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Intellectual Property and Opportunities for Food Security in the Philippines

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INTELLECTUAL PROPERTY AND OPPORTUNITIES FOR FOOD SECURITY IN THE PHILIPPINES

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ABSTRACT

By 2050, the Philippine population is projected to increase by as much as 41 percent, from 99.9 million to nearly 153 million people. Producing enough food for such an expanding population and achieving food security remain a challenge for the Philippine government. This paper argued that intellectual property rights (IPR) can play a key role in achieving the nation's current goal to be food-secure and provided examples to illustrate that the presence of sound intellectual property (IP) helps foster research, development, and deployment of agricultural innovations. This paper also offered key recommendations about how the IP system can be further leveraged to enable access, creation, and commercialization of new and innovative agricultural practices and technologies to enhance the nation's agricultural productivity, meet rice self-sufficiency, and sustain food security.

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INTRODUCTION

At a basic level, food security is about fulfilling each individual's human right to food.[2] The Rome Declaration on World Food Security and the World Food Summit Plan of Action describes it as "when all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food which meets their dietary needs and food preferences for an active and healthy life."[3] This simply means that a food-secure population does not live in hunger or fear of starvation. For the Filipino people, the presence of rice—the country's major staple—on the table already symbolizes food security and emancipation from hunger and malnutrition.

Based on FAO's latest publication titled, *The State of Food Insecurity of the World 2011,* the Philippines is one of the few Asian developing countries currently on track to cut its "food-insecure" population in half by 2015.[4] The Philippine government recently claimed that due to increased rice production in the past two years, the Philippines will be able to achieve its target of rice self-sufficiency (i.e. less rice importation), hence, achieve food security by 2013. With 50 million more mouths to feed by 2050, however, there is a constant pressure and marching mandate for the country to address hunger and malnutrition, expand domestic rice production, and continue to improve productivity of the country's rice industry.

This paper argues that the presence of a sound IP system is essential to the access, generation, efficient and effective commercialization of new and improved agricultural innovations to boost Philippine agriculture and foster rice self-sufficiency, which, in this country, is equated with food security. Higher productivity in the agriculture sector backed with appropriate government incentive policies, such as IPR, can increase food availability and income, resulting in economic growth and more opportunities for people to break out of the poverty-hunger-malnutrition trap. This view complements the report of the Commission on Intellectual Property Rights (CIPR) *Integrating Intellectual Property Rights and Development Policy,* which stated that by stimulating invention and new technologies, IPR can help increase agricultural production, promote domestic and foreign investment, facilitate technology transfer, and improve the availability of

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2. Philippe Cullet, *Food Security and Intellectual Property Rights in Developing Countries* 1 (2003), *available at* http://www.IPRonline.org/resources/docs/PCull.Food_sec_IPR_7.11.03.pdf.

3. U.N. FAO, Rome Declaration on World Food Security (Nov. 13-17, 1996), *available at* http://www.fao.org/documents/show_cdr.asp?url_ file=/docrep/003/w3613e/w3613e00.htm.

4. *See* U.N Food & Agric. Org. (FAO), The State of Food Insecurity in the World 46, Annex Table 1.1 (2012), *available at* http://www.fao.org/docrep/016/i3027e/i3027e.pdf.

food to combat hunger.[5] This view also supports recent econometric findings that IPR are important policy tools that promote agricultural development in developing countries.

This paper begins with an overview of the Philippine agriculture sector and the role of the rice sub-sector in the country's economic growth and food security objectives. The second and third sections present the importance of innovation to modernizing agriculture, the link of innovation and IPR, an update on the implementation of IPR laws and measures in the Philippines, and the relevance of the expansion of IPR protection on agriculture. These sections put into context the role of IPR in the country's effort to address food security and make the country self-sufficient in terms of rice. The fourth section presents two case studies featuring the experiences of the Philippine Rice Research Institute (PhilRice) and the Philippine Center for Postharvest Development and Mechanization (PhilMech). This section aims to illustrate that IP, when well-managed, helps the access, generation, and commercialization of agricultural innovations to benefit the country's rice industry. Specifically, this section shares PhilRice's success story on its rice varietal improvement program through effective transfer of biotechnology highlighting the case of golden rice and PhilMech's success story on the implementation of its new licensing protocol to deploy agricultural machinery effectively. Finally, the last section offers concluding remarks focused on lessons learned and recommendations on how IP can be further leveraged to meet rice self-sufficiency and attain food security in the Philippines.

I. A LOOK AT PHILIPPINE AGRICULTURE AND THE RICE SECTOR

The Philippines is an emerging economy and archipelago consisting of more than 7,100 islands situated in Southeast Asia. Although the contribution of agriculture to the national output has been decelerating over the years (See Figure 1), the Philippines remains largely an agriculture-based economy. The Philippine agriculture sector performs critical roles for the country's economic growth and development, as it is a source of food and vital raw materials; a source of jobs and employment especially for the rural poor a significant market for the products of the non-agricultural economy; and a source of surplus labor to the industry and services sectors.[6]

5. *See generally* Comm'n on Intellectual Property Rights, *Integrating Intellectual Property Rights and Development Policy* (2002), http://www.iprcommission.org/papers/text/final_report/reportwebfinal.htm.

6. Cielito F. Habito & Roehlano M. Briones, *Philippine Agriculture over the Years: Performance, Policies, and Pitfalls,* WORLDBANK.ORG1-2 (2005), http://siteresources.worldbank.org/INTPHILIPPINES/Resources/Habito-word.pdf.

The country's rice sector is one of the main sources of growth for the country's agriculture.[7] In 2010, rice accounted for 21.86 percent of gross value added in agriculture and 2.37 percent of GNP.[8] Labor absorption by the rice industry is highest among the agriculture sub sectors that involve 11.5 million farmers and family members. Close to three-fourths of farm household income is derived from rice farming and related activities.[9]

For 99.9 million Filipinos, rice is indeed life. Rice is the primary food source that is very much embedded in their cultural heritage and the most important food crop, essential to the nation's food security, poverty alleviation, and improved livelihoods. Rice provides the necessary calories to cover the daily energy needs of Filipinos and accounts for 35 percent of the average caloric intake of the population to as high as 60-65 percent for households in the lowest income quartile[10]. One Filipino consumes an average of 119 kilograms per year based on 2008 data.[11]

Rice, the country's main staple, is planted over 2.7 million hectares (M ha). The average farm size in the Philippines is 1.5 hectares (ha). In 2010, rice was harvested from some 4.35 M ha, 7 percent higher than the area harvested for 2000, which is an indication that farmers are planting more of the crop.[12] Production wise, the rice industry has been performing well, with a growth rate of 2.89 percent from 1980 to 2010. Over the past three decades, production has more than doubled despite the El Nino phenomenon and other natural and man-made factors that have affected the country (see Figure 2). In 2010, production reached 15.77 million metric tons (MT) mark,[13] or 27.29 percent higher than in 2000. Rice yield per

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7. *See* Bureau of Agricultural Statistics, Performance of Philippine Agriculture, Jan.-Dec. 2011, BUREAU OF AGRIC. STATISTICS, PERFORMANCE OF PHILIPPINE AGRICULTURE JANUARY-DECEMBER 2011, *available at* http://www.bas.gov.ph/?Ids=downloads_view&id=516 (last visited Jan. 11, 2012).

8. Nat'l Statistical Coordination Bd., *National Accounts of the Philippine Fourth Quarter 2010*, PHILIPPINE NAT'L STATISTICAL COORDINATION BD. (Jan. 31, 2011), http://www.nscb.gov.ph/sna/2010/4th2010/2010hi4.asp.

9. *Agri-Pinoy Rice Program*, REPUBLIC OF THE PHILIPPINES DEP'T OF AGRIC., http://www.da.gov.ph/index.php/2012-03-27-12-03-56/2012-04-13-12-38-11 (last visited Jan. 11, 2012).

10. Leocadio Sebastian, Pedro Alviola, and Sergio R. Francisco, Bridging the Rice Yield Gap in the Philippines (Minas Papademetriou, Frank Dent and Edward Herath ed. 2000), *available at* ftp://ftp.fao.org/docrep/fao/003/x6905e/x6905e00.pdf.

11. Kristine L. Alave, *Filipinos urged to reduce dependence on rice*, INQUIRER NEWS (Nov. 5, 2011, 2:47 AM), http://newsinfo.inquirer.net/88421/filipinos-urged-to-reduce-dependence-on-rice.

12. *See* Food and Agriculture Organization of the United Nations, FAOSTAT, http://faostat.fao.org/site/567/DesktopDefault.aspx?PageID=567#ancor (last visited Dec. 15, 2012) [hereinafter FAOSTAT Database].

