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Socio-economic Impacts, Social Inclusion, and Science-Policy Interphase: The Case of Rice Biotechnology in the Philippines

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The paper argues that the development of biotechnology policies in the Philippines vis-à-vis rice is enabled by structures and processes that are friendly to the furtherance of social inclusion and equity goals. This occurs in the context of attaining rice self-sufficiency amidst a globalized system, and is clearly expressed in the relative density of concepts and provisions related to participation, inclusivity and transparency in all the relevant policy instruments. However, spaces that are opened are vulnerable to a political system that has deep-seated structural flaws and a science community whose financial support from the state is limited and at the same time whose financial autonomy from vested interests is suspect. Thus, in addition to investing in research to build scientific knowledge and capacity, there should also be an investment in research on the political dynamics of the institutional domains for multi-stakeholder encounters and contestations. Further research should be done on the nature of the interplay between science, industry and policy, to determine appropriate institutional arrangements in which science-industry linkages remain robust without compromising the regulatory process, and without compromising science. In addition, it is also vital that research is conducted about the knowledge and information flows and communication pathways and their implications on policy outcomes and stakeholder positions. A deliberate effort should be done to study the processes of mythmaking on both sides of the biotechnology debate, and to clearly identify the nexus by which distortions occur, the form by which they happen, their manifestations, and the drivers that engender their emergence.

Keywords*: Science, technology and society; social impacts of genetically-modified crops; politics of science and technology*

The formulation of public policies, particularly those that have direct implications on development, occurs in a political environment, as embedded in processes of governance. Therefore, as a political process, various forces in society interact to influence not only the final policy outcome but also the policy formation process itself. However, development policies address complex problems that require solutions that are not only political but are also technical in nature. Unfortunately, the interplay between science and policy, while a reality, is a relatively unexplored terrain in

policy studies in the Philippines. This divide is particularly made evident by the impression that science and politics are two different worlds. Adhering to this false divide, however, is no longer tenable in the context of pressing issues that confront the world, such as threats to food security and of climate change. Application of technological advances in science in addressing these issues has become even more compelling that it now behooves social science inquiries to focus on the dynamics of the interplay between science and policy making.

This paper will inquire into the dynamic relationships that exist between the science of rice biotechnology on one hand and the development of agricultural food policy in the Philippines, with particular focus on its impacts on social inclusion. However, as a process that is still unfolding, considering that genetically-modified rice has yet to be commercialized even as the various scientific processes from laboratory to controlled testing have already begun, the paper may not be able to provide a more empirically-grounded discussion of the social impacts of more advanced forms of rice biotechnology as a technological breakthrough nor of their adoption and commercialization as embedded in an actual policy intervention. What the paper will present is a diagnosis of the current developmental trajectories associated with the interplay between rice science and agricultural policy, particularly on the promises and pitfalls it offers to the participation of the various relevant sectors in society, and a prognosis of where the Philippines might be heading.

The paper is divided into four parts. The first part is devoted to a discussion of the Philippine policy environment in general, as well as the context within which and the form by which agricultural food policy emerge, and how social inclusion is articulated within it. This will be followed by a discussion of the more specific policy processes in rice biotechnology. After this, the focus of the paper will shift to the anticipated impacts and social equity issues associated with rice biotechnology. Finally, the paper will offer recommendations for further research.

THE POLICY ENVIRONMENT FOR SOCIAL INCLUSION IN AGRICULTURAL POLICY

The Philippine policy environment, in general, and its science-based policy infrastructure, in particular, is full of contradictions. While the policy discourse and institutional framework are textually rich and even advanced, this is undermined by structural flaws emanating from a weak state and by administrative incapacity.

The Philippines possess, in structure and form, the ingredients of a democratic polity. The rites of democracy, from regular elections to functioning branches of government, are all present. Waves of popular mobilization have strengthened the role of civil society organizations in governance, even as such have been enabled by the re-emergence of civil society institutions as alternative sites from where citizens contested the power of the State during the authoritarian rule by the Marcos dictatorship as well as in succeeding administrations. The policy texts that came out, including even the fundamental law of the land (the 1987 Constitution) are replete with celebratory references to elements of good governance, such as autonomy and representation, participation and empowerment, and other political concepts that are theoretically born out of the desire for governance to become more inclusive.

In addition, gender mainstreaming policies are well-entrenched, even as participatory mechanisms are stipulated not only in policy development but in policy and project implementation not only in agriculture, but in other development sectors. Multi-sectoral bodies at all levels, from the national to the local, exist to provide stakeholders avenues to participate in the crafting of decisions. As will be discussed in the next section, for example, the process of approving the commercialization of a genetically modified crop, according to stated policy, should undergo an elaborate review process that involves the participation of stakeholders from the science community, the consuming public, as well as

the political branches of government. This is characteristic of a policy climate born out of the "people power" movement that toppled the Marcos dictatorship in 1986, in which, and at least in theory, the purported principle behind governance is decentralization and people participation. The Local Government Code (RA 7160), passed in 1992, is a key milestone in the entrenchment of this particular discourse in governance, as it sought the decentralization of the management of many environmental resources, included those related to agricultural development, to the local levels.

The policy shift, at least at it appears in policy texts, away from command and control strategies occurred in the context of a tacit recognition of a globalizing world, in which global competition is an inherent challenge to be faced. This developed in the context of the entry into force of the General Agreement on Tariffs and Trade/World Trade Organization (GATT/WTO). The recognition of participation and decentralization as governance strategies emerged in tandem with a strengthened economic policy orientation towards trade and industry liberalization, and an export oriented mind-set. This over-all orientation was captured by and embodied in the Agricultural and Fisheries Modernization Act or AFMA (RA 8435) passed in 1997. Section 2 of the Act declared the general policy of the Philippines vis-à-vis its agricultural and fisheries sector as follows (emphasis added):

> The goals of the national economy are more equitable distribution of opportunities, income and wealth; a sustained increase in the amount of goods and services produced by the nation for the benefit of the people; and an expanding productivity as the key to raising the quality of life for all, especially the underprivileged.
>
> ***The State shall promote industrialization and full employment based on sound agricultural development and agrarian reform*****,** through industries that make full and efficient use of human and natural resources, and which are competitive in both domestic and foreign markets. In pursuit of these goals, all sectors of the economy and all regions of the country shall be given optimum opportunity to develop. Private enterprises, including corporations, cooperatives, and similar collective organizations, shall be encouraged to broaden the base of their ownership. Thus, it is hereby declared the policy of the State to enable those who belong to the agriculture and fisheries sectors to participate and share in the fruits of development and growth in a manner that utilizes the nations resources in the most efficient and sustainable way possible by establishing a more equitable access to assets, income, basic and support services and infrastructure.
>
> ***The State shall promote food security, including sufficiency in our staple food, namely rice and white corn***. The production of rice and white corn shall be optimized to meet our local consumption and shall be given adequate support by the State.
>
> ***The State shall adopt the market approach in assisting the agriculture and fisheries sectors*** while recognizing the contribution of the said sector to food security, environmental protection, and balanced urban and rural development, without neglecting the welfare of the consumers, especially the lower income groups. The state shall promote market-oriented policies in agricultural production to encourage farmers to shift to more profitable crops. (AFMA, 1997)

