AN ANALYSIS OF THE IMPLICATIONS OF STRENGTHENED INTELLECTUAL PROPERTY RIGHTS TO AGRICULTURE OF DEVELOPING COUNTRIES AND RESPONSES OF SELECTED PUBLIC RESEARCH INSTITUTIONS IN SOUTHEAST ASIA

By

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Better understanding of intellectual property rights (IPR) is indispensable to informed policy making in all areas of development, including agriculture – the backbone of economy of majority of developing countries. For this reason, IPR and its impact to the future of agriculture in developing countries should gain priority in public discussions. As a contribution to the IPR debate, this dissertation analyzed the implications of the expansion of IPR to agricultural development, and determined how public agricultural research in developing countries has responded to the concept of IPR and its developments. Specifically, this dissertation reviewed the interaction of IPR, the WTO-TRIPS Agreement, and agriculture, and demonstrated through empirical analysis that the expansion of IPR in agriculture can positively impact agricultural development not only of developed countries, as critics would claim, but also of developing countries. Second, initially focusing on five developing countries in Asia, this research demonstrated that public R&D institutions in this region have good knowledge on the concept of
IPR, its features, and tradeoffs, and have started to build their institutional IP management structures and procedures to cope with IPR issues. Interestingly, this research found that research managers and scientists in these countries do not find IPR as a constraint to access proprietary technologies and research products they need to continue doing research. These attitudes of the public sector personnel on the implications of IPR on access, along with research generation, and technology transfer are found associated with their socio-demographic characteristics (i.e., education, position, and country of citizenship). Based on all these findings, this dissertation offers some recommendations that can open the door to transformative change among developing countries and their public research institutions to efficiently respond to the challenges, and opportunities of managing and exploiting IPR.
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INTRODUCTION

No country has ever achieved mass dollar poverty reduction without prior investment in agriculture (Lipton, 2005). Agriculture is important since it can contribute to development as an economic activity, as a livelihood, and as a provider of environmental services. This makes the sector a unique instrument tied to national food security issues and humanitarian concerns over hunger and malnutrition.

Performance of agriculture has been impressive through the years. From 1980 and 2004, GDP of agriculture expanded globally by an average of 2 percent a year, more than the annual population growth of 1.6 percent. Seventy-nine percent of this growth was due to agricultural growth in developing countries. The agricultural growth of developing countries rose 2.6 percent a year in 1980-2004, and its share of world agricultural Gross Domestic Product (GDP) rose from 56 percent in 1980 to 65 percent in 2004 (World Bank, 2007 p 50). Such progress in agricultural growth in developing countries has been dominated by significant gains in Asia, especially China. Cereal yields in East Asia rose by an impressive 2.8 percent per year from 1961 to 2004. A major contributor to this growth has been investment in research and development (R&D) and technological improvements, with improved crop varieties contributing an estimated half of the agricultural productivity improvements. Other factors, such as increased adoption of new technologies, policies, institutional changes, and major investments in infrastructure and subsidized inputs and outputs have also been reported as contributing to this growth (World Bank, 2007 p 51-53).

Despite these major advances in agriculture and accelerated growth in food production in recent years, food insecurity is still common in many parts of the developing world. Food
insecurity, exists when people lack sustainable physical or economic access to enough safe, nutritious, and socially acceptable food for a healthy and productive life. Many factors have been identified as root causes of food insecurity: poverty, war and civil conflict, corruption, national policies that do not promote equal access to food for all, environmental degradation, barriers to trade, insufficient agricultural development, population growth, low levels of education, social and gender inequality, poor health status, cultural insensitivity, natural disasters, and many others (Caldwell, 2011). Globally, certain groups of people are more vulnerable to food insecurity than others. As Delmer (2005) claimed, many of the developing countries, especially the sub-Saharan Africa, will remain global “hot spots” for hunger and malnutrition for many years to come. Wik, Pingali, & Broca (2010) also forecasted that, population increase combined with moderately high income growth could result in a more than 70 percent increase in demand for food and other agricultural products and may result in up to 9.0 billion people suffering from malnutrition and hunger in 2050. A majority of these will come from the poorest socio-economic groups in developing countries. Thus, governments in agriculture-dependent developing economies are, thus, more challenged to look for new ways including technology development, research, growth policies, and distribution systems, among others and take actions, to renew focus, improve, and boost the agriculture sector in a sustainable manner, to help reduce this statistic and foster food security.

Currently, one of the major debates involving addressing food security focuses on how agricultural innovations in this age of the Gene Revolution (e.g. modern biotechnology) and their application might be able to help improve agricultural output and productivity and help satisfy the food requirements in these countries. The advent of modern biotechnology and with agriculture becoming more of a technologically dynamic sector, agricultural industry especially
in developed countries now increasingly relies on formal means of protecting new technologies through intellectual property rights (IPRs). The introduction and strengthening of IPRs in the agricultural sector has been and remains controversial. Developing countries and their public research institutions have evolved in a world without IPRs; hence, IPRs as a policy option can impact public agricultural research, the linchpin of agricultural development in these countries.

This dissertation examines the potential impact of strengthened IPRs on agricultural development and the responses of developing countries and their public research institutions to the concept of IPRs and its developments. This manuscript is written in six major sections. The introductory section begins with a review of the concept of innovation and its role in the national innovation systems, then it presents modern biotechnology as one important agricultural innovation to help address food security and improve the agriculture sector. After highlighting the importance of modern biotechnology, the dissertation discusses how agricultural biotechnology and the concept of IPRs have evolved together. The paper also analyzes in a closer lens the issues surrounding IPRs, its rationale, the actors and players, implications and scholars and experts’ perception of its role and impacts – theoretically and empirically, to society, scientific community, and developing countries. This takes the background to the details of this dissertation research: beginning with the statement of the problem, the purpose of the research, research questions, some definition of terms, limitations, and the different study components of this research. The different studies, their objectives, methods, and conclusion are presented in detail in the next sections (sections 2-6).
Igniting Innovation for Agricultural Development and Growth

Innovation is important for human progress. Generally, an “innovation” is developing a new idea and introducing it into an economic or social practice, or simply putting it into practice. This process is a combination of various activities starting from research, and including design, market investigation, process development and may also include other activities like organizational restructuring and employee development. But innovation has not been easy to define. Specifically, Joseph Schumpeter is often mentioned as the first economist to have drawn attention to the importance of innovation (Organisation for Economic Co-operation and Development (OECD), 1997). He defined five types of innovation ranging from introducing a new product to changes in industrial organization. Schumpeter (1934) vividly characterized innovation as “industrial mutation,” which “incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. The World Intellectual Property Organization (WIPO), the international institution that promotes the use of innovation in society, adopts a Schumpeterian approach in defining innovation as the process of bringing valuable new products (goods and services) to market i.e., from the idea or concept formulation stage to the successful launching of a new or improved product to the marketplace, or the result of that process, so as to meet the explicit or implicit needs of current or potential customers. For the followers of Schumpeter proposals, innovation can result from technology transfer or through the development of new business concepts, which can be technological, organizational, or presentational (Lengrand, 2002).

A simple definition for innovation was given by Rogers in his adoption-diffusion model. He said that “an idea, practice, [or] object that is perceived as new by an individual or other unit of adoption.” According to him, it is the perceived newness of the idea for the individual that
determines his or her reaction to it. Similarly, Goldberger (2008) emphasized that what matters most is the subjective perception of “newness” by an individual or group regardless of the origin or the new idea, practice, or physical object in question. Moreover, a person perceives something as an innovation when he or she first becomes aware of it, irrespective of the time period when the idea or practice was originally developed. Fliegel & van Es (1983) added that agricultural innovations might be ranked, for example, on the degree to which they could be tried on a small scale before full adoption. Innovations could also be ranked on their cost to the farmer and their potential for increasing returns.

Recently, Archibugi & Juma (2004) argued that innovations are facilitating the process of globalization as ‘technologies of globalization.’ The most obvious example is the advances in information telecommunication technology that make global interactions possible, such as the integration of financial markets. Second, scientific research and product innovations are now located in a global space, a process of “globalization of the scientific and technological communities.” Of particular concern to them is whether innovations are within reach of all. As Archibugi and Juma noted, “Too often, it has been assumed that it is enough to produce knowledge for everyone to benefit from it. This is far from true, and the diffusion of vital innovation depends on the willingness of the community of researchers and engineers as much as on institutions devoted to implementing this agenda.”

Innovation was considered as an interactive process in the context of a national innovation system by Freeman (1987). This idea was further developed by Nelson (1993), Lundvall (1992), and Cimoli & Della Guista (2000), among others. Meanwhile, Metcalfe (1995) provided the following policy-oriented definition of a national innovation system: a set of institutions that jointly and individually contribute to the development and diffusion of new
technologies and innovations and that provides the framework within which governments form and implement policies to influence the innovation process.

Overall, despite these different definitions and interpretations, there is broad agreement that innovations based on existing or emerging technologies especially when linked to a national innovation system, are crucial for growth, increasing competitiveness, productivity, and social gain within organizations and among institutions. It is thought that these benefits are shared across various agents, sectors of the economy, and countries.

The 2001 Human Development Report stated that “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” (United Nations Development Programme, 2001). Meanwhile, technological development is recognized in “endogenous growth theory” as fundamental to the growth process, and describes the market for technology using incentives of supply and demand. It lays at the heart of economic growth, that it is excludable and can respond to market incentives, and that technology is a non-rival good that builds on existing levels of technology (Romer, 1990). In the agricultural sector, there is no doubt that technological innovations have contributed to delivering incremental yields, which can help balance the food demand-supply equation (World Bank, 2007). The Green Revolution of the 1960s and 1970s, showed that a development approach, which emphasized the use of new, high-yielding hybrid varieties, mechanization, fertilizers, and pesticides, agricultural innovations could be very successful in increasing crop yields and augmenting aggregate food supplies to keep pace with the population growth of the developing world. The ‘Seed-Fertilizer’ package of the Green Revolution was a major achievement for many developing countries especially those in South and East Asia, and South America, where food production figures increased
substantially in the past decades (Food and Agriculture Organization, 2010), and gave them unprecedented national food security (International Food Policy Research Institute (IFPRI, 2002 p 4). Green Revolution technologies were also claimed to have contributed to the overall economic growth of these nations by increasing the incomes of farmers (who were then able to afford tractors and other modern equipment), the use of electrical energy, and consumer goods, thus increasing the pace and volume of trade and commerce (Food and Agriculture Organization, 2000). With these outcomes, calls for a second Green Revolution with newer technological breakthroughs, have been raised to further transform agricultural production in developing nations.

However, the growing reliance on technology pushed by the Green Revolution development approach, has its criticisms. Critics charged that the adoption of Green Revolution technologies increased income inequality, inequitable asset distribution, worsened absolute poverty and resulted in environmental degradation (IFPRI, 2002 p 3; Niaze, 2007). There is some evidence that only the wealthiest farmers with large farms and the resources to acquire expensive inputs were able to benefit from Green Revolution methods but did not extend especially to the millions of smallholders living in rainfed and marginal areas or the rural poor, such as in sub-Saharan Africa (Hautea & Escaler, 2004; Food and Agriculture Organization, 2010). According to Lappe, Collins, & Rosset (1998) “such introduction of new agricultural technology into a social system stacked in favor of the rich and against the poor-without addressing the social questions of access to the technology's benefits will over time lead to an even greater concentration of the rewards from agriculture”. Environmentalists, in addition, criticize Green Revolution technologies as highly dependent on expensive inputs, diminish the
natural diversity and resilience of “natural” seed, and promote intensive use of synthetic 
materials which can lead to environmental disasters (e.g. pollution of soil and groundwater).

These debates about how past and future agricultural technologies should be developed, 
disseminated, and distributed are valid, continuing, and are being addressed however it is safe to 
say that technological innovations have been a cornerstone on the way agriculture is conducted 
worldwide and has benefited many people of many nations in need of modern technologies and 
increased food production. Increased agricultural productivity through technological solutions 
for the agricultural sector, hence, can certainly be part of the toolbox to achieve food security and 
development objectives. It is for governments, policymakers, and scientists to tap on the 
strengths of modern technologies, such as those of the Green Revolution, and avoid their 
weaknesses, and take the significant steps toward enhancing agricultural productivity, address 
the social dimensions (i.e. equitable distribution), and ecological sustainability, for the benefit of 
all their people.

**Modern Biotechnology, Food Security, and Sustainable Agriculture**

The World Food Program estimated that 840 million people in developing countries 
suffer from malnutrition and hunger. Hence, one of the main policy goals of developing 
countries is to enhance food security. In 1996, at the World Food Summit in Rome, more than 
180 countries pledged efforts to achieve “food security for all . . . with an immediate view to 
reducing the number of undernourished people to half their present level no later than 2015.” At 
a basic level, food security is defined as fulfilling each individual’s human right to food; and 
food security relates to issues of agricultural policy, economic development, and trade (Cullet, 
2003). The lack of food security has been described as “an extraordinarily complex social, 
economic, and political problem whose causes and solutions vary from country to country.” If
basic nutritional needs are not being met, the consequences are seen, certainly, in individual suffering and failure to thrive, but also in the failure of societies to thrive socially and economically. Food security, economic development, and poverty reduction are, hence, thoroughly intertwined. Modern biotechnology has been put forward as having the potential to help attain these three development goals.

The Convention on Biological Diversity (CBD) defined biotechnology as “any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products for specific use” (Secretariat of the Convention on Biological Diversity, 1992). This definition includes medical and industrial applications as well as many of the tools and techniques that are commonplace in agriculture and food production. Hence, agricultural biotechnology may be understood as the use of organisms or parts of an organism to make or improve products or processes in agriculture. It covers the application of tissue culture, immunological techniques, molecular genetics, and recombinant DNA techniques in all facets of agricultural production and agro-industry. Modern agricultural biotechnology allows a much more precise understanding of the genetic makeup of any crop variety, opening the door to sophisticated screening and reverse engineering techniques. Biotechnology is also playing a major role as a tool that could provide required inputs like biofertilizers, and biocontrol of harmful pests and diseases; for accurate diagnosis and control of plant and animal’ diseases; for remediation of the environment; and for bioprospecting purposes. Hence, many experts claim that modern biotechnology, with its tremendous applications and advantages, has the potential to address specific problems such as (1) increasing crop productivity; (2) diversifying crops; (3) enhancing nutritional value of food; (4) reducing environmental impacts of agricultural
production; and (5) promoting market competitiveness (Food and Agriculture Organization-Committee on Agriculture, 1999; Juma, 2000; Hautea & Escaler, 2004).

Over the last few years, the application of biotechnology to enhance crop breeding in developing countries is increasingly popular (Table 1) and is resulting in an increased adoption of GM plants (Table 2). However, as Table 2 demonstrates, most of the adoption has been in three major commodities. In 2009, more than 61 million hectares (ha) were planted to GM crops in 15 developing countries resulting to an unprecedented growth rate of 79% between 1996 and 2009, are now considered the fastest adopted crop technology (James, 2009). Aside from GM crops, a number of non-GM biotechnologies, including microbial, cell biology, molecular marker, and diagnostic are also currently being used in more than 100 crops in the developing world.

Table 1. Transgenic breeding objectives of developing countries.

<table>
<thead>
<tr>
<th>MODIFICATION OF AGRONOMIC TRAITS</th>
<th>INCORPORATION OF VALUE-ADDED TRAITS</th>
</tr>
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<tr>
<td>Already commercially grown</td>
<td>Herbicide tolerance, insect resistance, virus resistance</td>
</tr>
<tr>
<td>Tested within field trials</td>
<td>Fungus resistance, bacterium resistance, nematode resistance, cold tolerance</td>
</tr>
<tr>
<td>Expected in the medium run</td>
<td>Drought tolerance, salt tolerance, nitrogen fixation, higher genetic yield potential</td>
</tr>
</tbody>
</table>

Source: Qaim (2001)
Table 2. Global area of biotech crops in 2009: By country (Million Hectares).

<table>
<thead>
<tr>
<th>RANK</th>
<th>COUNTRY</th>
<th>AREA (MILLION HECTARES)</th>
<th>BIOTECH CROPS</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>64.0</td>
<td>Soybean, Maize, cotton, canola, squash, alfalfa, sugarbeet</td>
</tr>
<tr>
<td>2</td>
<td>Brazil</td>
<td>21.4</td>
<td>Soybean, maize, cotton</td>
</tr>
<tr>
<td>3</td>
<td>Argentina</td>
<td>21.3</td>
<td>Soybean, maize, cotton</td>
</tr>
<tr>
<td>4</td>
<td>India</td>
<td>8.4</td>
<td>Cotton</td>
</tr>
<tr>
<td>5</td>
<td>Canada</td>
<td>8.2</td>
<td>Canola, maize, soybean, sugarbeet</td>
</tr>
<tr>
<td>6</td>
<td>China</td>
<td>3.7</td>
<td>Cotton, tomato, poplar, papaya, sweet pepper</td>
</tr>
<tr>
<td>7</td>
<td>Paraguay</td>
<td>2.2</td>
<td>Soybean</td>
</tr>
<tr>
<td>8</td>
<td>South Africa</td>
<td>2.1</td>
<td>Maize, soybean, cotton</td>
</tr>
<tr>
<td>9</td>
<td>Uruguay</td>
<td>0.8</td>
<td>Soybean, maize</td>
</tr>
<tr>
<td>10</td>
<td>Bolivia</td>
<td>0.8</td>
<td>Soybean</td>
</tr>
<tr>
<td>11</td>
<td>Philippines</td>
<td>0.5</td>
<td>Maize</td>
</tr>
<tr>
<td>12</td>
<td>Australia</td>
<td>0.2</td>
<td>Cotton, canola</td>
</tr>
<tr>
<td>13</td>
<td>Burkina Faso</td>
<td>0.1</td>
<td>Cotton</td>
</tr>
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<td>14</td>
<td>Spain</td>
<td>0.1</td>
<td>Maize</td>
</tr>
<tr>
<td>15</td>
<td>Mexico</td>
<td>0.1</td>
<td>Cotton, soybean</td>
</tr>
<tr>
<td>16</td>
<td>Chile</td>
<td>&lt;0.1</td>
<td>Maize, soybean, canola</td>
</tr>
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<td>17</td>
<td>Colombia</td>
<td>&lt;0.1</td>
<td>Cotton</td>
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<td>Honduras</td>
<td>&lt;0.1</td>
<td>Maize</td>
</tr>
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<td>19</td>
<td>Czech Republic</td>
<td>&lt;0.1</td>
<td>Maize</td>
</tr>
<tr>
<td>20</td>
<td>Portugal</td>
<td>&lt;0.1</td>
<td>Maize</td>
</tr>
<tr>
<td>21</td>
<td>Romania</td>
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<td>22</td>
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<tr>
<td>23</td>
<td>Costa Rica</td>
<td>&lt;0.1</td>
<td>Cotton, soybean</td>
</tr>
<tr>
<td>24</td>
<td>Egypt</td>
<td>&lt;0.1</td>
<td>Maize</td>
</tr>
<tr>
<td>25</td>
<td>Slovakia</td>
<td>&lt;0.1</td>
<td>Maize</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>134</td>
<td></td>
</tr>
</tbody>
</table>

Source: James (2009)
Intellectual Property Rights and Agricultural Biotechnology:

When Science Meets and Interacts Law

Biotechnology as a means to benefit poor farmers has to be made available to the crop cultivators and to the public research institutions that will develop new varieties using biotechnology tools. Specifically, modern biotechnology has enhanced the importance of IPRs, which not only stimulate protection for the genes, tools, and processes that are an increasingly common part of modern plant breeding, but has also spurred the introduction of legal protection for plant varieties and hybrids in some countries.

What are Intellectual Property Rights?

IPRs are special kinds of property rights awarded by society to individuals or organizations principally over intangible assets associated with human ingenuity and creativity: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce (Suri, 2007). The Universal Declaration of Human Rights provides a broader definition of this concept: “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,” balanced by “the right [...] to share in scientific advancement and its benefits.” Several distinct forms of IPRs exist, including copyright, patents, trademark, plant variety protection, and geographical indication. Those evolved over time to define and deal with various forms of property. These IPRs share the principle that innovators receive a high priority or exclusivity in the economic exploitation of the product of their work.
**Why Intellectual Property Rights?**

John Locke’s labor theory of property, one of the foundations of traditional property rights in the modern world, is a logical starting point for attempts to justify IPRs. Specifically, the protection of exclusive ownership regarding intangible objects acquires value mainly from creative efforts. Property rights are well entrenched in the institutional setting of many societies, and have been considered as integral part of capitalism and market-oriented economies (e.g. Moschini, 2001). For instance, it is argued that the private sector will not be interested in investing in research, unless the IP ownership generated by the research is legally recognized and protected (Pardey, Wright, & Nottenburg, 2002). These sectors want a certain degree of limited monopoly to profit from advances and allow them to recoup their investments. In the 1960s, 1970s and 1980s, it was reported that private-sector investment in plant improvement research was limited, particularly in the developing world, owing to the lack of effective mechanisms for proprietary protection of the improved products (Food and Agriculture Organization, 2004). Proprietary protections, provided for biotechnology inventions namely patent protection and protection for plant varieties either through patents or *sui generis* system, provided the incentives for private sector entry in agricultural biotechnology research. By granting temporary exclusive rights on inventions, IPRs are intended to allow these companies to price these commercial crops above marginal cost, and recoup their initial research investment.

Another perspective focuses on IPRs as a system of rewards: a form of compensation for the results of the inventors’ efforts to come up with tangible or intangible output. Such exclusive rights create incentives for the performance of R&D leading to innovation (Legre, 2004) and commercial use of which ultimately facilitates the betterment of society. The rationalization of IPRs as an incentive system seems to be a major motivation in the patent laws of many countries.
For example, Article 1, Section 8 of the US Constitution—which empowers Congress to enact intellectual property legislation only as a means to “Promote the Progress of Science and useful Arts” (US Constitution).

Other justification for IPRs is derived from a traditional doctrine of utilitarian inference, whereby the right to property is granted based on maximizing the benefits society can obtain (Maskus K., Intellectual Property Rights in the Global Economy, 2000). Neo-classical economic theory shows that public goods are not provided at an optimal, socially desirable level. Since public goods are open to all (non-rival and non-price excludable), this means that they can typically be reproduced, regardless of cost; further indicating that innovations may be copied and imitated. This may create market failure since individuals and firms cannot prevent competitors from making use of the newly produced goods. If firms cannot appropriate the full returns from producing knowledge, they will have less incentive to invest in knowledge-producing activities. R&D with potentially high social returns but low expected private returns will not be undertaken. Since private sectors are also driven by commercial interests and firm’s profitability, their research investments naturally focuses on genetic engineering of crops and traits that can be protected and commercialized in higher income countries and not on agricultural public goods, such as minor crops and traits of importance to subsistence farmers in marginal production environments (Glenna and Jussaume, 2010).

IPRs will provide incentives that allow private investors to harvest the profits generated by their effort rather than have the gains shared with free-riders, hence, they can correct market failure. However, the tradeoff is that the high cost that comes with IPR protection may lead to the rising prices of goods and technology above an efficient level based on production costs (or more precisely their marginal costs). Underutilization of knowledge and underproduction of
goods also result in a loss to the economy. Under this context, IPR laws are beneficial as it results to greater innovative activity, more technology supply, exceeding the losses in higher product and technology prices.

Other than stimulating the production of new knowledge, the IP system facilitates its dissemination. The modern concept of IPR protection by a society is some kind of “quid pro quo,” or concession, granting exclusive rights to creators to exploit their intellectual creations for a limited period in exchange for the full disclosure of the invention. This disclosure requirement which is meant to contribute to the desirable dissemination of scientific and technical information is an additional societal benefit.

**Kinds of IPRs Relevant to Agriculture**

Although IP may be applied to any R&D field, it has become subject to attention and controversy when dealing with agricultural biotechnology. Similar to other inventions, there is an obvious need for the protection of biotechnological inventions, not only in the interests of inventors and their institutions but also in the public interest to promote technological progress. There tends to be more pressure for more stringent IPR protection in agricultural biotechnology because many of the agricultural biotechnology products and processes are easier to copy than in other areas of technology: seeds can be replanted, genes can be cloned based on sequence information, and methods can be copied following established protocols (Mayer, 2003).

A crucial development that triggered increased IPR protection in the biotechnology industry was the 1980 Supreme Court decision in the Diamond versus Chakrabarty case (Diamond, Commissioner of Patents and Trademarks v. Chakrabarty, 1980) which stated that a live, human-made, genetically engineered bacterium of the genus *Pseudomonas*, modified to
break down components of crude oil could be patented. International developments in the legal IPR regime, particularly the setting up of Trade Related Aspects of Intellectual Property Rights (TRIPS) in the World Trade Organization (WTO), initiated an era of rapid expansion in the patenting of new biotechnological innovations and products (Brewster, Chapman, & Hansen, 2005). Under TRIPS, WTO members are obliged to provide most of the existing type of IPR protection for all inventions, including those in biotechnology. The nature and scope of IPRs 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 States or Europe (The International Bank for Reconstruction and Development & The World Bank, 2006). With this changing legal doctrine on IPRs, not only do some countries allow the use of patents to protect plants, varieties, and genes, but the majority of tools and processes connected to molecular biology and genetic transformations that can be used for agricultural research can also be protected. The protection of these types of technologies has made IPR protection an international concern.

The most common IPRs in agricultural biotechnology are patents, material transfer agreements (MTAs) and plant breeders’ rights (PBRs) (Kowalski, Ebora, Kryder, & Reichman, 2002). Patents are usually granted for a “purified” or “isolated” sequence (such as cloned DNA) that is in a form not found in nature per se. The standard requirements for a patent include: an inventive step must be clear, novelty and enablement must hold, and specific and substantial utility (e.g. use of genetic information in a probe to diagnose a specific disease) must be shown.
IPR protection for plants that are sexually reproduced (by seed) or tuber-propagated are best protected using PBRs or through plant variety protection (PVP) certificates. These certificates share many similarities with patents. Varieties claiming a protection certificate must be new and must satisfy requirements of distinctiveness, uniformity, and stability. The protection offered by PVP certificates is similar to that offered by utility patents (including a standard 20-year term) with two qualifications: “a research exception” wherein protected varieties can be used by others for research purposes to develop other new varieties; and “a farmer’s privilege” wherein seed of protected varieties can be saved by farmers for their own replanting but not for reselling protected seeds. MTAs are a preferred mechanism for the transfer of tangible property such as, among others, cloned genes, plasmids, and vectors in countries where IPR enforcement is not appropriate (Kowalski, Ebora, Kryder, & Reichman, 2002). In addition to these three, trade secrets law offers further protection that is relevant to plants. This is particularly 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 secrets law.

**Strengthened IPRs in Agriculture: Whose Ballgame?**

To protect innovations in the life sciences that are relevant to agriculture, the current trend is for patents to assume more and more importance, relative to plant breeders’ rights. In the US, the upward trend in agricultural biotech patents has outpaced the overall upward trend in patenting throughout the economy (Figure 1). In particular, crops more amenable to the application of DNA modification techniques (e.g., corn) are experiencing a rapid growth in the number of patents. Currently, private firms are assigned 85-90 percent of all these utility patents
issued in a year in the United States alone (Heisey, King, & Rubenstein, 2005). Roughly, one
third of the $32 billion total public and private agricultural research investment worldwide comes
from the private sector (Chrispeels & Sadava, 2003). Given that a sizeable (and growing)
portion of agricultural R&D is now performed by private firms that supply inputs to agriculture,
it is not surprising that IPRs are becoming increasingly important in agriculture.

Figure 1. Upward trend in agricultural biotech patents in the US. As shown, agricultural
biotechnology patents have outpaced the overall upward trend in patenting throughout the
economy, 1976-2000. (Economic Research Service - United States Department of Agriculture,
2004).

The use and development of materials for which IPR protection is sought does not only
apply in the commercial sector. Universities, especially in the US, have also been rapidly
patenting in agricultural biotechnology, and are reported to produce about 3,000 US patents per
roughly one-fourth of the US patented inventions on agricultural biotechnology (i.e. tools
necessary to do basic biological research to develop new GM varieties) were made by public
sector researchers in different US universities (Figure 2).
Figure 2. Modern agricultural biotechnology patents by sector. US universities, next to US firms, have actively pursued patenting of modern agricultural biotechnology.

**IPRs and Benefits: Varying Viewpoints**

Systems for IPRs have long been recognized and widely used in industrialized countries as an essential prerequisite to the development of knowledge-based industries, yet until recently, IPRs were not an issue economically and politically. Strengthening of IPRs 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.