13. *See* FAOSTAT Database, *supra* note 12.

hectare has also improved through the years, averaging 3.5 tons per hectare (t/ha) in 2000 to 2010, more than double the figures in the 1990s.[14]

Notwithstanding the steady increase in production and yield, the Philippines, a rice self-sufficient country in the 1970s, cannot satisfy its own demand and has increasingly relied on rice imports since the 1990s to ensure its food security.[15] To meet its population's requirements, it imports rice from the world's top rice exporting countries, such as Thailand and Vietnam. It is the world's biggest rice importer, averaging 2.27 million MT per year in 2000 to 2010 (see Figure 3).[16] Such huge importation is due to several factors: small rice areas (at 4.35 M ha)compared to that of Asia's major rice producing countries;[17] shrinking rice harvested area to feed increasing number of people;[18] the frequent occurrence of typhoons and other calamities (average of 3 typhoons per month, which coincides with the cropping season); high post-production losses at 15 percent (mostly from sun drying); [19] low milling rice recovery because of outdated rice milling facilities;[20] and rice wastage.[21]

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14. *Philippine Rice Industry: Facts and Figures*, PINOY RICE KNOWLEDGE BANK, http://www.pinoyrkb.com (last visited Jan. 9, 2012).

15. Ronilo A. Beronio, Jane G. Payumo & Rowena Villanueva, *Status of Public Rice Biotechnology Research and Development and Commercialization in the Philippines, in* BUSINESS POTENTIAL FOR AGRICULTURAL BIOTECHNOLOGY 161, 161 (Paul S. Teng ed. 2007), *available at* http://www.apo-tokyo.org/00e-books/AG-19_BusinessPotential/AG-19_BusinessPotential.pdf ("A buffer stock of 60 days' worth is maintained through import to ensure food security.").

16. *See* FAOSTAT Database, *supra* note 12.

17. FOOD & AGRICULTURAL ORGANIZATION OF THE U.N. THE STATE OF FOOD INSECURITY IN THE WORLD: HOW DOES INTERNATIONAL PRICE VOLATILITY AFFECT DOMESTIC ECONOMIES AND FOOD SECURITY (2011), *available at* http://www.fao.org/docrep/014/i2330e/i2330e.pdf (stating that rice area harvested for China in 2010 is recorded at 29.49 M ha, 44 M ha for India, 12.31 M ha for Indonesia, 10.25 M ha for Thailand and 7.41 M ha for Vietnam).

18. Pinoy Rice Knowledge Bank, *Philippine Rice Industry: Facts and Figures*, PHILRICE (last visited Sept. 17, 2012), http://www.pinoyrkb.com/main/resources/facts-and-figures (follow "Philippine Rice Industry Q & A 2" hyperlink).

19. The Philippines is known for its "highway dryers," the cheapest, but unreliable method of drying high moisture paddy. Dante de Padue, *Rice Post Harvest E-mail Conference Draft Summary V.1.2*, FOOD & AGRICULTURAL ORGANIZATION OF THE U.N. (June 1998) (conference papers), http://www.fao.org/docrep/X5427E/x5427e0d.htm#drying%20of%20high%20moisture%20paddy). U.N. & SOCIAL COMMISSION FOR ASIA AND THE PACIFIC, ORGANIC AGRICULTURE AND RURAL POVERTY ALLEVIATION: POTENTIAL AND BEST PRACTICES IN ASIA 120-45 (2002).

20. Joji Co, Panel Discussion, *Private Sector Investments to Improve Rice Milling Efficiencies and Reduce Post-Harvest Losses*, at the USAID Food Security Conference: "Improving Access, Advancing Food Security" (July 18-19, 2011), *available at* http://aseanfoodsecurityfoodproduction.files.wordpress.com/2011/07/12-herculano-joji-co-rfs.pdf.

21. In 2008, the Philippine Food and Nutrition Research Institute reported that every Filipino wastes on average 3.3 kg/year. With 94 million people, total wastage of the country is 0.3 t, 36% of 2011 rice imports. Aileen Macalintal, *That Rice You Throw Away*, RICE TODAY, Apr.-June 2012, at 14.

The Philippine Department of Agriculture claims that the country's rice import situation can be changed and the country can become rice self-sufficient. This can be done by modernizing the country's rice sector as envisioned in the country's Agriculture and Fisheries Modernization Plan. Specifically, the country's rice modernization efforts are now focused on optimizing: the use of existing rice farms and labor productivity through new and improved technologies, from production to postharvest operations adapted to the agro-climatic conditions of the country; infrastructure development (e.g., irrigation and roads); farmers' training; and policy development. In 2010, the country's rice production improved by 15 percent, cutting the import volume to 0.86 million MT, more than 57 percent volume reduction of the country's 1999's import. By 2013 and onwards, the Philippine government is aiming to attain rice self-sufficiency again.

II. Igniting Agricultural Innovations Through Intellectual Property Rights

The 2001 Human Development Report stated: "innovation and technological advance has contributed greatly to the acceleration of human progress in the past several centuries and that those contributions have the promise of even greater acceleration."[22] There is general agreement that innovations based on existing or emerging technologies, especially when linked to a national innovation system, are crucial for growth. Innovations are also important to increase competitiveness, productivity, and social gain within organizations, among institutions, and across various sectors of the economy. In the rice sector, there is no doubt that technological innovations have contributed to increased production volumes and incremental yields over the past decades. For instance, the use of new, high-yielding rice varieties, mechanization, fertilizers, and pesticides, which were promoted by the Green Revolution[23] of the 1960s and 1970s, increased average rice productivity and rice supplies. The agricultural innovations during this period enabled the Philippines to become a net exporter of rice (albeit on a small scale) in the late 1970s. Green Revolution technologies were also claimed to have contributed to the overall economic growth of the country by increasing the incomes of farmers who were then able to afford tractors

22. U.N. Development Programme, Human Development Report 2001: Making New Technologies Work for Human Development 25 (2001), *available at* http://hdr.undp.org/en/media/completenew1.pdf (last visited Sept. 17, 2012).

23. The term "green revolution" was coined William Gaud, former Director of the United States Agency for International Development (USAID), when he described the spectacular increases in cereal crop yields in Pakistan, India, China, then to other developing countries. Norman Borlaug Institute for Plant Science Research, *The Green Revolution & Dr. Norman Borlaug: Toward the "Evergreen Revolution,"* AgBioWorld, http://www.agbioworld.org/biotech-info/topics/borlaug/green-revolution.html.

and other modern equipment. The Green Revolution also promoted the use of electrical energy and consumer goods, which increased the pace and volume of trade and commerce.[24] Publicly-funded national and international agricultural research institutes also played a significant role in the development of these agricultural technologies.

Agricultural innovations can be part of the toolbox to achieve food security and rice self-sufficiency objectives. However, development and implementation need a supportive environment in which to thrive, and intellectual property rights (IPR) protection plays a key role in creating such an environment. IPR are certain creations of the human mind that are given the legal protection of property rights.[25] Article 27 (2) of the Universal Declaration of Human Rights provides a broader definition of IPR as "the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.[26] Several distinct forms of IPR exist, including copyrights, patents, trademarks, plant variety protections, trade secrets, and geographical indications. These rights refer to the creator's right to exclude others and thereby control the use, sale, application, and distribution of his or her creations for a fixed and determinable period of time. IPR are justified from two distinct perspectives: either as a personal right, or as an economic incentive for investment in creative activities.[27]

Protection of IPR has a deep history in the Philippines. Starting in 1947, through Republic Act No. 165, the country already provided protection for inventions, utility models, and industrial designs. The Philippine government has made intellectual property a state policy by incorporating it into the 1987 Constitution. The Philippine government likewise supported several international agreements that promote the use of IP. It became a member of the World Intellectual Property Organization (WIPO) in 1980. In 1992, it became a party to the Convention on Biological Diversity (CBD), which recognizes the sovereignty of countries over their genetic resources, which can be subject to IPR. In 1995, the Philippines joined the Association of Southeast Asian Nation (ASEAN) Framework Agreement on Intellectual Property Cooperation. It joined the World Trade Organization in 1995, and ratified the Trade-Related Aspects of Intellectual Property Rights

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24. FOOD & AGRICULTURE ORGANIZATION OF THE U.N., THE STATE OF FOOD AND AGRICULTURE 2000 (2000) *available at* http://www.fao.org/docrep/x4400e/x4400e00.htm (follow "Food and Nutrition Security: Why Food Production Matters" hyperlink).

25. J. THOMAS MCCARTHY ET AL., MCCARTHY'S DESK ENCYCLOPEDIA OF INTELLECTUAL PROPERTY 308 (3d ed. 2004).

26. Universal Declaration of Human Rights, Art. 1, G.A. Res. 217 (III) A, U.N. Doc. A/RES/217(III) A (Dec. 10, 1948) [hereinafter Universal Declaration], *available at* http://www.un.org/en/documents/udhr/.

