ADOPTION AND UPTAKE PATHWAYS OF BIOTECHNOLOGY CROPS

The Case of Biotech Corn Farmers in Selected Provinces of Luzon, Philippines

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Los Baños, Laguna, Philippines
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Cover:

Rosalie Ellasus, an outstanding biotech corn farmer from San Jacinto, Pangasinan, influenced many farmers to adopt biotech corn.

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ACRONYMS

BIOTECH	National Institute of Molecular Biology and Biotechnology
Bt	*Bacillus thuringiensis*
DA	Department of Agriculture
FGD	Focus group discussion
IRRI	International Rice Research Institute
ISAAA	International Service for the Acquisition of Agri-biotech Applications
LGU	Local Government Unit
MAO	Municipal Agricultural Officer
NCBP	National Committee on Biosafety of the Philippines
NGO	Non-government organizations
PHILRICE	Philippine Rice Research Institute
PRA	Participatory Rural Appraisal

FOREWORD

Biotechnology crops have been the center of public concern for a time. Critics have raised many issues against these crops which being devoid of scientific evidence have failed to gain ground. On the contrary, after more than 15 years of commercial use, biotech crops have demonstrated the immense benefits they can contribute in terms of economic productivity, environmental protection, and upliftment of the welfare of poor farmers in many parts of the world.

But are the farmers adopting biotech crops aware of these benefits even before they start to plant these crops? With minimal or no knowledge at all on its purported benefits, how do they come to embrace such crops? Who influences them to try out the biotech crops and how is their adoption sustained? What are the dynamics of knowledge seeking and sharing among them? These are the key questions that this study probes into.

Complementing the statistics, the study also attempts to capture the process that the farmers go through as they acquire and eventually apply the knowledge and practices pertaining to cultivation of biotech corn. Beyond adoption, the study further elaborates on the dynamics of how farmers share their experience, good or bad, with other farmers in and outside their communities. There is indeed a variety of uptake pathways among farmer groups. It is noteworthy, that they do exhibit a certain pattern, and this is a growth point for new learning on the social processes that govern the farmers' behavior towards biotech crops.

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INTRODUCTION

The global share of biotechnology (biotech) crops has been increasing through the years. As reported by James in 2011, a total of 16.7 million farmers in 29 countries planted biotech crops in 160 million hectares. This, according to him, accounts for a sustained increase of 8% or 12 million hectares over that of 2010. He further noted that with the 94-fold increase in hectarage since 1996, biotech crops have become the fastest crop technology being adopted by farmers.

Such growth and expansion in biotech crops have led to favorable impacts on man and society. As borne by the same report (James, 2011), biotech crops have contributed to improved farmers' productivity and income, protection of biodiversity, sustainability of the environment, and provision of welfare benefits that ultimately lead to poverty alleviation.

The same impacts are beginning to be felt in the Philippines. As the first and only Asian country to grow biotech crop for food, feed, and processing, it has approved biotech corn MON 810 for commercialization in 2002 (Navarro and Hautea, 2011). Since then, farmers who have adopted biotech corn have reported higher crop yield and income, lesser expenditure on insecticides, and significant welfare effect than that of non-biotech corn farmers (Yorobe and Quicoy, 2006).

Rationale

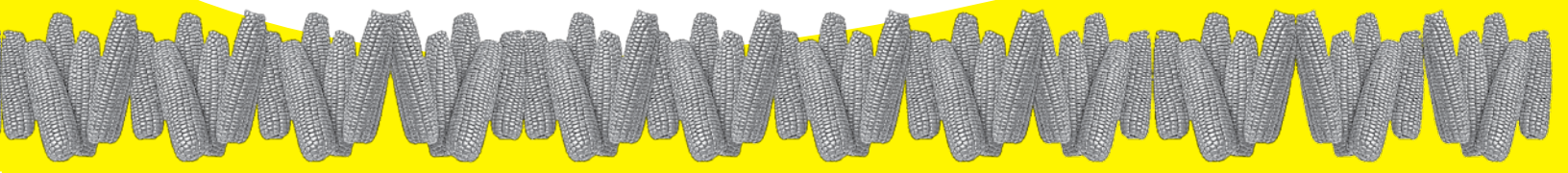
As a promising development intervention, it helps to understand how the adoption of biotech crops such as biotech corn may be scaled out (i.e., to spread out horizontally to other farmers and other areas) and scaled up (i.e., to bring vertically up to a higher level for policy support and possible institutionalization). To do this in a more strategic manner, there is a need to know who the adoptors of biotech crops are, what factors influence their adoption, who in their social circle influences their uptake, who in turn do they influence to adopt, and what changes have occurred in their lives as a result of biotech crop adoption.

The adoption of biotech crops, as with any other technologies, is not always bias-free or without constraints. Usually, it is affected by several factors, namely: (a) access or bias in patterns of sharing; (b) assets or ability to invest; (c) incentives such as markets, land tenure, and limited will to invest in public goods; and (d) poor communication among farmers, between farmers and research/extension, and among R&D institutions (German, 2007).

The adoption of biotech crops could also lead to unintended outcomes if no proper safeguards are put in place. For instance, the socially differentiated adoption could widen the socio-economic gap between the better off and the resource-poor farmers (Ismael et al., 2001). The richer farmers have an advantage in the adoption process because they can easily afford the cost of the inputs necessary in using biotech crops, leaving behind the poorer ones who may not even have the money to buy starters like biotech seeds. In the long run, the gap between these two groups can put the developmental value of biotech crops in peril.

Aside from the socio-economic divide, other factors (e.g., socio-cultural, technical, environmental, communication/information) may also come into the picture with regard to farmers' adoption decisions after they are introduced to biotech crops (Scandizzo and Savastano, 2010). These factors must be identified and looked into to improve the adoption-diffusion process, policies, and strategies in expanding the production of biotech crops. In addition, investments poured into the adoption of biotech crops should also be justified in terms of their contribution to improve the well-being of farmers.

A number of studies have focused on public perception and attitude towards biotech crops. This was especially so when biotech corn created a stir among the public as it was still being field tested prior to its full scale commercialization. When the crop was finally approved for commercialization in 2002, studies focused on its socio-economic impact.



While there are now well established reports that the hectarage of lands being devoted to biotech corn is dramatically expanding, it helps to generate concrete data explaining how this expansion came about. "Who adopts, why, how, and with what effects" are important questions whose answers can provide important directions and guidelines for integrating biotech crops in the country's efforts for sustainable development especially in the agriculture sector.