AFMA further declared that the State is committed to empower the agricultural and fisheries sector by adopting the following principles: poverty alleviation and social equity, food security, rational use of resources, global competitiveness, sustainable development, people empowerment, and protection from unfair

competition. Section 3 of the act explicitly states its objectives, which are as follows:

a) To modernize the agriculture and fisheries sectors by transforming these sectors from a resource-based to a technology-based industry;
b) To enhance profits and incomes in the agriculture and fisheries sectors, particularly the small farmers and fisherfolk, by ensuring equitable access to assets, resources and services, and promoting higher-value crops, value-added processing, agribusiness activities, and agro-industrialization;
c) To ensure the accessibility, availability and stable supply of food to all at all times;
d) To encourage horizontal and vertical integration, consolidation and expansion of agriculture and fisheries activities, group functions and other services through the organization of cooperatives, farmers' and fisherfolk's associations, corporations, nucleus estates, and consolidated farms and to enable these entities to benefit from economies of scale, afford them a stronger negotiating position, pursue more focused, efficient and appropriate research and development efforts and enable them to hire professional managers;
e) To promote people empowerment by strengthening people's organizations, cooperatives and NGO's and by establishing and improving mechanisms and resources for their participation in government decision-making and implementation;
f) To pursue a market-driven approach to enhance the comparative advantage of our agriculture and fisheries sectors in the world market;
g) To induce the agriculture and fisheries sectors to ascend continuously the value-added ladder by subjecting their traditional or new products to further processing in order to minimize the marketing of raw, unfinished or unprocessed products;
h) To adopt policies that will promote industry dispersal and rural industrialization by providing incentives to local and foreign investors to establish industries that have backward linkages to the country's agriculture and fisheries resource base;
i) To provide social and economic adjustment measures that increase productivity and improve market efficiency while ensuring the protection and preservation of the environment and equity for small farmers and fisherfolk; and
j) To improve the quality of life of all sectors. (AFMA, 1997)

A careful analysis of the provisions of the AFMA reveals a commitment to a modernized agriculture ready to take on the challenges of a globally competitive environment, even as it places value on food security and environmental considerations. More significantly, the statement of objectives reiterates the textual commitment of the Philippine state towards grassroots empowerment and stakeholder participation. In this regard, the specter of a looming rice crisis has fueled further the appropriation of the modernization discourse in agriculture.

The state policy discourse is also rich with progressive policy statements and actions vis-à-vis the heightened role of science in the development process. Specific to biotechnology, the Philippine state has provided a supportive policy climate, at least at the level of articulated policy statements. Table 1, culled from Peczon (2008), presents significant developments in state policy on biotechnology.

On the overall, the policy making process in the Philippines in general, and in agriculture in particular, while remaining to be centralized and State-directed, have opened up spaces for stakeholder participation and social inclusion. In fact, the very instruments which enable these are in themselves products of participatory and inclusive processes. For example, the AFMA has evolved from the work of the legislative

Table 1
Important Policy Milestones in Biotechnology in the Philippines

Date	Event
1979	National Institutes of Biotechnology and Applied Microbiology was established in the University of the Philippines at Los Banos by Presidential Decree under President Ferdinand E. Marcos
1986-1992	The Department of Science and Technology (DOST) identified biotechnology as a flagship of leading edge technologies "as strategic tool for achieving economic development" during the tenure of President Corazon C. Aquino
15 October 1990	President Corazon C. Aquino issued EO 430 entitled, "Constituting the National Committee on Biosafety of the Philippines (NCBP)"
1992-1998	Biotechnology remained a major program of DOST's Science and Technology program during the tenure of President Fidel V. Ramos
15 May 1998	DOST issued the "Guidelines on Planned Release of Genetically Modified Organisms and Potentially Harmful Exotic Species."
2000	President Joseph Estrada approved the institutionalization of biotechnology in government programs
16 July 2001	President Gloria Macapagal-Arroyo issued a National Policy Statement on Modern Biotechnology that states, "We shall promote the safe and responsible use of modern biotechnology and its products as one of the means to achieve food security, equal access to health services, a sustainable and safe environment, and industry development."
2002	The Department of Agriculture issued AO 8 entitled, "Rules and Regulations for the importation and Release into the Environment of Plants and Plant Products Derived from the Use of Modern Biotechnology"
17 March 2006	The Office of the President issued EO 514, entitled "Establishing the National Biosafety Framework, Prescribing Guidelines for its Implementation, Strengthening the National Committee on Biosafety of the Philippines and for Other Purposes
2006	Philippine Senate ratified the *Cartagena Protocol on Biosafety to the United Nations Convention on Biological Diversity* on 14 August and the Philippine Government submitted the Senate Ratification of the Cartagena Protocol to the United Nations on 5 October.

Source: Peczon, 2008.

agricultural committee (AGRICOM), which involved the participation not only of members of the legislature and policy makers from the agricultural bureaucracy. It also involved representatives from civil society, farmers and fishers communities, and from the academe. In this context, while the state and its various instrumentalities remain the key player in setting the agenda in agricultural policies, the institutional framework for participation and inclusion is, both on paper and to some extent in practice, robust.

However, the spaces, which are opened in the texts of the official policy discourse of the State, are seriously undermined by the prevailing negative drivers. These include funding constraints, organizational inertia, and administrative incapacity. They are further complicated by the presence of powerful interests and the politicization of the bureaucracy, the latter being manifested in the relatively political nature of the appointments of the Secretary of Agriculture, among others. Thus, the whole policy process becomes an interesting terrain littered with ideal types and frameworks being compromised by bureaucratic and political expediency. It is to this terrain of political contestations that this paper will now turn to, using the case of policy development in rice biotechnology.