27. *See* WILLIAM LESSER, Patenting of Plants and Animals: The Impacts on the Canadian Agri-Food Sector (1995), *available at* http://www.agr.gc.ca/policy/patent/elesser.html.

(TRIPS)Agreement in 1996, which sets the IP standards of today. In 2004, the Philippines ratified the international seed treaty, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), and now implements the standard material transfer agreement (SMTA) for the transfer and exchange of biological and genetic resources. All of these international treaties must be reconciled with local legislation, and either complemented or supplemented by national laws and policies. The Philippines has promulgated several pieces of legislation, which parallel these treaties.

In 1998, the country's IP law, the Intellectual Property Code of the Philippines, was updated to comply with TRIPS provisions. The Philippine IP Code further strengthens protection of the rights of its inventors, trademark owners, authors, and other creators of intellectual property through patent, utility model, industrial design, copyright and other related rights, geographical indications, and trademark[28]. A pertinent provision of this legislation relates to the patentability of life forms, which specifically excludes the patenting of plant varieties, animal breeds, and essential biological processes for the production of plants and animals, while allowing for the patenting of microorganisms, non-biological, and microbiological processes. In response to TRIPS, the Philippines also enacted the 2002 Plant Variety Protection Act (RA 9268), patterned after The International Union for the Protection of New Varieties of Plants (UPOV) , which provides *sui generis* (of its own kind) system protection for plants and gives rights to breeders. In 2002, Executive Order 247 was issued to prescribe the guidelines and a regulatory framework for the prospecting of biological and genetic resources, its by-products, and derivatives for scientific, commercial, and other purposes consistent with the CBD. Republic Act 9147 or the "Wildlife Resources Conservation and Protection Act" reinforced Executive Order 247. Several issuances by the Department of Environment and Natural Resources and the Department of Agriculture have likewise been released to regulate bio-prospecting in the country. In compliance to the CBD's Cartagena Protocol on Biosafety, the 2002 Administrative Order No. 8 of the Philippine Department of Agriculture was issued, which provides rules and regulations for the importation and release into the environment of plants and plant products derived from the use of modern biotechnology. Recently, the country has enacted the Philippine Technology Transfer Act, 2009 (RA No. 10055) similar to the 1980 US Bayh-Dole Act in the United States that sets rules on IP ownership and unifies national and institutional technology transfer efforts to strengthen the country's domestic industries. Table 1 presents the summary

28. Intellectual Property Code of the Philippines, Rep. Act No. 8293, § 151(1)(c) (1997), *available at* http://www.chanrobles.com/legal7intellectualpropertycodeofthephilippines.html#INTELLECTUAL_PROPERTY_CODE_OF_THE_PHILIPPINES.

of national IP legislation and membership of the Philippines in international agreements on IPR implementation.

At the institutional level, policies and offices for managing IP are being developed both at the department/ministry and agency levels: the Department of Agriculture and some of its attached agencies, such as PhilRice; the Philippine Center for Postharvest Development and Mechanization (PhilMech); the Bureau of Agriculture Research; the Department of Science and Technology; and the University of the Philippine System. These public sector institutions are actively leveraging on the country's IPR system to protect and commercialize inventions. The number of Philippine institutions wanting to improve capacity on IP has also increased (personal communication). A survey done by Payumo and Grimes (2011) among Philippine scientists and researchers revealed that a majority of them are aware on the concept of IPR and the developments and issues linking IPR with agriculture and agricultural biotechnology.[29]

III. Intellectual Property Rights and Relevance to Agriculture

Traditionally, IPR were not applied to agriculture. In recent times, this position has changed, especially with the ratification of the TRIPS Agreement, a compulsory requirement of the World Trade Organization (WTO). TRIPS,[30] central to stronger establishment of IPR around the world,,[31] obliges WTO members to provide most of the existing types of IPR protection for all inventions, such as those with utility in agriculture.

The nature and scope of IPR for genetic resources, including plant varieties, are also discussed in two international treaties: the Convention on Biological Diversity (CBD) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Additional pressure to strengthen protection, especially for plant varieties in developing countries (beyond the minimum TRIPS requirements), is also being exerted in bilateral trade negotiations between developing countries and the United

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29. Jane Payumo & Howard Grimes, *Institutional Responses on Strengthened Intellectual Property Rights in Agriculture and Needs' Assessment on Intellectual Property Management of Public Research Institutions in Asian Developing Countries,* 42 J. Res. Admin. 42, 50 (2011).

30. TRIPS sets a minimum international standard for IPR protection and effective and appropriate enforcement mechanisms. McCarthy et al., *supra* note 25, at 628.

31. Daniele Archibugi & Andrea Filippetti, *The Globalization of Intelletual Property Rights: Four Learned Lessons and Four Theses*, 1 J. Global Pol'y 137, 138 (2010); *see also* Carlos Correa, *Reviewing the TRIPS Agreement*, *in* A Positive Agenda for Developing Countries: Issues for Future Trade Negotiations 221, 221 (2000), *available at* http://www.unctad.org/en/docs/itcdtsb10_en.pdf.; *see generally* Keith E. Maskus, Intellectual Property Rights in the Global Economy (2000).

States and Europe.[32] Member-countries of these international agreements allow the use of IPR to protect plants, varieties, genes, and a majority of tools and processes that can be used for agricultural research.

Patents, plant breeders' rights (PBRs) or plant variety protection (PVP), trademarks, geographical indications (GIs), and trade secrets are forms of IPR that are relevant to the agriculture sector. Patents are probably the most important IPR today for agricultural goods and services because they provide, wherever available, the strongest protection for patentable plants, animals, and biotechnological processes for their production. New varieties of crops produced through sexual reproduction (seed) or tuber propagation can be granted PVP, an alternative to a patent, if they are distinct, uniform, and stable. Trademarks (e.g., Roundup Ready®) are used to distinguish agricultural goods and services from similar goods and services and indicate their source or origin, thereby influencing consumers' decisions.

GIs are marks associated with products originating from a country, region, or locality where the quality, reputation or other characteristics of the product are essentially attributable to its geographical origin (e.g., Darjeeling tea of India, Cognac brandy of France, and Roquefort cheese of France, etc.).In addition to these four forms of IPR, trade secret law offers further protection relevant to plants. Trade secrets are important for hybrid varieties (e.g. corn varieties), where commercialized F1 seeds ensure hybrid vigor only for the first generation of plants. In this case, the valuable "information" is in the parent lines, which typically are not commercialized and which can be effectively protected by trade secret law.

The existence of above types of IPR protection has encouraged more investment in agriculture, especially from the private sector, which is now the largest investor for agricultural research worldwide[33]. The use and development of materials for which IPR protection is sought does not only apply in the commercial sectors. Public research universities, especially in developed nations such as the United States, European countries, and Japan, and now in developing countries such as China and Taiwan, have been rapidly patenting to encourage commercialization of research, such as in agricultural biotechnology, to enhance the impact of publicly-funded research and development (R& D), promote economic growth through the

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32. THE WORLD BANK, INTELLECTUAL PROPERTY RIGHTS: DESIGNING REGIMES TO SUPPORT PLANT BREEDING IN DEVELOPING COUNTRIES 1 (2006), *available at* http://siteresources.worldbank.org/INTARD/Resources/IPR_ESW.pdf.

33. Roughly, one third of the $32 billion total public and private agricultural research investment worldwide comes from the private sector. *See* MAARTEN J. CHRISPEELS and DAVID E. SADAVA, PLANTS, GENES AND CROP BIOTECHNOLOGY 42, (2d ed. 2003). Gerard Barry and Robert Horsch, *Evolving Role of the Public and Private Sector in Agricultural Biotechnology for Developing Countries*, *in* AGRICULTURAL BIOTECHNOLOGY AND THE POOR: PROCEEDINGS OF AN INTERNATIONAL CONFERENCE 183 (G.J. Persley and M.M. Lantin, eds, 2000), *available at* www.cgiar.org/biotech/rep0100/Barryh.pdf.

creation of companies around academic technologies, create new jobs, and raise revenues that can be used to support academic research.

The expansion of IPR to agriculture, however, has caused mixed reactions over the past decades, and researchers have undertaken growing work to shed light on these debates, both from theoretical and empirical perspectives. Empirical findings support the conclusion that the expansion of IPR helps promote research investments and innovation, leading to significant economic activity and development.[34] Empirical studies also support the importance of IPR policies and the link of adequate IPR to agricultural development.[35] Findings of other studies, on the other hand, found that IPR elevate inequality across and within countries by mostly benefiting large private companies and rich countries, at the expense of small companies and poor countries, especially in the use of genetic resources.[36] . They also claimed that IPR could potentially stifle R&D efforts of national research agencies. However, reviews of literature show there are limited studies on determining the practical implications of IPR in agriculture in specific countries, such as the Philippines. The next section presents some additional evidence that can fill some of these knowledge gaps under the Philippine setting.