This study was undertaken to analyze the dynamics of adoption and uptake pathways of biotech crops and the changes these have brought about in farmers' lives. In this study, biotech crops will be limited to biotech corn. Adoption will refer to how the farmers acquire and eventually apply the knowledge and practices pertaining to the planting of biotech corn. Uptake pathway will refer to the process that captures how the biotech crop is introduced, adopted, disseminated, and shared by the farmers to others. With the ever growing importance of biotech crops to the country's agriculture program, it pays to know how they are shared and adopted by their end-users, the Filipino farmers.

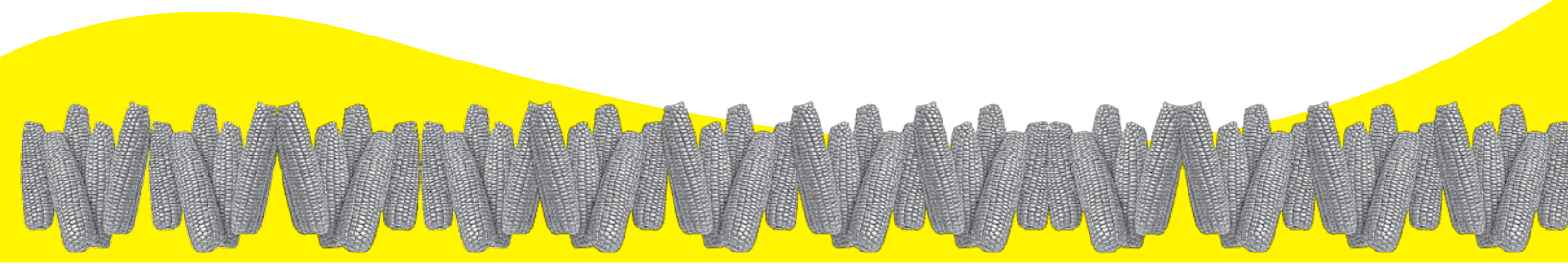
Objectives

In general, the study seeks to analyze the adoption and uptake pathways of biotech crops, specifically biotech corn, among farmers in selected provinces of Luzon. The specific objectives of the study are as follows:

1. Describe the biotech corn farmers in terms of their:
   a. socio-demographic profile (age, gender, civil status, number of children, educational attainment, other sources of income, and membership in organizations)
   b. farm-related profile (number of years in farming, farm size, source of capital, marketing of corn produce, farm income, and farming activities performed by household members)
2. Determine their adoption of biotech corn in terms of:
   a. number of years engaged in planting biotech corn
   b. factors considered in the adoption of biotech corn
   c. mode of adoption of biotech corn
   d. benefits from the adoption of biotech corn
3. Analyze their uptake pathways of biotech corn in terms of:
   a. sources of information
   b. people with whom farmers share knowledge with
   c. information shared to others
   d. attendance in trainings, seminars, and workshops
   e. groups/organizations that conducted trainings, seminars, and workshops
   f. contacts who convinced farmers to adopt biotech corn
   g. support services availed of by farmers
   h. institutions or groups providing support services
   i. support services needed by farmers
   j. problems encountered with biotech corn
   k. desire to continue planting biotech crops
4. Assess the changes in the farmers' lives brought about by the adoption of biotech corn.
5. Analyze the relationship between the farmers'
   a. socio-demographic characteristics and adoption level of biotech corn
   b. farm-related characteristics and adoption level of biotech corn.

Significance

This study hopes to contribute to the expanding discourse on technology adoption, especially on the constitutive role of communication in influencing a farmer's decision to adopt and share to others the use of biotech corn.



Results of the study can help unravel the process that a farmer goes through when he adopts a biotech corn variety. This includes the factors that enable and facilitate a grower's adoption and uptake of this technology and the difficulties encountered in the process.

The findings can help refine the extension and communication strategies that are now currently employed concerning biotech corn. Acquiring the knowledge on who influences farmers the most can help make the extension and communication more strategic by tapping these influential figures in the process. Resources can also be invested more wisely by concentrating efforts on these key people in the farmers' adoption process and uptake pathways.

The time lapse before adoption could indicate who the early and late adoptors are. Applied to the generation of biotech corn adoptors, results can either support or refute the earlier findings of diffusion studies among rice farmers that the younger, more educated, and better off farmers tend to be the early adoptors.

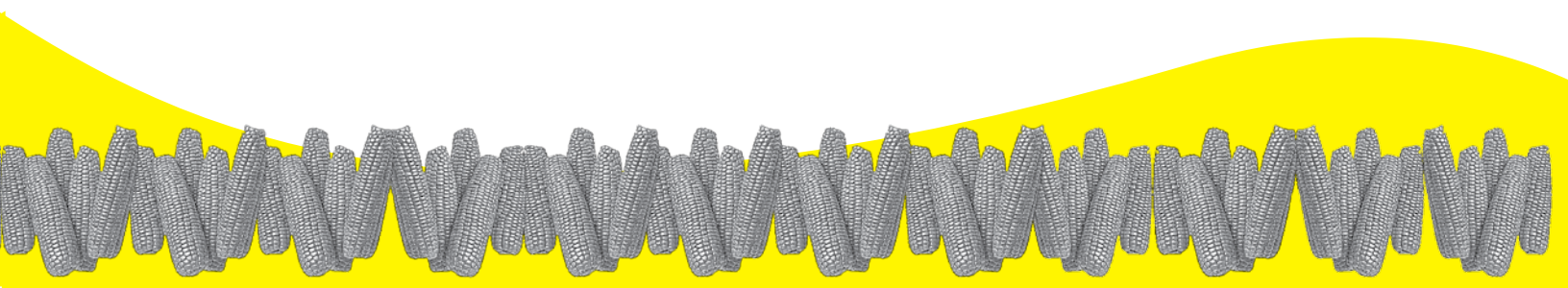
Likewise, the findings can help enlighten scientists working on biotechnology development on the attributes of the crop which farmers give importance to (e.g., weight, appearance, color, smell, etc.) or the final end-users' (feed millers and food processors) preferences. This would enable scientists to come up with biotech crops in the future that the farmers would plant because they possess their preferred attributes. Knowledge of such can facilitate adoption.

Results can also help government agencies, academic communities, and R & D institutions justify whether or not the amount of investments they pour into the scaling up of biotechnology in agriculture is bearing fruit based on the outcomes. Are biotech crops such as biotech corn being taken up? If so, at what rate and with what outcomes and impacts? Lastly, the findings can shed light on the physical, socio-economic, and other changes brought about by biotech crop adoption in the lives of the farmers, especially those who depend on small resources.