POLICY INSTRUMENTS AND PROCESSES IN AGRICULTURAL BIOTECHNOLOGY

Rice is an important agricultural commodity in the Philippines. In fact, it is undoubtedly a political commodity, it being the main staple crop. It is therefore ironic that the Philippines, which used to be a rice exporting country, has become the world's biggest rice importer. Production data issued by the Department of Agriculture (DA), reveals that local rice production has been short vis-à-vis a steadily increasing local demand since 1994. Online statistics reported by the Bureau of Agricultural Statistics in its website reveals that while there was no importation of rice before 1994, this has not been the case after 1994. It is also ironic that even as the AFMA has been casted in the mold of modernizing Philippine agriculture towards global competitiveness, the logic of which in fact was drawn from the forces unleashed by GATT/WTO: rice remains a crop that, on the balance, draws resources from the national economy through importation expenses instead of bringing resources from export earnings. The impending rice crisis, the initial waves of which were already felt recently, have pressured the government to double its efforts in promoting rice sufficiency. To achieve this objective, the government has fixed its sights at the scientific community, and the associated technologies of conventional breeding, as well as biotechnology-assisted crop improvement strategies.

The application of biotechnology in agricultural food production has already been explicitly recognized by state policy. The AFMA has for its goal the transformation of Philippine agriculture from a resource-based to a technology-based sector. The AFMA specifically contains provisions for biotechnology as an essential component to modernize Philippine agriculture. Specifically, it was envisioned for biotechnology to become an important component for the attainment of food security and sustainable agriculture through the development of rice that is resistant to pests and drought. It is also projected that it may increase famers' incomes due to a reduction in maintenance costs brought about by chemical dependence and crop losses from pests and diseases, even as it has positive environmental impacts. The development of crops that are resistant to pests and diseases would significantly reduce the use of chemicals, thereby greatly reducing the pesticide residues, which are harmful to human health. It was also noted that biotechnology could help in the promotion of proper nutrition among consumers, even as it also could minimize risks to food safety. Examples of this would be the use of biotechnology in the production of nutrient-enriched food crops.

In pursuance of the provisions of AFMA, the DA has adopted the following policies vis-à-vis biotechnology:

a) Adopt a program that facilitates rather than limits the development and application of biotechnology, particularly modern biotechnology in Philippine agriculture while ensuring human health, environmental protection and conservation, and equitable sharing of the benefits of our genetic resources.

b) Strengthen the capability of the scientific community to undertake development and risk assessment of biotechnology products such as GMOs through aggressive recruitment of appropriately trained individuals, non-degree and degree-oriented training of research staff and provision of adequate facilities and operating funds for continuing research in selected institutions.
c) Develop and adopt a transparent regulatory system for the commercialization of GMOs that is science- or product-based rather than technology or process-based.
d) Considering the limited experience the world has today in modern biotechnology products, the regulatory system shall allow for amendments as data and experience come along. Furthermore, acknowledging the great variety in the type and innovation process of biotechnology, the regulatory system shall treat biotechnology products on a case to case basis.
e) Promote the initiative of the private sector in the development and commercialization of biotechnology products through a transparent regulatory system and by focusing the public sector efforts in areas unattended to such as technologies for resource-poor farmers.
f) Promote the wise utilization of Philippine biodiversity by strengthening existing programs of genetic conservation, assessment and characterization of biological diversity and isolation of potentially useful genes. (Halos, 2000a)

To implement these policies, the DA has adopted a biotechnology program that has the following components: policy analysis and advocacy; biotechnology institutional development and capability enhancement; biotechnology research and development; risk analysis; assessment, management, and communication; and biotechnology commercialization (Halos, 2000a)

The formulation of these policies and programs of the DA was done through the leadership of the Office of Policy and Planning with the participation of the Biotechnology Technical Advisory Group (BioTAG). This group is a multi-agency body composed of the technical representatives coming from the regulatory agencies of DA, namely: the Bureau of Plant Industry (BPI), the Bureau of Animal Industry (BAI), and the Bureau of Fisheries and Aquatic Resources (BFAR). In addition, it also includes representatives from other government agencies such as the Bureau of Food and Drugs (BFAD), the Department of Health (DOH), the Intellectual Property Office (IPO), and the National Committee on Biosafety of the Philippines (NCBP), which is coordinated by the Department of Science and Technology (DOST). BioTAG also has members from the scientific community, specifically from the DA's own research bureau, the Bureau of Agricultural Research (BAR), and the Philippine Rice Research Institute (PhilRice), as well as from the Institute of Plant Breeding (IPB) and the National Institutes of Biotechnology and Applied Microbiology (BIOTECH), both based at the University of the Philippines at Los Banos (UPLB).

To enable the use of biotechnology in food production, there are specific provisions in the law, which ensures financial support for research and development (R and D) in biotechnology. Of the initial Php20 billion budget allocated in the first year of the implementation of AFMA, 10 percent was earmarked for R and D, four percent of which were supposed to have been allocated for the biotechnology program of the DA. In the succeeding years of implementation, the implementing rules and regulations (IRR) of AFMA likewise contained stipulations to support R and D in agricultural biotechnology. The latter was assured at least four percent of the total budget for R and D, which was to be drawn from the budget intended for basic research, which according to Rule 83.4 of the IRR should be at least 20 percent of the total R and D budget of the Department.

In reaction to the rice shortages that were experienced, the Philippine government, through the DA, committed 1.16 billion pesos to R and D for the next two years as part of the Rice Self-Sufficiency Plan 2009-2010 of the Department. The plan recognized the role of R and D on new rice technologies as essential component for attaining self-sufficiency and consumer affordability in rice by 2010. Taking into consideration threats from pests and diseases, as well as the reality of global warming and climate change, research institutions, in partnerships with national and local government agencies, were directed to develop next generation water-saving technologies, improve integrated strategies for pest and disease management, and design sustainable management of innovative food and feed production systems. The biggest component, of which around 400 million pesos was allocated, is the development of location-specific technologies on varieties, nutrient, and pest management. Rice biotechnology research, on the other hand, was allotted 60 million pesos and climate change research was given 40 million pesos.

Despite the potential of biotechnology to enable the modernization of Philippine agriculture, issues of biosafety remains paramount, particularly on the possible impacts of what genetically modified crops could unleash to the natural ecosystems and to human health. It is in this context that the Philippines adopted a policy that also emphasizes the safe and responsible use of modern biotechnology. In October 1990, the passage of Executive Order (EO) 430 formalized the policy of the Philippines vis-à-vis biotechnology regulation. EO 430 explicitly states the policy not to engage in any activity that is related to chemical and biological warfare. Furthermore, biosafety guidelines were issued to regulate the research, production, and manufacturing work and/or institutions in the country engaged in genetic engineering. EO 430 explicitly stipulates that genetic manipulation of organisms is allowed only if it serves the welfare of humanity, without compromising the environment. Furthermore, the approval also rests on a justification that shows that there are no other alternative approaches to attain the same goal. The guidelines also covered activities pertaining to the importation or introduction and/or breeding of plant pests and potentially harmful microorganisms, as well as to the use of domestic animals in laboratory tests related to genetic engineering.