Experts in favor of IPRs argue that, if some IPRs are good, more IPRs must be better. For instance, Maskus (2000) used the rationale of IPRs as an incentive for innovation and expand investment and technology transfer to justify its existence in developing countries. As noted by Boldrin & Levine (2002), economic agents are reluctant to exercise productive effort unless there is certainty of controlling its fruits. Hence, strengthening IPRs will ensure that a country’s resources are allocated to the most valuable uses. The importance of IPRs to the economy was
also defended by Gaisford and his co-authors (2001) who contended that although the grant of monopoly rights on an invention would impede its dissemination, under-provision of protected goods and monopoly distortions are usually considered acceptable costs to promote the creation of new knowledge and the increase in societal welfare that comes with the new generation of knowledge and new products. Kanwar (2006) claimed that strengthening IPRs could lead to greater innovation in developed countries, which in turn, could be helpful for developing countries. Similarly, it was also argued that strengthening IPRs affect innovation and economic growth (Gould & Gruben, 1996) directly and indirectly through the flow of foreign direct investment (FDI) and transfer of technology from the North to South (Taylor, 1994). The advent of multinationals in developing countries can generate important spillovers into the local economy and can pursue local R&D to exploit the intrinsic characteristics of the domestic market (Maskus K., Intellectual Property Rights in the Global Economy, 2000). This implies that even if a country is not sufficiently advanced to generate its own innovations after strengthening IPRs protection, invention activity can still be boosted by attracting innovative foreign firms.

New innovations and new product developed adds to stock of human knowledge. Thus, the cost of innovation falls as human knowledge accumulates (Gould & Gruben, 1996). Accordingly, by creating an environment conducive to such knowledge accumulation, IPRs will tend to increase innovation and economic growth. By stimulating invention and new technologies, according to report of OECD (2009), IPRs can help increase agricultural production, promote domestic and foreign investment, facilitate technology transfer and improve the availability of food to combat hunger. The report takes the view that the functional and workable system used by developed countries in advancing the agricultural sector could also be successfully applied in developing countries.
While many see IPRs as beneficial, others see the opposite and question whether IPRs lead to positive development outcomes. There exists a vociferous lobby of those who believe that IPRs are likely to cripple the development of local industry and technology will harm the local population and benefit only the developed world. Growing numbers of authors have maintained that IPRs do not play an important role in stimulating innovation in developing countries (Jaffe' & van Wijk, 1995; Thompson & Rushing, 1996; Sakakibara & Branstetter, 2001; Commission on Intellectual Property Rights, 2002) and that the strengthening of IPRs benefits industrialized countries while hurting developing countries (Pagariya, 1999) especially those that undertake limited or no R&D (Falvey, Foster, & Greenaway, 2006). Helpman (1993) provided theoretical support that stronger IPRs grant enough market power favoring welfare of the North at the expense of the South; hence, reducing innovation rate. In his model, products innovated in the North must also be produced in the North. All of these authors contend that technological capacities differ widely among developing countries, which imply that not all of them could easily assimilate technologies from other countries, let alone develop their own technologies. Imitation can be a source of technological development due to low level of innovative capabilities in developing countries and strengthening IPRs results in reduced growth by decreasing imitation of domestic industries that rely on pirated technologies (Horrii & Iwaisako, 2007). A strong patent regime, hence, will only attract foreign firms and discourage domestic innovative activity. IPRs (e.g. patents) provide long monopoly periods for these firms hence increasing the number of monopolistic firms, which limit competition within the economy as a whole. Monopolist limits output to below socially desirable levels, leading to reduced consumer welfare or dead weight loss. Hassan, Yaqub, & Diepeveen (2010) in support stressed that this movement to strengthen IPRs was initiated against developing countries, underscoring the
absence of earlier empirical evidence to justify the socio-economic benefits for developing countries from strengthening IPRs.

Overall, most of the polarized debates concentrate on the impact of more rigorous IPR regime on certain aspects of technology diffusion for example, arm’s length technology transfer, foreign direct investment (FDI), and exports. Proponents of strong IPR protection argue that they provide incentives for innovation and intentional knowledge transfer while opponents stress the reduction in knowledge spillovers through imitation that shifts all the rents of innovation to large enterprises, such as multinational corporations. This lack of consensus on the impacts of stronger IPR protection especially on specific sectors (e.g. agriculture) points to a need for more empirical investigations and case-by-case analysis of this important issue.

Implications of IPRs to the Agricultural Biotechnology Agenda of National Research Institutions in Developing Countries

The public sector has a long history of providing the world with important agricultural innovations (Graff, Cullen, Bradford, Zilberman, & Bennett, 2003; Pray, 2001). Public R&D institutions (i.e universities and government-funded research laboratories), are viewed by people as public servants (Danbom, 1986) that provide service of well-specified missions in which there is national interest not easily served by private institutions. They produce, among others: scientific and technological information (which can increase the efficiency of applied R&D in industry by guiding research towards more fruitful departures), equipment and instrumentation (used by firms in their production processes or their research), skills or human capital (embodied in students and faculty members), networks of scientific and technological capabilities (which facilitate the diffusion of new knowledge) and prototypes for new products and processes.
(Sampat, 2006). These outputs diffuse (or alternatively transferred to) through different channels such as hiring students and faculty, consulting between university faculty and firms, publications, presentations at conferences, informal communications, start-up company formation, and licensing of IPRs by public R&D institutions. These channels vary over industry and time.

In developing countries, these public research institutions are very active in agricultural biotechnology (Cohen, 2005). Moreover, as shown in Table 1, biotechnology is increasingly being used to improve crop breeding. Biotechnology R&D activities for banana, cassava, cowpea, plantain, rice, and sorghum, and on traits needed for food security, such as abiotic stress tolerance and quality is rapidly increasing in Argentina, Brazil, China, Cuba, Egypt, India, Mexico, and South Africa (Dhlamini, Spillane, MOss, Ruane, Urquia, & Sonnino, 2005).

However, like any other technologies, modern biotechnology presents new opportunities and challenges to impact how society functions, and public research institutions developing them need to better model the use and how it needs to be diffused to change and help the clienteles (e.g. farmers) they serve. The current proliferation of IP ownership on modern biotechnology tools, products, and processes worldwide, poses significant challenges to public sector institutions in developing countries, which are dependent on technologies generated by developed nations. The implications of IPRs to national research institutions center upon two important issues: 1) access; and 2) impact to public mission.

**Access and Conduct of Research.** Biotechnology innovations can benefit farmers in developing countries, if these countries and public research institutions that would develop the technology can gain access to these innovations and devote them to commodities and traits that
benefit all farmers. With strengthened IPRs, accessing these tools is now quite a challenge for these institutions. It is often said that currently, no biotechnology R&D project can be implemented without touching any IP issues. As Maredia, Oehmke, & Byerlee (2004) emphasized, “the inventor of a new transgenic variety, for instance, may have to address the following types of prior IPRs: 1) protected varieties into which the genetic material is to be inserted; 2) patented gene insertion techniques; 3) patented gene promoters; 4) patented marker sequences; and 5) previously incorporated patented traits (and their underlying genetic sequences)” before it can start working on varietal improvement through biotechnology. Access to new technologies and modern scientific methods covered by IPRs, and their eventual commercialization, would also require formal yet complex licensing agreements with corresponding royalty payments to the IP owners to avoid infringement of IPRs. (Van Wijk & Komen, 1993; Maredia, Erbisch, Ives, & Fischer, 1999). These licensing fees, as noted by Graff, Cullen, Bradford, Zilberman, & Bennett (2003) “led to the high transaction costs in obtaining R&D inputs.” The high degree of fragmentation in technology ownership on these research products across numerous institutions adds to the problem. This fragmentation produces situations where no single institution can provide a commercial partner with a complete set of IP rights to ensure freedom to operate (FTO) – the ability to practice or use an innovation – for a particular technology (Atkinson R., et al., 2003). The case of “enhanced beta-carotene” rice, reported to be based on technologies protected by about 70 patents and originally held by 31 different organizations (Kryder, Kowalski, & Krattiger, 2000), sets the best example of this type of complexity. Other types of biotech inventions may have similar problems with previously held patents. With IPR protection becoming a norm, it is also an open issue as to how many genomic
and proteomic sequences will be available in the public domain, and how many will be patented and available for a fee (Maredia, Oehmke, & Byerlee, 2004).

Under this changing environment for IPR protection, hence, agricultural research organizations in developing countries need to analyze how new technologies or products can be acquired and under what conditions. These developments also mean that the public research institutions have to undertake negotiation deals, which entail additional transaction costs. These also mean that public research institutions need to do seek assistance for a freedom-to-operate (FTO) agreement for them to use proprietary technologies royalty-free for research since acquiring biotech IPs through licensing may not be the best option for public sector institutions due to budget constraints. Because of strategic access considerations, IPR owners may also refuse to license enabling technology tools, even for developments not covered by their own product scope. Should R&D institutions want to commercialize locally developed agricultural biotechnology crops in which IPR-protected technologies are incorporated, they are legally obliged to negotiate and renegotiate with the IPR holders the terms and conditions under which commercialization take place. When no agreement on waiving of IPRs is reached, delay in commercialization could occur. Pardey, Wright, Nottenburg, Binenbaum, & Zambrano (2003), however, said that the concerns on developing-country access to essential IP is exaggerated, largely misdirected, and that the relationship among IPRs, agricultural research, and national research institutions in developing countries is poorly misunderstood. These authors have claimed that agricultural research centers have far greater FTO in agricultural research on food crops for the developing world than is commonly perceived. They also have claimed that agricultural researchers are freer than generally perceived to make use of innovations protected in the developed countries owing to the absence of an “international patent right.” There is no
such thing as international IPR law, so IPRs granted in one country do not automatically apply in others unless specific steps are taken to secure such rights. Thus, if there is no protection, one country and their public R&D institutions can freely use patented or copyrighted technologies once they become publicly disclosed through the process of patent grants or through the distribution of copyrighted materials, and can ignore the patent laws of another. But those technologies cannot be legally exported to countries where they fall under IPR protection.

To Embrace IPRs or Not: Impact on Public Sector’s Mission to Disseminate Public Good. The increased push for IPR protection for publicly-funded research means that public research institutions also need to investigate the possibility of their own research organizations developing the means of protection and commercialization of their technologies and products (Salazar, Falconi, Komen, & Cohen, 2000). Public sector institutions in developed countries, especially US universities, have increased their patenting and commercialization of modern agricultural biotechnology (Heisey, King, & Rubenstein, 2005). These efforts, which now play an important role in the university environment in the US, and are now increasing in other countries (like Austria, Denmark, and Germany, among a few), represent each institutions commitment to improve the public good by promoting the development of its intellectual property into usable products bringing about private and social benefits. IP protection and commercialization have the collateral benefit of enhancing the impact of publicly-funded research and development (R&D), promoting economic growth through the creation of companies around academic technologies, job creation, and attendance to economic multipliers. Other principal attraction of this process is the possibility of using them to raise revenues, especially when these institutions are expected to generate a portion of their income.
According to Maredia, Erbisch, Ives, & Fischer (1999), it is economically and socially justified for a public research institute to protect its IP when this helps to negotiate public-private cooperative relationships that hasten the development and commercialization of new products and services, particularly when the public sector does not have the business skills and venture capital to bring products to market. Given that the private sector is currently the largest investor, major owner of IPRs, and the main disseminator of new agricultural technologies — innovative, complementary, and synergistic public-private partnerships has long been promoted as recipe for success to foster socially beneficial agricultural biotechnology research. Current approaches to public-private sector partnerships include joint ventures in R&D with equal sharing of costs and returns on investments, information and knowledge sharing, technology transfer, outright donation of technology by private firms to national public research institutes, and institutional capacity building. Ingram & Rubenstein (1999) cited two important advantage of these partnerships for the public sector: collaborations with the private sector enable the public institutions to transfer technologies to the marketplace and supplement its limited public R&D resources.

Public research institutions in developing countries, may also want to use these rationales, and protect and commercialize biotechnology innovations, which they have developed with their own capacity and resources. Some national research institutions such as those in the Philippines, India, Malaysia, Thailand, Kenya, etc. are beginning to apply for patents on some of their innovations. These developments, however, raise several issues. One concern is that agri-biotech products generated by these institutions should not be protected because they are supported by public funds and thus should be ‘public goods’ and freely available. Sociologists of science find legal protection of IPRs as a violation of scientific cultural norms, which were
supposed to align the self-interest of individual researchers with the common goal of scientific progress. To them, scientific progress is linked with an ideal of free and open dissemination of scientific information. They argue that expansion of IPRs will adversely affect and/or impede dissemination of new technologies and innovations and exchange of information among scientists, an important aspect of scientific research. Many have argued that the implicit outcome of this trend in public institutions threatens to undermine the effective role of academic and scientific institutions in the “public sphere.” Many authors have also expressed the concern that innovation such as in agricultural biotechnology fields is ultimately held back, rather than encouraged, when IPRs protection is granted to the sorts of ideas that have traditionally been left in the public domain. Heller & Eisenberg (1998) talk of an "anti-commons" effect associated with early IPRs protection, arguing that "a proliferation of IPRs upstream may be stifling life-saving innovations further downstream in the course of research and product development."

Some critics contended that due to increasing partnership with the private sector commercial interests are changing university research from a publicly-funded enterprise performed for the social good into one pursued for private purposes and monetary gain. As Davis, Larsen, & Lotz (2000) specifically claimed, “the freedom to choose research subjects by public sector scientists may come under pressure whenever institutions “behave like firms” and institutions are encouraged or even forced to produce patentable and research results with commercial value; suggesting that non-patentable research activities are discouraged”. Meanwhile, some also questioned university-industry arrangements as a move that resulted in the suppression of research results. These university-industry arrangements further led to less dissemination of public research; thereby, hindering technological progress.
STATEMENT OF THE PROBLEMS

Researchers have undertaken a growing body of work to better understand the socio-economic effects of strengthening IPRs in developing countries, both from theoretical and empirical perspectives. In recent times, many studies have been done to ascertain the impact of IPRs on economic growth and various economic variables such as foreign direct investment (FDI), trade and innovation, as well as key areas such as public health and traditional knowledge (Hassan, Yaqub, & Diepeveen, 2010). Little empirical evidence is available concerning the impacts of IPRs, especially as it relates to agriculture. Reviews of the literature also reveal that unlike in the United States, Europe and other developed countries, diffusion of IPRs in developing countries and its impact on agricultural development and to public agricultural research are not well-documented and researched. If there is empirical evidence citing impacts of IPRs, they pertain to economic growth and development as a whole. However, generalizations are difficult to derive from such studies because agriculture is only one sector of the economy. All previous studies indicate the lack of uniform result and suggest that a case-by-case analysis must be performed to determine how IPRs protection will affect the development of a country’s agricultural sector. There is also limited published research on determining the current implementation status of IPRs in national research institutions as it relates to public agricultural research and the perception of the scientific community towards IPRs especially in Asian developing countries. As Binenbaum (2004) pointed out, the state of art in the IP challenges confronting nonprofit agricultural R&D is one in which a collection of recent papers convey "many interesting insights," but remain "essentially collections of ad-hoc observations without a clear analytical framework" or "explicitly systemic perspective.” Hence, there is a need to bridge these gaps and provide an overview of the current status, perceptions, and developments in the
area of intellectual property in developing countries and how it is affecting agriculture and public agricultural research in these countries. There is also a need to evaluate the knowledge and awareness, experience with, and perception of public agricultural research towards IPRs and its developments as they affect the agricultural biotechnology initiatives. These need to be studied to determine progress and constraints of implementation, areas of success, and areas needing intervention for the developing nation and their institutions.

PURPOSE OF THE RESEARCH

The premise of this research is based on the understanding that IPRs have never been as economically and politically important or controversial than they are today. IPRs specifically are becoming an important element in agricultural research, particularly in agricultural biotechnology. Hence, there is no doubt that a better understanding of IPRs is indispensable to informed policy making in all areas of development, including agriculture. For this reason, IPRs and its impact to the future of agricultural biotechnology in developing countries should gain priority in public discussions. The main goal of this doctoral study is to conduct an interdisciplinary analysis of the responses of developing countries and their national research institutions on IPR developments associated with agricultural biotechnology. Specifically, this research was conducted to:

1. determine whether strengthening of IPRs impact agricultural development;
2. document and analyze current IP management policies and practices at public research institutions in Asian developing countries and determine how these changes have affected their acquisition of research technologies from other institutions;
3. understand how IPRs are perceived by the scientific community in different national research institutions in developing Asia and develop econometric models to determine factors that affect these perceptions; and

4. recommend policy measures and future undertakings for developing countries to cope with international developments on IP and technology transfer affecting agriculture and agricultural R&D.

RESEARCH QUESTIONS

The main issues that this dissertation aimed to determine and answer include: (1) whether IPRs impacts of agricultural development in developing countries mirrors what has taken place in developed countries; 2) how developing countries are responding to the issues and impacts of IPRs especially those associated with agricultural biotechnology; (3) how public sector research currently perceives of the role and importance of IPRs in public agricultural research; and (4) factors that influence attitudes on IPRs among public sector personnel. Specifically, this research attempted to answer the following questions:

1. How does membership to IPR treaties (e.g. TRIPS), enactment of national policies regulating IPRs; and increased IPR protection impact agricultural development?

2. Are public research institutions in developing Asia ready to embrace IPRs and develop their model as IP-based? Do institutions have similar responses? Do IPR-related provisions of TRIPS, ITPGRFA, and CBD affect their system of access and transfer of genetic materials, which are critical components in doing agricultural biotechnology? Do the paradigms shifts really redefine how agricultural research organizations provide public goods to meet their country’s food and agricultural needs? Do IPRs impacts acquisition, and generation of
agricultural biotechnology and does it exert pressure for these institutions to change? Are
current efforts adequate to help these institutions address and cope with the complexity of
formulating decisions with regard to the stronger IPRs regime in agriculture? What then
remain to be the main gaps in managing institutional IP, and what are the IP management
capacity needs of these institutions?

3. Are scientists in the public sector, being one of the most important human resource of the
public research institutions, aware and ready for the impacts of IPRs? Are they following
the trend and footsteps of their private sector counterparts? What are the factors affecting
their acceptance/non-acceptance of the concepts and benefits/risks of IPRs? What are the
relationships formed among these factors?

**SIGNIFICANCE OF THE RESEARCH**

In this age of seemingly unprecedented scientific and technological breakthroughs, it is of
considerable interest to analyze the role that IPRs may play in bringing about innovations and
growth in agriculture. This research hence offers a contribution to current literature and
empirical research analyzing the impact of IPRs to agricultural development of developing
countries. It also offers an analysis of the current awareness, perceptions, and needs of public
sector research in Asian developing countries towards IPRs through an interdisciplinary
approach. An interdisciplinary approach using economics and sociological tools makes particular
sense in relation to questions about IPRs protection for biotechnology research tools because
traditional economics and sociology have perspectives to contribute on IPRs. Traditional
economic theories tend to support strong IPRs in general, while traditional sociology of science
theories emphasize the importance of free and open scientific exchange.
A review on the present capacity of some public research institutions in dealing with IPRs in agricultural biotechnology is also worth pursuing to determine the progress and constraints of implementation, areas of success, and areas needing intervention in IP management. Individuals play a major role in the success or failure of innovation processes and policies. Recognizing that IPRs are meant to support R&D, institutions represented by their heads and administrators, and scientists involved in research should be the first actors to perceive their impacts.

The outcome of this research is potentially relevant to the current debates and policy reflections on IP management among developing countries and their public agricultural research systems. This dissertation will help open the door to transformative change among public R&D institutions on how they manage and exploit IP. Results of this research may also serve as reference in developing further capacity building programs on IP management to help developing countries and institutions in Asia respond to the changes and challenges brought about by IPRs developments.

**DELIMITATIONS AND LIMITATIONS OF RESEARCH**

The research mainly focuses only on developing countries that are members of the Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization (TRIPS-WTO). Developed countries that are WTO-TRIPS members were also studied to confirm the positive influence of strengthening of IPRs to their agricultural development.

Yet other international agreements influence IPRs such as agreements over rights to traditional knowledge or national sovereignty over plant genetic resources, this research mainly concentrated on the introduction of IPRs as a result of the WTO-TRIPS Agreement. It referred to
aspects of other IPRs-related international agreements and organizations only when they are important to the discussion. Analysis did not go beyond interaction and complications of these legal developments as they have been extensively analyzed by several authors. This research did not also include an in-depth discussion of the philosophical and policy goals served by granting legal protection. However, a basic familiarity with these goals was presented to understand how the IP systems have evolved into their present forms.

This dissertation also spins-off from the interest in access, protection and commercialization of agricultural innovations (e.g. biotechnology) among public agricultural research institutions in developing countries. The huge debate on the ultimate value and criticisms of biotechnology for developing countries, discussed abundantly elsewhere, is beyond the scope of this research. Only the public R&D institutions initially focused on five countries in developing countries in Asia and their key personnel including the heads and senior researchers conducting agricultural biotechnology research were selected in this research. Public agricultural research in this research only refers to plant genetic resources research.

**ORGANIZATION AND SCOPE OF THE RESEARCH**

The starting point of this research is that the implementation of IPR systems is likely to be appropriated at some stage for developing countries, as it has been historically made important contribution to research and innovation for developed countries. The author contends that IPRs are here to stay and will continue to be rapidly diffused across the globe. However, IPRs has its advantages and disadvantages for developing countries and their public agricultural research institutions. The system provides the incentive for individuals and institutions to invent and develop new technologies that may benefit society. However, such incentive works
differently and its implementation depends on the capacity of individuals and institutions to respond to IPR developments. In addition, most key inventions in food and agriculture will occur and continue to occur at public-sector research institutions. Public funding must maximize public benefits through appropriate IP management and technology transfer of agricultural biotechnology, and from this process, food security is certainly an important public benefit.

Hence, this dissertation was conducted to determine whether IPRs benefits agriculture of developing countries the way it benefitted the economies of developed countries. This was also conducted to determine the current initiatives, perceptions, and capability building needs of developing countries and their public research institutions on IP management and technology transfer. This research has five component studies, namely:


Study 2. Institutional Responses on Strengthened IPRs in Agriculture and Needs’ Assessment on IP Management of Public Research Institutions in Asian Developing Countries;

Study 3. Scientists’ Understanding and Attitudes toward Intellectual Property Rights (IPRs) and their Impact to Research, Development, and Commercialization of Public Agricultural Research;

Study 4. Impact of Socio-Demographic Factors on Attitudes of Public Research Institutions’ Personnel towards Intellectual Property Rights (IPRs): An Econometric Investigation;

and

The first paper relies extensively on a review of the existing literature to establish a base understanding of the different IP systems of the country members of TRIPS. An econometric approach based on secondary data was then used to measure the impact of IPR policies and initiatives on agricultural development. Recognizing that the development of an effective program to spread the importance of IP management and technology transfer requires a thorough understanding of the attitudes and perceptions concerning intellectual property, two surveys were done to consult and collect primary data from institutional heads and scientists from different institutions in five countries in Asia: India, Malaysia, Philippines, Thailand, and Vietnam. The second paper specifically was done to consult with institutional heads from public research institutions to document and compare the experiences of their institutions in handling IPRs and associated developments affecting acquisition, generation, protection, and commercialization of agricultural biotechnology. This paper also did a needs’ assessment on IP management and technology transfer to serve as reference and guide for national and international institutions that aims to develop IP capacity building programs for these institutions in these countries. The third paper’s objective was to understand how IPRs are perceived by the scientific community in these five countries and their national research institutions. The fourth paper did an econometric analysis to determine factors (e.g. socio-demographic characteristics) that affect the perceptions and attitudes of research managers and researchers on IPRs and its implications to public agricultural research. The fifth study summarized and analyzed the findings of the four studies in terms of policy and theoretical implications. Lastly, this dissertation offers policy changes and recommendations to help developing countries and their public R&D institutions efficiently respond to the challenges of IPRs.
ABSTRACT

This study aimed to quantify the importance of strengthened IP policies on agricultural development of members of Trade-Related Aspects of Intellectual Property Rights (TRIPS). Setting the global IP standards today, TRIPS is an important IP agreement to study while the importance of agriculture to the economies of TRIPS member-countries makes it a bellwether for gauging the impact of TRIPS on agricultural development. Specifically, this study estimated the impact of strengthened IPR systems using different models and using a time series cross section data of 103 TRIPS member countries using secondary data from 1980 to 2005. Empirical results support a link between strengthened IPR systems and agricultural Gross Domestic Product (GDP) not only for developed countries but also for developing member-economies of TRIPS.

Keywords: TRIPS, IP, IPR, agriculture, development, developed countries, developing countries, TSCS, econometric, agricultural GDP
INTRODUCTION

With intellectual property rights (IPRs) being an important part of an economy’s system of innovation, and the increased interest in generating additional profits leading to more research and development (R&D), and hence fuelling economic growth (Romer, 1990; Grossman & Helpman, 1991), there is a strengthened global initiative in continuously encouraging economies to manage and protect their intellectual property positions. Central to the stronger reinforcement of IP rights around the world is the TRIPS Agreement (United Nations, 2000; Maskus, 2000; Archibugi & Filippetti, 2010), an important agreement in the establishment of the World Trade Organization (WTO) that aims to harmonize IPR protection worldwide. Strengthening of IPR implementation has taken place in developed countries and many developing WTO country members have been working to improve their IP systems to comply with TRIPS standards. Maskus (2000), who support this trend of “upward harmonization” by TRIPS, claimed that this will positively promote trade, foreign direct investment, and global innovation. However, some scholars contended that the harmonization of these laws could ossify the imperfect IP system of the North, impede development, and further widen the North-South divide (including Reichman & Dreyfuss (2007), Ramanna (2009), Kapczynski (2009), among others). In the area of agriculture, Wapal (1998) claimed that IPRs raise crucial issues for the future development of the sector, whether as a spur for innovation (by protecting the products of that innovation) or as an obstacle to dissemination of new technologies (by granting monopoly rights to the innovators).

In spite of the growing debate on the effect of IPRs on economic growth, the kinds of studies that determine the effects of the harmonization efforts and/or strengthening of the IP systems on agricultural development in TRIPS member countries using econometric framework is surprisingly of limited number. Most literature limits itself to research on the impact of more
rigorous IPR regime on certain aspects of technology diffusion in developing countries, for example, arm’s length technology transfer, foreign direct investment (FDI), and exports from developed countries. Much of the evidence on the working of IPRs (e.g. plant breeder’s rights) and their impact has emerged from developed nations such as United States and United Kingdom which were focused on R&D expenditures, new varieties released, and market concentration.

Hence, this paper investigates the relationship between strengthened IPR systems and agricultural development covering not only developed countries but developing country-members of TRIPS using time-series cross-sectional (TSCS) regression methods. This study is grounded on the underlying hypothesis that IPRs can serve as one important factor to create an enabling environment for national innovation systems for economic growth. As a significant factor affecting agricultural development, IPRs positively contribute to agriculture, the backbone of the economy of the majority of the TRIPS member-countries. This hypothesis is consistent with the view that IPRs as a policy tool to promote growth in the agriculture sector is important for both developed and developing countries. Different econometric models were tested to determine relationships and found that all the measures that represented the strength and status of IPR systems except the combination of patent laws and plant variety protection laws showed significant relationship with agricultural GDP, the proxy variable for agricultural development.

TRIPS AGREEMENT AND AGRICULTURE

Central to the spread of IPR systems is the TRIPS Agreement (United Nations, 2000; Maskus, 2000; Archibugi & Filippetti, 2010). TRIPS sets minimum standards of IPR protection, which member countries can legislate. The agreement contains 73 articles which govern the use, trade, and protection of eight IPRs: (1) copyright and related rights, (2) trademarks, (3)
geographical indications, (4) industrial designs, (5) patents, (6) lay-out designs (topographies) of integrated circuits, (7) protection of undisclosed information (or trade secrets), and (8) control of anti-competitive practices in contractual licenses. TRIPS also incorporates all major international conventions and treaties on IPRs, such as the Berne Convention for the Protection of Literary and Artistic Works (1971); the Paris Convention (1967) for the Protection of Industrial Property; the Rome Convention (1961) for the Protection of Performers, Producers of Phonograms, and Broadcasting Organizations; and the International Convention for the Protection of Integrated Circuits (1989). Thus, TRIPS establishes a formal relationship with the World Intellectual Property Organization (WIPO), the body that administers most of the existing treaties on IPRs. As of July 2008, there are 153 signatories to TRIPS (World Trade Organization, 2010).

Like other international treaties, the TRIPS agreement also has its share of critics. The positive case for the TRIPS Agreement is made on the basis that the value of goods and services traded between countries increasingly lies in the technology, know-how, and the creativity embodied in them. IPRs are crucial to provide incentives for risk-taking, research, and innovation and to enable the free flow of trade in knowledge products. Those in favor of stronger IPRs and the creation of a “level playing field” hail TRIPS as a useful tool in achieving these objectives. However, serious doubts about the extent to which these positive effects of TRIPS may take place have been raised. It is asserted that TRIPS was pushed into the WTO by developed countries with their superior negotiating capacity. Meanwhile, those who believe that IPRs are bad for developing countries contend that the economic playing field was not fair even before the formulation of TRIPS, and that its introduction has reinforced inequality. These critics argue that the inclusion of IP rules in trade agreements has increased the existing imbalances in the global economy in which developed countries and multinational companies are the main
beneficiaries of open markets and international trade. At a global level, IPRs rules benefit primarily countries with technologies to sell (developed countries), at the expense of countries that are net importers of technology (Mushita, 2009). IPRs are being used strategically, particularly by big multinational corporations, to further their commercial interests. Corporations are able to capture and manipulate the IPR system to support a way of doing business that increases their global market power and ability to fend off competition. Many are concerned that these corporations’ efforts to protect their profits will isolate developing countries from the benefits of important innovations by blocking access to new developments by public and nonprofit researchers. By favouring the interests of IPR holders, the IPR system acts as a barrier and stifles the flow of knowledge which is the very foundation from which innovation thrives. Some scholars also argue that TRIPS will impede low-innovation economies from catching up with developed countries, and that the minimum standards set out in TRIPS are too difficult for poorer countries to implement.

