Department of Agriculture
PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

2014 NATIONAL RICE R&D HIGHLIGHTS

THESIS ABSTRACTS

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I. Assessment of the Capability of PhilRice to Enhance the use of E-Commerce in the Service and Delivery of Rice Seed Products

CD Diaz

Abstract:

Government offices must upgrade their ICT infrastructure to better serve their clients. Computer networks are now used in businesses to streamline processes and operations management. There are limitless possibilities for business in the public sector if the needed ICT infrastructures are in place.

This study aims to assess the readiness and capability of PhilRice infrastructure, facilities, and personnel in employing e-Commerce in its business operations. Additionally it assesses the capability of PhilRice clients in using e-commerce. Results show that only the PhilRice Central Experiment Station (CES) has ready infrastructure and facilities for e-Commerce. All branch stations need infrastructure upgrade. Likewise, further training for existing PhilRice personnel and hiring of additional skilled manpower are recommended. Mobile phone-based initiatives on e-Commerce are in the right direction. This study concludes that PhilRice ICT infrastructure in the branch stations must be upgraded. Training of existing personnel and hiring of new staff members who are e-Commerce-ready must be realized. These moves are parallel to the plans of the Philippine government to optimize use of ICTs in its offices.

II. An Integrated Media Approach to Increase Technology Adoption Among Rice Farmers in Region II

DM Rebong III

Abstract:

This re-entry project identified low adaption of technologies by farmers leading to low farm productivity as the most significant gap to address. This gap is most vital since it is the mission of the Philippine Rice Research Institute to help increase productivity and profitability of rice farmers to help the country attain rice self-sufficiency and contribute to the Department of Agriculture's ultimate goal of food self-sufficiency.

Upon initial review of existing promotion condition in the subject area, the scholar found the creation and implementation of an effective communication plan using an integrated media approach as the most needed intervention to improve awareness of rice farmers on PhilRice technologies and information. As an expected output, this re-entry project

should help escalate rice farmers' level of adoption of new technologies and information. This was done by intensifying farmers' awareness on available and helpful farming techniques, which would eventually lead to adoption and increase in rice yield and profitability.

Several activities were implemented to meet the goal of the project. A total of five barangays with 68 farmers from three provinces of Region 2 participated in the promotion of PalayCheck and other rice technologies. Some activities involved the use of school-on-the-air radio program; distribution of information; education and communications materials; technical briefings; mobile advisories; radio interviews; publications in local newspapers; news releases in on line websites; and use of social media. Majority of farmers in all participating sites said they learned PalayCheck and other technologies promoted through the various forms of media used in the project. In Cordon, Isabela, the importance of balance fertilization using both organic and inorganic fertilizers to produce a higher yield at a lower cost was recorded as the major learning. In Maddela, Quirino, it was utilization of the land after planting rice to get additional income and at the same time maintain the fertility of the soil (e.g. planting legumes like mungbean). In Solana, Cagayan, farmers best appreciated knowing the quality seeds to plant and the right amount of seeds enough per unit area to increase yield and lessen production cost.

However, it is imperative to conduct further activities to confirm the ultimate outcome of this re-entry project. It could be on identifying the technologies farmers will actually adopt in their fields, measuring farmers' technology adoption rate, and exploring the increase in farmers' yields as a direct result of rice technology application. Given enough funding, this re-entry project is also recommended to be institutionalized or duplicated in other PhilRice stations due to its positive results in creating awareness and adoption among farmers and other rice stakeholders.

III. Sources and Levels of Chemical Elements in Major Paddy Soils od the Philippines

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Abstract:

Nutrient levels in rice areas can be translated to the soils' capacity to supply the essential elements for the rice plants, while information about nutrient sources can be used to formulate management options to areas deficient or toxic in nutrients. Industrialization, urbanization and intensive use of farm inputs can also pollute agricultural areas. This study was then conducted to assess the levels of cationic nutrients and heavy metals in soil and plant samples in the Philippines' major rice areas. The study also determined the contributions of soil properties, land uses, irrigation water, and farm practices to the element levels. Strategic collection of soil and plant samples, laboratory analyses of samples, and farmer interviews were done.

Potassium (K) concentrations of rice plants in La Paz (Tarlac) and Sta. Rosa City (Laguna) exceeded the toxic concentration of 3%. These K concentrations can be due to the increase of the nutrient's availability owing to the neutral soil pH levels in the two sites. The highest total calcium (Ca) levels were found in the Polangui (Albay), La Paz, and Villasis (Pangasinan) soils. These Ca levels can be ascribed to the occurrence of Ca in sand and silt-sized soil fractions. Total iron (Fe) and manganese (Mn) concentrations were very high in the Sta. Cruz (Zambales) soil due to the input of mine wastes. The San Leonardo (Nueva Ecija) soil's high total Fe concentration is probably due to the occurrence of Fe in clay-sized soil fractions. Iron and Mn levels of rice in most Central Luzon sites exceeded the toxic concentrations of 1000 mg kg-1 for Fe and 300 mg kg-1 for Mn. These concentrations can be due to the high total soil Fe and Mn levels, and their increased plant uptake due to periodic soil submergence and increased soil acidity from continuous cropping.