EO 430 also created the National Committee on Biosafety of the Philippines (NCBP), which is the primary regulatory body to oversee research, production, and manufacturing in biotechnology. The NCBP is attached to the DOST, and of which the Chairperson is the Undersecretary for R and D. As a regulatory body, NCBP is multi-agency and multi-disciplinary. It is composed of representatives from the various scientific disciplines, with one member each representing the biological, environmental, physical, and social sciences. In addition, it also includes designated representatives from other government agencies such as the DA, DOH, and the Department of Environment and Natural Resources (DENR). There are also two members appointed to the committee to represent the community at large, which are usually interpreted to be coming from civil society organizations and the private sector.

A close perusal of the provisions of EO 430 would reveal that its intended scope is large, as it includes research, production, and manufacturing. However, experience has revealed that much of the past work of NCBP relative to the application of biotechnology in agriculture was focused on research up to field trials only, considering that much of the introduction of GMO crops into the country, mainly corn but also including potato, sugarbeet, soybean, alfalfa, canola and cotton are mainly done through the activities of seed-producing transnational companies. Confronted with the increasing number of applications for releasing imported GMO seeds into the Philippines, NCBP issued a monograph entitled "Biosafety Guidelines for Planned Release of Genetically Manipulated Organisms and Potentially Harmful Exotic Species (PHES)" in 1998. To further regulate the importation and entry of these seeds into the country, their release

and eventual propagation or for direct use as food and feed or for processing, the DA, to supplement EO 430, has passed Administrative Order (AO) 8 in 2002. AO 8 institutionalized the operational arrangements that exist between DA's BPI, as the agency responsible for the approval of the production and release of improved planting materials, and NCBP.

A perusal of the policy and institutional framework for the application of biotechnology to agriculture reveals a relatively well-defined and stringent protocol in which biosafety principles are of paramount considerations. Aside from national policy statements, the Philippines signed in 2000, and later ratified in 2003, the Cartagena Protocol on Biosafety to the United Nations Convention on Biological Diversity. This act illustrates the priority given by the Philippines to the promotion of safe and responsible use of modern biotechnology to achieve food security even as other considerations are taken into account, such as health and the environment. This policy orientation was further institutionalized with the adoption of a National Biosafety Framework (NBF) with the passage of EO 514 in March 2006. The NBF aims to:

1. Strengthen the existing science-based determination of biosafety to ensure the safe and responsible use of modern biotechnology so that the Philippines and its citizens can benefit from its application while avoiding or minimizing the risks associated with it;
2. Enhance the decision-making system on the application of products of modern biotechnology to make it more efficient, predictable, effective, balanced, culturally appropriate, ethical, transparent, and participatory; and
3. Serve as guidelines for implementing international obligations on biosafety. (EO 514)

EO 514 also expanded the composition and revised the functions of the NCBP, to highlight not only its regulatory functions but also its accountability, scientific, and capacity-building functions. Aside from focusing on the regulatory elements of promoting biosafety, EO 514 also took extra effort to lay out further the mechanisms for public participation and social inclusion in its provisions that are already referred to in EO 430, making explicit references to the role of the private sector, the right of indigenous peoples and communities, the rights to information and participation, and the principles of local autonomy and subsidiarity, transparency, and consensus building. EO 514 also explicitly states that biosafety decisions will take into considerations all the relevant provisions of the Cartagena Protocol as well as existing laws, which covers the standard of precaution, the principles of risk assessment, and the role of environmental impact assessment. It also emphasized socio-economic, ethical, cultural, and other considerations in making biosafety decisions, particularly regarding the value of biodiversity to indigenous and local communities. To date, the IRR of EO 514 is still being developed, and as such, its provisions are not yet fully implemented.

The application of biotechnology in agricultural production in the country is relatively advanced, by global standards. Compared to the rest of the world, the Philippines is in fact considered a major player in the promotion and adoption of biotechnology in agricultural production, but this is limited mainly to Bt corn, and the main purpose of which is not for food but for feeds. In 2007, the country, with approximately 300,000 hectares planted with Bt corn, is listed as one of the 13 biotechnology mega-countries in the world (or those with areas of more than 50,000 hectares planted to biotech crops), 10th in terms of area planted, and one of the only three from Asia (India and China are the other two) (James, 2007). As indicated above, approval for the propagation and release of other GMO crops such as soybean, canola, cotton, potato, and sugarbeet were likewise issued but these were not in the same scale as Bt corn. For rice, significant developments have emerged in which

confined field testing of GMO rice, in the form of insect-resistant (BB rice) as well as Vitamin-A enriched (Golden Rice) varieties are on the way. The presence of the International Rice Research Institute (IRRI), whose headquarters is based in UPLB, have provided a significant impetus in the progress towards an anticipated commercialization of GMO rice, in which liberal estimates have even placed full commercialization to be achieved sometime in 2011. Much publicity is being given on the anticipated introduction and commercialization of the Golden Rice, or what others call as the "3-in-1" rice variety because of its nutrition potential, it being fortified with Vitamin A, iron, and Zinc—vitamins and minerals of which children and pregnant women are believed to be lacking (Philippine Information Agency, 2008.

It is also important to point out that biotechnology applications, through a mid-level biotechnology technique called marker-assisted selection (MAS) technology, have already been employed by researchers in PhilRice to develop improved rice varieties. In 2006, the National Seed Industry Council (NSIC) approved the release for commercial production the first biotech rice variety in the Philippines, the Tubigan 7 or NSIC Rc142 developed by scientists from PhilRice. This variety is a product of MAS and is resistant to the bacterial leaf blight (BLB) disease, which is particularly destructive during the wet season. This resistance of Tubigan 7 emanated from a line, IRBB5-21, from the Asian Rice Biotechnology Network (ARBN) of IRRI containing the BLB resistance gene Xa21. This gene, using DNA markers, was introduced into IR64, a commercially grown hybrid rice variety. Another similar variety, Tubigan 11, was also released later (Pablico, 2006).