In agriculture, the life patenting provisions of TRIPS have attracted much attention. Specifically, the provisions requiring signatories to implement a system of IPRs for the products and processes of biotechnology have raised the most widespread concerns. Article 27(3)b, for instance, requires all WTO members to provide some effective form of IP protection for plant varieties, as well as patent protection, for all other inventions, including those in biotechnology. However, certain exemptions are granted under TRIPS Article 27.3(b) which states that members may also exclude from patentability ‘plants and animals other that micro-organisms, and essentially biological processes for the production of plants or animals other than non-biological and microbiological processes. However, members shall provide for the protection of plants varieties either by patents or an effective sui generis system or by any combination thereof.’ The
term *sui generis* is, therefore, subject to both broad and narrow interpretation. The option of *sui generis* under TRIPs Article 27.3(b) provides sufficient flexibility for countries to design a system that best fits their circumstances and meets their goals and objectives. Accordingly, the scope of IPRs is being extended and existing IPR regimes are being strengthened in the countries who advocate for strong IPR regime. On the other hand, many developing countries have opted for a *sui generis* (of its own kind) system of intellectual property protection to comply with the requirements of TRIPs Article 27.3(b).

With the adoption of the TRIPS agreement, questions arose about whether such expansion of IPR protection to agriculture would be beneficial, both to producers and consumers, as well as its possible impact on food security (Commission on Intellectual Property Rights, 2003). Like medicines, a crucial issue is whether and how IPR protection can help promote research and innovation in the agricultural sector relevant to the needs of developing countries and poor people. The limitations placed by TRIPS on compulsory licensing, including the requirement of adequate compensation are also expected to impact agriculture of developing countries. There have also been increasing concerns about whether developing countries might lose their biodiversity, traditional knowledge and folklore, and traditional varieties to developed countries’ commercial interests, leading to “bio-piracy.” The concerns are logical as TRIPS authorizes other countries not only to exploit but even protect these valuable assets in their own countries as IPRs. Since most of the poor and developing countries’ economies are mostly agriculture-based, there is fear that with the enforcement of TRIPS, their agricultural development will be the first casualties. Thus, an important question is whether the enforcement of TRIPS will have a positive or negative impact on agricultural development in so-called “developing” countries.
PRODUCTIVITY GROWTH MODELS

Existing studies discussed factors considered to be important in determining agricultural productivity and development, an essential part of successful development strategies for countries (including, among others, Hauver (1989), Ball, Bureau, Nehring, & Somwaru (1997), Ahearn, et al., (1998); Nurkse, 1953; Rostow, 1960; Matsuyama, 1992). These include: quantifiable factors such as technical change, relative factor product prices, input use, education, agricultural research and extension, market access and availability of credit. Other factors include weather, farm production policies, land ownership patterns, inadequate involvement of beneficiaries in decision-making, insecurity and the legal and regulatory environment. Authors like Armagan & Ozden (2007) suggested that Cobb-Douglas type production function equations are appropriate for the functional analysis intended to measure the effects of these factors to agricultural productivity. Besides easy calculation, Cobb-Douglas production functions have the ability to test production flexibilities statistically and to obtain sufficient number of degree of freedom even where data are very few. The conventional Cobb-Douglas production function is expressed in the form:

\[ Q = f (AL^\alpha K^\beta T^\gamma Y) \]  

where \( Q \) denotes output, \( K \) physical capital, \( T \) intangible capital, and \( L \) labor. The technical efficiency of production is denoted by \( A \), and is assumed to be a function of environmental and institutional factors. Transforming this into log linear form: \( \ln Q = \ln A + \alpha \ln L + \beta \ln K + \gamma \ln T \) enables estimation of parameters. This functional form permits quantifying the marginal contribution of each category of inputs to aggregate production and mitigates the multi-collinearity problem.
Lewis, Martin, & Savage (1988) used a production function approach to calculate productivity growth rates for agriculture and for the remainder of the Australian economy (industry plus services) and concluded that the rate of productivity growth in agriculture had been higher than for the remainder of the economy. Several empirical studies including Hayami & Ruttan, (1970); Yamada & Ruttan (1980); Van Schalkwyk & Groenewald; (1992); Mundlak and Butzer (1997); and Zepeda, (2001) employed the Cobb-Douglas type of production function in the log linear form to analyze cross-country productivity differences and productivity growth in agriculture. The variables used in these studies include, amongst others, agricultural output as a dependent variable and labor, capital, technology and human capital as explanatory variables. Land and livestock were used to capture capital accumulation, fertilizer and tractors to represent technical aspects in production, and the level of education as a proxy for human capital.

The current study uses these factors, but the model’s main focus is on the relationship of strengthened IPR protection systems to agricultural development. Studies on the theoretical and empirical links between IPR protection and indicators of economic development are numerous. For instance, Park & Ginarte (1997) emphasized that patent rights stimulate factor accumulation (human capital, R&D capital, and physical capital) which, in turn, indirectly influence economic growth (Gould & Gruben, 1996; Schneider, 2005). Alfranca & Huffman (2003) estimated the impact of economic incentives and institutions on private innovation in agriculture using a panel of European countries, and found out the level of IP protection, institutional quality, economic openness and the lagged value of agricultural production to be positive and significant factors. Leger (2006) also analyzed the relationship between IPRs and innovation using a novel panel data-set of least developed countries and industrialized countries and found that IP protection was significant only at a low level for developing countries. Torstensson (1994), Svensson
(1998), and Kanwar (2006) also evaluated the link between property rights and economic growth. Kanwar specifically estimated a panel model for up to 32 countries between 1981 and 1990 and found that IPR protection has a significant positive effect on R&D investment. He concluded that stronger IPR protection can help spur innovation and technological progress, which in turn should impact positively on growth. However, Gould & Gruben (1996) in a study of 95 developed and developing countries from 1960 to 1988 found only a marginal effect of IPR on economic growth, which means that economic progress will not be experienced in all economies. Similarly, Thompson & Rushing (1996) estimated the impact of IPR on economic growth relationship and found differential effects of IPRs on the sample of countries studied. Their study involved 55 developed and developing countries over three time periods of five year intervals (1975 -1990), and indicated that IPRs had a positive significant effect on growth for the more advanced countries but had insignificant effect in developing countries. Prior studies also support the hypothesis that stronger IPRs increase both FDI and imports (see Khan, 1995; Lai, 1998; Lee & Mansfield, 1996; Hassan, Yaqub, & Diepeveen, 2010) leading to higher innovation rate. Cited studies are limited by the possibility that the strength of IPRs is an indicator of a well-functioning economy or legal system rather than the role of IPRs per se. Available sub-analyses indicate that the strongest effects are in high-technology sectors, which are typically most sensitive to IPR protection, suggesting that it is the property rights systems that are operational and not other associated factors. Yang & Maskus (2001) concluded that this finding is also applicable if production shifts via licensing. Helpman (1993) found that strengthening IPRs spurs innovation in the North only in the short run, and the South loses from stronger IPRs through a deterioration of its terms of trade, reallocation of production, and a global slowdown of innovation. Using a dynamic endogenous growth model, Saint-Paul (2004) revealed that the
South might lose more than the North from weak IPRs, and this will depend on relative comparative advantages and the growth potential of the goods concerned. All these studies, however, indicate a lack of uniform results and suggests that a case-by-case analysis must be performed to determine how IPR protection will affect the development of a country’s agricultural sector.

The research presented in this chapter uses the IPR protection index developed by Park (2008) to represent the status of IPR protection among the TRIPS members. Three alternative measures were used to represent the status of national IP systems based on domestic patenting activities, tier classification and a classification of countries whether they comply with patenting life forms of TRIPS and PVP provision. A human capital measure, defined as the ratio of skilled labor in the total labor force, was included to capture the efficiency of local imitation and the potential for the country to adopt and improve the new agricultural innovations. Population in the post-secondary education sector was used as proxy for human capital in the agriculture sector instead of the overall literacy rate; and the proportion of irrigated land was used as an additional variable to capture agricultural infrastructure. The presence or absence of GM crops was also included as new innovation in agriculture that is tied with IPR protection issues.

**METHODOLOGY**

Secondary data over multiple time periods and multiple cross sectional units were compiled to generate a panel dataset of 103 countries and annual data from 1980 to 2005. Since this study compared impacts of strengthened IPR systems in developed and developing countries, all 22 developed and 81 developing member-countries of TRIPS were included. With
TRIPS having no clear definition of developed and developing countries, this study used the classification by the 2010 International Monetary Fund’s World Economic Outlook Report (International Monetary Fund, 2010). Only 26 periods were selected since they contain sizeable cross section data. Our study used larger number of countries compared to studies by authors mentioned earlier. Table 1.1 presents the countries included in this research.

Table 1.1 List of sample countries.

<table>
<thead>
<tr>
<th>DEVELOPING COUNTRIES</th>
<th>DEVELOPED COUNTRIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola, Argentina, Armenia, Bahrain, Bangladesh, Belize, Benin, Botswana, Bolivia, Brazil, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Congo, Rep. Costa Rica, Dominican Republic, Egypt, Arab Rep., El Salvador, Gabon, Gambia, Georgia, Ghana, Guinea, Guinea-Bissau, Guatemala, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Jamaica, Jordan, Kenya, Kuwait, Kyrgyz Republic, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Rwanda, Saudi Arabia, Senegal, Sierra Leone, South Africa, Suriname, Swaziland, Sri Lanka, Tanzania, Thailand, Togo, Turkey, United Arab Emirates, Uruguay, Venezuela, Vietnam, Zambia and Zimbabwe</td>
<td>Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Italy, Japan, Korea, Netherlands, New Zealand, Portugal, Slovenia, Spain, Sweden, Switzerland, and United States</td>
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Econometric Model

In this research, an application of time-series cross-sectional (TSCS) modeling, which incorporates both across-units and across-time variation in data variables, was reported. The analysis focused on estimating the impacts of strengthened IPRs and country specific economic
The characteristics on agricultural development in TRIPS member countries using the panel data approach. Estimation for the pooled TSCS model is generally accomplished through a Generalized Least Squares (GLS) procedure since both the temporal and spatial properties of TSCS data make the use of ordinary least squares (OLS) problematic (Beck & Katz, 1995). The Da Silva method, which uses a two-step GLS-type estimator was selected for the different estimations (See SAS/ETS User’s Guide at University of Northern Iowa (2010). This method can be viewed as a mixed variance-component moving average model and can be expressed as:

$$Y_{i,t} = a_i + b_t + \beta X_{i,t} + \epsilon_{i,t}$$  \hspace{1cm} (2)

Where,

- $Y_{i,t}$ is the value of the dependent variable for the $i^{th}$ cross-section in the $t^{th}$ time period.
- $a_i$ is a time invariant cross-sectional unit effect;
- $b_t$ is a cross-sectional unit invariant time effect;
- $\beta$ is the slope parameter associated with the independent variable, $X_{i,t}$;
- $X_{i,t}$ is the value of the independent variable for the $i^{th}$ cross section in the $t^{th}$ time period.
- $\epsilon_{i,t}$ is a residual effect unaccounted for by the independent variable, the time effect, and the cross-sectional unit effect. $\epsilon_{i,t}$ is assumed to be a finite moving average process.

The specification for test for the determinants of agricultural development is adapted from the specification of Hayami & Ruttan, (1970); Yamada & Ruttan (1980); Van Schalkwyk & Groenewald; (1992); Mundlak and Butzer (1997); and Zepeda, (2001) and take the same form with Equation 2 except that the variables were transformed into log linear form:
Model 1: \( \ln AGGDP_{it} = a_i + b_t + \beta_1 \ln AG_{it} + \beta_2 \ln IRR_{it} + \beta_3 \ln FERT_{it} + \beta_4 GMD_{it} + \beta_5 \ln EDUC_{it} + \beta_6 \ln GPI_{it} + e_{it}; \)

Model 2: \( \ln AGGDP_{it} = a_i + b_t + \ln \beta_1 AG_{it} + \beta_2 \ln IRR_{it} + \beta_3 \ln FERT_{it} + \beta_4 GMD_{it} + \beta_5 \ln EDUC_{it} + \beta_6 \ln PAT_{it} + e_{it}; \)

Model 3: \( \ln AGGDP_{it} = a_i + b_t + \beta_1 \ln AG_{it} + \beta_2 \ln IRR_{it} + \beta_3 \ln FERT_{it} + \beta_4 GMD_{it} + \beta_5 \ln EDUC_{it} + \beta_6 T1_{it} + \beta_7 T2_{it} + \beta_8 T3_{it} + e_{it}; \) and

Model 4: \( \ln AGGDP_{it} = a_i + b_t + \beta_1 \ln AG_{it} + \beta_2 \ln IRR_{it} + \beta_3 \ln FERT_{it} + \beta_4 GMD_{it} + \beta_5 \ln EDUC_{it} + \beta_6 \ln TRIPS_{it} + \beta_7 \ln PVP_{it} + e_{it}; \)

Where \( a_i \) is a time invariant cross-sectional unit effect; \( b_t \) is a cross-sectional unit invariant time effect; \( \beta_j \) is the slope parameter associated with the independent variable, \( X_{i,t}, j=1,\ldots,6 \) (Model 1s and 2), \( j = 1, \ldots, 8 \) (Model 3), and \( j = 1\ldots7 \) (Model 4); \( \ln AGGDP_{i,t} \) is agricultural development measured as the natural log of the value of share of agriculture to GDP. \( \ln AG_{i,t} \) is natural log of the value of agricultural land; \( \ln IRR_{i,t} \) is natural of the value of irrigation; \( \ln FERT_{i,t} \) is natural log of the value of fertilizer use; GMD is presence of commercialized genetically modified crops and equals 1 if present, 0 otherwise; \( \ln EDUC_{i,t} \) is natural of the number of graduates with post-secondary education; \( \ln GPI_{i,t} \) is Ginarte-Park IPR index; \( \ln PAT_{i,t} \) is the natural log of the number of domestic patents; \( T1 \) is Tier 1; \( T2 \) is Tier 2; \( T3 \) is Tier 3; \( \ln TRIPS_{i,t} \) is a dummy variable which represents TRIPS-compliant patent laws (life-patenting provisions) and equals 1 if national legislation complying to TRIPS exists, 0 otherwise; \( \ln PVP_{i,t} \) is a dummy variable which represents plant variety protection laws which equals 1 if country has PVP legislation, 0 otherwise; and \( e_{i,t} \) is a residual effect unaccounted for by the independent variable, the time effect, and the cross-sectional unit effect. \( e_{i,t} \) is assumed to be a finite moving average process.
The four models were compared based on the estimates of regression coefficients, and goodness of model using $R^2$ (Buse R square), and the Akaike Information Criterion (AIC). The Buse R square, is the most appropriate goodness-of-fit measure for models estimated by using GLS. This number is interpreted as a measure of the proportion of the transformed sum of squares of the dependent variable that is attributable to the influence of the independent variables (SAS Institute Inc. , 2011). The model with the smallest AIC, the most popular criterion of model selection is considered the best (UCLA: Academic Technology Services, Statistical Consulting Group , 2011)

**Data Description**

The dependent variable is agricultural development (AGGDP) proxied by the natural log of the value agricultural GDP at current US dollars with 2000 as base year. This value was calculated by multiplying the agriculture, value added (% of GDP) with GDP at current US dollars. Both indicators are available in the 2010 World Development Indicators (WDI) by the World Bank.

The Ginarte-Park’s index (GPI) was used as a proxy for the strength of IPR protection (See Park, 2008 for the index of patents rights from 1960-2005 of several countries). This time-varying index of IP protection covers 5 categories of patent law: extent of coverage, membership in international agreements, provisions for loss of protection, enforcement mechanisms, and the duration of protection (Ginarte & Park, 1997). Each of these categories (per country, per time period) was scored a value ranging from 0 to 1. The unweighted sum of these five values constitutes the overall value of the patent rights index. Higher value of the index indicates stronger levels of protection. This index was designed to provide an indicator of the strength of
patent protection, not the quality of patent systems. This index according to Nunnenkamp & Spatz (2003) shows the highest level of protection for the group of industrialized countries and a lower level of protection for Asia and Latin America than for Africa.

Apart from this widely used index on IPR protection, different measures were used to gauge the robustness of the national IPR system of the TRIPS members and check the stability of our results. The second measure involved the domestic patents that are actually taken out in each country. The presence of domestic patents indicates that the locals/residents are actually utilizing the system and that more patents would mean that IPRs are stronger in that country. Data of this indicator were obtained from the WIPO Statistics Database (WIPO, 2010). The third model used the data on domestic patents to classify TRIPS-member countries according to tiers. The first tier contains countries with well-developed IP national systems and with domestic patents more than 10,000. The second tier (T2) contains those with an active IP system used vigorously by domestic patentees with patents ranging from 1,001 to 10,000. The third tier (T3) consists of countries actively seeking to become more innovative, with IP systems that are only beginning to be used by domestic patentees and with patents ranging from 100 to 1,000. The fourth-tier (T4) countries are those with limited or nascent IP systems and with domestic patentees of less than 100. This four-tier classification was a modification of study of Graff, Cullen, Bradford, Zilberman, & Bennett (2003), which classified 19 countries according to three tiers. The four tiers (k-1) were represented using dummy variables and the variable T4 was omitted for the analysis.

The last model included the combination of national patent policy complying with TRIPS and presence of PVP legislation (PVP). Under the WTO-TRIPs Agreement, all member-countries are required to provide an "effective" system of plant variety protection (PVP) within a
specific time frame. The presence of PVP laws indicates whether they have plant breeder’s rights to protect new varieties such as those produced from agricultural biotechnology. While IPRs has its source in international agreements, the national laws currently provide the basic enforcement mechanisms for their protection. Records of these national legislations are available from the WIPO Lex of WIPO (2010). The presence and absence of national laws were represented with dummy variables.

The additional determinants of agricultural development were used as control variables to reduce the problem of omitted variable bias. Variables for agricultural land (AG), irrigated land (IRR), fertilizer use (FERT), presence/absence of genetically modified crops (GMD), and population of post-secondary graduates (EDUC), and their log transformation were incorporated in the model to control their impacts on the dependent variable. To control the differences in country sizes, all inputs and outputs were measured on a 1000 per hectare basis to achieve comparability. As important factors in agricultural production, AG, IRR, and FERT should have positive effects on increasing the value of share of agricultural GDP. Meanwhile, econometric studies (e.g. Pray, Govindasamy, & Courtmanche, 2003) showed that plant breeders’ rights and the ability to patent plants are associated with the spread of GM crops. GM crops have already demonstrated their capacity to increase productivity and income significantly and serve as an engine of rural economic growth (International Services for the Acquisition of Agri-Biotech Applications, 2010), and hence, should have positively impact agricultural development. More human capital with more number of years of schooling indicates more number of skilled and productive workers who can adopt and improve new agricultural innovations. Thus, more years of education should have positive effects on improving efficiency of human capital, another important factor of agriculture productivity. Data on the control variables were obtained from
different sources including the Food and Agriculture Organization (FAO), World Bank's 2009 WDI Indicators (WDI), and World Intellectual Property Organization. Table 1.2 provides a summary description of all the variables used in our estimations, including expected signs, sources, and descriptive statistics.

Table 1.2 Description of variables.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>UNITS</th>
<th>EXPECTED SIGN</th>
<th>SOURCE OF DATA</th>
<th>DESCRIPTIVE STATISTICS</th>
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<td>MIN</td>
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<td><strong>Dependent variable</strong></td>
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<td><strong>Independent variable (s)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPI</td>
<td>5 with greatest protection; 1 with least protection</td>
<td>+</td>
<td>Ginarte-Park (2010)</td>
<td>3.8800</td>
</tr>
<tr>
<td>TRIPS</td>
<td>1 if complying with TRIPS standards; 0 if no</td>
<td>+</td>
<td>WIPO Lex (2010)</td>
<td>0.0000</td>
</tr>
<tr>
<td>PVP</td>
<td>+</td>
<td>UPOV (2010); WIPO Lex (2010)</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>T1</td>
<td>+</td>
<td>WIPO (2010)</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>T2</td>
<td>+</td>
<td>WIPO (2010)</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>T3</td>
<td>+</td>
<td>WIPO (2010)</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>T4</td>
<td>+</td>
<td>WIPO (2010)</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>lnPAT</td>
<td>n/a</td>
<td>+</td>
<td>WIPO (2010)</td>
<td>0.0000</td>
</tr>
<tr>
<td><strong>Control variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lnAG</td>
<td>1000 Ha</td>
<td>+</td>
<td>FAO Data (2010)</td>
<td>2.0794</td>
</tr>
<tr>
<td>lnIRR</td>
<td>1000 Ha</td>
<td>+</td>
<td>FAO Data (2010)</td>
<td>0.3275</td>
</tr>
<tr>
<td>lnFERT</td>
<td>kg/ha</td>
<td>+</td>
<td>FAO Data (2010)</td>
<td>-1.2729</td>
</tr>
<tr>
<td>GMD</td>
<td>1 if yes; 0 if no</td>
<td>+</td>
<td>ISAAA (2010)</td>
<td>0.0000</td>
</tr>
</tbody>
</table>
RESULTS AND ANALYSIS

Results of the regression analysis are presented in Table 1.3. All the four models representing strengthened IPR protection had significant results and with the expected signs except Model 4. The R squared is above 0.13 for all models. Model diagnostics based on AIC indicated adequate statistical fit of Model 3.

Table 1.3 Factors influencing agricultural development: Regression results.

<table>
<thead>
<tr>
<th></th>
<th>MODEL 1: GPI</th>
<th>MODEL 2: PAT</th>
<th>MODEL 3: T1 T2 T3</th>
<th>MODEL 4: TRIPS + PVP</th>
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</thead>
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<tr>
<td>GPI</td>
<td>0.0133***</td>
<td></td>
<td></td>
<td>-0.0098***</td>
</tr>
<tr>
<td></td>
<td>(0.000570)</td>
<td></td>
<td></td>
<td>(0.0052)</td>
</tr>
<tr>
<td>PAT</td>
<td></td>
<td>0.015***</td>
<td></td>
<td>0.0588***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.003)</td>
<td></td>
<td>(0.0039)</td>
</tr>
<tr>
<td>T1</td>
<td></td>
<td></td>
<td>0.2001***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0307)</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td></td>
<td></td>
<td>0.1662***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0232)</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td></td>
<td></td>
<td>0.0756***</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(0.0167)</td>
<td></td>
</tr>
<tr>
<td>TRIPS</td>
<td></td>
<td></td>
<td></td>
<td>-0.0098***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0052)</td>
</tr>
<tr>
<td>PVP</td>
<td></td>
<td></td>
<td></td>
<td>0.0588***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0039)</td>
</tr>
<tr>
<td>lnAA</td>
<td>0.8962***</td>
<td>0.2768***</td>
<td>0.2663***</td>
<td>0.9725***</td>
</tr>
<tr>
<td></td>
<td>(0.0061)</td>
<td>(0.0326)</td>
<td>(0.0309)</td>
<td>(0.0123)</td>
</tr>
<tr>
<td>lnIRR</td>
<td>0.0768***</td>
<td>0.098***</td>
<td>0.10231***</td>
<td>0.0014***</td>
</tr>
<tr>
<td></td>
<td>(0.0021)</td>
<td>(0.022)</td>
<td>(0.0217)</td>
<td>(0.0029)</td>
</tr>
<tr>
<td>lnFERT</td>
<td>0.0169***</td>
<td>0.1036***</td>
<td>0.1147***</td>
<td>0.0290***</td>
</tr>
<tr>
<td></td>
<td>(0.0007)</td>
<td>(0.0108)</td>
<td>(0.0109)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>lnEDUC</td>
<td>0.1365***</td>
<td>0.338</td>
<td>0.3550***</td>
<td>0.1616***</td>
</tr>
<tr>
<td></td>
<td>(0.0022)</td>
<td>(0.023)</td>
<td>(0.0225)</td>
<td>(0.0048)</td>
</tr>
<tr>
<td>GMD</td>
<td>-0.0049</td>
<td>0.063</td>
<td>0.0545</td>
<td>-0.0486***</td>
</tr>
<tr>
<td></td>
<td>(0.0032)</td>
<td>(0.036)</td>
<td>(0.0376)</td>
<td>(0.0062)</td>
</tr>
<tr>
<td>Constant</td>
<td>11.01813***</td>
<td>13.385***</td>
<td>13.16708***</td>
<td>10.319***</td>
</tr>
<tr>
<td></td>
<td>(0.0752)</td>
<td>(0.3154)</td>
<td>(0.3009)</td>
<td>(0.1300)</td>
</tr>
<tr>
<td>R square</td>
<td>0.1346</td>
<td>0.3409</td>
<td>0.3873</td>
<td>0.1543</td>
</tr>
<tr>
<td>AIC (small is better)</td>
<td>641.1</td>
<td>548.1</td>
<td>429.9</td>
<td>674.4</td>
</tr>
<tr>
<td>Number of observations</td>
<td>102</td>
<td>73</td>
<td>73</td>
<td>102</td>
</tr>
</tbody>
</table>

*** p<0.0001, ** p< 0.001, * p<0.01 Standard errors in parentheses.
Model 1: GPI as explanatory variables

As expected, the independent variable Ginarte-Park Index (GPI) was positively correlated with agricultural GDP at 0.0001% level of significance, which means that they rise and fall together. The coefficient associated with GPI indicates that with 1% increase (more increase in the GPI score), the value of agricultural GDP increases for all TRIPS members to 0.1%. The coefficients of the control variables (log-transformed values of agricultural area, irrigation, fertilizer, and post-secondary education graduates) also carried the expected sign and were statistically significant (p<0.0001). Overall, the natural log of the value of agricultural GDP increases as GPI, and the natural log of agricultural land (lnAA), irrigated land (lnIRR), use of fertilizer (lnFERT), and post-secondary graduates (lnEDUC) increase. The dummy variable representing the presence/absence of commercialized GM crops (GMD), however, was negative and not significant, which suggests that this variable can be removed in the model.

Model 2: Domestic patents as explanatory variables

As expected the regression results involving the natural log of the value of agricultural GDP and the numbers of domestic patents (lnPAT) yielded highly significant (p<0.0001) results. The coefficient with lnPAT indicates that a 1% increase in the number of domestic patents can contribute to increasing the value of agricultural GDP of TRIPS members-countries by 0.08%. All of the control variables were significant and had the expected signs. The log transformed agricultural land (lnAA), irrigated land(lnIRR), use of fertilizers (lnFERT), presence of commercialized GM crops (GMD), and post-secondary graduates significantly contributed (p<0.001) to the agricultural GDP at 0.0001% level of significance.
Model 3: Dummy variables for tiers based on domestic patenting as explanatory variables

The dummy variables, T1 T2 T3 were also highly significant (p<0.0001). This corroborates results of the previous model. The coefficients for these variables indicate that countries with advanced or existing national IP systems backed with the presence of domestic patents can contribute to increasing the value of agricultural GDP of TRIPS members-countries. All of the log-transformed control variables: agricultural land (lnAA), irrigated land (lnIRRI), use of fertilizer (lnFERT), and post-secondary graduates (lnEDUC) were significant and had the expected signs. lnAA, lnIRRI, lnFERT, and lnEDUC significantly contributed (p<0.001) to the agricultural GDP at 0.1% level of significance. However, the dummy variable (GMD) for the presence of GM crops was negative and significant. The negative sign on the GMD variable suggests that holding other things constant, the presence of GM crops can be associated to the decline in the value of agricultural GDP.

Model 4: Patent and PVP laws as explanatory variables

The dummy variables, TRIPS and PVP, both expected to have both positive coefficients, were significant but TRIPS was negative. The negative sign on the TRIPS variable suggests that holding other things constant, implementation of strengthened patent regulations on life forms lead to decline in the value of agricultural GDP while the positive sign on the PVP variable indicates that PVP can positively influence growth of agricultural GDP. Again, the log-transformed control variables: agricultural land (lnAA), irrigated land (lnIRRI), use of fertilizer (lnFERT), and post-secondary graduates (lnEDUC) were significant and had the expected signs. The dummy variable GMD was negative and highly significant. The negative sign on the GMD
variable suggests that holding other things constant, the presence of GM crops lead to the decline in the value of agricultural GDP.

CONCLUSION AND POLICY IMPLICATIONS

Intellectual Property Rights (IPRs) are perceived as an important source of economic growth process in developed nations, and now to developing countries. Given the increasing importance of agriculture for economic growth and development, and the increasing interaction of stronger IPRs to the sector, this paper investigated whether strengthened IPRs, along with other economic factors, are linked with agricultural development in member-countries of the Trade Related Aspects of IPR by the World Trade Organization (WTO). TRIPS has important provisions that have direct and indirect impacts on agricultural trade and development.