Limitations

In terms of scope, the study provides descriptive analysis of the patterns, dynamics, and uptake pathways of biotech crop adoption and the factors influencing such processes. Among the biotech crops, it dealt only with the farmers' experience with biotech corn, including Bt corn, as these were the ones already approved for commercialization at the time the study was conducted.

In terms of areas, the study covers only three provinces in Luzon, namely: Pangasinan, Isabela, and Cagayan. The number of municipalities per province were selected based on accessibility and the recommendation of the contact persons who were familiar with the location of biotech corn planters in these areas. These contact persons were the outstanding biotech corn farmer in Pangasinan, the provincial agriculture technician in Isabela, and the Director of Research at the Cagayan State University in Cagayan. As there was no list of biotech corn farmers in all the selected provinces, the ideal random sampling intended earlier gave way to purposive and snowball sampling. Hence, respondents of the study included only those that the contact persons knew were biotech corn planters and those available for the interview.



REVIEW OF LITERATURE

Biotechnology crops have become one of the fastest and most widely adopted crops in agriculture today. More farmers all over the world are adopting biotech crops and their share in hectarage is consistently increasing. In a global status report by Clive James (2011) released by the International Service for the Acquisition of Agri-biotech Applications (ISAAA), a record of 16.7 million farmers in 29 countries are said to have been planting biotech crops like corn, canola, cotton, and soybean, among others. Of this farmer population, the same report cited that over 90% are small and resource-poor farmers and that the global area planted to biotech crops has reached 160 million hectares or 395 million acres in 2011.

This figure represents a giant leap (pegged at 94-fold increase) from 1996 when biotech crops were first commercialized (James, 2011). This trend was attributed by James to the "consistent and substantial crop productivity as well as economic, environmental, and welfare benefits" of the technology. Issues and concerns of global food security, rural poverty, and climate change also provide impetus for adoption, or at the very least, consideration of biotech crops.

Biotechnology in the Philippines

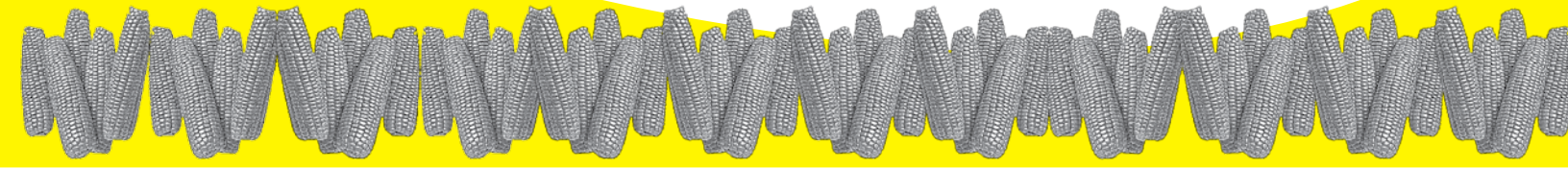
Biotechnology is defined as "a set of tools that uses living organisms or parts of organisms to make or modify a product, improve plants, trees or animals, or develop microorganisms for specific uses (ISAAA, 2010). It encompasses the tools and elements of conventional breeding techniques, bioinformatics, microbiology, molecular genetics, biochemistry, plant physiology, and molecular biology. In agriculture, these tools are used in crop and livestock improvement to complement the conventional technology.

The Philippines represents a significant stake in the global market of biotech crops because it is one of the 29 countries in the world using the technology. Together with India, China, and Myanmar, it is one of the only four countries using biotechnology in Asia (James, 2011).

In the Philippines, biotech corn has been planted since 2003 and is now currently available with the following traits: insect resistant (Bt), herbicide tolerant (HT), and a combination of the two (stacked Bt/HT). The Bureau of Plant Industry records show that Bt corn adoption was high in the beginning but has been slowly replaced in recent years by the stacked traits (Bt/HT) (James, 2011). Other biotech crops that are being developed for commercial planting include: Bt eggplant, Golden Rice, and papaya with delayed ripening trait (James, 2011).

The country is also the very first in the Southeast Asian region to have initiated a biotechnology regulatory system that even predates the commercialization of biotech crops worldwide. In 1990, President Corazon Aquino issued Executive Order No. 430, which established the National Committee on Biosafety of the Philippines (NCBP). A milestone in Philippine agriculture took place in 2002, when the Department of Agriculture issued Administrative Order No. 8 which provided the basis for commercial release of biotech crops. In 2006, Executive Order 514 was issued which further strengthened the NCBP and established the National Biosafety Network. In 2008, the Philippines launched its own biosafety clearing house, BCH Pilipinas – a mechanism consistent with the provisions of the Cartagena Protocol on Biosafety. Teng (2008) also cites the Philippines for its development of a "strong" public institutional capacity for pioneering agri-biotechnology related research and development." As early as 1980, the Philippines started its biotechnology programs with the formal creation of the National Institute of Molecular Biology and Biotechnology (BIOTECH). The Philippines is also home to two rice centers actively pursuing biotech research: the International Rice Research Institute (IRRI) and the Philippine Rice Research Institute (PHILRICE) (James, 2011; Cabanilla, 2007).

Public and scientific opinions on the safety and efficiency of biotech crops in the Philippines remain divided, to say the least. But the government



has already implemented policies and programs supporting biotechnology. In 2011, for instance, biotech corn has been planted in 644,000 hectares of agricultural land in the Philippines. This size of land represents almost 13% of the total arable land in the country and the trend in the last seven years indicates that this is likely to increase. Other biotech crops like rice, abaca, cotton, papaya, and eggplant are already in the pipeline (James, 2011).

Experiences in Adoption and Uptake Pathways of Biotechnology Crops in the Philippines

As depicted in the literature, many of the socio-economic studies on biotech crops focused on biotech corn. The number of biotech corn farmers in the Philippines in 2011 has climbed up to 322,000. This represents a 20% increase from the previous year's figure of only 270,000.

There are available data explaining the continuous increase of farmers adopting biotech corn. In most of its report, ISAAA generally attributes the trend to the consistent economic and environmental benefits provided by biotech corn to farmers planting it. The general message sent by status reports of organizations like ISAAA and SEARCA is that there is bandwagon or domino effect happening among corn farmers that is triggered by testimonies from their peers and by eyewitness encounter with the results of planting biotech corn. To this end, the role of farmers who actively advocate and educate people about biotechnology has been vital.