As can be derived from the above discussions, one can observe that the key institutional players in the development of agricultural biotechnology policy in the Philippines come mostly from the Government regulatory sector, such as the DA and DOST, and to some extent, DOH and DENR. What is also apparent is the presence of multi-agency bodies, such as the BioTAG and NCBP, that perform either advisory functions (as in the case of the former) or regulatory/advisory functions (as in the case of the latter). The operations of these bodies involve the participation of other key players, mainly from the R and D sector of the government bureaucracy (BAR and PhilRice) as well as from research institutes and centers based in universities, such as IPB and BIOTECH.

As an integral part of agricultural modernization, as stipulated in the AFMA, the use of modern biotechnology occurs in a context in which other major players coming from the non-government sectors are involved. The primacy given to public participation has necessarily drawn the involvement of producer and consumer groups, such as farmer organizations and traders associations. Other groups in civil society, such as environmental groups and church-based organizations have also joined the process, albeit mainly as oppositors. What is also characteristic of the development of agricultural biotechnology policy in the country is the significant role that transnational seed companies, such as Bayer, Monsanto and Syngenta, play not only as parties-in-interest subjected to the regulatory mechanisms of the government (as suppliers of agricultural biotechnology products and services), but also as funders of R and D. The dynamic, and oftentimes contentious, issues surrounding public participation and the role of interest and pressure groups in the development of biotechnology policy in agriculture in general, and in rice in particular, will be the subject of the next section of this paper.

ISSUES OF SOCIAL INCLUSION AND EQUITY

A discussion of impacts of rice biotechnology and its associated social equity issues in the Philippines is severely constrained by the fact that presently, aside from the Tubigan series of rice varieties that have been developed using MAS techniques, no single genetically-

modified (GM) rice variety has been approved for commercialization. Nevertheless, controversies have already emerged in anticipation of the eventual commercialization of GM rice, some of which like the Golden Rice variety, are now currently undergoing confined field trials. These controversies can serve as a template to conduct not only a prognosis of things to come, but also an analysis of the structural realities and their associated actors and institutions that would frame any discussion of impact and equity.

In 2006, Bayer Crop Science has already submitted its application to BPI to allow the introduction of LL62, a herbicide-tolerant GM hybrid rice variety, for food, animal feed and the manufacture of other products. Bayer argued that LL62 does not pose any risk to human health and the environment, as supported by the many scientific field trials, which were conducted in other countries. It further vouched for the safety of LL62 for human consumption, citing as evidence the claim that the protein conferring herbicide tolerance to LL62 is already commercially available in Canada, the European Union, Japan, Mexico, Russia, and the US. Civil society groups led by Greenpeace and the Southeast Asia Regional Initiatives for Community Empowerment (SEARICE) filed a motion for a temporary restraining order on the strength of their arguments that it has never been proven that LL62 is safe for human consumption. Furthermore, the petitioners lamented the lack of consultation conducted as provided for by law. The petition was granted by the court on September 2007 (Abano, 2007). DA and the BPI were restrained from approving Bayer's application until such time that scientific studies can prove that there are no adverse health and environmental effects.

Resistance to the introduction of GM rice is not confined to challenges posed against its entry in the form of seeds, or in its propagation and cultivation in open fields, but also includes challenges against its entry in forms ready for consumption. In April 2008, Greenpeace blasted the DA for allowing the importation of two GMO-contaminated rice varieties, the Blue Ribbon Texas Long Grain and the Riceland Arkansas Long Grain, and their eventual sales in S and R supermarkets in Metro Manila ("GMO-contaminated US rice slips again into the Philippines," 2008). A genetic examination commissioned by Greenpeace found samples of Blue Ribbon rice being contaminated by LL601, an experimental GMO rice strain developed by Bayer. The test, however, failed to definitively identify the GMO strain that contaminated the Riceland variety. Earlier in February 2008, Greenpeace has criticized the DA for another case of importation of 44,000 metric tons of US long grain rice believed to be GMO contaminated.

The debates between the pro and anti-GMO stakeholders capture the dynamics that exist in the development and implementation of policies vis-à-vis rice biotechnology in the country. One can argue that there are two sets of important realities that prevail.

Opportunities. The first set of realities is an expression of ideal types, which enable a constructive synergy between regulatory policies on one hand and a developmentalist science-policy interface on the other. These are as follows:

- A rigid and well defined body of policies that clearly spells out the regulatory standards and processes, as well as prescribes avenues by which public consultation and participation can occur;
- A healthy interface between science and policy; and
- An active and vigilant civil society.

The discussions in the previous section of the paper clearly illustrates a high density of policy instruments—from AFMA, to EO 430, AO 8 and the yet to be implemented EO 514—that spells out the relatively stringent procedures one has to undergo towards commercialization of GM crops, including rice. These regulatory policy instruments have been developed with significant participation from various stakeholders, including the scientific community and civil society. AFMA

has been prepared by a congressional committee, the AGRICOM, the work of which involved a series of public consultations, and which drew a lot of inputs from natural and social scientists and agricultural professionals. The BioTAG exists to provide scientific inputs to policy decisions making within the DA vis-à-vis biotechnology issues. The NCBP counts for its members not only representatives from the social, biological, physical, and ecological sciences, but also from civil society and the private sector. These mechanisms not only promote the participation of stakeholders, but also enable a significant opportunity for science to link with the policy making process.

In addition, specific provisions in these policy instruments clearly stipulates the avenues for public participation in the decision making process. For example, one of the functions of NCBP, as mandated by EO 430, is to hold public deliberations on proposed national policies, guidelines, and other biosafety issues. NCBP is also directed to be transparent, by publishing the results of its internal deliberations and agency reviews.

The events related to the issuance of a TRO against the entry of GM rice in the country dramatized the vigilance and, to some extent, effectiveness of civil society actors and organizations. Greenpeace, in particular, is very much engaged in serving as a watchdog to the activities of the Philippine government and the pro-GM sectors of the scientific community. Church-based organizations, and even some leaders of the Roman Catholic church, have joined the debate. There have been reports that some Catholic priests have admonished their parishioners in their sermons to boycott Bt corn, a GM crop that has now been commercialized in the country. Civil society activists were very effective in slowing the approval of the commercialization of Bt corn. Their deliberate campaign resulted to some local government units, like the City Council of General Santos, passing resolutions blocking field tests of Bt Corn. The Senate and the House of Representatives likewise passed similar resolutions for the investigation of the field testing. NGOs and civil society activists also filed a case at the Supreme Court against the DA, DOST, and IPB in connection with the Bt corn field tests, but such was dismissed.