In this paper, an initial investigation was undertaken to determine how international variations in the strength of IPR systems among TRIPS member-economies affect agricultural GDP as a proxy for agricultural development, using four measures: the Ginarte-Park Index, numbers of domestic patents; tier classification based on domestic patents; and TRIPS-life patenting provisions and presence of PVP laws. Results suggest that strengthened IPR using the Ginarte-Park Index (Model 1) as a measure, and domestic patenting activities (Model 2 and 3) in both developed and developing county-members of TRIPS are positively linked with agricultural GDP. Model 4 showed positive association for PVP and negative association for TRIPS with agricultural GDP. Results also reaffirmed the importance of the traditional economic indicators, agricultural area, irrigation, and human capital to agricultural development in TRIPS member-countries. The presence of the dummy variable representing the presence of GM crops yielded different results. Three of the four models (Models 1, 3 and 4) yielded negative relationship
between GMD and agricultural GDP. Results of Model 2 (with domestic patents as independent variable), however, supports empirical findings of Pray, Govindasamy, & Courtmanche (2003) which showed that the ability to patent is associated with the presence of GM crops.

There are four major implications of the empirical findings. Developed countries rely on IPRs as an essential prerequisite to the development of knowledge-based industries, including agriculture. As this study shows strengthened IPRs as policy tools can also be influential to agricultural development not only for developed but also for developing countries. The positive association of the domestic patenting activity in a country and agricultural development likewise indicates that indeed patents as policy tools to attract more innovation and technology innovation can encourage development in the agriculture sector. Yet the combination of strengthened patent and PVP laws yielded unexpected results it can be used to explain why majority of the developing country-members of TRIPS have instead adopted the *sui generis* option under Article 27.3 (b) of TRIPS and exclude patentability of plants and animals due to its perceived negative impacts to developing nations. Yet countries adopting the *sui generis* system already conform to TRIPS minimum standards for life forms, they may want to revisit and extend IPRs obligations to plant-related inventions and innovations and benefit from the process. Furthermore, this research suggests that the presence of traditional economic indicators, agricultural area, irrigation, and human capital alone can already promote agricultural development in TRIPS member-countries. In other words, a developing country with limited means would do well to focus first and foremost on improving these traditional factors if it wants to engage in positive agricultural development. National IPR regulations, that exist or will be developed, relating to agriculture, need to complement pro-growth policies focused on these indicators. Overall, the
results of this study could open an avenue for more research on the impact of strengthened IPRs on agricultural development so as to enhance the empirical findings of the study.

ACKNOWLEDGMENT

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REFERENCES


STUDY 2. INSTITUTIONAL RESPONSES ON STRENGTHENED INTELLECTUAL PROPERTY RIGHTS (IPRs) IN AGRICULTURE AND NEEDS’ ASSESSMENT ON IP MANAGEMENT OF PUBLIC RESEARCH INSTITUTIONS IN ASIAN DEVELOPING COUNTRIES

By Jane G. Payumo

Advising Committee Members: Raymond Jussaume, Karim Maredia, Keith Jones, and Howard Grimes

ABSTRACT

Intellectual property rights (IPRs) are being introduced or strengthened in developing countries as a result of international agreements such as the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO) and these changes are perceived to impact public agricultural research in these countries. This study conducted a web-based survey to gain some perspectives on the impact of IPRs to public research institutions in developing countries and how these institutions have responded to IPR developments. Specifically, this survey collected information from research directors (n=43) of public research organizations in India, Malaysia, Philippines, Thailand, and Vietnam on their perception on the different issues surrounding IPRs affecting public agricultural research, and the current capability and priority needs of their respective institutions in handling IP issues. Attitudes of these key personnel on IPR developments will be instrumental for the success of developing initiatives to promote and manage IPRs at the institutional levels of public research institutions. Overall, this study proved that research
administrators in the five countries are positive towards the concept of IPRs and the implementation of measures to build their institutional IPR management capacities. They have also started to build their IPR structures and procedures by setting up IP policies and offices yet still needs more strengthening particularly in the area of commercialization. This research can serve as reference for international institutions interested and/or evaluating capacity programs allowing them to craft projects that can better foster the importance of IP management to these and similar institutions in the developing world.

Key words: commercialization, developing countries, IPR, IP management technology transfer, public sector, capacity building, public agricultural research,

**INTRODUCTION**

The expansion of intellectual property rights (IPRs) in agriculture demand new roles and opportunities for public research institutions - the main source of technology and innovations in developing countries. IPRs are rights over IP conferred by law, and form part of a nation’s policy to encourage invention, innovation, and dissemination of technology for economic development. IPRs is a broad term used to cover patents, trademarks, plant breeders’ rights, copyright, trade secrets and other types of rights that the law gives for the protection of investment in creative effort and knowledge creation.

A lively debate has emerged in the academic literature about possible implications of IPRs to public agricultural research. Such implications of IPRs, in general, can be divided into three themes: access of proprietary technologies, conduct of R&D, and dissemination of research
results. With IP protection becoming a norm for public research institutions, it is also an open issue as to how many agricultural innovations will be available in the public domain, and how many will be patented and available for a fee (Maredia, Oehmke, & Byerlee, Economic Aspects of Intellectual Property Rights in Agricultural Biotechnology, 2004). Sociologists of science find this as a violation of scientific cultural norms because to them scientific progress is linked with an ideal of free and open dissemination of scientific information. Expansion of IPRs will restrict free circulation of ideas and will adversely affect and/or impede dissemination of new technologies and innovations and exchange of information among scientists, an important aspect of scientific research.

Hence, under this changing environment for IPR protection, agricultural research organizations in developing countries need to analyze efficient and effective ways of acquisition of new technologies or products and the conditions that these could be acquired. Access to new technologies and modern scientific methods covered by IPRs would require them to negotiate deals and execute formal licensing agreements (Van Wijk & Komen, 1993; Maredia, Erbisch, Ives, & Fischer, 1999). For institutions with budget constraints, these developments mean that they need to do seek assistance for a (FTO) agreement for them to use proprietary technologies royalty-free for research. Heller & Eisenberg (1998) and Graff, Cullen, Bradford, Zilberman, & Bennett (2003) claimed that these IPR-related mechanisms are additional transaction costs and serve as a barrier for these institutions that can stifle further scientific progress since when no agreement on waiving of IPRs is reached, delay in research could occur.

Likewise, the increased push for IPR protection for publicly-funded research means that research institutions also need to investigate the possibility of their own organizations developing the means of protection and commercialization of their technologies and products (Salazar,
Falconi, Komen, & Cohen, 2000). Public sector institutions in developed countries, especially US universities, have increased their patenting and commercialization of their research outputs especially in modern agricultural biotechnology (Heisey, King, & Rubenstein, 2005). For Thursby & Thursby (2002) these shifts research agenda of these institutions while Aghion, Bloom, Griffith, & Howitt (2002) claimed that IPRs can limit the process of cumulative scientific discovery. As Davis, Larsen, & Lotz (2000) claimed, the freedom to choose research subjects by public sector scientists may come under pressure whenever institutions “behave like firms” and institutions are encouraged or even forced to produce patentable and research results that are commercially viable; suggesting that non-patentable research activities are discouraged.

Public research institutions in developing countries have evolved in a world without IPRs, hence, it is important to understand how they have responded and adapted to this new environment, and continually perform delivery of service to their stakeholders. This paper discusses IPRs as they relate specifically to biotechnology and genetically modified organisms being used as tools to achieve sustainable improvement of crop productivity. Focusing in five countries in developing Asia, this study aims to provide such information and add insights to the state of the art in the IP challenges confronting public research institutions. Realizing that the development of innovative capabilities and institutional policies depends on a strong and sustained commitment from the authorities, this study targeted institutional heads and research administrators of public research organizations doing agricultural biotechnology in India, Malaysia, Philippines, Thailand, and Vietnam. The respondents were asked about their perceptions on the concept of IPRs and the implications of IPRs on public agricultural research, and the current capability and priority needs of their respective institutions in handling IP issues. This research can serve as reference for international institutions interested to develop action
plans and/or capacity programs on IP management for these institutions. This may also enable subsequent step towards an analytical framework to investigate institutional capacity for IP management in the public agricultural institutions in developing countries.

METHODOLOGY

The focus of this research was on public agricultural research institutions in five countries in Asia: India, Malaysia, Philippines, Thailand, and Vietnam. This scope includes universities and research institutions conducting agricultural biotechnology in these five countries. This list of institutions was obtained from the FAO-Biotech database. Names and contact information of the respondents were obtained from their respective institutional websites and were included in the circulation list.

A web-based survey format was constructed to determine current perceptions, status, and needs’ assessment of the different public research institutions on IPRs. This was chosen for several reasons. The survey sample was taken from personnel working in Asia’s public universities and research institutions with their own websites. These institutions tend to have high-speed Internet access; therefore difficulty in accessing a web-based survey is minimized. Web-based surveys also reduced time to completion, direct branching, and reduce overall survey costs if no significant programming is required (Schonlau, Fricker, & Elliott, 2002).

The survey questionnaire with 27 questions was split into three sections: Section A - Technology transfer capabilities, Section B – IP protection to agricultural biotechnology management; and Section C – Background information. Section A collected information on capabilities, including experiences, of institutions on IP management and technology transfer. Section B collected information on the attitudes of institutional heads and research managers on
the features of IPRs and its implications to their scientists, institutions, and public agricultural research, in general. Section C collected demographic information. For all three sections, multiple-choice questions, Likert-scaled responses, and open-ended questions were utilized. The survey questionnaire is included as Appendix B.

As an initial step in ensuring that these surveys were clear and concise, the questionnaire was pre-tested to review the survey instrument, improve the clarity of questions and instruction, and determine the understandability and validity of the contents. The pre-test group included members of the National Partners’ Initiative (NPI) of the Central Advisory on Intellectual Property (CAS-IP). NPI is a community of IP practitioners based in developing and emerging economies working together to support partnerships in relation to IP and technology transfer management between the Consultative Group on International Agricultural Research (CGIAR) centers and National Agricultural Research Systems (NARS). Comments received from this group were used to refine the survey instrument. None of the data collected in the pre-test were used in the final research analysis.

The online survey instrument and the resulting hosted web site was designed and managed by Washington State University’s Social and Economic Sciences Research Center (SESRC). Selected faculty and staff from WSU then tested the final web-based survey questionnaire and validated the survey process. The survey was designed in such a way that respondents can review and change their responses. Response to the survey was completely voluntary; hence, it is expected that some of the respondents skipped some of the questions. Undesirable access to survey pages was controlled through firewalls setup by the SESRC server. Randomly generated personal access codes assigned to respondents also controlled access to the survey. Respondents entered their unique access code at the survey homepage to gain access to
the survey itself. Once a survey was completed, the used access code became invalid and further access to the survey using the used code was denied. The SAS statistical package was used to analyze the survey data. Descriptive statistics such as mean, frequency, and percentage were primarily employed in the interpretation and comparison of data among groups. Decision rules were set for interpreting numeric data to draw final conclusions. For those items where one category received 40% or more with the other three categories receiving 25% or less of the responses, this occurrence was called “a clear majority.” On the other hand, a response pattern was called to be “without a clear majority” when all four categories received 25% or less of the responses.

RESULTS AND DISCUSSION

Through a web-based survey, this research collected information on how the research administrators view the concept, importance, and implications of IPRs to public agricultural research. It was also designed to determine the current capability, as well as capacity needs, of their respective institutions in handling IP issues especially those that relate to modern agricultural biotechnology. Ninety-one institutions conducting agricultural biotechnology and their institutional heads or research administrators were selected for the survey. Of these 91, 36 institutional heads completed the survey while seven of them partially filled out the form, registering a response rate of 47%.

Profile of Respondents

As shown in Table 2.1, the administration of agricultural biotechnology R&D in the five countries is led by male professionals (72.2%), with ages between 51-60 (52.8%), and who hold
a Doctor of Philosophy degree (75%). Most of them serve as Directors (38.2%) with an institutional size of more than 200-1000 employees (52.8%). Most of the respondents came from institutions in India and the Philippines (30.6%).

Table 2.1 Socio-demographic characteristics of the respondents.

<table>
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<th>FREQUENCY</th>
<th>PERCENT</th>
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</tr>
<tr>
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<td>36</td>
</tr>
<tr>
<td>Female</td>
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<tr>
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<td>Doctor (Phd/EdD/DSc)</td>
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<td>Others</td>
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<tr>
<td>6-10</td>
<td>6</td>
<td>16.7</td>
<td></td>
</tr>
<tr>
<td>11-19</td>
<td>7</td>
<td>19.4</td>
<td></td>
</tr>
<tr>
<td>20 or more</td>
<td>13</td>
<td>36.1</td>
<td></td>
</tr>
<tr>
<td>Size of institution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 200 employees</td>
<td>7</td>
<td>19.4</td>
<td>36</td>
</tr>
<tr>
<td>200 - 999 employees</td>
<td>19</td>
<td>52.8</td>
<td></td>
</tr>
<tr>
<td>1,000 - 4,999 employees</td>
<td>9</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>5,000 - 9,999 employees</td>
<td>1</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>11</td>
<td>30.6</td>
<td>36</td>
</tr>
<tr>
<td>Malaysia</td>
<td>2</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>11</td>
<td>30.6</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>4</td>
<td>11.1</td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>8</td>
<td>22.2</td>
<td></td>
</tr>
</tbody>
</table>
Perception and Awareness on IPRs and its Developments

Respondents were asked to evaluate, on the 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), the different features of IPRs. Most of the respondents strongly agreed that IPRs give owners exclusive rights to control the users of the property (20 of 35); give owners the exclusive rights to sell (18 of 35); lease or transfer the property right (18 of 35); clearly defines the geographic and time scope of the property (18 of 35); allow public access to the property under strict professional scientific guidelines (16 of 35); clearly defines relative rights of individual innovator/inventor and institution, agency, organization (24 of 35); and provide income/incentives to innovators or inventors (24 of 35) (Table 2.2). To them, IPRs can be a source of additional income and that the key important feature of IPRs is providing incentives to innovators or inventors. According to six survey respondents, IPRs as incentives can specifically help inventors stay in their own countries and develop new technologies. One institutional head particularly mentioned that in developing countries, regular incentives from the government are low or generally do not exist, which leads best researchers to migrate in foreign lands to earn more. The importance of incentive policies to attract local home-grown talents and know-how, such as the Philippines, to contribute in building national economies was also highlighted by Higazi (2005) as one of the ways to reverse ‘human capital flight’ or the ‘brain-drain’ phenomenon.
Table 2.2 Respondents’ perceptions on the features of IPRs.

<table>
<thead>
<tr>
<th>FEATURES OF IPRs</th>
<th>FREQUENCY (PERCENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Give owners the exclusive rights to control the users of the property</td>
<td>4 (11.4)</td>
</tr>
<tr>
<td>Give owners the exclusive rights to sell, lease or transfer the property right</td>
<td>2 (5.7)</td>
</tr>
<tr>
<td>Clearly defines the geographic and time scope of the property</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Allow public access to the property under strict professional scientific guidelines</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Clearly defines relative rights of individual innovator or inventor and institution, agency, organization</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Provide income/incentives to innovators or inventors</td>
<td>2 (5.7)</td>
</tr>
</tbody>
</table>

Analysis: Most of the respondents positively responded on the different features of IPRs.

Most of the respondents are aware on the three most talked about IPR-related international treaties and conventions: World Trade Organization’s Agreement on Trade-Related Aspects of Intellectual Property Rights (WTO-TRIPS); the Convention on Biological Diversity (CBD); and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (Table 2.3). They also claimed that their institutional IP policies comply with these international treaties.
Table 2.3 Awareness of respondents on international laws on IP and agricultural biotechnology.

<table>
<thead>
<tr>
<th>INTERNATIONAL TREATIES</th>
<th>FREQUENCY</th>
<th>PERCENT</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Trade-Related Aspects of Intellectual Property Rights (TRIPS)</td>
<td>Well Informed</td>
<td>15</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td>Somewhat Informed</td>
<td>17</td>
<td>47.2</td>
</tr>
<tr>
<td></td>
<td>Not Sure/Not Aware</td>
<td>4</td>
<td>11.1</td>
</tr>
<tr>
<td>2. Convention on Biological Diversity</td>
<td>Well Informed</td>
<td>16</td>
<td>43.2</td>
</tr>
<tr>
<td></td>
<td>Somewhat Informed</td>
<td>17</td>
<td>45.9</td>
</tr>
<tr>
<td></td>
<td>Not Sure/Not Aware</td>
<td>4</td>
<td>10.8</td>
</tr>
<tr>
<td>3. The International Treaty on Plant Genetic Resources for Food and Agriculture</td>
<td>Well Informed</td>
<td>15</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td>Somewhat Informed</td>
<td>15</td>
<td>41.7</td>
</tr>
<tr>
<td></td>
<td>Not Sure/Not Aware</td>
<td>6</td>
<td>16.7</td>
</tr>
</tbody>
</table>

Analysis: Most of the respondents are aware on these international treaties. They also claimed that their institutional IP policies comply with these international treaties.

**Implications of IPRs to Public Research Institutions and Public Agricultural Research**

These questions aim to reveal common perceptions of respondents on the benefits and risks of IP to public research institutions and to public agricultural research in general. As cited by one of the survey participants, universities receive funds from governments to create new invention so these technologies should be free to access by public for good. A majority of the respondents however, did not share this same perspective as they were positive on the impact of IPRs on agriculture and agricultural research. As presented in Table 2.4, they strongly agreed that IPRs:

1. fosters creativity and stimulates invention and new innovations by scientists (76.5%);  
2. helps increase agricultural production (50%);  
3. promotes and disseminates use of new knowledge and technologies (50%);  
4. promotes domestic and foreign investments in biological innovations(55.9%);  
5. serves as incentives/reward mechanism for scientists/researchers (67.6%);  
6. fosters public-private sector collaboration (50%);
7. provides additional budget for institution (52.9%);

8. influences institutional policy to generate more agricultural biotechnologies and products (50%); and

9. results in more focused R&D, increased institutional productivity, and credibility (60.0%).

Likewise, a majority of the respondents (more than 50%) said that IPR regulations do not:

1. promote competition; rather, IPRs regulations enhance collaboration with the private sector (55.9%);

2. delay the research process and often times results in stopping research (57.5%); and

3. constraint or reduce the flow of technology transfer among national agricultural research systems (51.5.6%).
Table 2.4 Perception of respondents on the impacts of IPRs to the agriculture and agricultural research.

<table>
<thead>
<tr>
<th>FEATURES OF IPRs</th>
<th>FREQUENCY (PERCENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Foster creativity and stimulates invention and new innovations by scientists</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Help increase agricultural production</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Promote and disseminates use of new knowledge and technologies</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Promote domestic and foreign investments in biological innovations</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Serve as incentives or reward mechanism for scientists or researchers</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Facilitates access of biotech IPs from other laboratories or countries</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Increases costs of accessing research material or tools</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Fosters public-private sector collaboration</td>
<td>2 (5.9)</td>
</tr>
<tr>
<td>Source of additional budget for institution</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Influences institutional policy to generate more agricultural biotechnologies and products</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Results in more focused R&amp;D, increased institutional productivity, and credibility</td>
<td>1 (2.9)</td>
</tr>
<tr>
<td>Distorts and conflicts with public mission of institution resulting in social disservice</td>
<td>9 (27.3)</td>
</tr>
<tr>
<td>Delays publication of research and has a negative effect on science</td>
<td>8 (23.5)</td>
</tr>
</tbody>
</table>
Table 2.4 cont.

<table>
<thead>
<tr>
<th>FEATURES OF IPRs</th>
<th>FREQUENCY (PERCENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Requires big investment (manpower, facilities, finances) for institutions</td>
<td>4 (11.8)</td>
</tr>
<tr>
<td>Promotes competition rather than collaboration with the private sector</td>
<td>7 (20.6)</td>
</tr>
<tr>
<td>Divers resources to areas resulting only in IPRs; thus, inhibits or hampers exploration of fundamental long-term basic research questions</td>
<td>7 (20.0)</td>
</tr>
<tr>
<td>Delays the research process and often times results in stopping research</td>
<td>8 (24.2)</td>
</tr>
<tr>
<td>Constrains or reduces the flow of technology transfer among national agricultural research systems</td>
<td>8 (22.9)</td>
</tr>
<tr>
<td>IPR agreements are too legalistic for scientists to understand and comply</td>
<td>3 (8.8)</td>
</tr>
<tr>
<td>Prevents or serves as threats to future scientific investigation from IPRs on previous research</td>
<td>7 (20.6)</td>
</tr>
</tbody>
</table>

Analysis: Majority of the respondents were positive on the impact of IPRs to agriculture and agricultural research.

**Current Capacity and Capability-Building Needs**

**of Institutions on IP Management and Technology Transfer**

A majority of the respondents (70%) indicated that their institutions have offices that manage the identification, promotion, and commercialization of intellectual property (Table 2.5). Most of them also have existing institutional policies (73%) on IP management and technology.
transfer. It was interesting to note, however, that the respondents indicated that there is no regular staff working in their IP management units. Despite limited human and financial resources, as Table 2.6 shows, most of the respondents considered their institutional capacity as good enough (38.9%) and well suited to address problems associated with access, generation, and technology transfer of agricultural biotechnology intellectual properties (50%). At present, most of the institutional heads indicated that their institutions are not having problems in accessing proprietary materials and new genetic resources from other local institutions and institutions overseas (Figure 2.1). Should there be problems, they cannot associate them to the strengthening of IPRs. Most of the respondents (47.2%) also claimed that their seeking protection or pursuing commercialization of their research outputs do not cause issues with their researchers and the community they serve (Figure 2.2).

Table 2.5 Current capacity on IP management and technology transfer.

<table>
<thead>
<tr>
<th>INVESTMENTS IN IP MANAGEMENT</th>
<th>FREQUENCY</th>
<th>PERCENT</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office engaged in IP identification, protection, promotion and commercialization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>69.4</td>
<td>36</td>
</tr>
<tr>
<td>No</td>
<td>10</td>
<td>27.8</td>
<td></td>
</tr>
<tr>
<td>Not Sure/Not Aware</td>
<td>1</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Protection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>67.6</td>
<td>37</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>32.4</td>
<td></td>
</tr>
<tr>
<td>Not Sure/Not Aware</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Promotion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>65.8</td>
<td>38</td>
</tr>
<tr>
<td>No</td>
<td>10</td>
<td>26.3</td>
<td></td>
</tr>
<tr>
<td>Not Sure/Not Aware</td>
<td>3</td>
<td>7.9</td>
<td></td>
</tr>
<tr>
<td>Commercialization</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25</td>
<td>65.8</td>
<td>38</td>
</tr>
<tr>
<td>No</td>
<td>10</td>
<td>26.3</td>
<td></td>
</tr>
<tr>
<td>Not Sure/Not Aware</td>
<td>3</td>
<td>7.9</td>
<td></td>
</tr>
</tbody>
</table>
Table 2.5 cont.

<table>
<thead>
<tr>
<th>INVESTMENTS IN IP MANAGEMENT</th>
<th>FREQUENCY</th>
<th>PERCENT</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institution IP policies and procedures</td>
<td>Yes, policies existing</td>
<td>28</td>
<td>73.7</td>
</tr>
<tr>
<td></td>
<td>Yes, policies in discussion</td>
<td>2</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td>No policies existing or planned</td>
<td>7</td>
<td>18.4</td>
</tr>
<tr>
<td></td>
<td>Not aware/don't know</td>
<td>1</td>
<td>2.6</td>
</tr>
<tr>
<td>Number of staff working IP management unit</td>
<td>None</td>
<td>14</td>
<td>37.8</td>
</tr>
<tr>
<td></td>
<td>1-3</td>
<td>9</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td>4-5</td>
<td>9</td>
<td>24.3</td>
</tr>
<tr>
<td></td>
<td>More than 5</td>
<td>5</td>
<td>13.5</td>
</tr>
<tr>
<td>Budget for IP management activities</td>
<td>None</td>
<td>17</td>
<td>45.9</td>
</tr>
<tr>
<td></td>
<td>Less than $20,000</td>
<td>13</td>
<td>35.1</td>
</tr>
<tr>
<td></td>
<td>$20,000 - 24,999</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>$25,000 - 39,999</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>$40,000 - 44,999</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>$45,000 - 59,999</td>
<td>1</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td>$60,000 - 79,999</td>
<td>2</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>$80,000 and above</td>
<td>1</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Analysis: Majority of the respondents (70%) indicated that their institutions have offices that manage the identification, promotion and commercialization of intellectual property. It was interesting to note, however, that the respondents indicated that there is no regular staff working on their IP management units. Most of them also indicated that there is no regular budget for their IP management efforts.

Figure 2.1 Percentage of respondents with experience on material exchange with different institutions. Institutional heads revealed that they did not have major problems in accessing new biological materials from other institutions, private or public, local and abroad.
Figure 2.2 Percentage of respondents that claimed that their seeking protection or pursuing commercialization of their research outputs do not cause issues with their researchers and the community they serve.

Table 2.6 Assessment of institutional capacity.

<table>
<thead>
<tr>
<th>INSTITUTIONAL CAPACITY</th>
<th>FREQUENCY</th>
<th>PERCENTAGE</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutional capacity rating</td>
<td></td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>Very good</td>
<td>5</td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>14</td>
<td>38.9</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>9</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>6</td>
<td>16.7</td>
<td></td>
</tr>
<tr>
<td>Very poor</td>
<td>2</td>
<td>5.6</td>
<td></td>
</tr>
<tr>
<td>Effectiveness of institutional IP management program</td>
<td></td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>IP management program was suited to address these programs</td>
<td>18</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>IP management program was not effectively organized to address these problems</td>
<td>6</td>
<td>16.7</td>
<td></td>
</tr>
<tr>
<td>Did not personally deal with these problems</td>
<td>7</td>
<td>19.4</td>
<td></td>
</tr>
<tr>
<td>Not sure/Not aware</td>
<td>5</td>
<td>13.9</td>
<td></td>
</tr>
<tr>
<td>Not sure/Not aware</td>
<td>5</td>
<td>13.9</td>
<td></td>
</tr>
</tbody>
</table>

Analysis: Most of the respondents considered their institutional capacity as good enough and well suited to address problems associated with access, generation, and technology transfer of agricultural biotechnology intellectual properties.
As shown in Table 2.7, most of the institutional heads indicated that they highly prioritize the further development of their institutional IP policies (29.4%), commercialization or licensing out their technologies (47.1%), and marketing their technologies (44.1%). For some of the research managers in Vietnam, developing an IP policy should be the first priority because IP awareness in their country is quite low. One research manager, meanwhile, stated that commercialization is important because it helps accelerate the rate of transfer of technology or end product to the farmers. This helps the farming community benefit from the technology in a better and uniform fashion, instead of technology benefits trickling to some pockets. Some respondents revealed that they give moderate priority on IP valuation (44.1%), freedom-to-operate and negotiation (32.4%), and prosecuting or filing for IPR protection (30.3%). Many of the respondents, however, indicated that they give less priority on improving their capacity on setting up new or start-up companies (21.2%), developing legal instruments (29.4%), and technology acquisition of protected technologies (30.3%).
Table 2.7 Priority of institution on each policy on IP management and technology transfer.

<table>
<thead>
<tr>
<th>IP MANAGEMENT AREAS NEEDING ASSISTANCE</th>
<th>FREQUENCY (PERCENT)</th>
<th>1 Very Low Priority</th>
<th>2 Low Priority</th>
<th>3 Moderate Priority</th>
<th>4 High Priority</th>
<th>5 Very High Priority</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing an IPR policy</td>
<td></td>
<td>6 (17.6)</td>
<td>5 (14.7)</td>
<td>8 (23.5)</td>
<td>10 (29.4)</td>
<td>5 (14.7)</td>
<td>34</td>
</tr>
<tr>
<td>Developing legal IP instruments</td>
<td></td>
<td>6 (17.6)</td>
<td>10 (29.4)</td>
<td>9 (26.5)</td>
<td>7 (20.6)</td>
<td>2 (5.9)</td>
<td>34</td>
</tr>
<tr>
<td>Freedom-to-operate and negotiation</td>
<td></td>
<td>4 (11.8)</td>
<td>5 (14.7)</td>
<td>11 (32.4)</td>
<td>12 (35.3)</td>
<td>2 (5.9)</td>
<td>34</td>
</tr>
<tr>
<td>Prosecuting/filing for IPR protection</td>
<td></td>
<td>6 (18.2)</td>
<td>4 (12.1)</td>
<td>10 (30.3)</td>
<td>7 (21.2)</td>
<td>6 (18.2)</td>
<td>33</td>
</tr>
<tr>
<td>Technology commercialization or licensing out of technologies</td>
<td></td>
<td>3 (8.8)</td>
<td>3 (8.8)</td>
<td>4 (11.8)</td>
<td>16 (47.1)</td>
<td>8 (23.5)</td>
<td>34 (100.0)</td>
</tr>
<tr>
<td>Technology acquisition of protected technologies</td>
<td></td>
<td>5 (15.2)</td>
<td>10 (30.3)</td>
<td>8 (24.2)</td>
<td>8 (24.2)</td>
<td>2 (6.1)</td>
<td>33 (100.0)</td>
</tr>
<tr>
<td>IP valuation</td>
<td></td>
<td>5 (14.7)</td>
<td>2 (5.9)</td>
<td>15 (44.1)</td>
<td>7 (20.6)</td>
<td>5 (14.7)</td>
<td>34</td>
</tr>
<tr>
<td>Marketing of technologies</td>
<td></td>
<td>3 (8.8)</td>
<td>2 (5.9)</td>
<td>8 (23.5)</td>
<td>15 (44.1)</td>
<td>6 (17.6)</td>
<td>34</td>
</tr>
<tr>
<td>Setting up of new or start-up companies</td>
<td></td>
<td>9 (27.3)</td>
<td>4 (12.1)</td>
<td>7 (21.2)</td>
<td>6 (18.2)</td>
<td>7 (21.2)</td>
<td>33</td>
</tr>
</tbody>
</table>

Analysis: Most of the institutional heads indicated that they give high priority to developing further their institutional IP policies, commercializing or licensing out their technologies, and marketing their technologies.