Two Filipino farmers featured by ISAAA in its report are Rosalie Ellasus (Navarro and Tababa, 2009a) and Edwin Paraluman (Navarro, 2009). Both testify to how biotech corn changed their lives for the better. However, their foray into biotechnology happened under different circumstances.

Ellasus was introduced to biotechnology when she attended a 16-week Integrated Pest Management - Farmers' Field School on corn sponsored by the Department of Agriculture (DA) in 2001. It was in this workshop where she saw field demonstrations on biotech corn and decided to give it a shot. Needless to say, she has been very satisfied with the results and has since continued planting biotech corn. After this, she has been more interested in biotechnology and even made herself present in succeeding activities like workshops and seminars on biotechnology held in the country and abroad. Right now, she is actively advocating the use of biotech corn. The DA regularly invites her to speak in farmers' festival in other provinces where she "spreads the good news" and convinces other farmers to use the technology (Navarro and Tababa, 2009a).

Paraluman, on the other hand, got interested in biotech corn after reading various farmers' testimonials in farming magazines. These inspired him to try biotech corn and he was in fact, among the first ones to inquire about it when field trials were conducted in his province. He has continued planting biotech corn since then and has "inspired fellow farmers with his success story." Like Ellasus, Paraluman has also been invited to share his experience with biotech corn in farmers' gatherings here and abroad. Aside from his fellow farmers, Paraluman also claims to have impressed the feed processors and animal raisers who purchase his corn (Navarro, 2009).

Factors Affecting the Adoption of Biotechnology Crops in the Philippines

Two separate studies conducted by Teng (2008) and Hosseini and Alikarami (2009) identified four groups of factors that influence adoption of biotechnology: (1) economic and environmental, (2) socio-cultural and political, (3) regulatory, and (4) educational. Some of these factors are more decisive than the others but they are all intricately related. In some instances, some factors may contribute to how and to what extent another factor could influence adoption.

Economic and Environmental

In 2003, the Philippines initiated the commercial planting of biotech corn, making it the first country in Asia to have a biotechnology crop approved for distribution as food and animal feed (Navarro and Tababa, 2009a). This development would have strong implications on the overall landscape of agriculture and food security because next to rice, corn is considered the second most important crop in the country. Biotech corn has its own share of strong opposition when it was introduced. At the moment, however, the documented economic benefits of the technology have temporarily tipped the scale in favor of its continued adoption.

A country report for the Philippines published by the ISAAA estimates the annual increase in the adoption of biotech corn at a steady 5% since it was first commercialized in 2003. ISAAA reports that "the farm level economic benefit of planting biotech maize in the Philippines in 2003 to 2010 is estimated to have reached USD170 million" (Brookes and Barfoot, 2012, Forthcoming, as cited in James, 2011). About 50% of worldwide gain from biotechnology crops have been obtained by resource-poor farmers in developing countries like the Philippines.

On the ground level, the economic benefit of planting biotech corn translates to around Php10,132 (USD180) increase in profit per hectare (Yorobe and Quicoy, 2000). Another study by Gonzales (2007) states that biotech corn could provide an overall income advantage of 5% to 14% during wet season and 20% to 48% during the dry season. Viewed from a communication perspective, the economic benefits alone are substantial messages that could convince or persuade different audiences to accept or adopt the technology.

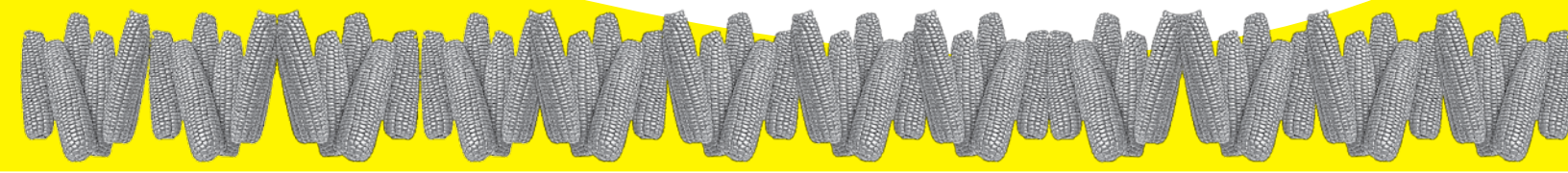
The documented environmental benefits of biotech corn likewise look encouraging. Data from Brookes and Barfoot (2012, Forthcoming), as cited by James (2011), show that pesticide use on biotech crops in the countries where they have been planted have fallen by at least 443 million kilograms from 1996 to 2010.

Taken as a whole, the economic and environmental benefits do not only ensure that a farmer who has adopted the technology will continue using it. As agriculture production in the country still stands on a strong culture of community, it could also serve as an impetus for a multiplier effect through the traditional word-of-mouth, especially because most users of biotech crops are resource-poor farmers who are known to share farm practices and knowledge among each other.

Education and Information

Studies suggest that the attitude of the general public towards scientific developments is, in general, closely associated with their trust in sources of information (Cavanagh et al., 2005, as cited by Amano Jr., 2009). In the Philippines, educating the public about biotechnology is a challenge for several reasons. For instance, R&D for biotechnology often requires huge logistical and financial resources that leave very little, if at all, to communication activities in developing countries like the Philippines. While some state colleges and universities have included biotechnology in their curriculum in a bid to increase people's understanding of biotechnology, most of the information about it is usually known only by the public through the mass media. In fact, surveys show that people's knowledge of science and how they make sense of scientific breakthroughs including biotechnology are based on what they read in newspapers, watch on television, hear over the radio, and view on the Internet (Navarro, 2009c).

In the Philippines, media coverage of biotechnology has increased together with the technology's adoption. For instance, Juanillo (2003) observed that journalists were "not too interested in the subject of biotechnology." This situation significantly changed in the years that followed when, incidentally, biotech corn has been planted increasingly on Philippine farms. In addition, from an average of only 23 per month in 2002, the number of articles on biotechnology published in national dailies climbed to 43 per month in the period 2003-2008. Media coverage could have also contributed positively to the adoption of biotechnology (Navarro and Hautea, 2011 and Navarro et al., 2011). Results of a ten-year



(2000-2009) analysis of news coverage and framing showed that majority of articles were positive (41.3%) and neutral (38.2%) in tone (Navarro et al., 2011).