IV. MANAGING INTELLECTUAL PROPERTY IN THE PHILIPPINE RICE SECTOR: CASE STUDIES

The expansion of IPR in agriculture, and its increasing influence in agriculture, has demanded new roles and opportunities for public research institutions in the Philippines. This section presents the experiences of two Philippine institutions under the country's Department of Agriculture, namely the Philippine Rice Research Institute (PhilRice) and the Philippine Center for Postharvest Development and Mechanization (PhilMECH). With main headquarters in Nueva Ecija, the Philippines' rice granary, these institutions have important roles in generating and disseminating

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34. Michele Boldrin & David Levine, *The Case Against Intellectual Property*, 92 AMERICAN ECONOMIC REVIEW 209 (2002); *see also* JAMES D. GAISFORD ET AL, THE ECONOMICS OF BIOTECHNOLOGY (2001). Sunil Kanwar, *Innovation and Intellectual Property Rights* (Ctr. for Dev. Econ., Delhi School of Econ., Univ. of Delhi, Working Paper No. 142, 2006). David M. Gould & William C. Gruben, *The Role of Intellectual Property Rights in Economic Growth*, 48 J. OF DEV. ECON. 323, 323-50 (1996).

35. Jane Payumo, Howard Grimes & Philip Wandschneider, *Status of National Intellectual Property Rights (IPR) Systems and Its Impact to Agricultural Development: A Time Series Cross Section Data Analysis of TRIPS Member-Countries*, 5 INT'L J. FOR INTELL. PROP. MGMT. 82, 82-99 (2012).

36. NRRDN is a formal and functional structure of 57 strategically located agencies around the country: two national centers, six branch stations representing the country's major rice-growing zones, 14 regional research centers, and 35 cooperating stations. *Partners*, PHILRICE, http://www.philrice.gov.ph/?page=partners&page2=national (last visited Sept. 17, 2012).

technological solutions for the rice sector. Cases were purposely drawn to acknowledge the efforts of these institutions as early adopters of IPR management for public research institutions in developing countries. These cases show the institutionalization of a sound institutional IP framework facilitates access and commercialization of technologies and tools such as seeds and machinery.

A. Case Study 1. Accessing Biotechnology: PhilRice's Experience

PhilRice, established in 1985 as a government instrumentality under the Philippine Department of Agriculture, leads the country's national rice efforts. It accomplishes this mission through research, technology development, policy advocacy, and knowledge transfer. The Institute's current efforts are focused on the development and deployment of sustainable agricultural innovations. Examples of such developments include new crop varieties and cropping systems with high-yield potential even in adverse agro-climatic conditions (drought and flooding) that requires less chemical inputs, but with enhanced pest, disease, and stress tolerance. Producing inexpensive machinery and tools for rice cultivation to further improve output and productivity of the rice sector is also included in the Institute's rice research and development (R&D) program. PhilRice works closely with members of the National Rice Research and Development Network (NRRDN)[37] and other national stakeholders across the Philippines. It also actively collaborates with global research and development (R&D) partners such as the International Rice Research Institute (IRRI) on rice varietal improvement, policy, and technology transfer, among others.

PhilRice embarked on a modest but organized effort to access and use modern biotechnology[38] to enhance its rice varietal improvement, one of its key R&D programs.[39] The institute implements the following biotechnology research:

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37. The Philippines advocates the safe and responsible use of modern biotechnology and is noted for being the first Asian country to commercialize planting of the genetically modified corn. Biotechnology research in the country is primarily being undertaken to address food security, equitable access to health services, sustainable and safe environment, and industry development, which are the four goals of the 1997 Agriculture and Fisheries Modernization Act (AFMA). Saturnina C. Halos, *Agricultural Biotechnology in the Philippines*, SEARCA BIOTECHNOLOGY INFORMATION CENTER 1-6, http://bic.searca.org/seminar_proceedings/bangkok-2000/I-country_papers/halos.pdf (last visited Sept. 10, 2012).

38. Other PhilRice's R&D programs focuses on developing natural products and value-adding systems, impact evaluation, policy research and advocacy, and development of location-specific rice technologies for irrigated, rainfed, and upland areas. PHILRICE, *supra* note 36.

39. *See generally* JEROEN VAN WIJK, JOEL I. COHEN & JOHN KOMEN, INTELLECTUAL PROPERTY RIGHTS FOR AGRICULTURAL BIOTECHNOLOGY: OPTIONS AND IMPLICATIONS FOR DEVELOPING COUNTRIES (1993); Karim M. Maredia et al., *Technology Transfer and*

1. DNA marker technology to map agronomically important traits in rice such as yield components, seedling vigor, resistance to rice tungro virus, green leafhopper, brown planthopper, and blast; develop/apply molecular marker aided selection techniques for tungro and bacterial leaf blight (BLB); and analyze genetic diversity of rice germplasm;
2. *In vitro* techniques to improve grain quality and develop lines with tolerance to adverse conditions (cold, salinity, drought);
3. Map-based and expression-based techniques to clone agronomically important genes like tungro resistance; and
4. *Agrobacterium*-mediated transformation and particle-gun bombardment to produce rice plants with resistance to BLB, blast, sheath blight, stemborer, and tungro and with tolerance to drought and salinity.

Implementation of these projects and development of final biotechnology products require investment in facilities, manpower, and linkages, which PhilRice has built through the years with support from the national government and its international partners and donors. The acquisition of biotechnology tools is also very important. PhilRice has acquired these tools through various technology acquisition and transfer methods, which include: donations, material transfer agreements (MTAs), licensing arrangements, joint ventures, overseas training of technical staff, purchase of product and equipment, exchange of information at international meetings, and information in the public domain. Table 2 presents some of PhilRice's technology transfer arrangements involving biotech products particularly for transgenic rice research. This list excludes MTAs with IRRI. Most of the materials under these agreements are plasmid constructs, clone DNA sequences, promoters, vectors, selectable markers, and transgenic seeds. Several rice varieties produced using molecular marker and tissue culture technologies are currently being commercialized in the country.

However, the increasing proprietary nature of modern biotechnology and agriculture, its effects on material exchange, and how to deal with them have become major concerns of the Institute and its scientists. It is often said that currently, no biotechnology R&D project can be implemented without touching any IP issues. Access to new technologies and modern scientific methods covered by IPR, and their eventual commercialization, would now require formal and complex licensing agreements with corresponding royalty payments to the IP owners to avoid infringement of IPR.[40]

Licensing of Agricultural Biotechnologies in the International Arena, 17 AGBIOTECHNET 1, 1-7 (1999).

40. World Health Organization (WHO), *Nutrition: Micronutrient deficiencies*: *Vitamin A deficiency* (2012), http://www.who.int/nutrition/topics/vad/en/.

Public research institutions in developing countries, such as PhilRice, have evolved in a world without IPR. It is against these backdrops that the Institute exerted major efforts to build its capacity to deal with IPR matters, starting in 1998 and going fully operational in 2003. In 2004, PhilRice was the first attached agency of the Philippine Department of Agriculture to initiate an IPR policy, which is focused on proactive generation, protection, and commercialization of IPR. PhilRice was also the agency which setup its own IP management office. The Institute has also embarked on continuing IP education programs for its scientists and staff, so they will be more aware on the concept of IP and understand the ever-evolving legal environment in the area of IPR, especially the areas that affect the use and access of biotech innovations and genetic resources. These IP awareness campaigns translated to high respect for IPR among PhilRice scientists and staff, lessened their fear of the unknown, and brought back their enthusiasm to exchange materials with their foreign counterparts. With IP policy and institutional mechanisms in place, any form of modern biotechnology, such as that of golden rice (discussed in the next section), should be within the reach of PhilRice and its scientists.

Guided by the IP policy, the institute proactively pursues protection of its research results and technologies (e.g., rice wine making process, engineering prototypes, varieties, and publications) through several forms of IPR, such as patents, PVP, copyright, and trademarks. The PhilRice's IPR portfolio, which includes biotechnology inventions, has grown throughout the years. In 2010, about PhP 3.5 million (USD 81,395) were generated as new sources of R&D money and incentives for researchers. The Institute had nine pending patent applications, and 23 knowledge products were deposited at the National Library and given with Certificates of Copyright Registration and Deposit. In terms of plant protection, TGMS varieties underwent two seasons of distinctness, uniformity, and stability testing. New applications were submitted for newly developed varieties including their female parents and for restorer lines. The institute also connects to the private sector to commercialize IP generated from its research activities.