A Note on Interpretation of Statistics

There are two important caveats related to population coverage and response rates that need to be accounted for in the statistical interpretation and percentages given in this paper. The statistics reported here are based on a non-random sample of research administrators with email addresses available in the web and whose institutions are also listed in FAO Biotech database. Therefore, the results of the study may not represent all research administrators of institutions working on public research institutions in these countries. The population represented by the
statistics and percentages given here is also the population of the respondents. Their answers in aggregate form are useful for policy decisions (among others, competence training and budget support). The study also did not include measurements of sampling or non-sampling errors. Such error measurements are only appropriate when a statistic is being estimated for a wider population from a sample as the measurement of error informs the reader about how close the statistic might be to the value for the entire population. Statistics and percentages again may not represent a larger population than the respondents to the survey.

IMPLICATIONS OF FINDINGS AND CONCLUSION

Public research institutions, the significant supplier of technological innovations in agriculture in developing countries now operate in an environment of intellectual property rights (IPRs). The advent of the international IPR regime, the concomitant protection of research tools and other technologies needed for research, the increased participation of the private sector in agriculture, and the increasing emergence of public-private partnerships are some of the developments that are transforming public agricultural research and pose challenges to how public research institutions manage their intellectual assets. There are profound implications for national research institutions not taking care of the intellectual assets within its public trust – including local germplasm, technologies, software, information, publications, vaccines, databases, methodologies and know-how. It is therefore important to understand how these institutions have adjusted to the challenges associated with the expansion of IPRs in the agriculture sector.

This study conducted a web-based survey to gain perspectives on the implementation status of IP management and technology transfer among public research institutions in developing
countries in Asia. Specifically, this survey consulted institutional heads from 91 public research organizations in India, Malaysia, Philippines, Thailand, and Vietnam to determine their perceptions on the impact of IPRs on agriculture and agricultural research. This research was also done to determine their capability, as well as capacity needs, in handling IP issues especially as they relate to the use and commercialization of modern agricultural biotechnology.

Forty three out of 91 respondents participated in the survey with a response rate of 47%. The summary of major findings and their implications are as follows:

- Respondents are aware of the features and advantages of IPRs and are positive towards its implementation in public research institutions and impact to public agricultural research. Majority of the surveyed institutions (73.7%) have an existing internal IP policy on IP management and technology transfer which indicates their appreciation on the importance of IPRs and acceptance that such policies are now important to help in their institutional IPR decisions whether to deliver services and technologies for free or license them to other institutions for a fee. The institutional heads (47.22%) indicated that they did not experience conflicts with their researchers and the community they serve with regards to protecting and commercializing their research outputs. This may indicate that their researchers and their clienteles understand and support their IPR initiatives. However, the institutions’ policy and procedures are not well supported with regular personnel and budget. Public institutions need more than just policy to enable owning and protecting intellectual assets. These findings may indicate that the institutions surveyed deal with IPR management through an ad hoc committee. The nonprofit international agricultural research, International Rice Research Institute (IRRI), for instance, dealt initially with IPR issues using a similar committee but later on built an in-house facility
due to increasing activity on IP management. This is an area which these heads need to further review and consider.

- The strengthening of IPRs in agriculture did not impair the different institution’s access to proprietary technologies from other institutions that are needed for research. This complements findings of Pardey, Wright, Nottenburg, Binenbaum, & Zambrano (2003), who claimed that agricultural research centers have far greater FTO in agricultural research and that agricultural researchers in developing countries are freer than generally perceived to make use of innovations protected in the developed countries owing to the absence of an “international patent right.”

- Most of the respondents considered their institutional capacity on IP management and technology transfer as good but consider technology commercialization or licensing out of technologies as their highest priority needing capacity assistance. Competency training, focused on understanding the process of licensing new of agricultural innovations to the private sector, will be important for these institutions to bring their research outputs into the commercial marketplace.

A survey conducted by Maredia (2001) among 27 researchers and managers in 28 developing countries identified four indispensable broad areas that are vital in implementing the IPR framework in public research institutes. These include: human resources development (training and awareness creation on IPR issues, negotiation skills, research and marketing tools to value intellectual properties, institutional capacity building (establishment of an IP management office, developing guidelines, policies, handbooks), and financial resources to meet the expenses of protecting and accessing IP technologies. Almost a decade after that study, the survey reported in
this chapter has proved that public institutions in developing countries are still faced with the same capacity challenges on IP management and technology transfer. However, these are understandable as IP management and technology transfer are quite novel concepts for these institutions. Embracing IPRs, as an organizational innovation, in government-funded institutes is not an easy task; institutional policies can be slow to take shape, and dedicating resources, establishing offices, and deploying staff takes time and commitment.

The number of institutions surveyed may not be indicative of the whole picture of IP management and technology transfer in developing countries in Asia. However, this study shows that the surveyed institutions are supportive of IPRs and its management despite negative stories about impact of IPRs to public mission of public research institutions. This also indicates that the changing mindset towards managing and exploiting IP is already taking stage in the public research institutions surveyed. In spite of this shift in perspective, the efficiency of the institutions’ IP management structure cannot be fully deduced considering the lack of regular personnel and budget to support their IP management efforts. Pefile & Krattiger (2007) also recognize this lack of funding and inadequacy of human and financial resource capacity to invest in institutional IP management policies and resources for developing countries.

Coherent IP management and technology transfer strategies and institutional policies are essential to ensure that benefits from new technologies resulting from investments in agricultural research, such as in agricultural biotechnology, are developed and flowed to the public. This can be an expensive activity, and can be very difficult to implement and justify. Institutions and countries with limited resources may consider other options to achieve the same goals, e.g., a common office for various institutions, appointing an IP officer rather than establishing a full-fledged office, etc. IP management bottlenecks can also be overcome with creativity such as
building strategic alliances, outsourcing, building a seed fund, and asking for external resources. The positive perception and remarkable start on IP management and technology transfer by these institutions, should guide them in further improving and/or strengthening their IP structures and procedures. Overall, this study presented the current status of IP management in surveyed institutions in India, Malaysia, Philippines, Thailand, and Vietnam, and can be used for action planning and serve as reference for international institutions aiming to develop programs that can further build capacities of these and similar institutions in developing countries on IP management and technology transfer.

ACKNOWLEDGMENT

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REFERENCES


Brain drain is a global phenomenon. In Philippines alone, there were about 25,000 science works emigrated to search for jobs overseas in 2009 (Tapang, 2011). Other developing countries in Southeast Asia such as India (Khadria, 2002), Thailand (International Labor Organization, 2001), and Vietnam also experience the same problem.
STUDY 3. SCIENTISTS’ UNDERSTANDING AND ATTITUDES TOWARD INTELLECTUAL PROPERTY RIGHTS (IPRs) AND THEIR IMPACT TO RESEARCH, DEVELOPMENT, AND COMMERCIALIZATION OF PUBLIC AGRICULTURAL RESEARCH

By Jane G. Payumo

Advising Committee Members: Raymond Jussaume, Tom Okita, and Howard Grimes

ABSTRACT

Scientists and engineers are often at the vanguard of generating innovation and technological advancements. Thus, their understanding of the value of IPRs and associated issues is critical for their basic discovery to reach the marketplace in a timely and efficient manner. Understanding how these innovation developers perceive IP and its management is thus instrumental in developing robust and effective management strategies at the institutional and national level(s). This study, thus, used survey-based methodologies to explore scientists’ awareness on IPRs and perspectives on the possible effects of IPRs on public agricultural research. Data were collected from scientists in five countries in developing Asia: India, Malaysia, Philippines, Thailand, and Vietnam. The survey is consist of 28 questions covering three overall areas: 1) IP awareness; 2) importance and impact of IPR protection on agricultural biotechnology; and 3) the demographics of the respondents. Results revealed that survey respondents have good knowledge on the concept of IPRs, its features, developments, and risk factors. However, they need to have more exposure to, and training on, the use of the different IPR instruments. Results can serve as reference for institutions developing IPR training
programs, including identification of training needs, to further foster the importance of IP management and technology transfer to scientists in public research institutions in developing countries. Results also have implications on understanding the ultimate success or failure of IPR policies, including how increased patenting affects the way scientists conduct agricultural research.

Key words: agricultural biotechnology, scientists, IP, IPR, technology transfer, public sector

INTRODUCTION

The public sector, especially public research institutions and academic universities, is a significant contributor to knowledge generation and management of the agriculture sector of developing countries. Researchers of these institutions generate information, either codified (e.g., a paper or blueprint), embedded (e.g., an improved seed), or tacit (e.g., why an experiment failed). All of these lead to innovations when an agent (e.g. private firms or individual farmers) uses and applies the information to improve his or her practices or profitability. These scientific discoveries and innovations as intellectual property (IP) can have great value to researchers in advancement of knowledge, to governments and institutions in setting policies, to industry in developing and marketing new products, and overall, to the society.

Intellectual property rights (IPR) puts in place a mechanism that would provide the public sector scientists and the researchers a way of controlling the utilization and optimization of their works, either in form of an invention, technology, information, process, or method, thereby ensuring that they are properly rewarded for such inventive endeavors. IPRs are special kinds of
property rights awarded by society to individuals or organizations principally over intangible assets associated with human inventiveness and creativity: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce. The Universal Declaration of Human Rights provides a broader definition of IPRs 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,” balanced by “the right…to share in scientific advancement and its benefits.” Several distinct forms of IPRs, which include among others, copyrights, patents, trademarks, plant variety protection, and geographical indications, have evolved over time to define and deal with various forms of property. These forms of IPRs share the principle that innovators receive a priority or exclusivity in the economic exploitation of the product of their work.

Public sector scientists compared to their counterparts in the private sector, often have different motivations in conducting research. Scientists working in the public sector have long operated within a community of “open science” defining their own research priorities and are guided with the belief that knowledge and discoveries generated through publicly-funded research are public goods to be placed in the public domain. Their credibility is generally based on the number of publications they produced and the quality and number of distinguished colleagues citing their research. On the other hand, scientists from the private sector operate within a community of “proprietary science,” and are therefore concerned chiefly with the appropriation of rents from the knowledge and inventions they have generated and produced. Their research agenda is determined according to their companies’ larger missions and goals. This delineation, however, is softening as public sector scientists are increasingly encouraged to think and act like their private sector counterparts. They are now challenged to redefine their
roles and upgrade their expertise in this changing world of new science, with new norms governing IP ownership, sharing, and use of research products.

This paper explores the perceptions of public sector scientists toward the importance of IP and how they are responding to the rapid emergence of IP in agriculture and the implications of IPR to public sector research. Bercovitz and Feldman (2008), Gulbrandsen and Smeeby (2005), Baldini, Grimaldi, and Sobrero (2005), are among a few who claimed that success or failure of academic patenting policies are determined by scientists’ attitude and motivation to submit invention disclosures to their tech transfer offices for the invention to be evaluated for protection then commercialized. Hence, it can be said that the success of patenting and licensing policies is ultimately a matter of personal choice and responses among the scientists on the concept of IPRs and its importance.

Building on the research of Beronio, Payumo, Arceo, & Galvez (2008) and Westerburg, Asher, Kisielewski, & Hansen (2007), which demonstrated the IP experiences and attitudes of the scientific community in Philippines and Germany, respectively, a survey instrument was developed to determine the current level of awareness, competencies, and attitudes toward IPRs among public sector scientists in five developing countries in Asia; ultimately assessing the success or failure of their respective institutional IPR policies. This study had two phases: 1) measuring the level of knowledge, awareness, and competencies of scientists on the concept of IP and IP-related instruments; and 2) determining the scientists perspectives on IP and its implications to scientists, their institution, and public agricultural research.
METHODOLOGY

This study tried to capture perspectives of scientists from public research institutions doing agricultural biotechnology from five countries in developing Asia: India, Malaysia, Philippines, Thailand, and Vietnam. The list of public biotech institutions was obtained from the FAO-Biotech database. Scientists’ names were obtained from biotechnology scientists’ database of the countries’ that are available at the country’s respective Science and Technology Ministry, institutional websites, and professional directories. The scientists in the sample are well qualified to report on the relevant issues concerning agricultural biotechnology and IPRs; most of them have been engaged in agricultural biotechnology-related research for 15-20 years and actively involved in tissue culture, molecular markers, gene cloning, genetic engineering, and plant breeding. Their responses reflected their own practices and experiences.

A web-based survey was constructed to determine how the scientists currently view IPRs and its impacts. This survey approach was chosen for the following reasons: the survey sample composed of scientists working in public universities and research institutions with their own websites and email access. These institutions and individuals tend to have high-speed Internet access, therefore, minimizing, if not avoiding, the difficulty in accessing the web-based survey. Web-based surveys reduce time to completion, direct branching, and reduce overall survey costs if no significant programming is required (Schonlau, Fricker, & Elliott, 2002). The survey consisted 28 questions covering three overall areas: IP awareness; importance and impacts of IP protection to agricultural biotechnology; and 3) demographics. The survey consisted of multiple-choice questions, Likert-scaled responses, and open-ended questions (Appendix B).

As an initial step in ensuring that these surveys were clear and concise, the questionnaires were pre-tested to review the survey instrument, improve the clarity of questions and instruction,
and determine the understandability and validity of the contents. The pre-test group included members of the National Partners’ Initiative (NPI) of the Central Advisory on Intellectual Property (CAS-IP). NPI is a community of IP practitioners based in developing and emerging economies working together to support partnerships in relation to IP and technology transfer management between the Consultative Group on International Agricultural Research (CGIAR) centers and National Agricultural Research Systems (NARS). Comments received from this group were used to refine the survey instruments. None of the data collected in the pre-test were used in the final research analysis.

The online survey instrument and the resulting hosted web site was designed and managed by Washington State University’s Social and Economic Sciences Research Center (SESRC). Selected faculty and staff from WSU then tested the final web-based survey questionnaire and validated the survey process. The survey was designed in such a way that respondents can review and change their responses. Response to the survey was completely voluntary; hence, it is expected that some of the respondents skipped some of the questions. Undesirable access to survey pages was controlled through firewalls setup by the SESRC server. Randomly generated personal access codes assigned to respondents also controlled access to the survey. Respondents entered their unique access code at the survey homepage to gain access to the survey itself. Once a survey is completed, the used access code becomes invalid and further access to the survey using the used code was denied.

The SAS statistical package was used to analyze the survey data. Descriptive statistics such as means, frequency, and percentages were primarily employed in the interpretation and comparison of data among groups. Bar graphs generated with Excel were used to compare and analyze the different responses. Decision rules were set for interpreting numeric data to draw
final conclusions. For those items where one category received 40% or more with the other three categories receiving 25% or less of the responses, this occurrence was called “a clear majority.” On the other hand, a response pattern was called to be “without a clear majority” when all four categories received 25% or less of the responses.

RESULTS AND DISCUSSION

This research was designed to determine the current level of awareness, perceptions, and views of public sector researchers and scientists from developing countries on IPRs and the impact of strengthened IPRs on their careers, their institutions, and public agricultural research, in general. The researchers and scientists included in the study were from India, Malaysia, Philippines, Thailand, and Vietnam. A total of 945 scientists were contacted online. Of this number, 285 respondents completed or partially completed the questionnaire (230 fully completed and 55 partially completed) resulting in a response rate of 30%. There were ineligible respondents who reported that their work currently focused on non-agricultural biotechnology activities and thus were not included in the analysis. The response rate of the survey is higher than recent study of Lei, Juneja & Wright (2009) with 25% response rate. Response rate of this survey is also higher than recent studies in the United States (27%), the United Kingdom (16%) and Japan (19%) reported in the American Association for the Advancement of Science (AAAS) study by Hansen (2007). Discussion of survey findings is divided into three parts: (1) profile of respondents; (2) awareness, perception, and actual experience on IPRs protection and exploitation among the respondents; and (3) respondents’ attitudes on the implications of IPRs to scientists, public research institutions, and public agricultural research.
Profile of Respondents

Most of the respondents who participated in the survey were mid-career professionals (Table 3.1). Most of them occupy supervisor positions, manning less than five researchers, have doctoral degrees (n=146, 63.5%), and are between 41 to 50 years old (n=104; 45%). Males (n=134; 58%) dominated the survey and they have been conducting biotech research for 6-10 years (n=46; 20.5%). Majority of the respondents were from the Philippines (n = 92; 32.3%) and India (n= 74; 26.0%).

Table 3.1 Socio-demographic characteristics of the respondents.

<table>
<thead>
<tr>
<th>CHARACTERISTICS</th>
<th>FREQUENCY</th>
<th>PERCENT</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>134</td>
<td>58.0</td>
<td>231</td>
</tr>
<tr>
<td>Female</td>
<td>97</td>
<td>42.0</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 30</td>
<td>9</td>
<td>3.9</td>
<td>231</td>
</tr>
<tr>
<td>31-40</td>
<td>68</td>
<td>29.4</td>
<td></td>
</tr>
<tr>
<td>41-50</td>
<td>104</td>
<td>45.0</td>
<td></td>
</tr>
<tr>
<td>51-60</td>
<td>43</td>
<td>18.6</td>
<td></td>
</tr>
<tr>
<td>More than 60</td>
<td>7</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Highest level of education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor (BA/BS)</td>
<td>32</td>
<td>13.9</td>
<td>230</td>
</tr>
<tr>
<td>Master (MA/MS)</td>
<td>48</td>
<td>20.9</td>
<td></td>
</tr>
<tr>
<td>Doctor (Phd/EdD/DSc)</td>
<td>146</td>
<td>63.5</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>4</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Years doing agricultural biotechnology R&amp;D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 year</td>
<td>37</td>
<td>16.6</td>
<td>223</td>
</tr>
<tr>
<td>1-5 years</td>
<td>45</td>
<td>20.2</td>
<td></td>
</tr>
<tr>
<td>6-10 years</td>
<td>46</td>
<td>20.6</td>
<td></td>
</tr>
<tr>
<td>11-15 years</td>
<td>42</td>
<td>18.8</td>
<td></td>
</tr>
<tr>
<td>15-20 years</td>
<td>25</td>
<td>11.2</td>
<td></td>
</tr>
<tr>
<td>More than 20 years</td>
<td>28</td>
<td>12.6</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>68</td>
<td>27.4</td>
<td>285</td>
</tr>
<tr>
<td>Malaysia</td>
<td>48</td>
<td>20.8</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>73</td>
<td>31.7</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>36</td>
<td>15.7</td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>10</td>
<td>4.4</td>
<td></td>
</tr>
</tbody>
</table>
Awareness, Perception, and Actual Experience on IPR Protection and Exploitation

To determine the knowledge and understanding of respondents on the concept of IPRs and developments of implementation in their institutions, respondents were asked to provide information on the following: training on IPRs; knowledge on the features of IPRs; familiarity on IP legal instruments; actual experience on IPR protection and execution of IP agreements; presence of IPR office; and encountered problems with IPRs, if any. The respondents were also asked about their awareness and knowledge on international and national IP policies.

Figure 3.1 shows the percentage of respondents who received formal training on IPRs. A majority of the respondents (n=188, 70.4%), though they did not have recognized diplomas and qualifications on IPRs from education and training institutions, strongly agreed to all the features of IPRs (Table 3.2). They strongly agreed that IPRs provides exclusive rights to the IP owners (n=119; 51.5%); gives owners the exclusive rights to control the users of their property (n=100; 45.7); gives owners the exclusive rights to sell, lease or transfer the property right (n=104; 47.5%); allows public access to the property under strict professional scientific guidelines (n=88; 40.7%); and defines clearly relative rights of individual innovator or inventor and institution, agency, organization (n=109; 50%). They somewhat agreed (n=91; 42.5%) on IPRs as clearly defining the geographic and time scope of the property. Interestingly, more than half of them (52.5%) recognized IPRs as a tool in generating additional income or incentives.
Figure 3.1 Percentage of respondents who received formal training on IPRs. More than 70% of the survey respondents did not have formal education or training on IPRs.

As Smiler & Erbisch (2004) claimed, this offer of exclusive rights to inventors will prevent others from taking advantage of their ingenuity and their intellectual works. Inventors and their assignees can exploit IPRs over inventions through different models: a) free, public distribution, b) selling of the rights, and c) licensing. Successful licensing of IP enables inventor or its assignees (i.e. university) to receive licensing income. This may be in the form of lump sum or as stream of royalty income over a period of time. Most of the institutional IP policies of public research institutions such as in the academe, nowadays, state that inventors upon assignment of rights will get a share of the financial benefits (i.e. royalty share) if the invention is commercially successful. Many of these universities have a standard scheme for the apportionment of its license income which reflects the involvement of the inventors concerned, the host Department and the University centrally.
Table 3.2 Respondents’ perceptions on the features of IPRs.

<table>
<thead>
<tr>
<th>FEATURES OF IPRs</th>
<th>FREQUENCY (PERCENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Gives exclusive rights to owners</td>
<td>8 (3.5)</td>
</tr>
<tr>
<td>Give owners the exclusive rights to control the users of their property</td>
<td>12 (5.5)</td>
</tr>
<tr>
<td>Give owners the exclusive rights to sell, lease or transfer the property right</td>
<td>4 (1.8)</td>
</tr>
<tr>
<td>Clearly defines the geographic and time scope of the property</td>
<td>9 (4.2)</td>
</tr>
<tr>
<td>Allow public access to the property under strict professional scientific guidelines</td>
<td>8 (3.7)</td>
</tr>
<tr>
<td>Clearly defines relative rights of individual innovator or inventor and institution, agency, organization</td>
<td>6 (2.8)</td>
</tr>
<tr>
<td>Provide income or incentives to innovators or inventors</td>
<td>9 (4.1)</td>
</tr>
</tbody>
</table>

Analysis: In general, results showed that scientists were more knowledgeable (tend to agree more strongly) on the different features of IPRs.

Although the respondents are aware of the features of IPRs, as shown in Figure 3.2, the respondents are not all familiar with IP instruments. They are very familiar only with MTA; somewhat familiar with CDA, license agreement, sponsored research agreements, and assignment of rights; and somewhat unfamiliar to option licenses. MTAs are now a preferred mechanism for the transfer of tangible property (e.g. cloned genes and plasmids) in countries where IPR enforcement is not appropriate (Mayer, 2003). This may explain the familiarity of the respondents with this IPR instrument. Even in the United States, the commonly used mechanism
to acquired patented technology is through the use of MTA than through a nonexclusive or exclusive license (Hansen, Kisielewski, & Asher, 2007). Results also indicate that although a majority have no actual experience on applying for patents, trademark, and geographical indications, some of the respondents have IPRs under their name and are now being commercialized (Figure 3.3). These developments indicate that these scientists and their institutions have started to exploit their own IP.

Figure 3.2 Percentage of respondents and their familiarity with IPR instruments/agreements. MTA is the IP instrument that most of the respondents are very familiar with.
Figure 3.3 Percentage of respondents and status of their IPR assigned. Although majority of the respondents have no IPR on their name, some have existing IPR (e.g. patents) that are being commercialized. Some respondents also reported that they are in the process of applying some of these IPR protections.

Many of the survey participants also revealed that their institutions have an office engaged in the identification (n=142; 61.5%), protection (n=158; 67.5%), promotion (n = 152; 65.2%) and commercialization (n=156; 67.2%) of IP (Figure 3.4). As shown in Figure 3.5, respondents also revealed that their institutions seek protection for copyrights (n=162, 68.6%), industrial design (n=106; 46.5%), patents (n=183; 77.5%), and trademarks (n= 116; 50.4). These are the types of IP protection that are relevant to biotechnology: patents for new inventions; trademarks for distinguishing marks of products or services, protection for new industrial designs; trade secrets for technical business or commercial information; and copyright for publications. Patents are probably the most important IPRs today for agricultural goods and services as they provide, wherever these are available, the strongest protection for patentable plants and animals and biotechnological processes for their production. Almost half of the respondents are, however, not sure/unaware of geographic indications (n = 122; 53.5%) and trade
secrets (n = 106; 46.5%).

Figure 3. 4 Percent of respondents with office in charge of IP identification, protection, promotion, and commercialization. Majority of the scientists work in institutions with IP policy.

Figure 3.5 Kinds of IPRs sought by the institutions. Scientists revealed that their institutions apply for almost all types of IPR protection.

The World Intellectual Property Organization (WIPO) defines a geographical indication (GI) as “a sign used on goods that have a specific geographical origin and possess qualities, a reputation, or characteristics that are essentially attributable to that origin.” Such unfamiliarity with GI could be attributed to its nature as IPRs. Unlike the other forms of IPRs such as patents, trademarks, and copyrights, so far, there is no international register for GIs that exist. Therefore, an overview of already protected and registered GIs in the coffee market will be provided by
surveying the literature and using data from trademark bases as well as from governments and grower associations (Ramona, 2007). Many developing countries stand to gain from stronger WTO rules for GI protection, but have to put more efforts because they have just recently begun to develop their respective regulatory systems to protect GI (van Caenegem 2004; Josling, 2006; Fink & Maskus, 2006). A trade secret, on the other hand, is generally any confidential information that provides a competitive edge for a business such as those of the famous trade secret of formulating Coca Cola.

When asked about their institution’s capacity on IP management and technology transfer, more than 30% (n=76) of the respondents considered their IP programs as good (Figure 3.6).

![Figure 3.6 Rating of respondents on capacity of their institutions on IP management. More than 30% of the respondents indicated that their institutional IP management capacity is good.](image)

These findings support Bigman (2002) and Graff (2007) who said “that many public organizations around the world, including developing countries, have set up or are in the process of establishing offices of intellectual property to aid institutional IPR decisions.” These offices are dedicated to identifying research which has potential commercial interest and strategies on how to exploit them. Technology transfer offices also exist to educate staff on the benefits and legal aspects of IP related issues and to serve as a valuable resource to staff who need assistance in obtaining protection and licensing activities.
**Awareness on international IP laws.** A majority of the respondents are somewhat familiar with the TRIPS, IPRFA and CBD. These three treaties are the most discussed and debated international treaties concerning IP and are perceived to impact public research institutions especially in developing countries. However, respondents are very unfamiliar with the United States’ Bayh-Dole Act of 1980, Paris Convention for the Protection of Industrial Property (Paris Convention); Budapest Convention: Deposit of Microorganisms (Budapest Convention); and Patent Cooperation Treaty (PCT) (Figure 3.7). The dramatic acceleration of patenting activity by US universities was attributed to the passage of the 1980 Bayh-Dole Act by the American Congress. This law assigns the default ownership of US government-funded research to the researcher as opposed to the funding agency and most governments are patterning their technology transfer laws under this Law. On the other hand, the Paris Convention, Budapest Treaty, and Patent Cooperation treaties are administered by the World Intellectual Property Organization and are of interests to individuals and institutions that are active in securing international patents such as in the biotech field. It is encouraging to note that more than 40% (n=107) of the researchers said that they are familiar with their national IP policies, which after all, can directly affect them as researchers and citizens of their countries (Figure 3.8).
Figure 3.7 Percentage of respondents familiar with international IPR laws/policies. Majority of the respondents are somewhat familiar with the TRIPS, ITPRFA and CBD, three of the most important international treaties on IP and concern IP management among public research institutions especially in developing countries.

Figure 3.8 Percentage of respondents with knowledge on national policies on IPRs affecting agricultural biotechnology. Less than half of the respondents are aware of their national IP policies.

**Actual experiences with material exchange.** Scientists must have access to genetic diversity to help bring forth new varieties that can resist pests, diseases, and environmental stresses. Hence, it is important for them to gain access to suitable germplasm. However, gaining access to suitable germplasm is becoming increasingly politicized and legally controlled and is
now subjected to developing international agreements as well as to national legislation.

Interestingly, respondents disclosed that even with the developments in IP, they did not have problems accessing new biological materials from local and international private companies (Figure 3.9).

![Figure 3.9 Percentage of respondents with experience on material exchange with different institutions. Scientists revealed that they did not have major problems in accessing new biological materials from other institutions, private or public, local and abroad.](image)

Attitudes on the Implications of IPRs to Scientists, Public Research Institutions, and Public Agricultural Research

In this part of the survey, respondents were asked to indicate their perceived consequences of employing IPRs in public research institutions. This questionnaire asked them to rate their attitudes on a five-point scale ranging from 1 to 5 (1 indicating a very negative effect, 4 indicating a very positive effect, and 5 indicating no effect) to express their opinions on twenty items.