Social and Cultural

The Philippines is a predominantly Catholic country, but religious leaders in general, regardless of their affiliation, wield a significant degree of influence over matters concerning the social, ethical, and moral implications of scientific developments.

As regards biotechnology, the Catholic Church leadership in the Vatican has been critical of biotechnology, dealing with *in vitro* fertilization, stem cell transplant, animal and human cloning, and others that are deemed to undermine the dignity or sanctity of human life (Allen, 2008).

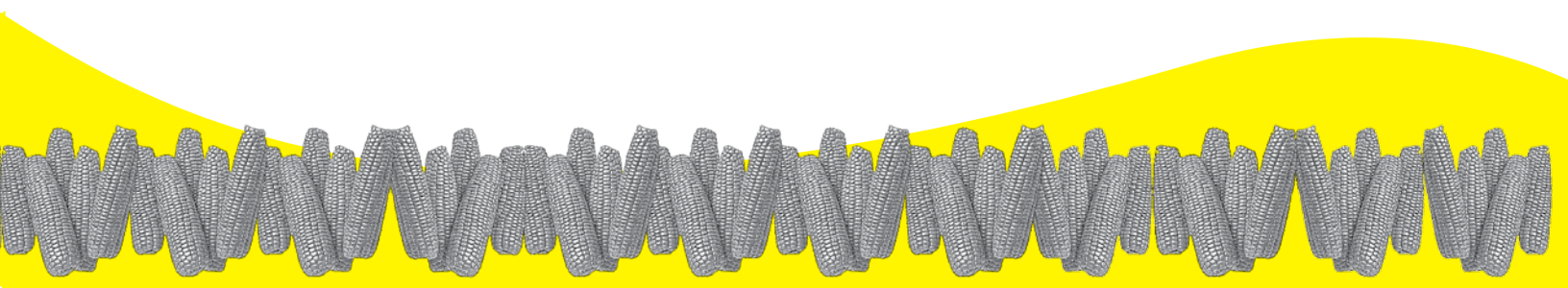
It is prudent to say, however, that the Catholic Church is not against biotechnology as a whole. The Catholic Church in the Philippines, as a case in point, has been objective and open-minded in its position concerning agricultural biotechnology (Prakash, 2001). While biotech corn was still in the pipeline and debate over its adoption in the Philippines was ongoing, Cardinal Jaime Sin issued the "Pastoral Statement On Genetic Engineering in Agricultural Products" in May 2001. The statement acknowledged the possible social worth of the technology even as the prelate expressed concern over the grave ethical and moral dilemma involved in biotechnology. In his statement, Cardinal Sin, who was at that time the most revered and influential Church leader, stated that biotechnology is acceptable if "all risks are minimized."

The emphasis on ensuring the safety of agricultural biotechnology has been echoed in other actions of the Philippine Catholic Church. In 2003, the Catholic Bishops Conference of the Philippines (CBCP) initiated a signature campaign to petition the prevention of distribution of a biotech corn produced by United States-based Monsanto Corporation (Estabillo, 2003). Consistent with the pastoral statement of Cardinal Sin released two years prior to the campaign, the CBCP's opposition to biotech corn similarly raised issues on the environmental and human health and safety.

But even as official church position has consistently expressed reservation about biotechnology, some sectors of the clergy have been enthusiastic about it primarily because of the prospect of its benefits that are aligned with the church's campaign against hunger and poverty. Prakash (2001), for example, reported the efforts of Rev. Father Noli Alparce, one of the most active supporters of biotechnology, in advocating "the continued development of agricultural biotechnology to address the problems of poor farmers, and in assuring "that there was no incongruence in the use of this technology with the Church's beliefs."

Other voices of opposition to biotechnology come with strong political undertones as issues such as patent to life forms and profits are included in the discussion. This is hardly surprising in the context of Philippine agriculture, which, for decades now, has been in the center of an intense, sometimes bitter, political debate over agrarian and land reform. Within this "politicized" environment, interventions and development can be expected to be approached with skepticism as farmers, stakeholders, and other interest groups factor in the economic and political ramifications. The debate on biotechnology eventually shifts to the question of who profits the most. Aerni (2002), thus, argues:

> "In spite of its potential for resource-poor farmers, the introduction of agricultural biotechnology in developing countries is seen as being even more driven by corporate Western interests than it was with the green revolution. This is understandable if we consider that the public sector gradually withdrew its financial support for international agricultural research leaving it mainly in the hands of the private sector. As a consequence, genetically modified crops that have been commercialized hitherto are mainly designed for the large markets in industrialized countries."



In addition, the Philippine civil society groups also have strong presence in the agriculture sector as they try to respond to a gamut of issues like rural reconstruction, indigenous people's rights, environmental protection, and sustainable agriculture, among others. Some of these non-government organizations (NGOs) advocate organic farming, which can be taken as an alternative model to biotechnology farming (Aerni, 2002). Meanwhile, other NGOs directly refute the central arguments in favor of biotechnology (i.e., food security and economic benefits for small farmers). This observation and line of thought is echoed by Aerni et al. (1999) who summarized the prevailing perspective among many Philippine NGOs that "technology alone cannot solve the structural inequalities in any society." In this sense, many Filipinos, especially NGOs, tend to be skeptical of new technologies, and consequently the institutions behind such technology (Aerni et al., 1999).

Suffice it to say that, as active players in the agriculture sector, these NGOs, whether for or against, contribute to the discourse on biotechnology, especially at the grassroots level where their influence is mostly manifested.

Regulatory

As discussed earlier in this paper, the Philippines has one of the most comprehensive regulatory and safety system for biotechnology in place. The National Biosafety Committee of the Philippines (NCBP) was formally institutionalized through Executive Order (EO) 430 as early as 1990. In 2002, the regulation governing the commercialization of biotech crops (Department of Agriculture Administrative Order No. 8) was issued in the Philippines. The functions of the NCBP were expanded under EO 514, issued in March 2006, and established the National Biosafety Framework (NBF). Section 2 of EO 514 specifically provides consistency with the Cartagena Protocol on Biosafety (Cabanilla, 2007).