1. *The Golden Rice Project*

PhilRice, an active member of the Golden Rice Network, leads the development of new golden rice varieties tailored to specific rice-growing conditions in the Philippines. Golden rice is one potential tool to reduce vitamin A deficiency (VAD) in the Philippines and can contribute to food security needs of the country. Vitamin A deficiency increases the risk of death from certain common disease infections among young children[41].

41. Antonio A. Alfonso, Project Leader, Golden Rice, Powerpoint presentation at the Southeast Asian Regional Center for Graduate Study and Research in Agriculture

It is also the leading cause of blindness among children. VAD has been the cause of death of about 670,000 and blindness for 350,000 children around the world.[42] Approximately 90 million Southeast Asian children also suffer from VAD[43]. Deficiency in vitamin A also causes night blindness and increases risk of maternal mortality among pregnant and nursing women. In the Philippines, VAD is addressed through dietary diversification, vitamin A capsule supplementation, and food fortification. However, VAD continues to adversely affect many people, especially the last 10-20 percent in the hardest-to-reach areas in the Philippines. Hence, there is a need to develop and deploy new, improved tools to supplement existing measures and overcome vitamin A deficiency among at risk populations.

Developed by Ingo Potrykus (ETH-Zurich, Switzerland) and Peter Beyer (University of Freiburg, Germany), the vitamin A-enriched rice contains a gene maize and another gene from a common soil bacterium. Added through genetic transformation, the two genes completed the biosynthetic pathway for beta-carotene in the rice grains. Beta-carotene is a pro-vitamin A carotenoid that is converted into vitamin A in the body of humans and animals when that individual's vitamin A status is low or deficient. Unlike vitamin A, beta-carotene has no known toxicity level. Because rice is the country's main staple, golden rice has the potential to reach many Filipinos. It was estimated that eating about one cup a day of golden rice could provide half of an adult's vitamin A needs.

Putting together the golden rice technology platform, however, required the use of multiple inventions with complex IP ownership. The overall Freedom-to-Operate (FTO) analysis[44] and product deconstruction of golden rice tentatively identified 15 tangible property (TP) components and 70 patents (with 31 assignees) of potential relevance[45] (See Table 3 for the IPs relevant to golden rice). Syngenta (formerly AstraZeneca), the world's largest agricultural biotechnology company, has acquired the rights to golden rice from Greenovation (the company formed by the original inventors) and was able to negotiate access to all pieces of the puzzle necessary for the intended humanitarian purposes of the technology forming

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(SEARCA) Forum: Straight from the Scientists: Golden Rice: A Potential Tool to Address Vitamin A Deficiency in the Philippines (Aug. 26, 2011).

42. International Rice Research Institute (IRRI), *Golden Rice and vitamin A deficiency* (2012), https://www.integratedbreeding.net/sites/default/files/attachments/golden_rice_project_brief_2012.pdf.

43. FTO is defined as the ability to practice or use an innovation for a particular technology. *See* Richard C. Atkinson et al., *Public Sector Collaboration for Agricultural IP Management*, 301 SCIENCE 174, 174-75 (2003).

44. *See generally* R. DAVID KRYDER, STANLEY P.KOWALSKI & ANATOLE F. KRATTIGER, THE INTELLECTUAL AND TECHNICAL PROPERTY COMPONENTS OF PRO-VITAMIN A RICE (GOLDEN RICE™): A PRELIMINARY FREEDOM-TO-OPERATE REVIEW (2000).

45. Jorge E. Mayer, Peter Beyer & Ingo Potrykus, *The Golden Rice Project*, GOLDEN RICEPROJECT, http://www.goldenrice.org/PDFs/The_Golden_Rice_Project_Mayer_et_al_2006.pdf (last visited Sept. 10, 2012).

the golden rice patent pool.[46] The Golden Rice Humanitarian Board, which now provides strategic guidance to development and deployment of golden rice, manages sub-licensing arrangements on the use of the technology by breeding institutions in developing countries such as PhilRice and the International Rice Research Institution (IRRI). The golden rice research at PhilRice is being funded by the Bill and Melinda Gates Foundation (through research grants to the University of Freiburg and IRRI), Rockefeller Foundation, the United States Agency for International Development (USAID) (also through IRRI) and the Philippine Department of Agriculture. PhilRice also works closely with IRRI and the Helen Keller International, a nonprofit organization dedicated to preventing blindness and reducing malnutrition worldwide. Besides PhilRice, national institutions in India, Vietnam, Bangladesh, China, and Indonesia have sublicense rights to this technology to integrate it to local varieties. The International Services for the Acquisition of Agri-Biotech Applications was also an important player in helping to solve the IPR issues in golden rice and served as a technology broker to enable the transfer of golden rice to these countries.

The participation of PhilRice in the golden rice project is one of the best, and most clearly documented, examples of developing country access to biotechnology through IPR management and mechanisms. The Philippines has IPR protection mechanisms in place to allow protection for products and processes involving biotechnology, which prevents imitation and unauthorized use of these technologies. The country also continues to strengthen its IPR protection mechanisms to further encourage the private sector and investors to protect and transfer technologies to the Philippines.[47] The existence of patent protection on golden rice in the Philippines (Patent title**:** Method for improving the agronomic and nutritional value of plants Application No. 1-2000-00496) and the number and the legal provisions of the IP-related agreements (e.g., sublicensing agreement with Golden Rice Humanitarian Board[48]) that PhilRice need to accomplish did not discourage its research administrators and scientists to negotiate for access and use the technology for its rice improvement program. PhilRice's involvement in the golden rice project is driven by its national mandate, its existing manpower

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46. The Philippines was not considered in the Priority Watch List of the U.S. Trade Representative in 2010 due to its improving IPR enforcement mechanisms. See highlights of report at Press Release, Office of the United States Trade Representative, USTR Releases 2010 Special 301 Report on Intellectual Property Rights (Apr. 30, 2010), *available at* http://www.ustr.gov/about-us/press-office/press-releases/2010/april/ustr-releases-2010-special-301-report-intellectual-p.

47. For further explanation on the golden rice licensing agreements, see Golden Rice Project: Golden Rice Humanitarian Board, http://www.goldenrice.org/Content1-Who/who4_IP.php (last visited Dec. 15, 2012).

48. The field testing of golden rice is now being evaluated using the same national regulatory policies that the country used to approve commercialization of GM (genetically modified) crops, starting as early as 2002 with the commercial planting of Bt (*Bacillus thuringiensis*) corn event MON810.

and facilities, and the well-established national regulatory policies on biosafety[49]. Despite golden rice becoming a *cause célèbre*[50] for years due to its technical and IPR issues, the golden rice research at PhilRice is moving forward, with the final product expected to be commercialized in the next two years. One popular rice variety currently being developed by PhilRice to have a Golden Rice counterpart is PSB Rc82 (Peñaranda), a popular, high-yielding, and widely grown rice variety. In accordance with regulatory requirements, PhilRice will conduct field and laboratory tests to generate regulatory data that will serve as basis for possible regulatory approval. PhilRice will subsequently conduct more extensive field tests to establish agronomic performance for varietal approval. PhilRice is also developing a '3-in-1' variety of golden rice, which will have resistance to the rice tungro disease and bacterial blight, two of the most devastating rice diseases in the country. The incorporation of pest resistance would reduce yield losses and is expected to drive farmer adoption.

B. Case Study 2. Commercialization of Mechanization Technologies PHilMech's Experience

Agricultural mechanization, as one of the major and important components of agricultural modernization, is one of the major thrusts of PHilMech. PHilMech, formerly the National Postharvest Institute for Research and Extension, then renamed to Bureau of Postharvest Research and Extension, was established in 1978 as a bureau under the Philippine Department of Agriculture. It was mandated to generate, extend, and commercialize appropriate and problem-oriented agriculture and fishery post-harvest and mechanization technologies.[51] It was tasked with spearheading the development of the country's post-harvest industry through dynamic orchestration, research, technology promotion, and policy advocacy. The institute's research, development, and extension (RD&E) thrusts focus on: 1) increasing the profitability through efficient drying and dehydration; 2) promoting appropriate handling, storage and processing techniques for increased food value; 3) preventing and controlling mycotoxin, pests and diseases toward food preservation and safety; and 4) empowering stakeholders toward profitable entrepreneurship.[52] Three departments implement PHilMech's R&D activities: post-harvest engineering, food protection, and post-harvest systems and analysis. The

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49. Golden rice, one of the products of genetically modified technology, and its promised benefits to prevent blindness and death from vitamin A deficiency in millions of children, has become an intimate public debate across the globe.

50. *About Us*, PHILMECH, http://www.philmech.gov.ph/?page=aboutus (last visited Dec. 15, 2012).

51. *Programs*, PHILMECH, http://www.philmech.gov.ph/?page=programs (last visited Dec. 15, 2012).

Training and Extension Department facilitates technology transfer of PHilMech's R&D outputs.