Respondents have expressed agreement/disagreement on some of IPR’s impact to scientists, research institutions, and public agricultural research (Table 3.3). A majority of the respondents agreed that IPRs foster creativity and stimulates invention and new innovations by scientists (n=202; 87.8%). They also agreed that IPRs contributes in helping increase agricultural
production (n=156; 67.3%); promotes domestic and foreign investments in biological innovations (n=168; 71.2%); serves as incentives/reward mechanism for scientists/researchers (n= 90; 38.8); facilitates access of biotech IPs from other laboratories/ countries (n=174; 75.7); fosters public-private sector collaboration (n=187; 81.7%); provides source of additional budget for institution (n=188; 81%); influences institutional policy to generate more agricultural biotechnologies technologies and products (n=191; 83.1%); and results in more focused R&D, increased institutional productivity, and credibility (n=183; 79.2%).

Table 3.3 Perception of respondents on the impacts of IPRs to scientists and public agricultural research.

<table>
<thead>
<tr>
<th>IMPLICATIONS OF IPRs</th>
<th>FREQUENCY (PERCENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Foster creativity and stimulates invention and new innovations by scientists</td>
<td>9 (3.9)</td>
</tr>
<tr>
<td>Help increase agricultural production</td>
<td>13 (5.6)</td>
</tr>
<tr>
<td>Promote and disseminates use of new knowledge and technologies</td>
<td>19 (8.2)</td>
</tr>
<tr>
<td>Promote domestic and foreign investments in biological innovations</td>
<td>9 (3.9)</td>
</tr>
<tr>
<td>Serve as incentives or reward mechanism for scientists or researchers</td>
<td>10 (4.3)</td>
</tr>
<tr>
<td>Facilitates access of biotech IPs from other laboratories or countries</td>
<td>11 (4.8)</td>
</tr>
<tr>
<td>Fosters public-private sector collaboration</td>
<td>9 (3.9)</td>
</tr>
<tr>
<td>IMPLICATIONS OF IPRs</td>
<td>FREQUENCY (PERCENT)</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Source of additional budget for institution</td>
<td>10 (4.3)</td>
</tr>
<tr>
<td>Influences institutional policy to generate more agricultural biotechnology technologies and products</td>
<td>7 (3.0)</td>
</tr>
<tr>
<td>Results in more focused R&amp;D, increased institutional productivity, and credibility</td>
<td>9 (3.9)</td>
</tr>
<tr>
<td>Increases costs of accessing research material or tools</td>
<td>13 (5.7)</td>
</tr>
<tr>
<td>Distorts and conflicts with public mission of institution resulting in social disservice</td>
<td>22 (9.6)</td>
</tr>
<tr>
<td>Delays publication of research and has a negative effect on science</td>
<td>25 (11.0)</td>
</tr>
<tr>
<td>Requires big investment (manpower, facilities, finances) for institutions</td>
<td>13 (5.6)</td>
</tr>
<tr>
<td>Promotes competition rather than collaboration with the private sector</td>
<td>23 (10.3)</td>
</tr>
<tr>
<td>Diverts resources to areas resulting only in IPR; thus, inhibits or hampers exploration of fundamental long-term basic research questions</td>
<td>18 (7.9)</td>
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</table>
Table 3.3 cont.

<table>
<thead>
<tr>
<th>IMPLICATIONS OF IPRs</th>
<th>FREQUENCY (PERCENT)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>Delays the research process and often times results in stopping research</td>
<td>27 (11.7)</td>
</tr>
<tr>
<td>Constrains or reduces the flow of technology transfer among national agricultural research systems</td>
<td>19 (8.2)</td>
</tr>
<tr>
<td>IPR agreements are too legalistic for scientists to understand and comply</td>
<td>14 (6.1)</td>
</tr>
<tr>
<td>Prevents/or serves as threats to future scientific investigation from IPRs on previous research</td>
<td>22 (9.5)</td>
</tr>
</tbody>
</table>

Analysis: Respondents have expressed agreement/disagreement on some of IPR’s impact to scientists, research institutions, and public agricultural research. They recognize the advantages of IP management in public research institutions and also recognize its tradeoffs.

The respondents also recognized the trade-offs of IP. They agreed that the presence of IPRs increases costs of accessing research, material or tools; distorts and conflicts with public mission of institution resulting in social disservice; requires big investment (manpower, facilities, finances) for institutions; promotes competition rather than collaboration with the private sector; and diverts resources to areas resulting only in IPRs. Thus, respondents appear to think that IPRs inhibits or hampers exploration of fundamental long-term basic research questions. They also agreed that IPRs constrains or reduces the flow of technology transfer among national agricultural research systems IPR agreements; too legalistic for scientists to
understand and comply; and prevents or serves as threats to future scientific investigation from IPR on previous research (Table 3). A majority of them, however, disagreed that IPRs delays the research process and often times results in stopping research (n=105; 45.5%) and delays publication of research and has a negative effect on science (n=133; 58.3%).

**A Note on Interpretation of Statistics**

There are several important caveats related to population coverage and response rates that need to be accounted for in the interpretation of the percentages given in this paper. The findings reported are based on a non-random sample of public sector scientists with email addresses available in the web and whose institutions are also listed in FAO Biotech database. Therefore, results of the study may not represent all public sector scientists working on agricultural biotechnology in the countries under study. Also, the sample was not designed to be a stratified cross section of researchers from the five countries so results of the study are only limited to the respondents. Hence, the population represented by percentages given here is also the population of the respondents. Their answers in aggregate form are useful for policy decisions (among others, competence training and budget support). Additionally, the research design has some limitations. The results derived from this quantitative methodology may be limited in terms of depth than would be the case if a qualitative interview process had been utilized. No measurements of sampling or non-sampling errors were included in this report. Based on the literature, such measurements of error are only appropriate when a statistic is being estimated for a wider population from a sample as the measurement of error informs the reader about how close the statistic might be to the value for the entire population. Thus, the percentages may not represent a larger population than the respondents of the survey.
SUMMARY, IMPLICATIONS OF FINDINGS, AND CONCLUSION

Scientists are generators of intellectual property. It is therefore important to understand how strengthened IPR laws affect these scientists in public research institutions. Attitudes of scientists working in public research institutions in developed countries towards IPRs has been examined theoretically from several perspectives, specifying different factors of influence. Methods of quantitative analyses vary as a result of choice, availability of data, and the concepts, theories, and objectives involved. However, studies on IPR-related attitudes of public sector personnel from developing countries have not yet been thoroughly investigated or are very limited. For this reason, the survey-based paper explored scientists’ awareness on IPRs and perspectives on the possible effects of IPRs on public agricultural research in developing countries in Asia: India, Philippines, Malaysia, Thailand, and Vietnam. These countries are actively engaged in agricultural biotechnology research and also demonstrated some progress in establishing a modern, transparent, and effective IPR system.

A total of 285 of the 941 contacted biotech scientists participated in the survey, resulting in a response rate of 30%. The summary of the major findings and their implications are as follows:

- The majority of the respondents were aware of IPRs though only a few had attended formal training. They are familiar with existing international and local policies and laws regarding IPRs. Most of the respondents agreed that IPRs is beneficial to researchers. A few of them agreed that IPRs also has potential risks.

- Other than the material transfer agreement, scientists are less familiar with other IP instruments. Of particular importance is the assignment of rights. An assignment of rights agreement has to be signed by the scientists (inventors) and is important so that their IP management offices can proceed with licensing and option agreements to transfer their
inventions to the private sector. The fact that they are less familiar with assignments of rights may indicate that this has not been addressed in their institutions. Alternatively, their institutions may use other ways (e.g. patent laws, labor laws, and employment laws) to manage IP. IP ownership as cited by (Graff, 2007) along with protection and management capacity are the three fundamental policy concerns that public research institutions should be able to address so they can exploit IP as a tool to encourage and facilitate commercialization. The lack of specific policies on IP ownership often indicates a lack of coordination or transparency (Graff, 2007). So far, only the Philippines and Malaysia have rules concerning the disposition of IP rights over inventions that result from publicly funded research.

- The developments in the IP legal regime did not impair the scientists’ access to technologies needed for research. This results complement those of Merges (1996) who claimed “that despite the widespread use of patents this “informalness” of property rights among the scientific community is still maintained by “relinquishing (or at least not asserting) some of the scientist’s formal rights.” Hence, there is a continued practice of “costless sharing” despite patents. Likewise according to Kent (2004), the argument that public sector researchers in these countries are restrained by IPRs is misunderstood, since certain key technologies are rarely patented in developing countries and that researchers tend to just share them freely (e.g. gene promoters, transformation vectors, and plasmids).

Overall, the results of this survey indicate that scientists in the institutions and countries surveyed have openness in answering IPR-related questions despite the current ambiguity and debate surrounding property rights. Their attitudes toward IPRs is an encouraging result which
may indicate the changing mindset of public sector scientists from India, Malaysia, Philippines, Thailand and Vietnam, from the traditionally perceived mission of generating publications, and providing free information because they are funded by public funds.

Agricultural scientists are clearly affected by globalization trends and IP regimes. Researchers and scientists should be aware of this potential value of IPRs and of the interest of their laboratories and institutions, be knowledgeable on how to protect their own interests, and be familiar with the rules governing the fair and proper use of IPRs. For many, this means becoming more strategic and systematic in their collaborative research programs, and seeking clearer understanding of the institutional implications of their work. There are also many administrative matters to attend to, including the way in which laboratory or research notebooks are handled, and knowing when and how to make public presentations or disclosures of research results (Crespi, 1998). Thus, this appears to be the right time for those responsible to promote the training of current and future generations of scientists to introduce into their training some activities designed to educate importance of IPR management. Such capability-building efforts hopefully would encourage scientists to fully exploit their intellectual capital by pursuing more patenting applications, and commercialization initiatives promoting public-private sector linkage, which would eventually result to more locally developed products in the market.

ACKNOWLEDGMENTS

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REFERENCES


STUDY 4. Impact of Socio-Demographic Factors on Attitudes of Public Research Institutions’ Personnel towards Intellectual Property Rights (IPRs):
An Econometric Investigation

By Jane G. Payumo

Advising Committee Members: Raymond Jussaume and Howard Grimes

ABSTRACT

This research was conducted to determine whether socio-demographic factors can be used to explain the attitudes of key public sector personnel from five Asian developing countries toward IPRs and its impact to access of research technologies, conduct of research and development (R&D), and dissemination of knowledge by public research institutions. This research was based on a web-based survey conducted among scientists and research administrators (n = 328) in public agricultural biotechnology research institutions in India, Malaysia, Philippines, Thailand, and Vietnam. Estimates of ordinal logistic regression clearly show that in general, attitudes toward IPRs are affected by socio-demographic characteristics with education, position held, and country of citizenship as significant influential factors. This econometric analysis may serve as reference for institutions developing capability training programs, including identification of target training groups, to more actively promote the understanding and importance of IP to public research institutions in developing countries.
INTRODUCTION

Socio-demographic variables are usually among the first that come to mind as potential factors influencing individuals’ attitudes and intentions. These status characteristics as defined by Ridgeway (1991) “are attributes on which individuals vary that is associated in a society with widely held beliefs according to greater esteem and worthiness to some states of the attribute (e.g., Caucasians or males) than others (e.g., African Americans or females).” According to Israel (2009), the identification of relationships between specific topics and the socio-demographic characteristics of individuals for an evaluation can help identify which segments of program participants changed the most, and this information can lead to ideas for improving the delivery and impact of certain programs to segments of population with unique sets of needs. Hence, it is not surprising that the role of socio-demographics has been commonly examined and measured in numerous studies (e.g. Onyango & Nayga 2004; Hossain et al. 2002; Jussaume & Judson 1992; Ceci, 1988; Beronio, Payumo, Arceo, & Galvez, 2008).

In this paper, the predictive impacts of socio-demographic factors on public sector personnel’s attitudes on the implications of intellectual property rights (IPRs) to public agricultural research were investigated. The expansion of IPRs in agriculture is a hot topic in developing countries since public agricultural research in these countries has evolved without IPRs. This development poses new roles and challenges for public research institutions, the main lead of public agricultural R&D in these countries.

This research is based on the premise that attitudes of key personnel from public research institutions on IPRs will be instrumental for the success of developing initiatives to promote and
manage IPRs at the institutional levels. Ceci (1988) studied public sector scientists’ attitudes toward data sharing and did logistic regression analysis, with the scientists’ fields, level of past federal research support (i.e., the amount of federal funding they had received during the most recent 36 months for which data were available), and types of institutional affiliation (such as private university, public university, government, private laboratory, and hospital) as independent variables. From the survey, he found that financial reasons, specifically fear of losing patent rights or obtaining future grants, limit the biotechnology scientists in sharing data. Only a few studies have analyzed the socio-demographic factors as a critical component. The work that comes closest to this research focus is the study conducted by Beronio, Payumo, Arceo, & Galvez (2008) which analyzed the effects of socio-demographic factors (e.g. age, gender, institution, presence of IP policy) on the perception of researchers working at the Philippine’s Department of Agriculture, specifically on the generation and commercialization of agricultural biotechnology and intellectual property. They found that gender and the institution where they work significantly affect awareness on IPRs and existence of IPR policies. Hussain (2009) likewise found that sex, age, education attainment, and income have significant relationship with perceptions on and behavior of Indian citizens towards IPRs. Hence, this study was conducted to enrich existing literature on the relationship between socio-demographic characteristics and IPR perceptions, as well as to do econometric investigations to further examine and confirm the extent of the relationships.

This research was based on an original survey that gathered the perceptions and attitudes of research administrators and scientists from public research institutions in five developing countries in Asia: India, Malaysia, Philippines, Thailand, and Vietnam, on the concept IPRs and its impact to the fulfillment of mandate of public research institutions. Logistic regression
models were constructed to explore the relationship of socio-demographic conditions of these respondents to their degree of agreement on the implications of IPRs on access of research tools, conduct of research and development activities, and dissemination of public knowledge and technology. Estimates of ordinal logistic regression clearly show that in general, attitudes of public sector personnel from the five countries toward IPRs are affected by socio-demographic characteristics with education, position held, and country, as significant influential factors. The ultimate goal of the study is to make recommendations that will enhance the development of capacity building programs on IP management and technology transfer among public research institutions in developing countries.

**RESEARCH MODEL AND HYPOTHESES**

Figure 4.1 presents the research model to investigate the relationship between the dependent and independent variables. Gender ($X_1$), education ($X_2$), position held ($X_3$), and country of citizenship ($X_4$) constitute the independent variables whereas attitude toward impacts of IPRs on access of technologies ($Y_1$), research focus ($Y_2$), and dissemination of knowledge and technology ($Y_3$) are the three alternative dependent variables. The justification for decision variables and corresponding hypotheses are given as follows.
Figure 4.1 Research model used to represent the relationship of socio-demographic factors and attitudes of public sector personnel on IP and its implications.

**Gender**

The gender divide is one of the most significant inequalities amplified by the digital revolution, and cuts across all social and income groups. Many international bodies, including the United Nations Development Program, and the World Trade Organization have declared support to help address the reciprocal impacts among gender relations and IPRs (United Nations Development Programme, 2010) and facilitate a more gender sensitive approach to IPRs (International Labour Organization, 2003). If IPRs contributes to agriculture and sustainable development, and the public sector workforce contribute to generating agricultural IPRs, then an analysis of gender contribution to public sector personnel’s attitudes toward the importance of IPRs will yield insights on gender dimensions of IPRs and its implications. Against this backdrop, the predictive impact of public sector personnel’s gender on their attitudes toward IPR implications is worth investigating, which lead to postulation of the following hypothesis:
Hypothesis 1: $X_1$ does not have predictive impact on $Y_i$, $i=1,2,3$.

**Education**

It is widely accepted that the more formal education a person has attained, the more liberal are their attitudes. In terms of intellectual property rights, it is expected that personnel will treat patents, inventions, and other creative works as important mechanism to recognize efforts of their creations. Personnel who have earned higher degrees, received more training, and obtained more academic exposures could better understand and appreciate the importance of IPRs. Since they are often more exposed to these concepts, they will arguably be more aware about its impact. Against this backdrop, the following hypothesis is postulated:

Hypothesis 2: $X_2$ does not have predictive impact on $Y_i$, $i=1,2,3$.

**Position**

A quick survey of the capacity building program on IP for developing countries reveals that a majority of the IPR training for developing countries target middle and senior-level managers and researchers. This supports the third prediction that higher ranks personnel hold, the more likely that they are trainable and will understand the consequences of IPRs to public research institutions. Thus, the third null hypothesis of this research:

Hypothesis 3: $X_3$ does not have predictive impact on $Y_i$, $i=1,2,3$. 
Country of Citizenship

Eurobarometer (2001) identified country as the most important factor of differentiation in studying differences of attitudes on genetically modified crops, a modern biotechnology closely tied with IPR issues. The authors recommended the need to understand the components of this factor [country] as it underlies, among others, national culture, differences in government actions, economic development and industrialization, and tradition. Different countries, so its citizens, have different appreciation on the importance of IPRs, especially on the enactment, implementation, and enforcement of its rules. Hence, the fourth null hypothesis is:

Hypothesis 4: X₄ does not have predictive impact on Yᵢ, i=1,2,3.

METHODS

Research Instrument

This paper draws on data collected via a web survey questionnaire sent to scientists, research managers, and institutional heads in five countries in Asia: India, Malaysia, Philippines, Thailand, and Vietnam. The survey was conducted from May to September 2009. The survey was developed by the author in collaboration with the Social & Economic Sciences Research Center of Washington State University (SESRC-WSU), the largest university-based survey research center in the Pacific Northwest. A total of 328 survey questionnaires were included for this research.
**Statistical Analysis**

The ordinal regression method was used to model the relationship between the variables. Ordinal regression method seems to be the most suitable and practical technique to analyze the effects of explanatory variables on the ordinal outcome that cannot be assumed to be a continuous measure with a normal distribution (Chen & Hughes, 2004). The problem was treated as linear for each dependent variable:

\[ Y_i = \beta_0 + \beta X_i \quad i = 1, 2, 3 \]

Logit type of regression analysis was included as methodology because this study aims to model a dependent variable (implications of IPRs) in terms of one or more of the independent variables (gender, education, position, and country) while the dependent variable was categorical and ordinal data (Cramer, 1991; Greene, 1993). The outcome variables for this study were measured on an ordered categorical, and five-point Likert scale - strongly disagree, somewhat disagree, somewhat agree, strongly agree, and don’t know/uncertain. The ordinal outcome was not altered as binary or dichotomous measure for logistic regression analysis to avoid loss of inherent information. Responses for “don’t knows” as well as the missing values were not included in the analysis (Krosnick, et al., 2002; personal communication).

Version 9.2 of the SAS System for Windows (2008) was used to generate descriptive statistics and bivariate equation estimates. Ordinal response data was analyzed using cumulative logit and the logistic regression model parameters for this model were computed using SAS Proc Logistic. The chi-square test (test of independence), one of the most popular non parametric method for statistical inference, was used to examine the relationship between the variables.
An alpha of 0.05, the frequently used level of significance in the social science, was generally used in all tests (McMillan & Schumacher, 2001).

RESULTS AND DISCUSSION

Descriptive Results

The male respondents were observed to be dominant with just under 60% in this survey (Table 4.1). This is expected since a majority of the R&D personnel working for the government and in agriculture in the five countries are males (UNESCO, 2010). Most of the respondents had a doctorate degree (64.91%) with more than a third having the position of Professor (37.86%). This is also not also surprising especially for India, which invests in training and producing more young doctorates and helping India achieve its position as a knowledge economy. Malaysia, Philippines, Thailand, and Vietnam are likewise pursuing the same initiatives to produce more Phds. Most of the respondents came from institutions in the Philippines and India.

Most of the respondents perceived that IPRs brings negative impacts to public agricultural research. They agreed that IPRs impacts access of research material or tools (44.90%); diverts resources to research areas resulting only in patentable IP, thus, inhibiting/hampering exploration of basic research questions (35.22%); and constrains or reduces the flow of technology transfer among national agricultural research systems (41.46%). This indicates that the respondents are negative towards IPRs. Descriptive statistics for the dependent and independent variables are reported in Table 4.1.
Table 4.1 Summary statistics of the variables.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>OBSERVATION</th>
<th>N</th>
<th>%</th>
<th>MEAN</th>
<th>SD</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables</td>
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<tr>
<td>Gender</td>
<td>Male</td>
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<td></td>
<td>Female</td>
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<td>Doctor (Phd/EdD/DSc)</td>
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<tr>
<td></td>
<td>Others</td>
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<td>1.89</td>
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<td>Position Held</td>
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<td></td>
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<td>34.15</td>
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<td></td>
<td>Assistant Professor</td>
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<td></td>
<td>Director</td>
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<td>2.44</td>
<td>2.459</td>
<td>1.976</td>
<td>1</td>
<td>9</td>
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<td></td>
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<td>5.28</td>
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<tr>
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<td>40</td>
<td>15.09</td>
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<tr>
<td></td>
<td>Vietnam</td>
<td>17</td>
<td>6.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes on IPRs as impacting access of research material/tools (ACCESS)</td>
<td>Strongly Disagree</td>
<td>14</td>
<td>5.71</td>
<td>3.216</td>
<td>0.867</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Somewhat Disagree</td>
<td>29</td>
<td>11.84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Somewhat Agree</td>
<td>92</td>
<td>37.55</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Strongly Agree</td>
<td>110</td>
<td>44.90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes on IPRs as influencing R&amp;D focus (RESEARCH)</td>
<td>Strongly Disagree</td>
<td>25</td>
<td>10.12</td>
<td>2.802</td>
<td>0.957</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Somewhat Disagree</td>
<td>67</td>
<td>27.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Somewhat Agree</td>
<td>87</td>
<td>35.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strongly Agree</td>
<td>68</td>
<td>27.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes on IPR as constraining or reducing flow of technology transfer among public agricultural research (DISSEMINATION)</td>
<td>Strongly Disagree</td>
<td>27</td>
<td>10.98</td>
<td>2.736</td>
<td>0.921</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Somewhat Disagree</td>
<td>64</td>
<td>26.02</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Somewhat Agree</td>
<td>102</td>
<td>41.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strongly Agree</td>
<td>53</td>
<td>21.54</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

SD = standard deviation; MIN = minimum value; MAX = maximum value.
Test Results

Regression results are reported in Table 4.2.

Table 4.2. Cumulative logit regression results.

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLE</th>
<th>INDEPENDENT VARIABLE</th>
<th>HYPOTHESIS</th>
<th>ESTIMATED COEFFICIENT (SE)</th>
<th>WALD CHI-SQUARE</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCESS</td>
<td>Gender (X₁)</td>
<td>H11</td>
<td>0.0600 (0.2249)</td>
<td>0.0713</td>
<td>0.7895</td>
</tr>
<tr>
<td></td>
<td>Education (X₂)</td>
<td>H12</td>
<td>-0.3847 (0.1439)</td>
<td>7.1466</td>
<td>0.0075</td>
</tr>
<tr>
<td></td>
<td>Position Held (X₃)</td>
<td>H13</td>
<td>0.0590 (0.0484)</td>
<td>1.4882</td>
<td>0.2225</td>
</tr>
<tr>
<td></td>
<td>Country (X₄)</td>
<td>H14</td>
<td>0.1973 (0.0906)</td>
<td>4.7390</td>
<td>0.0295</td>
</tr>
<tr>
<td>RESEARCH</td>
<td>Gender (X₁)</td>
<td>H21</td>
<td>-0.0448 (0.2197)</td>
<td>0.0417</td>
<td>0.8383</td>
</tr>
<tr>
<td></td>
<td>Education (X₂)</td>
<td>H22</td>
<td>-0.4181 (0.1420)</td>
<td>8.6676</td>
<td>0.0032</td>
</tr>
<tr>
<td></td>
<td>Position Held (X₃)</td>
<td>H23</td>
<td>0.1776 (0.0487)</td>
<td>13.3026</td>
<td>0.0003</td>
</tr>
<tr>
<td></td>
<td>Country (X₄)</td>
<td>H24</td>
<td>0.2979 (0.0896)</td>
<td>11.0582</td>
<td>0.0009</td>
</tr>
<tr>
<td>DISSEMINATION</td>
<td>Gender (X₁)</td>
<td>H31</td>
<td>0.2071 (0.2211)</td>
<td>0.8770</td>
<td>0.3490</td>
</tr>
<tr>
<td></td>
<td>Education (X₂)</td>
<td>H32</td>
<td>-0.4123 (0.1424)</td>
<td>8.3791</td>
<td>0.0038</td>
</tr>
<tr>
<td></td>
<td>Position Held (X₃)</td>
<td>H33</td>
<td>0.1224 (0.0482)</td>
<td>6.4593</td>
<td>0.0110</td>
</tr>
<tr>
<td></td>
<td>Country (X₄)</td>
<td>H34</td>
<td>0.0980 (0.0884)</td>
<td>1.2294</td>
<td>0.2675</td>
</tr>
</tbody>
</table>

Attitude on IPRs Impacting Access of Research Technologies. Based on the regressions results Hypothesis 11 (X₁ does not have predictive impact on Y₁) is not rejected (p value = 0.7895). This means that contrary to what is expected, there is no predictive effect of key public sector personnel’s gender on attitudes on IPRs as affecting access of research tools. This also indicates that the male and female personnel surveyed equally weighed the implications of
IPRs and their decisions to agree/disagree on IPR implications on access were not influenced by their gender.

Position held was also not significant (p value = 0.225), hence, H13 (X3 does not have predictive impact on Y1) is also not rejected. Respondents with high (19.72%) and low position (0.46%) strongly agreed that IPRs impacts access of technologies. The huge gap was not significant, which indicated that position of the respondents cannot be used as predictor to determine their attitude on IPR implication on access of technologies by the public sector institutions in the five countries. However, the results of the ordinal regression for education and country were significant with p value = 0.0075 and 0.0295, respectively, indicating the rejection of null hypothesis H12 (X2 does not have predictive impact on Y1 and H14 (X4 does not have predictive impact on Y1). This suggests that education and country can be used as a predictor to predict attitudes of respondents on implications of IPRs to access of technologies.

**Attitude on IPRs Impacting R&D Focus.** Hypothesis 21 (X1 does not have predictive impact on Y2) is also not rejected (p value = 0.8383), hence, there is no predictive effect of key public sector personnel’s gender on their attitudes on IPRs as influencing focus of research. This also indicates that male and female personnel’s surveyed equally weighed the implications of IPRs and their decisions to agree/disagree on IPRs as impacting R&D focus were not influenced by their gender. Education (p value = 0.0032), position held (0.0003), and country (0.0009) were found significant predictors, hence, rejecting the null hypothesis H22 (X2 does not have predictive impact on Y2), H23 (X2 does not have predictive impact on Y2) and H24 ((X2 does not have predictive impact on Y2). These suggest that education, position held, and country can be
used as predictor to predict agreement of respondents on implications of IPRs to influencing research focus.

**Attitude on IPRs Impacting Dissemination of Public Knowledge/Technologies.**

Hypothesis 31 ($X_1$ does not have predictive impact on $Y_2$) and Hypothesis 34 ($X_3$ does not have predictive impact on $Y_3$) are also not rejected (p value = 0.3490 and 0.2675, respectively), hence, there is no predictive effect of key public sector personnel’s gender and country on their attitudes on IPRs as affecting dissemination of public knowledge/technologies. These also indicate that male and female personnel from different countries surveyed equally weighed the implications of IPRs and their decisions to agree/disagree on IPRs affecting technology transfer were not influenced by their gender and country. Education (p value = 0.0038), and position held (0.0110) were found to be significant predictors, hence, rejecting the null hypothesis H32 ($X_2$ does not have predictive impact on $Y_3$) , and H33 ($X_3$ does not have predictive impact on $Y_3$). These suggest that education and position held can be used as predictor to predict agreement of respondents on implications of IPRs to affecting dissemination of public knowledge/technologies.

**IMPLICATIONS**

This research attempted to deepen understanding about public sector personnel perceptions and attitudes toward implications of IPR to agriculture and public agricultural research and how such perceptions and attitudes differ across different characteristics of the personnel such as socio-demographics. Although the method used in this study was descriptive, the results provide some theoretical and practical implications to the management of intellectual
property for public research institutions, particularly capability building efforts. Theoretically, this research supports that socio-demographic characteristics serve as potential factors influencing individual’s attitudes. The data obtained from the present research also have some clear practical implications, showing how important it is to plan and implement IP training programs which not only consider training topics and relevance, qualification of trainers and quality of programs, training schedule, among others but also criteria in selecting the training groups. IP management courses train individuals to become IP practitioners and to be successful IP training institutions need to be able to meet trainers’ expectations by understanding their attitudes on the different implications of IPR. Moreover, IP management training is an expensive activity, training sponsors should be able to identify the right individuals and be aware of the needs of differentiating client segments. This information, hence, may serve as reference for institutions developing capability training programs, including identification of target training groups, to more actively promote the understanding and importance of the concept of IPRs to public research institutions in developing countries.

**SUMMARY AND CONCLUSION**

This paper examined the potential impact of socio-demographic factors (gender, educational attainment, position, and country) on key personnel’s (institutional heads/research managers and scientists) attitudes towards IPRs. Attitudes of public sector key personnel on issues associated with exploitation of IP by public R&D institutions have significance for policy making.