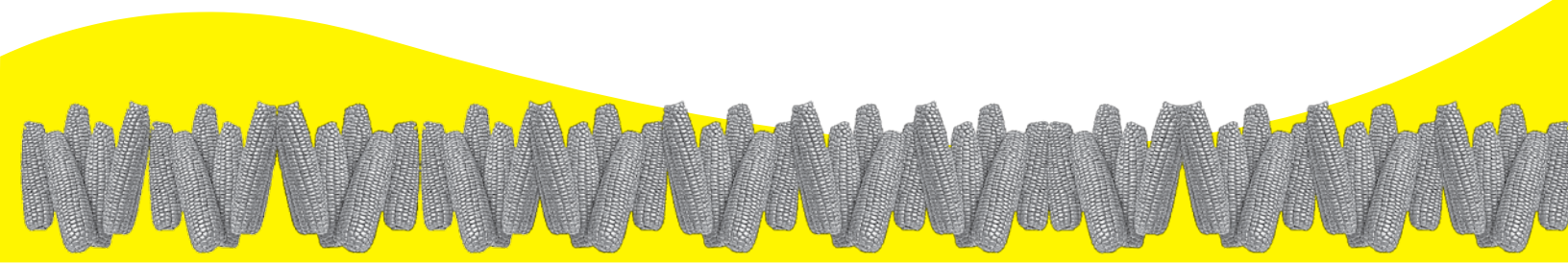
In general, regulatory frameworks serve as an enabling tool for the development of the biotechnology industry (Teng, 2008). The existence of a regulatory body or system has been a big advantage for the Philippines since this has ensured that biotech efforts would not be stuck in the R&D phase. This has been the case with biotech corn and will likely be the case with the other biotech crops in the pipeline. The ISAAA describes the prospect of biotechnology crops in the Philippines as "very promising."

Hopes are high that the country will be the first to commercialize the biotechnology crop Golden Rice by 2013/14.

Impact of Biotechnology Crop Adoption

A study on the economic impact of biotech corn in the Philippines was undertaken one year after its approved commercialization in the country (Yorobe and Quicoy, 2006). Among its salient findings are as follows:

- Yield and income of biotech corn farmers were significantly higher than those of the non-biotech corn farmers.
- Expenditure on insecticide was significantly lower among biotech corn farmers.
- Results in all study locations showed a significant welfare effect of using biotech corn variety among corn farmers.
- Educational level and farm income were among the significant factors that influenced the adoption of biotech corn.



METHODOLOGY

Research Design

The study made use of descriptive, normative research design. It analyzed the pattern and dynamics of adoption and traced the uptake pathway common to a selected segment of farmer population engaged in planting biotech corn. It described these patterns using appropriate descriptive statistics and tools for analysis.

Locale of the Study

The study was conducted in the three provinces of Luzon where different biotech crop-related activities have been or are being conducted at the time of the study: (1) Pangasinan, where Bt eggplant field location trials were going on at the time of the study; (2) Isabela, where biotech corn has been planted on a commercial scale since 2002; and (2) Cagayan, which has been covered by the second phase of biotech corn commercialization. Figure 1 shows the map locating the three provinces as study areas.

A list of hectarage planted to biotech corn in the different municipalities of the three provinces was the available data from ISAAA which was used for identifying the number of sample respondents for the study.

In the course of doing the study, however, it was found out that no such list of biotech corn farmers was available in all the provinces and municipalities targeted for the study. Preliminary contacts with the Municipal Agricultural Officers (MAOs) revealed that they did not a have a list of corn farmers, much more the list of those using biotech corn. While they have a list of farmers (mostly rice farmers) per barangay, they could not distinguish those engaged in corn. So while the list of biotech corn hectarage was a useful guide for identifying the municipalities, it did not help solve the problem of identifying exactly who the biotech corn farmers were for purposes of sampling for the survey.

Figure 1. Map locating the three provinces of Pangasinan, Isabela, and Cagayan as study areas

As an alternative, outstanding biotech corn farmers were contacted. From these farmer-contacts, other biotech corn farmers and their locations were identified. With the farmer-contact person, areas to be covered were finally chosen based on accessibility and number of biotech corn farmers available for the interview. These are reflected in Table 1.

Table 1. List of municipalities identified as sample areas for the study

Pangasinan	Isabela	Cagayan
Alcala	Benito Soliven	Iguig
Binalonan	Echague	Solana
Laoac	Ilagan	
Malasiqui	Naguilian	
Mapandan	Reina Mercedes	
San Fabian		
San Jacinto		
Urbiztondo		

Respondents and Sampling

The study was limited to having respondents who were available for the survey as arranged by the project team's farmer-contacts in the field. Nonetheless, best efforts were made and the farmer-contact was informed that the preferred respondents should have the following qualifications:

- have been cultivating biotech corn for at least a year; and
- should have at least one hectare of land planted to biotech corn.

The above criteria are important to provide enough experience for the farmers and enable them to trace and describe their adoption and uptake pathway.

Based on the list of hectarage planted to biotech corn, the population of biotech corn farmers per province was then estimated. The study used the assumption based on previous studies that a corn farmer would have an average of 2 hectares. Then using the estimated population of farmers derived per province, the number of samples was computed using Slovin's formula as follows:

$$n = N/(1+Ne\ 2)$$ where: n=number of samples
N= total population
e=error tolerance or
desired margin of error

The resulting computations indicated that the samples would be 99 each for Pangasinan and Isabela, and 97 for Cagayan (Table 2).

Table 2. Number of sample respondents from each province

Province	Total hectarage planted to Bt corn (2004-2005)	Estimated population of Bt corn farmers	Number of sample respondents
Pangasinan	22,597	11,298	99
Isabela	28,825	14,412	99
Cagayan	10,537	5,268	97
		Total	295

Data Gathering Methods and Instruments

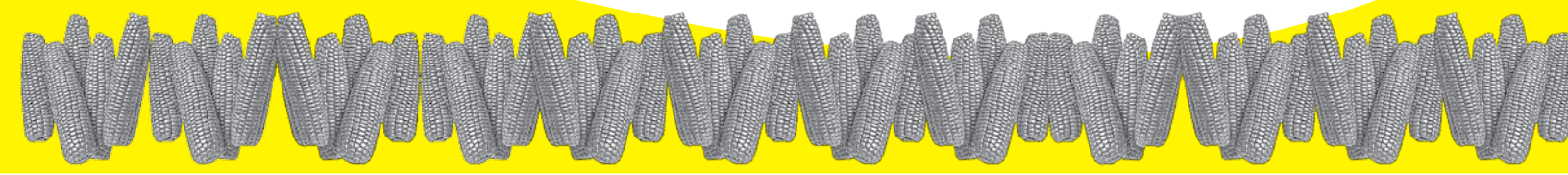
Survey

The study employed a one-shot survey using structured interview schedule to gather data from sample respondents. The survey data were used to describe who the biotech farmers are, the factors they consider in adopting biotech, and their adoption and uptake pathways and related issues.