Civil society resistance to the introduction of GM crops, including GM rice, to the country is premised on scientific, political-economic, and ethical grounds. Oppositors argue that there is not enough scientific evidence to ensure that GM crops are safe for human consumption, and that it will not have adverse environmental impacts, notwithstanding the scientific studies, which are presented by GM defenders. There is also a growing fear that the entry of GM crops would adversely affect the livelihoods of farmers, who may further lose control of their own production systems and maybe held hostage by an agro-seed industry in the hands of transnational giants like Bayer, Monsanto, and Syngenta. This fear is largely drawn from the earlier experiences of small farmers vis-à-vis the implementation of the Green Revolution, in which the massive adoption of the hybrid rice technology, while leading to dramatically increased yields, have also failed to address issues of social inequality. In fact, adoption of the modern rice technologies led to new forms of poverty and inequity brought about by the increased capital requirements associated with such technologies, such as increased farm maintenance costs due to heavy reliance on chemical pesticides, herbicides, and fertilizers, as well as on mechanization. Self-reliant farmers were also forced to rely on commercially distributed seeds, considering that hybrid rice varieties are by nature good only for one cropping season and could not be efficiently used as sources of planting stock. Thus, any increase in yield was offset with a corresponding increase in capital requirements. Thousands of farmers were driven to debt as a consequence.

The failure of the Green Revolution to uplift the rice economy of the country, as aggravated by the presence of unequal political and economic structures, all contributed to the reversal of fortunes for the Philippines, seen in its transformation from

being a rice exporter to being the world largest rice importer. Ironically, while this tragic development has motivated the government to set its sights on modern biotechnology as a possible vehicle to pull out the country from an impending rice crisis, it also becomes the source for a deep-seated aversion by grassroots farmers and their allies in the progressive sectors of civil society to the introduction of new and modern technologies, such as biotechnology, to rice production. It is not helping the cause of GM vis-à-vis grassroots resistance that IRRI is at the forefront in the development of GM rice, considering that IRRI is the same organization that led the charge for the adoption of hybrid rice technologies in the 1970s.

Beyond scientific and political-economic grounds, another powerful source of doubt is the various ethical questions that arise from the very nature of biotechnology and genetic engineering. While it is easy to dismiss the science-based claims by oppositors as based on wrong information or the political-economic arguments by farmers as unfair projections from the past sins of a different type of technology, it is difficult to argue against ethical and moral questions. These types of questions emanate from a highly contentious yet doctrinal argument about life, and the right of science to tamper with nature, more so of corporations to patent its manipulated forms.

However, despite the boiling controversies, and the various confrontations which emerged between the oppositors and the defenders of GM not only in rice but in general, the Philippines remain as a hot-spot for the propagation and widespread commercialization of GM crops. The existence of debate is not necessarily dysfunctional. In fact, what these debates point out is the presence of a relatively open and free domain for contestations, further assured by a relatively democratic political space in which institutional arrangements exist to enable stakeholders to appeal to the rule of law and the fairness of procedures to redress grievances. This has constructive effects to both sides of the debate. This forces the stakeholders to increasingly rely on science to support their arguments. Greenpeace, as the primary actor in civil society leading the charge against GM crops, has repeatedly contracted its own scientific experts to counter the arguments of GM supporters. On the other side of the debate, and to neutralize doubts on the acceptability of GM crops, several studies were conducted, some of which were commissioned by GM supporters, to support the argument about the safety of biotechnology and its acceptability to farmers and consumers. In 2007, the Biotechnology Program Office (BPO) of the DA released the results of an impact study of GM rice that was conducted by PhilRice on 1,000 farmers and consumers from Isabela, Nueva Ecija, Iloilo, Davao del Sur, and Davao del Norte. The study revealed that between 49 and 55 percent of those surveyed expressed willingness to pay more for the GM Golden Rice variety, even as a substantial majority (85%) expressed interest in knowing more about rice biotechnology, and 63 percent accepted GM rice. The study also revealed that 58 percent of the respondents were willing to plant, buy, and sell GM rice, and only nine percent were unwilling.

An earlier survey was conducted for a period of two months in 1997 by a team from the Department of Agricultural Economics of the Swiss Federal Institute of Technology (ETH), in collaboration with scientists from UPLB. Results of the survey were published in 1999. The survey covered 65 respondents representing 46 organizations distributed as follows: 16 from government institutions, 18 from NGOs, farmer organizations, churches, and other public interest groups; 4 from academe; 8 from IRRI; 8 from the private sector, and others from international NGOS and donor agencies, the mass media, and the legislature. A cluster analysis of the survey respondents in the same study revealed three main groups:

- The first group, composed mainly of civil society actors, are generally opposed to biotechnology;
- The second group, composed mainly by government officials and politicians, have

generally highly positive outlooks on the potential of genetic engineering to solve the problems of the rice economy of the country not only in agronomic but even in structural terms; and

- The third group, composed mainly by scientists from private companies and from research centers have relatively modest, but still positive views about biotechnology, in that they see its potential to solve agronomic and natural problems even as they recognize that it is not capable of solving the structural problems of the rice economy (Aerni Anwander Phan-huy, & Rieder, 1999).

Results of the survey indicate that:

- Respondents agreed most with the statement indicating doubt regarding the sustainability of GM rice, particularly when pests are able to break the built-in resistance of the plant.
- Respondents strongly disagreed with the statement that GM rice could pose a serious health risk to consumers.
- Most agreed that genetic engineering is just one new technology that may help in ensuring food security not only in the Philippines but in Asia.
- However, most respondents believed that the real problems in the Philippine rice economy are structural in nature, such as adverse market conditions; poor irrigation, post-harvest and transportation facilities; and weak extension services (Aerni et al., 1999).

A similar study was conducted in 2003 by a team from the project entitled "Participatory Assessment of Social and Economic impacts of Biotechnology," a project funded by the Initiative for Future Agriculture and Food Systems (IFAFS) and is a collaborative effort of Virginia Tech, Virginia State University, University of Tennessee, North Carolina State University, and IRRI. The findings of the study, based from 492 completed surveys, revealed that 44 percent of the respondents had generally favorable perceptions of rice biotechnology, seven percent had generally unfavorable perception, while a plurality of 49 percent were neutral. In terms of level of awareness, 79 percent of the respondents were aware of rice biotechnology, and 61 percent were familiar with the term "GMO," having heard of it at least once. It is interesting to note that only 25 percent of the respondents have been exposed to the phrase "Frankenfood," a term that anti-GMO activists use. Eighty percent of the 44 percent (or 35 percent of total) who had favorable opinions on biotechnology were aware of its benefits, while 63 percent of the seven percent (or four percent of total) who were opposed to biotechnology had high levels of awareness of its risks. Seventy-six percent of the respondents expressed their conditional support to research in rice biotechnology, even as only 15 percent stated their unequivocal support. Support for biotech rice was also found to be independent from educational attainment and from level of knowledge of rice biotechnology.