Given the qualitative nature of the dependent variables, logit models were estimated associating the examined socio-demographic factors with the probability of occurrence of the
dependent variable. Logit estimates consistently show and confirm the significant association of attitudes on IPRs with education, position held, and country. In summary, our findings provide empirical evidence suggesting that attitudes of public sector personnel differ with education, position held, and country and that these factors appear to have a concise and clear impact on attitude of public sector personnel on IPRs and its implications on access of research technologies, research focus, and dissemination of research results. This econometric analysis supports theory that socio-demographic factors influence attitudes of public sector personnel in five countries in Asia. Understanding these relationships is paramount to the development of interventions that will be efficacious in developing and implementing IP management training programs, including identification of target training groups and generate more IP practitioners, to more actively promote the understanding and importance of IPR to public research institutions in developing countries.

Although generalizations have to be avoided, this research adds to existing literature supporting the use of socio-demographic factors as indicators of attitudes toward IPRs. The study further emphasized that results only serve as indications and not as global proof of the relationship between socio-demographic factors and attitudes toward IPRs.

Although additional research is needed to address other aspects of this topic, institutions and groups developing capability training programs on IP should consider these findings in deliberations and debates about the regressive impact of education, position, and country on public sector personnel’s attitudes and perceptions on IPRs. Overall, this econometric analysis can serve as reference for institutions developing capability training programs, including identification of target training groups, to further foster the importance of IP management and technology transfer to public research institutions in developing countries.
ACKNOWLEDGMENT

This project was supported by a research grant [001-01-06R-2928-0005] of Dr. Howard Grimes, Vice President for Research and Dean, Graduate School of WSU. The author would like to acknowledge the valuable assistance of Taurean Sutton, Charisma Love Gado, Mark Abalos, Leona Ding, and anonymous reviewers.
REFERENCES


STUDY 5. PERSPECTIVES ON MANAGEMENT OF INTELLECTUAL PROPERTY AND COMMERCIALIZATION OF AGRICULTURAL INNOVATIONS FOR DEVELOPING COUNTRIES AND THEIR PUBLIC RESEARCH INSTITUTIONS: THE WAY FORWARD

By Jane G. Payumo

Advising Committee Members: Keith Jones, Tom Okita, and Howard Grimes

ABSTRACT

Intellectual Property Rights (IPRs) and their application and expansion to agriculture are at the center of polarized debates. IPRs impact agriculture—which is often the backbone of the economy of majority of developing countries and public agricultural research and the linchpin of agricultural development. We review the implications of IPRs to agriculture and public agricultural research and present the highlights of the different studies conducted to reaffirm such implications. We also offer new strategies that might assist developing countries and public R&D institutions in leveraging IPRs to benefit their agricultural sector. Our purpose is to encourage discussion of possible future directions of IP management priorities at national and organizational levels which will then drive policy support for the benefit of developing countries and their public research institutions.

Keywords: developing countries, IP, IPRs, IP management, agriculture, public agricultural research
INTRODUCTION

Developing countries depend on agriculture as an immediate source of food but also as a stepping stone to economic stability. Agriculture’s direct and indirect linkages and its contribution to the growth process (Johnston & Mellor 1961; Timmer, 2002) as an engine for agricultural-demand-led industrialization has always been recognized (Adelman, 1984). A productive and sustainable agricultural sector have also been recognized as important to addressing national food security issues and humanitarian concerns over hunger and malnutrition; and achieving economic growth and poverty reduction (Commission on Intellectual Property Rights (CIPR), 2003). The agricultural sector in most of the developing countries is the major source for employment (up to 81%), income (more than 50% of primary income on average) and export earnings (30% to 50%) (Kaya, Kaya, & Gunter, 2008). Its share in Gross Domestic Product (GDP) ranges from 3.5% to 36%.

Agricultural performance is impressive. From 1980 and 2004, GDP of agriculture expanded globally by an average of 2 percent a year, more than the annual population growth of 1.6 percent. Seventy-nine percent of this growth was due to agricultural growth in developing countries. The agricultural growth of developing countries rose 2.6 percent a year in 1980-2004, and its share of world agricultural Gross Domestic Product (GDP) rose from 56 percent in 1980 to 65 percent in 2004 (World Bank, 2007 p 50). Such progress in agricultural growth in developing countries was dominated by significant gains in Asia, especially China. Cereal yields in East Asia rose by an impressive 2.8 percent per year from 1961 to 2004. A major contributor to this growth is the investment in research and development (R&D) and technological improvements, with improved crop varieties contributing an estimated half of the agricultural productivity improvements. Other factors, such as increased adoption of new technologies,
policies, institutional changes, and major investments in infrastructure and subsidized inputs and outputs also contributed to this growth (World Bank, 2007 p 51-53).

Despite major advances in agriculture and accelerated growth in food production, food insecurity is still common in many parts of the developing world. Food insecurity exists when people lack sustainable physical or economic access to enough safe, nutritious, and socially acceptable food for a healthy and productive life. Factors identified as root causes of food insecurity include poverty, war and civil conflict, corruption, national policies that do not promote equal access to food for all, environmental degradation, barriers to trade, insufficient agricultural development, population growth, low levels of education, social and gender inequality, poor health status, cultural insensitivity, natural disasters, and many others (Caldwell, 2011). Globally, certain groups of people are more vulnerable to food insecurity than others. As Delmer (2005) claimed, many of the developing countries, especially the sub-Saharan Africa, will remain global “hot spots” for hunger and malnutrition for many years to come. Wik, Pingali, & Broca (2010) also forecasted that increases in population combined with moderately high income growth could result in a more than 70 percent increase in demand for food and other agricultural products. This may result in 7.9 billion people in 2050 suffering from malnutrition and hunger with the majority of this clustered in the poorest socio-economic groups in developing countries. Governments in agriculture-dependent developing economies are, thus, challenged to look for new ways to help reduce this statistic and foster food security. New approaches may include technology development, expansion of agricultural research, new growth policies, refined distribution systems – all of which are designed to take actions and renew focus that results in bolstering the agriculture sector in a sustainable manner.
Currently, one of the major debates involving food security focuses on how agricultural innovations in this age of Gene Revolution (e.g. modern biotechnology) and their application will help improve agricultural productivity and satisfy the food requirements in developing countries. Acceptance of these technologies (e.g. genetically modified (GM) crops) is growing in many parts of the developing world. Some 12 countries in Africa now have national biosafety frameworks, and 11 others have interim versions to allow the safe adoption of GM crops. However, the integration of these modern technologies into public agricultural research and delivering the benefits of agricultural biotechnology is fraught with many hurdles and challenges including financial, technical, political, environmental-activist, intellectual property rights (IPRs), bio-safety and trade-related issues. Of these, the protection and expansion of IPRs to agriculture has become one of the most contentious issues, whether as a spur for innovation (by protecting the products of that innovation) or as an obstacle to dissemination of new technologies (by granting monopoly rights to the innovators). IPRs refer to the legal ownership of by a person or business of an invention/discovery attached to a particular product/process which protects the owner against unauthorized copying or limitation. These are rights given to persons over the creations of their minds. This concept of protecting intellectual property, which originated from developed countries, are promoted to induce additional research spending especially from the private sector, technology acquisition and creation, encourage new business development, increase economic growth, and thereby improve development (Maskus, 2000; CIPR, 2003). With the adoption of the TRIPS Agreement, which harmonizes and strengthens IPR rules worldwide, all agricultural innovations and inventions including those in agricultural biotechnology can be protected.
The primary aim of the article is to contribute to the international IPR literature and debate by: reviewing the different implications of IPRs on agricultural development to member-countries of World Trade Organization Trade Related Aspects of Intellectual Property Rights (WTO-TRIPS); determining the responses of developing countries in Southeast Asia and their public research institutions; and sharing some perspectives on how developing countries and their public agricultural research institutions should leverage from managing IP to benefit their agricultural sector.

This paper demonstrates that strengthened IPR systems through TRIPS can impact agricultural development not only of developed countries as critics would claim but also of developing countries. Second, this research shows that public research institutions, at least in developing Asia, have realized the importance of IP and its management in this changing IPR regime. Interestingly, it was noted that research managers and scientists in these countries do not find IPRs as a constraint to access proprietary technologies and research products they need to continue doing research. These attitudes on the implications of IPRs on access, along with research generation, and technology transfer, were found associated with their socio-demographic characteristics (i.e., education, position held, and country of citizenship). This paper concludes with some considerations of ways for developing countries and their public research institutions to cope with IPR developments and benefit from this process while at the same time ensuring their national goals and public mandates to develop and deliver technological innovations, respectively are not compromised.
IMPLICATIONS OF IPRs ON AGRICULTURAL DEVELOPMENT

IPRs are justified from two distinct perspectives either as a personal right or as a form of economic incentive for investment in creative activities. In general, the second perspective that highlights IPRs as an economic incentive role is predominant. IPRs provide economic incentives for research and development (R&D) activities by prohibiting direct copying without permission (e.g., the payment of a royalty). This prevents competition between the creator and the copier, who contributes nothing to the development costs. Thus, IPRs enable investment in R&D potentially to be more profitable.

IPRs are territorial in that they only apply to countries where it is available and granted. IPRs, hence, are important to access creations that are made in other countries. Otherwise, the creator, fearing loss of the work, will often prevent or at least delay transfer to countries where IPR protection is weak or unavailable. Technology transfer thus becomes part of the incentive for countries to protect IPRs and ratify WTO-TRIPS.

WTO-TRIPS is the most comprehensive international IP agreement contributed for strengthening and “harmonization” of IPR systems around the world (United Nations, 2000; Maskus, 2000; Archibugi & Filippetti, 2010). Irrespective of development status, this minimum standards agreement sets benchmarks for most forms of IPRs, including copyright and related rights, patents, trademarks, geographical indications, including appellations of origin, industrial designs, integrated circuit layout-designs, protection of undisclosed information, and control of anti-competitive practices in contractual licenses, within 153 WTO member-countries. TRIPS also specifies enforcement procedures, remedies, and dispute resolution procedures. This agreement allows members to provide more extensive protection of IPRs if they so wish and are left free to determine the appropriate method (e.g. use of patent or sui generis system to protect
plants) of implementing the Agreement’s provisions within their own legal system and practice. Strengthening of IPR implementation has taken place in developed countries and other TRIPS members have been working to improve their IPR systems to comply with TRIPS standards. Maskus (2000), who support this trend of “upward harmonization” by TRIPS, claimed that this will positively promote trade, foreign direct investment, and global innovation. However, some scholars including Reichman & Dreyfuss (2007), Ramanna (2009), Kapczynski (2009), among others contended that the harmonization of these laws could ossify the imperfect IP system of the North, impede development, and further widen the North-South divide.

In agriculture, the life patenting provisions of TRIPS have attracted more attention. Specifically, the provisions requiring signatories to implement a system of IPRs for the products and processes of biotechnology have raised widespread concerns. Article 27(3)b, for instance, requires all WTO members to provide some effective form of IPR protection for plant varieties, as well as patent protection, for all other inventions, including those in biotechnology. With the adoption of the TRIPS agreement, questions arose whether such protection would be beneficial for agriculture, both to producers and consumers, as well as its possible impact on food security (Commission on Intellectual Property Rights, 2003). Like pharmaceuticals, a crucial issue is whether and how IPR protection can promote research and innovation in the agricultural sector relevant to the needs of developing countries and the poor people. The limitations placed by TRIPS on compulsory licensing, including the requirement of adequate compensation are also expected to impact agriculture of developing countries. Developing countries are also concerned about issues related to losing their biodiversity, traditional knowledge and folklore, and traditional varieties to developed countries’ commercial interests, leading to “bio-piracy”. Since
most developing countries’ economies are mostly agriculture-based, there is fear that with the enforcement of TRIPS, their agricultural development will be the first casualties.

In spite of the growing yet contradictory debate in this field of study, the effects of the harmonization efforts and/or strengthening of the IPR systems on agriculture development in TRIPS member countries using econometric framework is surprisingly of limited number. Literature review limits itself to research on the impact of more rigorous IPR regime on certain aspects of technology diffusion in developing countries, for example, arm’s length technology transfer, foreign direct investment (FDI), and exports from developed countries (Hassan, Yaqub, & Diepeveen, 2010; Leger, 2006; Kanwar, 2006; Schneider, 2005; Saint-Paul, 2004; Yang & Maskus, 2001; Svensson, 1998; Lai, 1998; Park & Ginarte, 1997; Lee & Mansfield, 1996; Gould & Gruben, 1996; Thompson & Rushing, 1996; Torstensson 1994; Khan, 1995; Helpman, 1993). All previous studies, however, indicate the lack of uniform result and suggest that a case-by-case analysis must be performed to determine how IPR protection will affect the country’s growth and development, especially in the agricultural sector. Hence, the relationship between strengthened IPR systems and agricultural development in TRIPS member-countries was investigated using time-series cross-sectional (TSCS) regression methods. This study was grounded on the underlying hypothesis that IPRs serve as one important factor to create an enabling environment for national innovation systems for economic growth. As a significant factor affecting agricultural development, IPRs positively contribute to agriculture, the backbone of the economy of majority of the TRIPS member-countries. This hypothesis is consistent with the view that IPRs as a policy tool to promote growth in the agriculture sector are important for both developed and developing countries.
Secondary data over multiple time periods and multiple cross sectional units were compiled to generate a panel dataset of 103 countries and annual data from 1980 to 2005. The dependent variable is agricultural development (AGGDP) proxied by the natural log of the value agricultural gross domestic product (GDP). The independent variable(s) focused on the status of IPR protection among TRIPS members. Four measures were used: IPR protection index by Ginarte-Park (GPI), domestic patenting activities (PAT), tier classification (T1 T2 T3) and a classification of countries whether they comply with patenting life forms of TRIPS and PVP provision (TRIPS + PVP). Results suggest that strengthened IPR using the Ginarte-Park Index (Model 1) as a measure, and domestic patenting activities (Model 2 and 3) in both developed and developing country-members of TRIPS are positively linked with agricultural GDP. Model 4 showed positive association for PVP and negative association for TRIPS with agricultural GDP. Results also reaffirmed the importance of the traditional economic indicators, agricultural area, irrigation, and human capital to agricultural development in TRIPS member-countries. The presence of the dummy variable representing the presence of GM crops yielded different results.

Overall, majority of the measures representing IPR protection showed significant relationship with agricultural GDP, the proxy variable for agricultural development. These were observed for both developed countries, and developing country-members of TRIPS. This indicates that IPR protection as enabling policy for a national innovation system can be used as explanatory variable to explain agricultural development not only for developed countries but also for developing countries. The positive association of the domestic patenting activity in a country and agricultural development likewise indicates that indeed patents as policy tools to attract more innovation and technology innovation can encourage development in the agriculture sector. Yet the combination of patenting life forms and PVP laws yielded unexpected results it
can be used to explain why majority of the developing country-members of TRIPS have instead adopted the *sui generis* option under Article 27.3 (b) of TRIPS and exclude patentability of plants and animals due to its perceived negative impacts to developing nations. Yet countries adopting the *sui generis* system already conform to TRIPS minimum standards for life forms, they may want to revisit and extend IPRs obligations to *plant*-related inventions and innovations and benefit from the process. Furthermore, this research suggests that the presence of traditional economic indicators, agricultural area, irrigation, and human capital alone can already promote agricultural development in TRIPS member-countries. In other words, a developing country with limited means would do well to focus first and foremost on improving these traditional factors if it wants to engage in positive agricultural development. National IPR regulations, that exist or will be developed, relating to agriculture, need to complement pro-growth policies focused on these indicators. Overall, the results of this study could open an avenue for more research on the impact of strengthened IPRs on agricultural development so as to enhance the empirical findings of the study.

**RESPONSES OF PUBLIC RESEARCH INSTITUTIONS IN SOUTHEAST ASIA ON INTELLECTUAL PROPERTY DEVELOPMENTS**

Public research institutions in developing countries have evolved in a world without IPRs where products and processes for research resided in the public domain unlike their counterparts from developed nations; hence, it is important to understand how they have been affected and how they are responding to this new environment. Initially focusing in public R&D institutions in five countries in developing Asia, namely India, Malaysia, Philippines, Thailand, and Vietnam, two surveys with institutional heads and scientists as respondents were done to
determine the impacts of IPRs to public research institutions. Results showed that they are aware of the features, advantages, and tradeoffs of IPRs. The fact that majority of the institutions surveyed have existing IP offices indicate that, overall, the respondents’s respective institutions are supportive of IPR management and recognize the importance of implementing IP procedures and systems to help them address IPR issues, if any, and leverage from IPR management and technology transfer. Survey respondents likewise indicated that the strengthening of IPRs in agriculture did not impair the different institution’s access to proprietary technologies needed for research. On one level, these results seem to imply that all is well in terms of accessing technologies by the scientific community in the five countries; nearly all of the respondents in the survey agreed that access was not an issue of concern despite strengthened IPR systems worldwide. Their work continues, trusting that as final products are developed, no legal instruments will block the dissemination of improved materials to their clients. Although this surveys did not ask which mechanisms enabled them to access some proprietary technologies, this in a way, suggests that the concerns on access for technologies and resources especially in the area of agricultural biotechnology due to IPR developments are not an immediate threat at least in the public sector institutions included in this research. This result complements findings of Pardey, Wright, Nottenburg, Binenbaum, & Zambrano (2003), who claimed that agricultural research centers have far greater freedom-to-operate in agricultural research and that their agricultural researchers are freer than generally perceived to make use of innovations protected in the developed countries owing to the absence of an “international patent right.” As they claimed, IPRs are national in character and there is no such thing as international IPR law, so IPRs granted in one country do not automatically apply in others unless specific steps are taken to secure such rights. Thus, if there is no protection, one country and their public R&D
institutions can freely use patented or copyrighted technologies once they become publicly disclosed through the process of patent grants or through the distribution of copyrighted materials, and can ignore the patent laws of another. But those technologies cannot be legally exported to countries where they fall under IP protection. Finally, econometric investigation revealed that research managers’ and scientists’ socio-demographic characteristics, particularly education, position, and country of citizenship, can affect accepting the concept of IPRs. This information can be useful for developing training programs to enhance institutional IP management and technology transfer capabilities.

MOVING FORWARD: LESSONS LEARNED AND RECOMMENDATIONS

At the onset, it should be recognized that that while IPRs continue to be plagued with negative criticisms, they are nevertheless here to stay and will play significant roles in agriculture in the foreseeable future. Countries will not, and should not, wait for the passage of IP out of the agricultural sector as it is vital to drive R&D throughout the world. Furthermore, IP is needed to access innovative and productivity-increasing technologies which are crucial in helping the developing world break out of poverty and obtain food security that is secure within their borders. It is worth noting that IPRs has advantages and disadvantages and will have different effects in different contexts depending on how they are used and managed. In addition, most key inventions in food and agriculture will occur and continue to occur at public sector research institutions. Public funding must maximize public benefits through appropriate IP management and technology transfer of agricultural innovations such as biotechnology, and from this process, food security is certainly an important public benefit.
Discussion on IPRs and its role for agriculture especially in developing countries should not stop here for the immensity of tasks is still daunting. The following, yet not complete or exhaustive, offers some additional perspectives and recommendations to enhance the current state and successes on IP management by developing countries and their public agricultural research institutions:

**Implementation and Enforcement of TRIPS-Compliant Laws.** TRIPS promote flexibility and not a “one size fits all approach” through its provision allowing countries to legislate IPR regimes suited for its development needs. National IPR policies and laws complying with TRIPS legislation have been updated and are now in place in developing countries using different models. Some member countries followed models of advanced nations such as the United States and Europe while others chose to set up *sui generis* laws specifically to provide protection for plant varieties as required by TRIPS. Whether these laws are implemented and enforced will need to be monitored.

By their nature, TRIPS encourages reevaluation of its provisions and are the subject of an ongoing debate as to whether there is a need to revise the current text of the TRIPS Agreement. These debates focus on various issues such as the relationship between IPRs and plants and competing policy objectives of TRIPS with other international treaties. But for now, rather than proposing to roll back key provisions of TRIPs, member-countries should focus on implementing these national laws with new standards and adequately complement them with safeguards and pro-growth policy programs. These programs should be focused on traditional economic indicators such as use of capital, inputs, technology, and human capital. Studies documenting experiences and ex-post evaluations of the TRIPS provisions, however, will also be a big
contribution to IP literature, and can also serve as reference for discussion and reevaluation of the TRIPS agreement. These can also serve as future reference for other countries that have yet to comply with TRIPS standards and are wanting to be TRIPS-members.

**More Studies on the Impact of TRIPS to Agriculture.** Understanding the role of IPRs in the further development of the agricultural sector and the kind of international rules that best suit the needs not only of developing countries but also the least developed ones are important. In spite of the growing, yet contradictory, discussion on this area, studies on the developments in the IP systems and their impact on agricultural development in TRIPS member countries are surprisingly of limited number. This is understandable since TRIPS has just been recently implemented in many developing countries while others have yet to ratify it completely. Meanwhile, all previous economic impact studies on IPRs suggest that a case-by-case analysis must be performed to determine how IPR protection will affect the development of a country’s agricultural sector. Hence, more IP studies focused on economic, social and cultural impact assessment in the agricultural sector need to be conducted. Adequate systems to monitor the impacts of TRIPS to agriculture, including the development of appropriate and new impact indicators that go beyond the usual measurement indicators of GDP; and measure of strength of IP protection such as existence of IP laws and policies, and number of patents, need to be developed that can be used in relation to each specified impact area. More broadly, there needs to be continued research on the links between IPRs, FDI, and research investment in the agricultural sector of developing countries.
Refocusing of Capacity Building Efforts and More. With developments on IP, the operating ethos of the public sector R&D in developing countries is changing. The need for capacity and competency in the area of IP management is one of the new frontiers that public sector institutions in these countries will face in this ever-changing IP regime. Implementation of a sound IP management program by these institutions, hence, needs continuing capacity building. Researchers and scientists of these institutions should be aware of the potential value of IPRs and of the interest of their laboratories and institutions; be knowledgeable on how to protect their own interests; and be familiar with the rules governing the fair and proper use of IP.

Governments and institutions in developing countries have to invest in building the necessary IP and legal capacities. At least this would ensure that they are not short-changed by developed countries or institutions with advanced IP management structures. Most public research institutions in developing countries will sign research agreements with advanced institutions in developed countries without understanding provisions on IP contained therein, while those of the advanced institutions will have a legal/IP unit to look at any agreements before signing. It is difficult to leverage a system that one does not understand.

International institutions such as the World Intellectual Property Organization (WIPO) that sponsor capacity building programs (e.g. trainings and workshops) should implement tailor-design programs according to the level of development and training needs of the different countries, and should take place both at national and regional levels. Currently, most of the training programs on IP are targeted for developing countries as whole. A blanket approach to IPR education similar with IP policy implementation may not be the best approach because developing countries differ in their training needs and capacities. For instance, public research institutions in the five developing countries in Asia currently prioritize the further development
of their institutional IP policies, commercialization or licensing out their technologies, and marketing their technologies. For these countries, future IP trainings should focus more on these priority areas and less on IP awareness seminars. Training activities also should as much as possible highlight experiences from countries and institutions with the same or similar level of development to convey realistic expectations with regard to the complexity of IP management and technology transfer. Follow up training courses in the form of practical workshops and mentorship programs will also be useful. Meanwhile, in the study of factors affecting attitudes of public sector personnel from the five Asian countries on IP and its implications, educational attainment, position held, and country of citizenship were found influential determinants of their attitudes. Studies on the predictive impact of socio-demographic variables on public sector personnel’s attitudes in other developing countries are interesting studies to explore. Results of these studies can help design IP training programs, including selection of training participants, to enhance capacity building programs on IP management and technology transfer.

Prerequisites for a Successful IP Management Program and Managing IP

Infrastructure Bottlenecks in Public R&D Institutions. Building capacity of IP management will not only help in the development of research programs (such as in biotechnology) but can also be used as a research management tool to help public R&D institutions accomplish their research objectives and promote adoption of technologies for free access and those for private commercialization (Figure 5.1). As shown in this figure, IPRs can also help national public R&D institutions, and enable them to:

1) monitor, choose, access, adopt, and modify new tools and technologies from the public agricultural sector such as IARC (International Agricultural Research Centers), CGIAR
(Consultative Group on International Agricultural Research) system, academic institutions, and the private sector;

2) develop technology transfer mechanisms that will commercialize, promote, and diffuse agricultural innovations from laboratories to farmers at the domestic level guided by, among others, IPR policies and biosafety issues;

3) promote and invigorate relationships with IARCs and other public sector R&D laboratories; and

4) promote better partnerships with the private sector as important source of technologies and funding support.

These opportunities and advantages, however, can be maximized with a strong internal environment among public sector research institutions, which components include: 1) trained and competent human resources, with effective indigenous knowledge, who will undertake agricultural R&D; 2) modestly equipped facility and infrastructure; 3) adequate budgetary support from government and other investors; 4) presence of institutional policy and incentive frameworks; and 5) strong R&D organization and structure, and style of R&D governance.
Figure 5.1 Framework outlining the implications of the expansion of IPRs to agriculture and institutionalization of IPRs to developing country’s public agricultural research system. Adopted from Sebastian & Payumo (2008).

IP management is more complex where there is limited capacity, which is common for most developing countries. As this research shows, many of the public R&D institutions in India,
Malaysia, Philippines, Thailand, and Vietnam do not have the sufficient resources to institutionalize IP management efforts. Other public R&D institutions in developing countries may also have the same bottlenecks. Institutional IP management entails additional institutional investment, which means that costs must be carefully considered and justified against other needs. If the institution has a critical mass of R&D activity and the institution promotes protection and commercialization of its research outputs, then a fully functioning IP management and technology transfer office is justified. Institutions and countries with limited resources may consider other options and explore creative ways to achieve the same goals. Public R&D institutions, with limited R&D activity, can collaborate with each other, and/or pool resources to establish a common office with support staff or with just an IP focal person to facilitate managing their institutional IPs. Further, it should be realized that IP management is not only the responsibility of the IP or tech transfer office alone. IP management should work closely alongside research units, and other important administrative of the organization, including finance, audit, and human resource management, just like in any modern-day knowledge-based organization.

**IP Generation, Protection and Commercialization of Agricultural Biotech Innovations by Public R&D Institutions.** The CGIAR centers have reduced their investment in agricultural research capacity, particularly on crop biotechnology, and seem unlikely to expect them to be a major supplier of this kind of research for developing countries. So it is expected that national agricultural research systems in developing countries will have to be the suppliers of biotechnology R&D and take the lead in building the national IP portfolio of these countries. Many of these institutions, however, have so far focused on imitative research or reverse
engineering, and have depended heavily on borrowed technology from abroad. It is important for these institutions to engage in the improvement of technologies, and much more generate home-grown technologies, and help create a road map that leads to agricultural and economic growth in their respective countries. Ties with CGIAR centers, which have successful partnership with the private sector and international donors, need to be strengthened and enhanced.

Meanwhile, the primary ways in which these public R&D institutions disseminate their discoveries are through publication, and provision of training and extension support to their clienteles (e.g. farmers). But since many of the developing countries (e.g. Philippines, Malaysia, India, etc.) have also enacted technology transfer laws such as the US 1980 Bayh-Dole Act, many public R&D institutions are now using patents and licensing to transfer inventions and research outputs into the marketplace. However, protection of agricultural biotechnology tools (e.g. genes) is still an unexplored issue in developing countries. IPR legislation in majority of developing countries, however, ends to deny protection for novel plant varieties, animals and biological processes to produce them. This can become an obstacle for a public R&D institution(s) that aims promote IPR protection to enable commercialization of their research results through the private sector. However, public R&D institutions in developing countries can partner with public research institutions in developed countries, that can help them manage their IP and commercialize them in the US, for instance, which supports patenting of these products and where many of the private companies reside. This is a new model which can further increase linkage among public R&D institutions in developed and developing countries, and enable public R&D institutions in developing countries to commercialize their home-grown agricultural innovations to reach developed nations, which has a wider market.
Access of Agricultural Biotechnology Tools and Need for New Models for Biotech Innovation. Interests to research and generate new stream of innovations grounded on genetic manipulation of living organisms is not going to stop, even when GM crops takes a hard time to reach the market due to regulatory issues and public acceptance. Access to these technologies and tools and resources to generate these modern crops will be very important for developing countries. It is clear that unequal access to the fruits of biotechnology research will lead to differential rates of technological progress between countries and institutions. Again, comes the issue of IPRs.

Confidential agreements, material transfer agreements (MTA), licensing, purchase, and joint ventures are some of the IPR tools and options that developing countries and their public research institutions use to gain access to proprietary technologies and resources in biotechnology (Erbish and Fischer 1998). So far, based from experiences of several public R&D institutions in the five Asian developing countries and of experiences of public R&D institutions from developed countries such as US, United Kingdom, and Japan, existing legal mechanisms especially the use of MTA are not hindering access to proprietary technologies. However, with evolving and complicating rules on material exchange, particularly on germplasm and transgenic materials, required by other international treaties, many of the terms and provisions of these agreements especially on aspects of commercialization (e.g. payment of royalties) will take on new forms and terms. Developing countries and their public R&D institutions should monitor these developments, be prepared to form new strategies, benchmark best practices from other successful institutions, and take the necessary policy measures to attain their research goals while keeping in mind national policies and frameworks.
Meanwhile, there have been many suggestions, including patent pools, to facilitate technology transfer of agricultural innovations, especially those with multiple and complex IPRs, at the international level. The Public Intellectual Property Resource for Agriculture (PIPRA) was established because of this. A clearinghouse for agricultural technology, PIPRA takes languishing patents on agricultural technologies from public and private sectors, bundles them into usable tools, and serves them up to public sector research institutions, which then develop scientific innovation such as new plant varieties, and improved crops. Beside the story of the transfer of Golden Rice to some developing countries, patent pools, however, remains generally untested.