Innovation Tree

The survey was complemented by focus group discussions (FGDs) where the Innovation Tree exercise was carried out.

The Innovation Tree is a participatory rural appraisal (PRA) tool developed by Van Mele and Zakaria (2002). It is designed to "help people visualize and analyze the way in which an innovation is spread



over time among community members." It also helps development workers distinguish various types of adoptors and identify some social, economic, political, and cultural factors that influence the adoption, diffusion, and modification, if any, of an innovation. The method is qualitative in nature and provides a venue for the farmers to discuss with fellow farmers the dynamics of adoption of biotech corn in their community.

The following steps summarized how the Innovation Tree was facilitated by the researchers in several communities purposively selected for the study.

- Ten to 20 farmer-respondents were gathered together in a specific place.
- A facilitator introduced the research project and the purpose of the activity.
- The farmers were each given a piece of paper and a permanent marker. They were instructed to write on the paper their names and the month and year they started planting biotech corn.
- Each farmer was then asked to share the month and year s/he adopted biotech corn (as written on the paper), the person from whom s/he learned about the crop, the person and his/her attributes that convinced him/her to adopt, and those whom s/he convinced in return to adopt biotech corn, and other things s/he may wish to relay about the experience. The order was based on the chronology of adoption – from the earliest to the most recent adoptors.
- The facilitator then drew lines to indicate social and chronological connections between and among the biotech corn adoptors.

The FGD also probed on the socio-economic benefits and changes they value the most from adopting biotech corn. The facilitator solicited clarifications and comments and brought the group into open discussion about these topics.

Data Analysis

Quantitative data from the survey were analyzed using descriptive statistics (i.e., means, frequencies, percentages). The data generated from the qualitative methods, on the other hand, were examined and analyzed using illustrations, flow charts, and thematic approach to surface the main patterns regarding adoption and uptake pathway of biotech corn.

Due to the non-probability samples used in the study, no statistical test for significance of relationship was used. Instead, it was the strength of relationship between sets of variables that was subjected to test: (a) strength of relationship between socio-demographic characteristics and mode of adoption, and (b) strength of relationship between farm-related profile and mode of adoption. Whatever results are generated applies only to the samples of this study and cannot be generalized to population of biotech corn farmers in the country.

Goodman-Kruskal Tau was used as the statistical test. It is a measure of the proportional increase in accurately predicting the outcome of one categorical variable (e.g., age) when we have the information about a second categorical variable (e.g., full adoption or partial adoption) where it is assumed that the predictions are based on their overall proportions (Agresti, 2002).


Researcher connecting the farmer's name to the source of information regarding biotech crops in innovation tree exercise


Farmers writing their name and the year they started planting biotech corn


Researcher interviewing farmer

RESULTS AND DISCUSSION

Distribution of Respondents

The total number of respondents actually interviewed was 309, slightly exceeding the targeted 295 based on earlier computation using Slovin's formula. They came from Pangasinan (101), Isabela (103), and Cagayan (105) (Table 3). Respondents came from 5 municipalities in Pangasinan, 5 municipalities in Isabela, and 2 in Cagayan. Fewer municipalities were covered in Isabela because farmers in other towns were unavailable for interviews due to fiesta celebrations. In Cagayan, only municipalities with stable peace and order and accessible were selected for the study.

Table 3. Distribution of respondents by province and municipality

Province/Town	Frequency (n=309)	%
Pangasinan		
Alcala	31	10
Malasiqui	14	5
Binalonan	13	4
Mapandan	13	4
Laoac	10	3
San Jacinto	10	3
Urbiztondo	7	2
San Fabian	3	1
Sub-total	**101**	**33**
Isabela		
Naguilian	33	11
Reina Mercedes	24	8
Ilagan	24	8
Benito Soliven	14	5
Echague	8	3
Sub-total	**103**	**33**
Cagayan		
Solana	82	26
Iguig	23	7
Sub-total	**105**	**34**
GRAND TOTAL	**309**	**100**

Socio-Demographic Profile

Age

The age of biotech corn adoptors ranged from 19 to 83 years old. The mean age was 47. Majority (61%) belonged to the 41-60 years age bracket or the middle-aged to senior year group (Table 4), and this was consistent for all the three provinces. Only about one-fourth (27%) were in the relatively younger group of 21-40 years old.

This implies that biotech corn farmers are mostly seasoned farmers by age or have had considerable experience in farming. This belies the earlier findings on adoption and diffusion of innovation that younger farmers tend to adopt new technologies more than the older farmers (Rogers, 1962). For biotech corn farmers, it is the older ones who tend to adopt the biotech crop. This suggests that there could be something in the biotech corn worth considering for the usually hesitant "late adoptors" or older farmers to pay attention to it and try planting it themselves.

Gender

In terms of gender, there were more male (68%) than female farmers (32%) adopting biotech corn (Table 4). The trend was common for the three provinces. This could be attributed to the fact that farmers in the Philippines are generally males, farming being regarded as strenuous job suited more for men than women. This may also be due to the common practice for households to be represented by the male head in legal and business transactions.

Civil Status

An overwhelming majority of biotech farmers (90%) were married (Table 4). This was observable across all provinces. This is expected since many of the respondents were already into the age bracket of 40 years and above, a stage when most people are already married and have established their own families.

Number of Children

The number of children of biotech farmers ranged from 1 to 13, with an average of 4. Nearly one-half (44%) had 1 to 3 children, followed closely by those with 4 to 6 children (36%) (Table 4). At the provincial level, the pattern was for many of the respondents to have 1 to 3 children. On the whole, biotech corn farmers have smaller family size when compared with the typical farming households in the Philippines which have 6 or more children.

Educational Attainment

Most (40%) of the biotech corn farmers had either some high school education or were high school graduates (Table 4). About one-third (36%) had elementary schooling. The trend was evident in all the three provinces. This shows that biotech corn farmers have relatively higher education than the typical farmers in the Philippines who usually have only elementary schooling (Torres, 2011). This also supports the finding of Yorobe and Quicoy (2006) describing the biotech corn farmers as better educated, having 10 years of schooling, than non-biotech corn farmers.

Other Sources of Income

Majority of the respondents (60%) reported having no other source of income except farming (Table 4). Data for the three provinces depicted the same trend. Only 10% at most had other sources of income, which included carpentry, retail selling, driving, and office work. This suggests that biotech corn farmers are generally into full-time farming.