To support the Philippine Department of Agriculture's rice mechanization program in collaboration with some members of the national rice R&D network, PHilMech develops and deploys appropriate technologies, machinery, and systems to address the country's rice mechanization needs and provides practical solutions to the post-harvest and post-production problems faced by rice farmers. To help achieve the national rice sufficiency objectives by 2013, PHilMech was tasked by the national government to help increase rice production through farm mechanization by five percent and to reduce the country's postharvest losses from 15 percent to five percent.

Since the average Filipino rice farmer has very small, and often scattered, land holdings, averaging two or less hectares, PHilMech concentrates on developing and promoting modern tools and machinery for small to medium-scale rice farming operations. PHilMech's engineers adapt imported technologies to suit local farming conditions. Currently, PHilMech promotes four pieces of rice drying equipment, which use rice hull and biomass as a fuel. These pieces of equipment are distributed to rice producing provinces in central Philippines. Based on its nationwide assessment in July 2011, PHilMech's flatbed dryers have improved the earnings of farmers and farmer organizations because of the improved quality of their paddy and reduced postharvest losses.[53] Farmers who dry their harvest using flatbed dryers can sell their produce at prices of up to 100 percent higher than the rice dried on the pavement, streets or highways. Sun drying the harvested crop on these areas is a common practice in the country.

1. Sustaining R&D's Linkage to Industry: PHilMech's New Licensing Protocol

PHilMech's more than 30 years of R&D involvement has led to significant research findings, such as prototypes of machinery, which are disseminated to the farming sector through a two-pronged approach. Farmers tend to adopt technologies they have witnessed working in their areas. Hence, the first approach (agricultural extension) involves technology promotion through demonstrations during field days and agricultural trade exhibits. Although this is a conventional technology transfer approach, the conduct of technology demonstrations has been proven to be one of the most appropriate extension strategies in promoting vital technologies in the

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52. *PhilMech Says Flatbed Dryers Boost Farmer Incomes*, MANILA TIMES (Aug. 29, 2011), http://www.manilatimes.net/index.php/business/5857-philmech-says-flatbed-dryers-boost-farmer-incomes.

farming sector. Technology demonstration activities also include advising farmers on the features and benefits of the new technologies and persuading them to try the new ones. Through this scheme, PHilMech transfers its technologies, generated information, and tacit knowledge on postharvest to the farmers for free. However, there are some PHilMech-generated technologies that cannot be directly transferred to farmers or in the marketplace; hence, support from intermediaries are needed for farmers and other stakeholders to easily access the technologies.

Meanwhile, some technologies and techniques generated by PHilMech require the support of the industrial community for them to be commercialized. Thus, the Institute's second approach, called industrial extension, is being implemented to transfer the technologies to the private sector, such as local agricultural machinery manufacturers. This group of PHilMech's partners plays critical roles in the mass fabrication of machines and operates on economies of scale to produce and sell the machines at a lower price. This approach relates to the new paradigm for technology transfer, shifting from the informal and free exchange of discoveries, innovative ideas, materials, and technologies, to the use of more formal and creative approaches tailored to commercialization agreements.

Under this second approach of technology transfer, manufacturers apply for PhilMech accreditation to get access and commercialize its machines. With three years of renewable accreditation, the technology commercialization agreement is done via a Memorandum of Agreement, which specifies procedures and policies stipulating that PhilMech's designs and technical assistance are made available to co-operating manufacturers. The commercialization involves two phases. The initial commercialization phase, which takes about one year, covers the period when the manufacturer produces commercial units to be used for government promotional activities. The full commercialization phase, called the utilization phase, is the stage when demand for the machine has already been established and the manufacturer takes full responsibility on the promotion, marketing, sales, and sales support for the machines.

The Industrial Promotion Program (PIPP) (formerly Industrial Extension Program), launched in 1989, implements the second strategy of commercializing the PHilMech's technologies. A major objective of the PIPP is to foster postharvest equipment manufacturing in the Philippines by providing manufacturers with designs of appropriate agricultural equipment and by extending technical assistance on fabrication, testing, marketing, and operation. PIPP serves as a linchpin between the technology generators (engineers, science research specialists, and designers) and the users of technology. Specifically, the program conducts socio-economic and demand surveys, identifies the right market location, conducts demonstration and pilot tests, and accredit local manufacturers. It also implements the following activities in support of these functions: provision of technical assistance to manufacturers; provision of assistance to initial adopters, such as cooperatives, in securing easy loan packages so they can acquire PhiMech's technologies; and implementation of incentive awards program for top performing manufacturers to encourage the undertaking of joint machine development. Since the establishment of PIPP, the Center has a pool of accredited local manufacturers and fabricators, who develop and sell commercial units of improved maize shellers, moisture meters, mobile flash dryers, in-store dryers, and outdoor postharvest storage.

Despite the success of PIPP, gray areas on IPR remain unresolved, such as how to manage intellectual property (original designs of PHilMech's engineers and improvements made by the manufacturer) and how PHilMech as a Center, and its engineers, will acquire recognition for invention and receive monetary benefits from the process. The Department of Agriculture's national technology commercialization and the benefits gained by PhilRice in its IP and technology commercialization activities influenced PHilMech to organize itself to build its capability on IP management and licensing and promote public-private partnership to further disseminate its technologies. This attempt and initiative of PHilMech to initially support the management of institutional IP and technology commercialization started during the last quarter of 2005.

Currently, PIPP is institutionalizing other technology transfer modalities, like the execution of licensing agreements to fast track its technology commercialization activities. PIPP's technology licensing protocol (See Figure 4), implemented by the Technology Management and Training Division, institutionalizes a uniform procedure for the non-exclusive licensing of the institute's IP and equipment designs:

1. *Filing of application for a technology license.* All prospective licensees for PHilMech's technologies submit letter of intent to PHilMech Licensing Unit. The letter of intent comes with submission of several documents related to the applicant's business.
2. *Initial evaluation and notice of eligibility.* The Technology Management and Training Division evaluates the application, inspects the manufacturing capability and compliance of the manufacturer, and notifies the applicant if it meets all the requirements. Along with the notice is a confidentiality undertaking that the potential licensee needs to sign and a notice of payment of a non-refundable technology license fee.
3. *Release of engineering designs/drawings and fabrication by the company.* The engineering designs/drawings will then be released to the company's proprietor and, within a reasonable period of time, will be required to fabricate a prototype unit strictly in accordance with the specifications. Upon written request by the license applicant, technical assistance maybe provided by PHilMech.
4. *Testing/Evaluation of Prototype Unit.* Upon completion of the prototype unit, the license applicant shall request the conduct of testing

and evaluation by the PHilMech. The testing and evaluation shall cover the prototype unit's compliance with the technical design/drawing, fabrication specifications, if any, and performance standards.

5. *License Certificate/Contract.* Once the prototype unit has satisfactorily complied with the technical drawings, fabrication specifications, and performance standards, PHilMech shall cause the execution of a License Agreement and the issuance of a License Certificate to the qualified licensee. The licensing agreement, in particular, contains confidentiality provisions for how PHilmech's intellectual property will be handled by the licensee, improvements made in the design and provisions for joint intellectual property, and payment of royalty fees by licensee to PHilMech.

The new licensing protocol[54] requires the Center to apply for IPR protection for all its designs. The new process serves as venue to level the playing field among the manufacturers, who are interested in becoming PHilMech's licensee, which would allow them to use, make, sell, and/or lease the Center's generated technologies. This protocol also provides due recognition to the inventions and IP of PHilMech's employees and enables them to receive monetary entitlement to any technology commercialization activities. Recently, legal and policy developments in the country (e.g., Magna Carta for S&T workers,[55] and the Technology Transfer Act[56] patterned after the 1980 US Bayh-Dole Act) provide positive prospects for the continuous implementation of this technology commercialization protocol to fast track public-private sector partnerships and incentivize PHilMech's engineers.

V. Lessons Learned and A Way Forward

In recent years, the Philippines has made progress in its state of food and agriculture; however, food insecurity for the future remains a major concern and is associated with a number of specific challenges. The introduction and strengthening of intellectual property rights (IPR) in agriculture further constitutes a significant change in the policy environment for addressing food security. Although the Philippines has a long history of IPR implementation, the actual implications and magnitude of impact of the

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53. *PhilMech Technology Licensing Protocol*, Philippine Center for Postharvest Development and Mechanization, http://www.philmech.gov.ph/Default.asp?page=licensing (last visited Sept. 10, 2012).

54. Rep. Act No. 8439, An Act Providing A Magna Carta For Scientists, Engineers, Researchers and Other Science and Technology Personnel In Government, *available at* http://www.chanrobles.com/republicactno8439.htm#.UM035-RQVe9.