The willingness of respondents to purchase and consume different types of biotech rice was also measured in the study. Most respondents expressed conditional willingness to purchase and consume, while those who were unwilling were on the minority. The level of unconditional willingness to purchase and consume was found to be 58 percent for vitamin A-enriched rice, but it was only 40 percent for iron-enriched and 32 percent for insect-protected rice. As expected, respondents who were generally opposed to biotechnology also expressed their unwillingness to purchase and consume biotech rice, with 68 percent unwilling to purchase and consume insect-protected rice, 47 percent for vitamin A-enhanced rice, and 43 percent for iron-enriched rice. These results, even including for those that are unwilling to purchase and consume, indicate a more favorable response towards commercializing nutrient-enhanced varieties compared to insect-protected varieties,

with the former exhibiting higher percentages of willingness to purchase and consume and lower percentages of unwillingness compared to the latter.

A study conducted by Mamaril and Norton (2006) made projections on the level and distribution of the benefits from Bt rice. By assuming cross-country technology and price spillover effects, and by using Bt Indica rice for stemborer control in the Philippines and Vietnam as an example, benefits were quantified in terms of changes in the present value of economic surplus and compared with the potential benefits of other types of pest-related rice biotechnologies. The study computed the total gains from Bt rice adoption in the Philippines under baseline scenarios and using 2000 prices to be $270 million (range of $136-276 million). For Vietnam, the total economic gain was relatively higher at $329 million (range of $159-415 million). The gains were equivalent to six percent of the value of milled rice in both countries, with two-thirds of these accruing to producers. The study also revealed that a delay in the release of Bt technology by just five years, assuming a discount rate of five percent, would significantly reduce the benefits by 20 percent.

These studies have provided some indicators relative to the acceptability of and monetary benefits from GM rice, and have been used as counter-arguments against the challenges posed by the oppositors. In fact, the 2007 survey conducted by PhilRice was a reaction to the TRO issued by the court against Bayer's importation of LL62. In addition to the pressures of providing more evidence to support GM rice, the debates also motivated the pro-GM sectors to heighten its information and education campaigns, and to engage its oppositors in a dialogue. One of the occasions in which this happened was when a group of technical experts and scientists, as well as officers of the DA, held a dialogue with the head of the chair of the bioethics committee of the Catholic Bishops Conference of the Philippines (CBCP) in May 2008 ("CBCP open to dialogue on biotech with DA", 2008).

What these debates lack, however, is a clear gender agenda. It is noteworthy to point out that the policy instruments and processes, while providing an ample opening for social inclusion and participation, are silent on women's issues and concerns. In fact, even as there are explicit stipulations on the inclusion of indigenous peoples in EO 430 and EO 514, the texts of these two important biotechnology-related policy instruments are bereft of any reference to women as a sector. Furthermore, the perception studies conducted on the acceptability of GM rice have not mentioned gender as a disaggregating variable upon which results can be analyzed. The only gender-related inference that one can make is the nutritional benefits that pregnant women can have from GM rice that is fortified with Vitamin A. It has been shown that the annual child birth-related mortality rate for women is nearly 600,000, most of which are due to complications brought about by Vitamin A deficiency (Sommer & West, 1996). This relative absence of gender in the discourse on biotechnology may be interpreted either as an issue of gender-blindness, or a structural symptom of a gender-neutral issue that affects men and women equally. Nevertheless, this absence is a gap that needs to be filled. Fortunately, the current policy climate, as indicated by the texts of the different policy instruments and the processes that they engender, have significant social inclusion provisions that may be taken advantaged of in pushing for a gender agenda.

Constraints. So far, what has been amplified are the functional and enabling realities that attend the dynamic interplay between stakeholders in the context of the development and implementation of policies vis-à-vis rice biotechnology in the Philippines. However, there is another set of realities that are disenabling, and in turn undermine the credibility of social inclusion strategies that have been explicitly laid down in the policy texts. These are as follows:

- A government bureaucracy saddled with capacity and funding problems, compounded by political uncertainty; and

- A scientific community lacking in public resources and is mainly funded by industry players with vested interests.

While the Philippines is considered as a biotechnology mega-country, it being the 10th largest grower of biotechnology crops in terms of land area in the world in 2007 (James, 2007), and even as it is considered relatively advanced in terms of degree and extent of policy institutionalization, there is also a tacit recognition that it has only a relatively modest level of required expertise both in academe as well as in the bureaucracy. In 1999, there were only 50 scientists with doctoral degrees who were trained in DNA manipulations and another 15 trained in biochemical and serological methods. There were only 13 institutions that had scientists who were capable to conduct biotechnology research, and only seven institutions had the needed equipment for DNA work and only three had micro-projectile bombardment equipment for transforming plant cells (Halos, 2000b). Within the government bureaucracy, the situation is even worse in 2008, in which there are only five people at PhilRice who are knowledgeable in genetic engineering according to the director of the Biotechnology Program Office (BPO) of DA.

While top-level support for biotechnology is evident in executive policy pronouncements from the time of President Marcos, and manifested in an increase in the budget for R and D in biotechnology research, much has still to be done to raise the level of funding for biotechnology R and D. This may even be compromised by the relative vulnerability of top executive positions in DA to political expediency, as evidenced by the frequent changes that have occurred in the position of DA Secretary, one that has increasingly become more political in nature instead of career-based. Shortage of public funds for R and D in biotechnology have led to a situation in which scientists in research centers depend on privately-sourced funding, mainly coming from the big transnational agro-seed and agro-chemical industries which have significant interests in biotechnology production and commercialization. While the strong linkages between science and industry may have enabled R and D, it has also undermined the credibility of many scientists in the eyes of the oppositors to biotechnology. For them, scientists that have strong linkages with the big industry players could not be relied upon to render objective judgments on the risks that biotech crops inflict to human health and the environment.