Metal levels were very high in Zambales and Negros Occidental soils due to deposition or use of metal-enriched mine tailings and irrigation water. Soil metal concentrations in Zambales far exceeded the intervention values of 180 mg kg-1 for chromium (Cr) and 100 mg kg-1 for nickel (Ni). Soil metal levels in Negros Occidental exceeded the intervention values of 190 mg kg-1 for copper (Cu) and molybdenum (Mo). Rice plants in Negros Occidental exceeded the toxic levels of 30 mg kg-1 for Cu and 10-50 mg kg-1 for Mo due to the very high soil Cu and Mo concentrations in the area. Molybdenum concentrations of rice plants in Sultan Kudarat and Camarines Sur exceeded the toxic level due to the high amounts of foliar chemicals applied at >66 sprayer loads per year.

The study implies that K, Ca, Fe and Mn are enriched in rice areas due to soil properties and farm practices. Furthermore, rice areas deposited with mine wastes have high heavy metal levels, and foliar chemicals can increase metal levels in rice.

IV. Elucidating the Molecular Mechanisms of Epichloae Endophyte in Plant Protection Against Grass Pathogens

JT Niones

Abstract:

The symbiotic association of epichloae endophytes (Epichloë/ Neotyphodium species) with temperate grasses of the subfamily Pooideae is known to enhance plant host tolerance to abiotic and biotic stresses. While the protection of the host plant from insect herbivory by epichloae endophytes is well characterized, the mechanism by which they protect their host against grass pathogens is largely unknown.

The studies presented here have demonstrated that the production of antifungal compound by the endophytic symbiont is involved in disease suppression and thus contribute to our understanding of the role of a mutualistic endophyte in plant disease resistance.

An Epichloë festucae isolate , E437, showed growth inhibitory activity against grass pathogens Drechslera erythrospila, D. siccans, D. dictyoides, Colletotrichum graminicola and Bipolaris sorokiniana. The endophyte reduced hyphal tip growth and differentiation of the D. erythrospila , but did not cause any lysis. The isolate produced a thermal stable and a low- molecular weight antifungal compound in culture. Perennial ryegrass infected with E437 isolate exhibited reduced disease symptom caused by D. erythrospila.

Through a genetic approach the involvement of a vegetative incompatibility gene (vibA) in the biosynthesis and regulation of inhibitory substances produced by the endophyte against grass pathogens was established. An Epichloë festucae mutant defective in antimicrobial substance production was isolated by a mutagenesis approach. In an isolated mutant that had lost antifungal activity, the exogenous DNA fragment was integrated into the promoter region of the vibA gene, encoding a homologue of the transcription factor VIB-1. VIB-1 in Neurospora crassa is a regulator of genes essential in vegetative incompatibility and promotion of cell death. Deletion of vibA gene severely affected the antifungal activity of the mutant against the test pathogen D. erythrospila. Overexpression of this endophyte gene resulted to an enhanced antifungal activity of the wild type isolate

against test pathogens. Moreover, transformants overexpressing vibA showed an inhibitory activity on test pathogens that the wild type isolate could not. Overexpressing vibA in a nonantifungal E. festucae wild-type Fl1 isolate enabled the transformant to inhibit the mycelial and spore germination of D. erythrospila. On the other hand, deletion of E. festucae vibA canceled the protective effect of wild-type E437 infection in suppressing disease development caused by D. erythrospila. Altogether, these results implicate the critical role of VibA in the antifungal compound production and disease suppression by Epichloë festucae.

V. Effect of Age and Size of Rice Straw on Gasification Performance

PS Ramos

Abstract:

This study was conducted to determine the effect of age and size of rice straw in the gasification performance. Three ages of rice straw: 5 month-old, 2 month-old, and the newly harvested NSIC Rc222 rice straw combined with different sizes : S1 (40 to 50mm), S2 (30 to 40mm), and S3 (20 to 30mm) lengths of rice straw were used as the factors in this study. The results of the experiment were analyzed using the Statistical Tool for Agricultural Research (STAR) developed by IRRI.

There were significant differences in the heating value of different ages of rice straw. The older the rice straw resulted to higher heating value of 4.63MJ/kg for 5 month-old compared with the newly harvested rice straw with 2.97MJ/kg. The size of rice straw also significantly influenced the heating value of 4.47MJ/kg for the smaller size of 20 to 30mm in length, and 2.96MJ/kg for the bigger size of 40 to 50 mm length of rice straw.

The production of combustible gases such as carbon monoxide and hydrogen was also affected by the age and size of the fuel. As the age of the fuel increases, the production of CO and H2 also increases while as the size of the straw becomes smaller, the production of CO and H2 increases.