55. *See* Rep. Act. No. 10055, Philippine Technology Transfer Act of 2009, *available at* http://www.senate.gov.ph/republic_acts/ra%2010055.pdf.

introduction of IPR in the agriculture, specifically to the rice sector, have yet to be ascertained. However, as presented in this paper, a number of points can already be made on how and why IP needs to be leveraged for food security and rice self-sufficiency.

The Philippine Rice Research Institute (PhilRice) and the Philippine Center for Postharvest Development and Mechanization (PHilMech), are among the first national research institutions in the Philippines that have established respective models to actively manage institutional innovations and intellectual property (IP). Both institutions have also advance technology commercialization programs in support of the country's food security and rice self-sufficiency objectives. The institutions implement activities to ensure that IP issues do not hinder research activities, and that research discoveries are properly managed, used, and transferred to the marketplace for the benefit of the rice industry. PhilRice and PHilMech also ensure that scientists and innovators receive appropriate recognition and necessary incentives.

Specifically, PhilRice's experience proves that strengthening IPR in agriculture, especially in agricultural biotechnology, did not impair its access to proprietary technologies needed for research. Although PhilRice's involvement with the transfer of golden rice technologies came later and was largely downstream, following the earlier crucial steps of identifying IPR constraints, the Institute has formed the requisite organizational, technical, and IP capacity to better understand the IP provisions and legal implications of the different agreements on golden rice, and accelerate golden rice research towards its deployment and future commercial availability. On the other hand, PHilMech's experience shows that with management, staff support, and enabling national policies, institutional IP that is developed using government funds can be protected and commercialized for the benefit of the institution and its scientists and engineers. Although the institution's technology licensing protocol can be further simplified, it recognizes that IP protection is one important way to bring technologies to the market and indicates a change in perception among government R&D institutions. PHilMech's experience shows that the old mindset on IPR as only important to the private sector is gradually changing.

Overall, the two cases demonstrate that the presence of national and institutional IP framework and implementation of strategic IP activities serve as valuable tools for public research institution, which used to evolve in a world without IPR. These initiatives are starting to help these institutions enhance networking capabilities and linkages, improve access to modern technologies, disseminate technologies on a wider scale, as well as reward the scientists and researchers. These benefits of IPR add value in fulfilling mission and commitment as public research institutions working for the country's food self-sufficiency and food security agenda.

PhilRice and PHilMech have taken the challenge and are taking strides in maximizing the advantages of IP to perform their public mission and deliver public goods. These government-funded research institutions in the Philippines may have its own set of circumstances (mission, goals, research focus and capacity, among others); however, these institutions both prove that embracing IP and technology commercialization can be advantageous not only to the public research institutes, but also in contributing to public mission to contribute to the country's goal of rice self-sufficiency and food security. With the insights gained from the cases, we suggest that PhilRice, PHilMech, and other agricultural institutions in the Philippines consider the following call for actions to further support the sensible introduction and diffusion of new agricultural practices and technologies:

Innovation needs collaboration and keeping collaboration from growing needs continuous institutional capacity building. Formation of partnerships between the technology suppliers, governments, and private entities that acquire and develop the technology, and the agriculturalists that deploy the technology should be actively nurtured. Several of these public-private collaborations have enabled transfer and access to some important innovations such as the golden rice. However, golden rice, albeit a success story in many ways, is also a wake-up call: reliance on external humanitarian entities to address critical food security issues could be limiting and unsustainable. Serious and committed capacity building efforts for developing countries should continue to foster sustainable improvement of absorptive capacity for innovations in agriculture. These efforts should focus on helping these economies move from being passive bystanders to becoming active participants in the technology transfer process necessary for the country's food security.

National agricultural research institutions, such as PhilRice and PHilMech, with existing IP management and technology commercialization capacity, should scale up IP management efforts, foster continuous learning especially on issues affecting genetic resources and germplasm, and step up to identify IP bottlenecks that can stifle access and commercialization of innovations. They need to take the lead in helping to build national IP portfolio (e.g., domestic filings), composed of local and indigenous innovations, and home-grown improvements on imported technologies to meet their particular agricultural needs. They also need to step and participate actively in technology access negotiations needed for food security. Lastly, national agricultural research institutions need to increase engagement in economic development activities by deploying research products using other avenues of technology commercialization (e.g., the formation of startup businesses) and expand market reach (e.g., the United States).

IP issues in agricultural research and embracing IP by public research institutions necessitate many complex decisions, significant challenges, and changes. These involve investments, resources, systems, procedures, and a different mindset among its personnel. Other institutions, however, may not have the resources to develop and implement the same strategies and activities done by PhilRice and PHilMech. Both institutions along with other Philippine institutions with quite advance IP capacity should take active role in training a supportive "community of IP experts" in the agriculture sector, form smart coalitions to spread the importance of IP, understand and address its issues as it affects agricultural research, and help implement the necessary institutional changes. This may be as simple as consolidating institutional expertise and cost-sharing among agencies in the country. Many advanced institutions in developed nations, which have a long history of managing ideas and technology commercialization of agricultural products, also offer capability building support to help developing countries and their institutions further enhance their competency on managing IP. Some of their practices may be transferable or modified as appropriate for the Philippines.

Overall, IPR is an 'enabler' that can help drive delivery of innovative and productivity-increasing technologies crucial to agricultural and economic growth and achieving future needs for food security in countries such as the Philippines. The key is to match the proper IPR mechanisms with specific conditions, and to manage them effectively and efficiently for more extensive innovative research, technology transfer, and wealth creation.

Figures and Tables

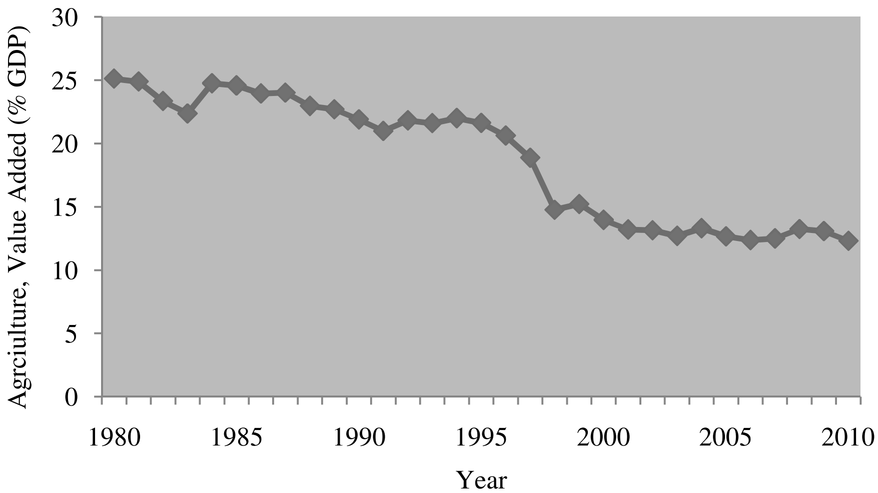

Figure 1. Gross value added, Agriculture, 1980—2010.
Source: FAO (2012): *FAOSTAT-Agriculture,*
http://faostat.fao.org/site/339/default.aspx

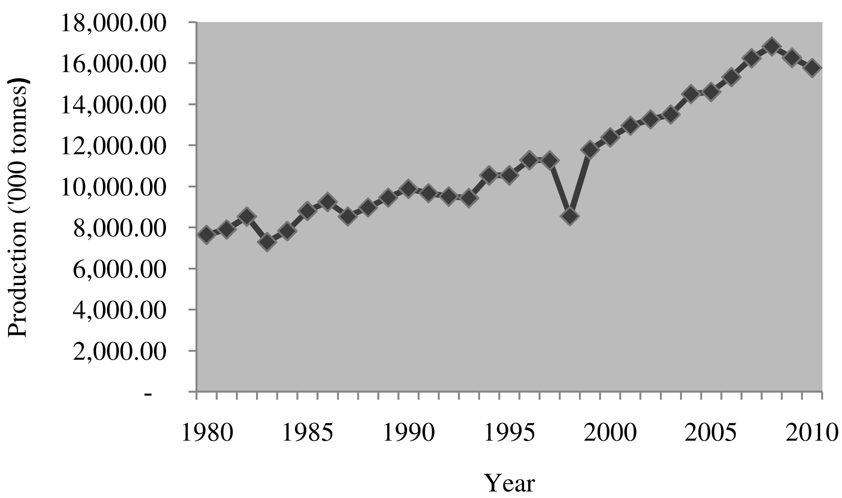

Figure 2. Rice Production in the Philippines, 1980—2010.
Source: FAO (2012): *FAOSTAT-Agriculture,*
http://faostat.fao.org/site/339/default.aspx.