This is particularly damaging to the efforts of fostering social inclusion, considering that the authenticity and reliability of the approval process for the production and commercialization of biotech crops and products derived from them—as stipulated in EO 430, AO 8, and EO 514—largely depend on the participation of an objective science community. Considering that there is a dearth of knowledgeable experts on the field, there is a high probability that the technical consultants that will be tasked to render objective judgment on biotechnology applications would necessarily be drawn from the same pool of experts a big majority of which is most likely involved in R and D projects funded from the biotechnology industries. In a report posted in its website in 2007, Greenpeace exposed the intricate web of interlocking interests that prevail in the biotechnology regulatory bodies of government, in which science experts that are tapped to act as advisers and/or reviewers have records of involvement with the same industry they are supposed to regulate, thereby suggesting a conflict of interest. These allegations are damaging the credibility of the whole process, and if not checked, may undermine the legitimacy of the otherwise many opportunities for stakeholders, including oppositors, to be heard in a fair process of decision-making. Ultimately, such may also compromise the social equity agenda that is tacitly recognized in the various policy instruments. This may lead to a tragic situation in which science becomes a political tool that would disenable the provisions that promote the interests of the marginalized farmers and indigenous people in favor of the interests of big transnational agro-

industrial companies. Thus, and ironically, the two positive features of the biotechnology landscape in the Philippines, namely, a strong biotechnology science-policy linkage and a relatively healthy biotechnology industry-science interface, when taken together, could in fact become threats to the attainment of social equity and inclusion goals.

RECOMMENDATIONS FOR FURTHER RESEARCH

At this point, and in conclusion, it is important to emphasize two things. First, the development of biotechnology policies in the Philippines vis-à-vis rice is enabled by structures and processes that are friendly to the furtherance of social inclusion and equity goals. This occurs in the context of attaining rice self-sufficiency amidst a globalized system, and is clearly expressed in the relative density of concepts and provisions related to participation, inclusivity, and transparency in all the relevant policy instruments. Second, the spaces that are opened are vulnerable to a political system that has deep-seated structural flaws and a science community whose financial support from the state is limited and at the same time whose financial autonomy from vested interests is suspect. This is a classical pitfall that the Philippines has always fallen into—rich in policy texts and "in principle" empowerment, but compromised when it comes to actual implementation. Thus, the knowledge gap that undermines the attainment of social equity and inclusion goals no longer resides in the legal-discursive context, but in the bureaucratic-political arena of policy implementation. This is with the exception of the question on the relative absence of any reference to gender in all the policy instruments and their associated processes, of which it is recommended that efforts should be done to inquire into the gender dimensions of biotechnology, and to explicitly mainstream the gender agenda in policy instruments and processes, It may also help if in addition to continued emphasis on the challenges brought about by the global food crisis, that the agenda for climate change be more strongly articulated and that this should be matched with more support to R and D.

In addition to investing in research to build scientific knowledge and capacity, there should also be an investment in research on the political dynamics of the institutional domains for multi-stakeholder encounters and contestations. One of the glaring threats pointed out in the previous section is the dysfunctional effect of a strong science-industry linkage on the credibility and legitimacy of the biotechnology review process. Thus, further research should be done on the nature of the interplay between science, industry and policy, to determine appropriate institutional arrangements in which science-industry linkages remain robust without compromising the regulatory process, and without compromising science. In addition, it is also vital that research is conducted about the knowledge and information flows and communication pathways and their implications on policy outcomes and stakeholder positions vis-à-vis biotechnology in general and rice biotechnology in particular. A deliberate effort should be done to study the processes of mythmaking on both sides of the debate, and to clearly identify the nexus by which distortions occur, the form by which they happen, their manifestations, and the drivers that engender their emergence, giving particular attention to those that are merely reflections of innocent ignorance or those that are deliberately crafted to serve vested interests.

In the final analysis, while threats exist that may compromise the already articulated agenda for social equity and inclusion, there is also an important opportunity. Since the actual implementation of policy towards full commercialization of GM rice is still at the field-testing stage, there is still plenty of time to conduct ex-ante studies on institutional and communication structures in the administrative-political arena that would ensure the attainment of the intended development goals, including the social equity and inclusion agenda.

REFERENCES

Philippine Information Agency. (2008. '3-in-1' rice country's first GM rice. Retrieved from http://www.pia.gov.ph/?m=12&fi=p070913.htm&no=45 on Accessed September 5, 2008.

Aerni, P., Anwander Phan-huy, S., & Rieder, P. (1999). An indication of public acceptance of transgenic rice in the Philippines. *Biotechnology and Development Monitor*, *38*, 18-21.

CBCP open to dialogue on biotech with DA. (2008, May 27). *PinoyPress*. Retrieved from http://www.pinoypress.net/2008/05/27/cbcp-open-to-dialogue-on-biotech-with-da/ on September 4, 2008.

Abano, I. (2007). Court halts introduction of GM rice in the Philippines. *Science and Development Network*. Retrieved from http://www.scidev.net/en/agriculture-and-environment/agri-biotech/news/court-halts-introduction-of-gm-rice-in-the-philipp.html on September 2, 2008.

GMO-contaminated US rice slips again into the Philippines. (2008). PinoyPress. Retrieved from http://www.pinoypress.net/2008/04/27/gmo-contaminated-us-rice-slips-into-philippines-again/ on August 30, 2008.

Greenpeace. (2007). The ties that bind: regulatory capture in the country's GMO approval process. Retrieved from http://www.greenpeace.org/seasia/en/press/reports/ties-that-bind-regulatory-cap

Halos, S. (2000a). *Agricultural biotechnology in the Philippines*. Retrieved from http://www.bic.searca.org/seminar_proceedings/bangkok-2000/I-country_papers/halos.pdf

Halos, S. (2000b). *Agricultural biotechnology research and development in the Philippines: the need for a strategic approach* (Discussion Paper Series No. 2000-17). Makati, Philippines Philippines Institute for Development Studies.

James, C. (2007) *Global status of commercialized biotech/GM crops: 2007* (ISAA Briefs No. 37-2007). Los Banos: ISAA.

Mamaril, C. B., & Norton, G. W. (2006). Economic evaluation of transgenic pest resistant rice in the Philippines and Vietnam. *Quarterly Journal of International Agriculture, 45*(2) 127-144.

Pablico, S. (2006, December 24). National Seed Industry Council of the Philippines releases first biotech rice variety. Philippine Star. Retrieved from http://www.seedquest.com/News/releases/2006/december/17966.htm on September 5, 2008)

Participatory Assessment of Social and Economic Impacts of Biotechnology (2003) *Philippine Survey*. Retrieved from http://www.aaec.vt.edu/biotechimpact/surveys-new/Philippine%20survey1.htm on September 2, 2008.

Peczon, B. D. (2008). Government guidance on biotechnology. In B. D. Peczon & A. J. Manalo (Eds.), *Straight talk on biotechnology,* Vol. 1. Quezon City: Ateneo De Manila University Press.

DA commits 1.16 B for agri research. (2008, June 15). Philippine Daily Inquirer , pp. 166-207.

Sommer, A., & West Jr., K.P. (1996). *Vitamin A deficiency: Health, survival, and vision*. New York: Oxford University Press.