VI. The Economic Effects and Food Security Impact of Philippine Rice Market Interventions: An Analysis using a CGE model

MJM Mariano

Abstract:

The Philippines has been a net rice importer since the 1990s. Against a background of rapid population growth and a high dependence by the country's rural poor on paddy production, recent price volatility in global rice markets has made food security a significant policy issue in the country. The main focus of the government's food security agenda is the rice market, with self-sufficiency and price stabilisation being key goals. The centrality of rice in the government's food security policy is understandable given the commodity's dietary and economic importance.

This thesis concerns the analysis of food security interventions in the Philippines. More specifically, I carried out policy simulations that investigate the impact – both for the broader economy, household welfare, and for indices of food security – of the following scenarios: (1) the removal of rice market price subsidies, (2) the removal of rice tariff import restriction, and (3) an external rice price shock to the domestic economy. To undertake the policy simulations, I developed a large-scale dynamic computable general equilibrium (CGE) model of the Philippine economy. This Philippine economic model is distinct from other CGE models for the Philippines because of the following modelling extensions: (1) a detailed treatment of agricultural land supply-use process, tracking the transition through time of agricultural land between competing land uses;(2) a three-stage demand structure of household food consumption, to better model inter-food substitution possibilities, particularly as they relate to food staples, so as to properly elucidate food security consequences of policy reform; (3) modelling of surplus agricultural labour, and the mechanism governing rural-urban migration, to better model the full economic benefits of agricultural policy reform; (4) multi-household top-down income-expenditure extension of the CGE model, in order to understand the distributional consequences of policies that affect relative food prices; and (5) modelling of a number of food security indices, in order to track the year-on-year policy-induced changes in national and household food security.

For the price subsidy simulations, I investigated the effects of three policies: (1) the paddy 'price floor' which provides a subsidy on the sales of paddy, (2) the rice 'price ceiling' which provides a subsidy on the consumption of rice, and (3) a price subsidy on intermediate seed inputs used by paddy farmers. These government interventions are aimed at enhancing the incomes of small farmers through price support (in the form of the paddy price ceiling and input subsidy policies) while simultaneously

lowering the price of rice to consumers (via the rice price floor policy). However, these programs have been criticised within the Philippines on the grounds of allocative inefficiency, poor targeting, and high public budgetary cost. Simulation results indicate that, as an exercise in demonstrating policy concern for the incomes of farmers and the food security needs of households, the three policies would appear to have a modest budgetary cost, while improving several measures of food security. The allocative efficiency gains available from ending the programs are small, and may be outweighed by the potential for adverse short-run macroeconomic consequences.

Like the price subsidy interventions in the rice market, another favourite subject of public debate in the Philippines is whether or not the government should liberalise the domestic rice market. At present, rice remains as the most protected traded commodities in the Philippines, with a tariff rate ranging from 40 to 50 per cent. For my second simulation, I examine the national economic consequences and food security implications of permanently removing the tariff trade barrier in the domestic rice market. Macro results show that the removal of rice tariff enhances the country's real GDP, and household's real consumption particularly urban non-farming households. Removing the rice tariff import restriction also generates allocative efficiency gains. The economy becomes more efficient because: (i) workers are shifted from the agriculture sector, where returns to labour are relatively low, into the manufacturing sector, where returns to labour are relatively high, and (ii) land moves out from low-rent paddy agriculture into higher value uses in non-paddy agriculture. In terms of food security impacts, the removal of the tariff on rice imports generates a deterioration in two of the four food security indexes in the model.

The results of the first two simulations support the argument that removing the existing rice tariff import restriction and price subsidy programs of the government generates allocative efficiency gains to the domestic economy. Despite the economic benefits of program removal, the government justifies these programs on the grounds that they insulate the domestic economy from unexpected price spikes in the international rice market. An interesting matter for policy evaluation therefore is to quantify the insulation benefit that the government rice interventions provide in such circumstances. To examine this question, I carried out a third simulation in which the Philippines is subject to an external rice price shock. I run this scenario against two alternative baselines: one in which the existing rice import tariff and price subsidy interventions are in place (the "with support" case), and one in which they have been removed (the "without support" case). Results indicate that, relative to the "without support" case, the economy is more insulated from the rice price spike under the "with support" case, reducing the real consumption loss from a 2008-like event by approximately 0.10 per cent. However the cost of insuring against these price spikes is significant. The estimated annual allocative efficiency cost of implementing the rice market interventions is approximately 0.40 per cent of real consumption.

This thesis makes two broad contributions in the current literature. One relates to the methodological contribution, and the other relates to the policy simulations. The methodological contribution is the modelling extensions incorporated in the PhAGE model, which made it possible to evaluate the full effects of food security interventions. The policy contribution is an in-depth analysis of simulation results that identifies policy implications for the removal of existing price subsidies and import tariff in the Philippine rice market, and provides policy insights on the extent to which the government rice market support mechanisms insulate the domestic economy from external rice price shocks.

Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit

LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
$mtha^{-1}$ - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

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