Presently, “open source” licensing as a new style of accessing IP is evolving in the agricultural biotechnology industry. An offshoot of this new IP style is the "Open Source Biotechnology," which refers to the possibility of extending the principles of commerce-friendly, commons-based peer production exemplified by Open Source software development to the development of research tools in biomedical and agricultural biotechnology. The Biological Innovation for Open Society (BiOS) Framework by CAMBIA, for instance, works on this initiative towards developing new licensing and distributive collaboration mechanisms to promote open access for biotechnologies like Transbacter, an alternative to Agrobacterium tumefaciens transformation to splice non-native genes to plants. A. tumefaciens is just a small part of the puzzle and additional technologies(e.g. selectable markers, promoters, etc.) are needed to create a patent-protected transgenic plant. Hence, the open-source approach cannot circumvent all patents and be completely patent-free way of creating a transgenic plant.

A new model to put enabling science and biotech research tools into the public domain to benefit society and spur innovation in the agriculture sector needs to be developed. A recast
patent pool managed not by a virtual organization may be of better fit, that is, an institution with better resources, practices IP management (socially responsible licensing and commercial patenting), and international visibility may be able to deliver the job better.

**Forging More Partnerships and Role of CGIAR.** In a world in which the science required to generate improved technologies is becoming increasingly complex and expensive, the level of collaboration among public institutions, and between public, private, and non-government organizations (NGO) must increase from its current level. Institutional arrangements to facilitate effective partnerships between the public and private sectors in agricultural R&D are just beginning to emerge. Many of these public-private arrangements involve institutions in rich countries and are still largely unresolved regarding research directed toward the poorer parts of agriculture in developing countries. Bridging this private-public divide can have profound long-term development consequences and opportunities. These arrangements could help enable the sharing of expertise along with research products and processes, and help direct some private research toward orphan or minor crops.

As government budgets, staff and foreign aid resources have diminished in magnitude or failed to materialize, philanthropic institutions have attempted to close the gap in technology, including supply of services, materials, training, and communication support to promote international development. The Alliance for a Green Revolution in Africa, an approach forged by philanthropic foundations, for instance, has been established to transform African agriculture via an ‘African Green Revolution’. Philanthropic and NGOs, hence, can be good resources to facilitate technology access, support enhance IP management capabilities, and promote development for other developing countries and their public research institutions.
The international centers of CGIAR should also continue to serve as facilitator and play a constructive role in the transfer of technologies between the public R&D institutions in developing countries, advanced laboratories in developed countries, the private sector, and NGO groups. Many discoveries, similar with ‘Golden Rice’ technologies, from these institutions can be channeled to CGIAR centers and transfer them to the national agricultural research systems.

These are just a few of the strategies and actions that developing countries and their public R&D institutions may try in their quest to leverage from IP to benefit their agricultural sector. Overall, the key is to match the proper IPRs with specific socioeconomic, technical, commercial, and administrative conditions with specific developing countries and their public research institutions, and manage them well. In conclusion, the concept of IPRs should be dealt with fair optimism and should not be regarded as insurmountable problems for developing countries and their public agricultural research, but rather should be perceived as offering new extraordinary opportunities and ways for these nations and institutions to deliver alternative or yet better service for their agricultural sector, especially the poor.

ACKNOWLEDGMENTS

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US Constitution Art 1, Sec 8


http://www.worldbank.org/


Appendix A

GLOSSARY OF ACRONYMS AND TERMS

1. Agricultural biotechnology - an advanced technology that allows plant breeders to make precise genetic changes to impart beneficial traits to the crop plants we depend for food and fiber (Biotechnology Industry Organization, 2009).
2. Biotechnology – any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use (Convention on Biological Diversity, 2007).
3. Capacity building - a phrase frequently used in international development literature. Broadly means ‘the strengthening and/or development of human resources and their institutional support structures’ (Maredia & Erbisch, 1998).
4. CAS-IP - Consultative Advisory Service on Intellectual Property
5. CBD - Convention on Biological Diversity
6. CGIAR - Consultative Group on International Agricultural Research
7. FAO - Food and Agriculture Organization of the United Nations
8. Food security - a situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meet their dietary needs and food preferences for an active and healthy life (Food and Agriculture Organization, 2001).
9. Freedom-to-operate (FTO) - the ability to undertake research projects and/or commercial development and sales activities involving a particular technology or product with a minimal risk of infringing the unlicensed patent or tangible property ownership rights of another party (Kryder, Kowalski, & Krattiger, 2000).
10. FTO - Freedom to Operate
11. GDP - Gross Domestic Product
12. Geographical indication (GI) – a sign used on goods that have a specific geographical origin and possess qualities, reputation, or characteristics that are essentially attributable to that origin. An appellation of origin (AO) is a special kind of GI. GIs are protected in accordance with international treaties and national laws under a wide range of concepts, including laws specifically for the protection of GIs or AOs, trademark laws in the form of collective marks or certification marks, laws against unfair competition, consumer protection laws, or specific laws or decrees that recognize individual GIs (World Intellectual Property Organization, 2010).
13. GMO - Genetically Modified Organisms
14. Green Revolution - a significant increase in agricultural productivity as a result of using high-yielding varieties of grains, pesticides, and improved management techniques. During this time, specifically, improved germplasm was made available to developing countries as a public good through an explicit strategy for technology development and diffusion. It was responsible for productivity growth of the rice sector in Asia, wheat in irrigated and favorable production environments worldwide and maize in Mesoamerica and selected parts of Africa and Asia (Pingali & Raney, 2005).
15. IFPRI- International Food Policy Research Institute
16. Intellectual property (IP) - taken to mean, without limitation, intellectual property rights, including patent rights, plant variety protection certificates, unpublished patent
applications, and any inventions, improvements, and/or discoveries that may or may not be legally protectable, including know-how, trade secrets, research plans and priorities, research results and related reports, statistical models and computer programs and related reports, and market interests, and product ideas (Kryder, Kowalski, & Krattiger, 2000).

17. ISAAA - International Service for the Acquisition of Agri-Biotech Applications
18. ITPGRFA - International Treaty on Plant Genetic Resources for Food and Agriculture
19. License - a binding, revocable privilege to transfer IP rights in exchange for royalties or other consideration. Licenses are contractual agreements, and should, among other things, specify term, territory, and whether rights granted are exclusive or non-exclusive (Erbisch & Fischer, 1998).
20. Material transfer agreements (MTAs) - type of contractual agreement that offers a variety of proprietary protection, frequently for materials (e.g. TP) not covered by patents. In agricultural research, MTAs are used, among others, in the transfer of plant genetic resources, plasmid constructs, and transformation vectors (Blakeney, Cohen, & Crespi, 1999; Soong, 1999).
21. NARS - National Agricultural Research Systems
22. Patent(s) - an exclusive right given to an inventor to exclude all others from making, using and/or selling the invention. The right the inventor has depends on which country issued the patent (Erbisch & Velasquez, 1998; Scalise & Nugent, 1995).
23. PBR - Plant Breeders’ Rights
24. Plant breeder’s rights – rights granted to the breeder of a new variety of plant giving them exclusive control over the propagating material (including seed, cuttings, divisions, tissue culture) and harvested material (cut flowers, fruit, foliage) of a new variety for a number of years. With these rights, the breeder can choose to become the exclusive marketer of the variety, or to license the variety to others. To qualify for these exclusive rights by plant breeders’ rights, a variety must be new, distinct, uniform, and stable (Congress of the Philippines, 2002).
25. Plant variety protection (PVP) - form of protection for plant varieties similar to a patent, but with some significant exemptions. Also known as ‘plant breeders rights; an international convention (UPOV) sets minimum standards in providing protection for crops that reproduce sexually and clonally (i.e. tuber-bearing crops). Among other requirements, varieties must be distinct, uniform and stable (Scalise & Nugent, 1995; Goss, 1996).
26. Public agricultural research – is a broad term that includes plant and animal genetic resources, agricultural and food policy, natural resources, and their management, farming systems and practices, etc.
27. Public good – is a good that is non-rivalrous and non-excludable. Non-rivalrous means that consumption of the good by one individual does not reduce availability of the good for consumption by others while non-excludability that no one can be effectively excluded from using the good. Economists use this term to classify investments necessary to sustain agricultural productivity (Haggblade, 2007). These are goods that the private sector will not supply because they cannot recoup their investments.
28. R&D - Research and Development
29. Technology commercialization - the generation of a business profit from the conversion of theoretical material or laboratory concepts into real-world commercial practices. It
includes the process of taking an invention from idea to business concept, then to market (National Renewable Energy Laboratory, 2010).

30. Technology transfer - the transfer of commercial rights under intellectual property derived from research efforts in academic laboratories to the commercial marketplace for both public and financial benefit (Partners Research Ventures & Licensing, 2010).

31. TRIPS Agreement on Trade Related Aspects of Intellectual Property Rights

32. UN - United Nations

33. UNDP - United Nations Development Programme

34. UPOV - Union Internationale pour la Protection des Obtentions Végétales (International Union for the Protection of New Varieties of Plants)

35. Valuation - evaluation of technologies to assess their value, as well as the value of related patents and portfolios. One common objective in valuation is determining potential royalty rates coupled with licensing of technology (Degnan, 1998; Bramson, 1999).

36. WIPO - World Intellectual Property Organization

37. WTO - World Trade Organization
Appendix B

Survey Instruments for Institutional Heads

Effects of Intellectual Property Rights on Agricultural Biotechnology

Please use these definitions as you answer the questions in the survey. Thank you for your help!

**Intellectual property (IP)** refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs that are used in commerce.

**Intellectual property rights (IPR)** are private rights over intellectual property and are ordinarily protected under these legal theories: patent, copyright, trademark, trade secret, geographical indication, and plant variety protection.

**Agricultural biotechnology** are research tools scientists use to understand and manipulate the genetic make-up of organisms for use in agriculture: crops, livestock, forestry and fisheries and includes genomics and bioinformatics, marker-assisted selection, micropropagation, tissue culture, cloning, artificial insemination, embryo transfer and other technologies, and genetic engineering).

### Technology Transfer Capabilities

**Q1.** Does your institution have an office engaged in intellectual property management in any of the following ways? *(Please check one response for each item.)*

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Not Sure/ Not Aware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Protection</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Promotion</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Commercialization</td>
<td>1</td>
<td>2</td>
<td>3</td>
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</tbody>
</table>

**Q2.** Does your institution have policies and procedures in place with regard to intellectual property management and technology transfer? *(Please check one)*

1. Yes, policies existing
2. Yes, policies in progress
3. Yes, policies in discussion
4. No policies existing or planned  → **Skip to Q9**
5. Not aware/don’t know  → **Skip to Q9**
Q3. How informed were you on each of the following international laws that relates to intellectual property and agricultural biotechnology in your institution? (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Well Informed ▼</th>
<th>Somewhat Informed ▼</th>
<th>Not Sure/Not Aware ▼</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. The Trade-Trade Related Aspects of IPR (TRIPS)..............</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>B. Convention on Biological Diversity CBD).......</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C. International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) .........</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>D. Other</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Q4. How many people work in your IP management unit? Please include full-time, part-time, contracted, or seconded employment. (Please check one)

1 None
2 1-3
3 4-5
4 More than 5 → How many people work in your IP unit?

Q5. How much money per year do you allocate for IP management activities including personnel and other costs? (Please check one)

<table>
<thead>
<tr>
<th>None</th>
<th>Less than $20,000</th>
<th>$20,000 – 24,999</th>
<th>$25,000 – 39,999</th>
<th>$40,000 – 44,999</th>
<th>$45,000 – 59,999</th>
<th>$60,000 – 79,999</th>
<th>$80,000 and above</th>
</tr>
</thead>
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<tr>
<td>1</td>
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<td>4</td>
<td>5</td>
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<td>7</td>
<td>8</td>
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</tbody>
</table>

Q6. Does your institution have a policy that ensures compliance with the international laws like TRIPS (Trade-related Aspects of IPR), CBD (Convention on Biological Diversity) and ITPGRFA (International Treaty on Plant Genetic Resources for Food and Agriculture? (Please check one)

1 Yes
2 No

Q7. How effective was your institutional IP management program in helping you address problems associated with access, generation, or technology transfer of agbiotech intellectual properties? (Please check one response.)

1 IP management program was very well suited to address these programs
2 IP management program was somewhat well suited to address these programs
3 IP management program was not effectively organized to address these problems
4 Did not personally deal with these problems
5 Not sure/Not aware

Q8. How do you rate your institutional capacity with respect to intellectual property management and technology transfer? *(Please check one)*

1 Very good
2 Good
3 Fair
4 Poor
5 Very poor

Q9. In the last two years, have you experienced *problems* accessing or acquiring new biological materials from the United States of America or other foreign-government supported laboratories overseas? *(Please check one)*

1 Yes, major problems
2 Yes, some problems
3 No
4 Not sure/not aware

Q10. In the last two years, have you experienced *problems* accessing or acquiring new genetic resources from local and international private companies? *(Please check one)*

1 Yes, major problems
2 Yes, some problems
3 No
4 Not sure/Not aware

Q11. Have you experienced *conflicts* (with the researchers, community, others) with regards to protecting or commercializing your agbiotechnologies? *(Please check one)*

1 Yes, major conflicts
2 Yes, some conflicts
3 No
4 Not sure/Not aware

If you answered **NO** to Q9, Q10, and Q11, *skip to Question 14*

Q12. Do you think these problems or conflicts on access and transfer of agbiotech were brought on by the *complexity of the provisions and requirements required by these international treaties*? *(Please check one)*

1 Yes, major factor
2 Yes, moderate factor
3 Yes, minor factor
Q13. Please tell us how much priority your institution places on each policy on intellectual property management and technology transfer. (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Policy</th>
<th>Very low priority</th>
<th>Low priority</th>
<th>Moderate priority</th>
<th>High priority</th>
<th>Very high priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Developing an intellectual property rights policy</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
<tr>
<td>B. Developing legal intellectual property instruments</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. Freedom-to-operate negotiation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. Prosecuting/filing for intellectual property rights protection</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E. Technology commercialization or licensing out of technologies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>F. Technology acquisition of protected technologies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>G. IP valuation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>H. Marketing of technologies...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I. Setting up of new or start-up companies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Q13a. Of the categories marked as “Very Low Priority” above (Q13), which one has the **lowest priority**? (Please indicate below the letter that correspond to the priority listed in Q13) (If no “Very Low Priority”, skip to Q13b)

_____ Lowest priority → Please explain:

Q13b. Of the categories marked as “Very High Priority” above (Q13), which one has the **highest priority**? (Please write the letter that corresponds to the priority listed in Q13) (If no “Very High Priority”, skip to Q14)

_____ Highest priority → Please explain:
Q14. Please indicate the extent to which you disagree or agree with each of the following statements about the effectiveness of IPR. (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Effective intellectual property rights.....</th>
<th>Strongly Disagree ▼</th>
<th>Somewhat Disagree ▼</th>
<th>Somewhat Agree ▼</th>
<th>Strongly Agree ▼</th>
<th>Don’t Know ▼</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Give exclusive rights to owners to control who may use the property …</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>B. Give exclusive rights to owners to sell, lease or transfer the property right..</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. Clearly defines the geographic and time scope of the property…</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. Allow public access to the property under strict professional scientific guidelines…..</td>
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<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E. Clearly defines relative rights of individual innovator/inventor and institution, agency, organization.....</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>F. Provide income/incentives to innovators/inventors …</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Q14a. Of the categories marked as “Strongly Disagree” above (Q14), which one is the least important key feature of intellectual property rights? (Please indicate below the letter that correspond to the intellectual property rights listed in Q14) (If no “Strongly disagree”, skip to Q14b)

_____ Least Important Key Features of IPR ➔ Please explain:

Q14b. Of the categories marked as “Strongly Agree” above (Q14), which one is the most important key feature of intellectual property rights? (Please indicate below the letter that correspond to the intellectual property rights listed in Q14) (If no “Strongly Agree”, skip to Q15)

_____ Most Important Key Features of IPR ➔ Please explain:
Q15. Please indicate the extent to which you disagree or agree with each of the following statements about the role of IP at institutions. (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Intellectual Property Rights (IPR) at public R&amp;D institutions…</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Foster creativity and stimulates invention and new innovations by scientists</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
<tr>
<td>B. Help increase agricultural production…</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>C. Promote and disseminates use of new knowledge and technologies</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>D. Promote domestic and foreign investments in biological innovations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E. Serve as incentives/reward mechanism for scientists/researchers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>F. Facilitates access of biotech IPs from other laboratories/countries</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>G. Increases costs of accessing research material or tools</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>H. Fosters public-private sector collaboration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>I. Source of additional budget for institution</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>J. Influences institutional policy to generate more agbiotech</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>K. Results in more focused R&amp;D, increased institutional productivity, and credibility</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>L. Distorts and conflicts with public mission of institution resulting in social disservice</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>M. Elays publication of research and has a negative effect on science</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>N. Requires big investment [manpower, facilities, finances] for institutions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
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P. Diverts resources to areas resulting only in IPRs thus inhibits/hampers exploration of fundamental long-term basic research questions.................. 1 2 3 4 5
Q. Delays the research process and often times results in stopping research.................. 1 2 3 4 5
R. Constrains or reduces the flow of technology transfer among national agricultural research systems .............................................. 1 2 3 4 5
S. IPR agreements are too legalistic for scientists to understand and comply .......... 1 2 3 4 5
T. Prevents/or serves as threats to future scientific investigation from IPR on previous research 1 2 3 4 5
U. Gives exclusive rights to owners ........................................ 1 2 3 4 5

Q15a. Of the categories marked as “Strongly Disagree” above (Q13), which one is the least important key feature of intellectual property rights? (Please indicate below the letter that corresponds to the intellectual property rights listed in Q13) (If no “Strongly disagree”, skip to Q13b)

____ Least Important Key Features of IPR  →  Please explain:

Q15b. Of the categories marked as “Strongly Agree” above (Q13), which one is the most important key feature of intellectual property rights? (Please indicate below the letter that correspond to the intellectual property rights listed in Q13) (If no “Strongly Agree”, skip to Q14)

____ Most Important Key Features of IPR  →  Please explain:

**Background Information**

To help us analyze the results, please answer the following questions about yourself and your work.

**Q16.** Are you...

   Male  2   Female
Q17. What is your current age?

1  Less than 30  2  31-40
3  41-50  4  51-60
5  More than 60

Q18. Please select one category that best fits your position in your institution.

1  Professor  6  Executive Director
2  Associate Professor  7  Director
3  Assistant Professor  8  Senior Research Scientist
4  Dean  9  Other
5  Associate Dean

Q19. What is your formal title? _________________

Q20. Which one of the following best describes your highest level of education?

1  Bachelor (BA/BS)
2  Master (MA/MS)
3  Doctor (PhD/EdD/DSc)
4  Others (Please describe):

Q21. What is your field of specialization? (Please describe)______________________________

Q22. In which year did you complete your highest degree? Year ________________

Q23. How many staff do you supervise?

1  None
2  1-5
3  6-10
4  11-19
5  20 or more

Q24. Please indicate the size of your institution? (Please estimate the number of employees.)

1  Less than 200 employees
2  200 – 999 employees
3  1,000 – 4,999 employees
4  5,000 – 9,999 employees
5  10,000 and more employees
Q25. How much does your institution uses agricultural biotechnology as a tool in your crop improvement program?

1 Greatly used
2 Slightly used
3 Do not use at all

Q26. In which country is your institution located?

1 India
2 Malaysia
3 Philippines
4 Thailand
5 Vietnam

Q27. Would you like to receive a report of final results? This report may be useful to help develop better programs for managing IP in your region/country.

1 Yes, → What is your email address for sending the report?
2 No

If you have any comments about this questionnaire or about intellectual property management of biotechnology, please write them in the space below.

Please return your completed questionnaire to:
Jpayumo4@wsu.edu
Office of Intellectual Property
Washington State University
1610 NE Eastgate Blvd, Suite 650, Pullman, WA 99164
Phone: (509) 335-7066
Appendix C

Survey Instruments for Researchers

Effects of Intellectual Property Rights on Agricultural Biotechnology Researchers

Please use these definitions as you answer the questions in the survey. Thank you for your help!

Intellectual property rights (IPR) are defined here as private rights over intellectual property and are ordinarily protected under these legal theories: patent, copyright, trademark, trade secret, geographical indication, and plant variety protection.

Agricultural biotechnology are research tools scientists use to understand and manipulate the genetic make-up of organisms for use in agriculture: crops, livestock, forestry and fisheries and includes genomics and bioinformatics, marker-assisted selection, micropropagation, tissue culture, cloning, artificial insemination, embryo transfer and other technologies, and genetic engineering).

Intellectual Property Awareness

Q1. Did you have any formal training on Intellectual Property Rights? (Please check one)

1  Yes
2  No

Q2. How familiar are you with each of the following intellectual property rights instruments/agreements? (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Instrument/Agreement</th>
<th>Very Familiar</th>
<th>Somewhat Familiar</th>
<th>Somewhat Unfamiliar</th>
<th>Very Unfamiliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidential disclosure agreement (CDA)</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
<td>▼</td>
</tr>
<tr>
<td>Licensing Agreement</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Option-to-License Agreement</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Material transfer agreements (MTA)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Sponsored research agreements (SRA)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Assignment of Rights</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Q3. **How often did you use each of the following agreement?** *(Please check one response for each item.)*

<table>
<thead>
<tr>
<th>Agreement</th>
<th>Very Familiar</th>
<th>Somewhat Familiar</th>
<th>Somewhat Unfamiliar</th>
<th>Very Unfamiliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidential disclosure agreement (CDA)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Licensing Agreement</td>
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<td>4</td>
</tr>
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<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Sponsored research agreements (SRA)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Assignment of Rights</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Q4. **How familiar are you with each of the following international laws/policies?** *(Please check one response for each item.)*

<table>
<thead>
<tr>
<th>International Law/Policy</th>
<th>Very Familiar</th>
<th>Somewhat Familiar</th>
<th>Somewhat Unfamiliar</th>
<th>Very Unfamiliar</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Trade Organization-General Agreement on Tariff and Trade-Trade Related Aspects of IPR (WTO-GATT-TRIPS)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Convention on Biological Diversity CBD</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>United States Bayh-Dole Act of 1980</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Paris Convention for the Protection of Industrial Property</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Budapest Convention: Deposit of Microorganisms</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Patent Cooperation Treaty (PCT)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Q5. **Do you know any national policies affecting IPR and agbiotech in your country?** *(Please check one)*

- 1 Yes
- 2 No → **Skip to Q7**
- 3 Don’t know → **Skip to Q7**
Q6. If yes, please list the five main policies affecting IPR and agbiotech in your country.
1.
2.
3.
4.
5.

Q7. Does your institution have an office engaged in intellectual property management in any of the following ways? (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Identification ……</th>
<th>Yes</th>
<th>No</th>
<th>Not Sure/ Not Aware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection ………</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Promotion …………</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Commercialization …</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q8. Does your institution presently use any of the following methods to protect your institution’s IP? (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Copyrights and related rights ................................</th>
<th>Yes</th>
<th>No</th>
<th>Not Sure/ Not Aware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic Indications .........................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Design ..................................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Patents/Utility model.............................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trademark .............................................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trade Secret ..........................................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Not aware ...............................................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Q9. In the last two years, have you experienced problems accessing or acquiring new biological materials from the United States of America or other foreign-government supported laboratories overseas? (Please check one)

1 Yes, major problems
2 Yes, some problems
3 No
4 Not sure/Not aware

Q10. In the last two years, have you experienced problems accessing or acquiring new genetic resources from local and international private companies? (Please check one)

1 Yes, major problems
2 Yes, some problems
3 No
Q11. How effective was your institutional IP management program in helping you address problems associated with access, generation, or technology transfer of agbiotech intellectual properties? *(Please check one)*

1. IP management program was very well suited to address these programs
2. IP management program was somewhat well suited to address these programs
3. IP management program was not effectively organized to address these problems
4. Did not personally deal with these problems
5. Not sure/Not aware

Q12. How do you rate your institutional capacity with respect to intellectual property management and technology transfer? *(Please check one)*

1. Very good
2. Good
3. Fair
4. Poor
5. Very poor

---

**IP protection to Agbiotech**

Q13. Please indicate the extent to which you disagree or agree with each of the following statements about the role of IP at institutions. *(Please check one response for each item.)*

<table>
<thead>
<tr>
<th>Intellectual Property Rights (IPR) at public R&amp;D institutions…</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
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<th>Strongly Agree</th>
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<tbody>
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<td>A. Foster creativity and stimulates invention and new innovations by scientists ..........</td>
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<td>▼</td>
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<td>F. Facilitates access of biotech</td>
<td></td>
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IPs from other laboratories/countries ............................................ 1 2 3 4 5
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P. Diverts resources to areas resulting only in IPRs thus inhibits/hampers exploration of fundamental long-term basic research questions .......... 1 2 3 4 5
Q. Delays the research process and often times results in stopping research ...................... 1 2 3 4 5
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S. IPR agreements are too legalistic for scientists to understand and comply .. 1 2 3 4 5
T. Prevents/or serves as threats to future scientific investigation from IPR on previous research 1 2 3 4 5
U. Gives exclusive rights to owners ..............................

Q13a. Of the categories marked as “Strongly Disagree” above (Q13), which one is the least important key feature of intellectual property rights? (Please indicate below the letter that corresponds to the intellectual property rights listed in Q13) (If no “Strongly disagree”, skip to Q13b)

_____ Least Important Key Features of IPR  →  Please explain:

Q13b. Of the categories marked as “Strongly Agree” above (Q13), which one is the most important key feature of intellectual property rights? (Please indicate below the letter that correspond to the intellectual property rights listed in Q13) (If no “Strongly Agree”, skip to Q14)

_____ Most Important Key Features of IPR  →  Please explain:

Q14. Please indicate the extent to which you disagree or agree with each of the following statements about effectiveness of IPR. (Please check one response for each item.)

<table>
<thead>
<tr>
<th>Effective intellectual property rights ……</th>
<th>Strongly Disagree</th>
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</tr>
<tr>
<td>C. Clearly defines the geographic and time scope of the property...</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>D. Allow public access to the property under strict professional scientific guidelines……</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
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<td>E. Clearly defines relative rights of individual innovator/inventor and institution, agency, organization.....</td>
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<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>F. Provide income/incentives to innovators/inventors …</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
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Q14a. Of the categories marked as “Strongly Disagree” above (Q14), which one is the least important key feature of intellectual property rights? (Please indicate below the letter that correspond to the intellectual property rights listed in Q14) (If no “Strongly disagree”, skip to Q14b)

____ Least Important Key Features of IPR → Please explain:

Q14b. Of the categories marked as “Strongly Agree” above (Q14), which one is the most important key feature of intellectual property rights? (Please indicate below the letter that correspond to the intellectual property rights listed in Q14) (If no “Strongly Agree”, skip to Q15)

____ Most Important Key Features of IPR → Please explain:

**Background Information**

To help up analyze the results, please answer the following questions about yourself and your work.

Q15. Are you…

1. Male
2. Female

Q16. What is your current age?

1. Less than 30
2. 31-40
3. 41-50
4. 51-60
5. More than 60

Q17. Which one of the following best describes your highest level of education?

1. Bachelor (BA/BS)
2. Master (MA/MS)
3. Doctor (PhD/EdD/DSc)
4. Others (Please describe):

Q18. What is your field of specialization? (Please describe)

Q19. In which year did you complete your highest degree? Year _______

Q20. How many years have you been in agbiotech R&D?

1. Less than 1 year
2. 1-5 years
3. 6-10 years
4. 11-15 years
5. 15-20 years
6. More than 20 years
Q21. Please indicate the size of the lab or research unit that you work in?

1. Myself only
2. 2 - 4 researchers, including myself
3. 5 - 9 researchers, including myself
4. 10 or more researchers, including myself

Q22. Please select one category that best fits your position in your lab or research unit.

1. Head of lab → Please describe
2. Senior research staff
3. Junior research staff
4. Technical staff
5. Other (Please describe):

Q23. What is the status of each IPR assigned to you?

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<th>Now Being commercialized</th>
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</table>

Q24. Please estimate the average income for research personnel in your field in your country?

Income in local currency → Which currency?
Income in US currency

Q25. How would you compare your income to the average research personnel in your country?

1. Below average
2. About average
3. Above average
4. Significantly above average
5. Don’t know/uncertain
Q26. What is your major research involvement?

1. Tissue culture  2. Molecular markers
5. Plant breeding  6. Others (Please describe):

Q27. In which country is your lab/research institution located?


Q28. Would you like to receive a report of final results? This report may be useful to help develop better programs for managing IP in your region/country.

1. Yes,  2. No

What is your email address for sending the report?

If you have any comments about this questionnaire or about intellectual property management of bio technology, please write them in the space below.

Please return your completed questionnaire to:

Jpayumo4@wsu.edu
Office of Intellectual Property
Washington State University
1610 NE Eastgate Blvd, Suite 650, Pullman, WA 99164
Phone: (509) 335-7066