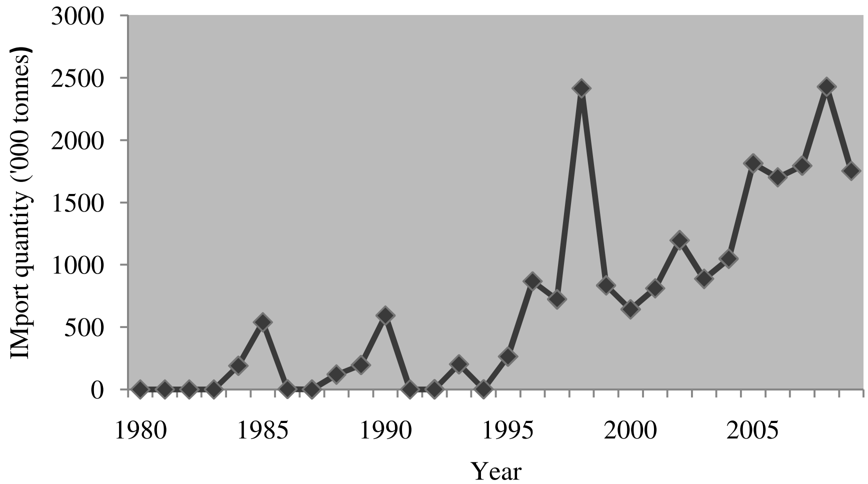

Figure 3. Import quantity, rice (milled). 1980—2009. Philippines. Source: FAO (2012): *FAOSTAT-Agriculture* http://faostat.fao.org/site/339/default.aspx

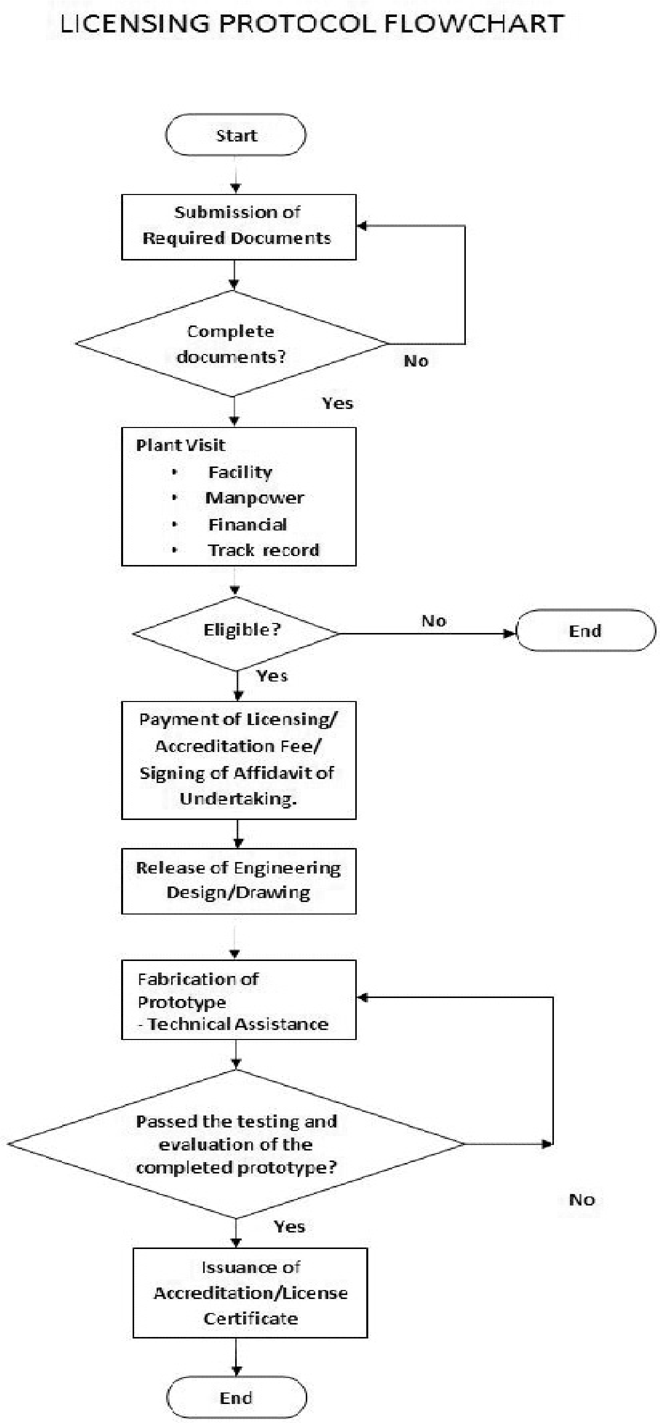

Figure 4. PHilMech - Licensing protocol flowchart. Source: PHilMech (2012). PHILMECH TECHONOLOGY LICENSING PROTOCOL (2012), http://www.philmech.gov.ph/?page=lprotocol.

Table 1. Basis of the Philippine IPR system.

National Laws
▪ 1987 Constitution (Article XIV, Section 13) ▪ 1997 Magna Carta for Science and Technology (S&T) Workers ▪ 1998 Intellectual Property Code ▪ 2002 Plant Variety Protection Act ▪ 2010 Technology Transfer Act
International Laws/Treaties
▪ 1951 Berne Convention on Literary and Artistic Works ▪ 1980 WIPO Convention ▪ 1981 Budapest Treaty on Deposit of Microorganisms ▪ 1984 Rome Convention on Performers, Phonograms and Broadcasting Organizations ▪ 1992 Convention on Biological Diversity ▪ 1995 Agreement on Trade-Related Aspects of Intellectual Property ▪ 1995 Paris Convention on Industrial Property ▪ 2001 Patent Cooperation Treaty

Table 2. Biotechnology products and tools accessed by PhilRice from 1996 to 2004.

BIOTECHNOLOGY MATERIALS AND DESCRIPTION	INSTITUTION	NO. OF IP-RELATED PROVISIONS
1996		
1. pZ100 (plasmid construct)	Salk Institute for Biological Studies	2
1. PBY520 and pTW-a (includes potato *pin2 gene* and *bar* gene for selection) and constructs' map	Cornell University	4
2. *hva1*-containing plasmid pBY520	Cornell University	4
1997		
1. Clone pC822-3 with Xa21 Leucine Rich repeat and clone pB822-1 containing Xa-21 kinase	University of California Davis	3

2003		
1. pCambia-SB-IR2. A rice genomic DNA insert cloned into pCAMBIA 1305 vector. Insert is the indica (IR64) gene orthologous to the japonica (Nipponbare gene)	Cornell Research Foundation	8
2. Genomic rice insert of 19 kb from IR64 cloned in Hd3 site of the pCAMBIA 1305.1 vector. The genomic insert comprises the homolog of the gene OSJNBa0017E08.19 found in the BAC OSJNBa0017EO8 (AC068923) from Nipponbare	Cornell Research Foundation	8
3. pSMAB801 construct containing multimer of CaMV35S promoter	National Institute of Agrobiological Sciences, Tsukuba, Japan	9
4. PSMAB704 binary Ti plasmid vector carrying *bar* selectable marker gene	National Institute of Agrobiological Sciences, Tsukuba, Japan	9
5. Stress tolerant transgenic cereal plants by hva1 genes	Cornell Research Foundation	9
6. Monocot having dicot wound inducible promoter	Cornell Research Foundation	9
2004		
1. Xa21 gene cloned to a modified pCambia 1300 vector w/c replaces hygromycin gene with PMI	University of California Davis	3
2. Golden rice	Prof. Potrykus and Syngenta	>15

Table 3. Intellectual Property Relevant to Golden Rice

PRODUCT COMPONENT	SOURCE OF COMPONENT
1. Rice germplasm transformed with gene constructs	Taipei 309, from IRRI
2. PGEm4	Promega
3. PbluescriptKS	Strategene
4. PCIB90 and AphIV gene: hygromycin phosphotransferase	Ciba-geigy Limited (Novartis Seeds AG)
5. CaMV35s promoter and	Monsanto

terminator	
6. PKSP –1 and GT1 Promoter: glutelin storage protein	Thomas Okita, Washington State University
7. PUCET4 and Pea Rubisco transit peptide Crtl gene: phytoene desaturase	N. Misawa, Kirin Brewery Co., Ltd.
8. PPZP100	Pal Maliga, Rutgers University
9. pYPIET4	Clontech, now marketed by Life Tech.
10. Electroporation Apparatus and Microprojectile bombardment apparatus	Bio-Rad Corp., Gene Pulser II System

Source: R. David Kryder, Stanley P. Kowalski, and Anatole F. Krattinger, *The Intellectual and Technical Property Components pro-Vitamin A Rice (*Golden*Rice*™*): A Preliminary Freedom-To-Operate Review*, ISAAA Briefs 20, *available at* http://www.isaaa.org/kc/Publications/pdfs/isaaabriefs/Briefs%2020.pdf.