 10,679.68 kcal, baking energy efficiency of 36.69%, operating time of 72.67 min, fuel consumption rate of 8.1 kg/hr and weight of fuel use of 9.7 kg.

The gasifier reactor and oven entailed investment cost of PhP 75,000.00. The cost of operation was PhP 70.46/hr which can generate savings of PhP 72,955.09/year. The CFRHGBO reaches breakeven point after baking 60,660 pieces of salt bread (1,091.88 kg of flour). It's return on investment was 26%, benefit cost ratio of 1.39 and payback period of 4.32 months. Salt bread baked using rice husk-fed oven showed no significant difference on quality of salt bread baked using LPG-fired oven in terms of after taste, aroma, color, mouth feel and overall flavor.

DESIGN, FABRICATION, AND PERFORMANCE EVALUATION OF A CHARCOAL BRIQUETTE MOLDER FOR DIFFERENT BIOMASS

by

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ABSTRACT

This study was conducted to design, fabricate and evaluate the performance of a household-level briquette molder using charcoal from different biomass.

A Two-Factor experiment in a Randomized Complete Block Design was used in this study. Three sources of biomass were considered, which include coco shell, corn cob, and wood. Factor B includes the compression time in molding briquettes using the molder such as 15, 30, 45, 60, 75, and 90 seconds. Data gathered were average dimension, relaxed dimension after three days drying, particle density, bulk density, porosity index, durability, ignition time, combustion rate, heating value, volatile matter, ash content, fixed carbon content, the time to boil one liter of water, specific fuel consumption, as well as volume capacity, and the best time to compress the charcoal.

Highly significant variations were observed in heating value (MJ/kg), volatile matter, ash content, time to boil one liter of water, and specific fuel consumption. Highest heating value, volatile matter, fixed carbon were observed in corn cob charcoal briquettes, and the least ash

content, time to boil one liter of water, and specific fuel consumption over charcoal briquettes from other biomass sources.