It should be noted that the farmer-respondents in this study were also rice farmers. They plant rice during the first cropping or wet season, and then shift to planting corn during the second cropping or dry season. It is during the dry season when they need to spend time attending to the irrigation of their farms for their biotech corn.

Membership in Organizations

Majority (61%) of the farmers were members of organizations (Table 4). This trend, however, was not manifested among farmers in Cagayan where two-thirds (77%) indicated being non-members of organizations.

Farming Profile

Number of Years Farming

More than half of the respondents (68%) have been farming for 16 years and more, with 40% falling under the 16 to 30 years experience (Table 5). Biotech corn farmers from Cagayan were farming longer than those from Pangasinan and Isabela. The average years of farming was 23 for all the three provinces, which means that biotech corn farmers are seasoned farmers. This supports the earlier finding on farmers' age indicating that they are not amateur or greenhorn farmers but ones who have had wide exposure and experience already.

Farm Size

The average farm size of biotech corn farmers, whether they own the land or not, was 2.17 hectares, with about one third (35%) having 1-1.9 hectares and one-fourth (26%) having 3 and more hectares (Table 5). The average size is not very far from the finding in 2006 that biotech corn farmers have an average of 2.64 hectares (Yorobe and Quicoy, 2006). This is larger than the 1.64 hectare farmed by the non-Bt corn farmers. Meanwhile, the range of farm size across the three provinces concentrated mostly on 1-9 hectares.

Sources of Capital

Table 6 shows that the biotech corn farmers have multiple sources of capital for farming. The top three sources were the traders (43%), personal savings (34%), and loans from banks (29%). A few also sought

Table 4. Respondents' socio-demographic characteristics

Socio-demographic Profile	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq (n=101)	%	Freq (n=103)	%	Freq (n=105)	%	Freq (n=309)	%
Age								
20 and below	2	2	0	0	0	0	2	0.5
21-40	27	27	33	32	23	22	83	27
41-60	61	60	59	57	70	67	190	61
61 and above	11	11	10	10	12	11	33	11
No answer	0	0	1	1	0	0	1	0.5
Gender								
Male	78	77.	73	71	59	56	210	68
Female	23	23	30	29	46	44	99	32
Civil Status								
Married	89	88	95	92	94	89	278	90
Single	6	6	3	3	3	3	12	4
Separated	4	4	4	4	2	2	10	3
Widow/widower	2	2	1	1	6	6	9	3
Number of children								
None								
1-3	10	10	8	8	4	4	22	7
4-6	39	38	51	49	45	43	135	44
7 and above	35	35	39	38	39	37	113	36
	17	17	5	5	17	16	39	13
Educational attainment								
Elementary								
High school	16	16	39	38	56	53	111	36
College Vocational	53	52	35	34	37	35	125	40
No answer	18	18	21	20	6	6	45	15
	11	12	8	8	6	6	26	8
	2	2	0	0	0	0	2	1
Religion								
Roman Catholic	63	62	82	80	102	97	247	81
Aglipayan	2	2	11	10	0	0	13	4
Born again	9	9	1	1	1	1	11	3
Iglesia ni Cristo	6	6	1	1	0	0	7	2
Others (UCCP, Jehovah, Pentecostal, Methodist, Espiritista, Union, Church of Living God)	6	6	8	8	1	1	15	5
No answer	15	15	0	0	1	1	16	5
Sources of income								
Skilled work	17	17	7	7	6	6	30	10
Retailing	6	6	11	11	12	11	29	9
Driving	13	13	8	8	2	2	23	7
Others (pension, animal raising, office work)	7	7	17	16	17	16	41	14
None	58	57	60	58	68	65	186	60
Membership in organizations								
Member	88	87	75	73	24	23	187	61
Not a member	13	13	28	27	81	77	122	39

Table 5. Number of years farming and farm size

Farming Profile	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq (n=101)	%	Freq (n=103)	%	Freq (n=105)	%	Freq (n=309)	%
Number of years engaged in farming								
15 and below	38	37	36	35	26	25	100	32
16-30	35	35	39	38	50	47	124	40
31-45	20	20	24	23	22	21	66	22
46 and above	8	8	4	4	7	7	19	6
Farm size								
Less than 1 ha	23	23	16	16	18	17	57	18
1-1.9	33	32	32	31	42	40	107	35
2-2.9	20	20	27	26	18	17	65	21
3 and above	25	25	28	27	27	26	80	26

money lenders (10%) and relatives (8%) to source their capital. Across provinces, most farmers from Pangasinan (55%) and about one-third from Isabela (31%) obtained loan from banks or individuals. An overwhelming majority from Cagayan (80%) and another one-third (37%) from Isabela sought the traders. Those from Cagayan exhibited the highest dependency on traders for their capital.

Traders in this case refer to farmers who serve as suppliers of seeds from companies (e.g., Monsanto, Pioneer Hi-Bred, Syngenta) in the community. The traders lend capital in cash or in the form of farm inputs such as seeds and fertilizers to the farmers who, in turn, sell their corn harvest to these traders as part of the informal deal or partnership. The traders are also known as seed company "ambassadors" in the community. In Cagayan, these traders are also biotech corn growers themselves. The trading relationship has persisted for years as both parties mutually benefit from it.

It is worth noting that some farmers reported having personal savings which they used to augment their capital for farming. Their capital would range from Php45,000 (if they own the land) to Php55,000 per hectare (if they only rent the land). This reinforces the finding that biotech corn adoptors are financially better off than non-biotech corn farmers (Yorobe and Quicoy, 2006).

Marketing of Corn Produce

Though biotech corn farmers have multiple market outlets for their produce, traders stood out as the highly and frequently mentioned item (91%) (Table 6). All of their harvested corn are threshed into kernels or grains for selling to traders. In Cagayan, all except one had their produce sold to the traders since they had the highest dependency for capital on traders. This is part of the informal relationship that has persisted between traders and farmers through the years and which both parties continue to honor to this day. A few (12%) were also selling to cooperative. It was very rare for farmers to do direct selling of their corn in the market.

Income

There was observed difficulty among the biotech corn farmers in all the three provinces to recall and compute their net income. The best that they could remember was the amount left to them after the traders have deducted the cost of inputs provided them in the form of seeds and fertilizers. But this still excluded the amount they paid for labor during land preparation, planting, fertilizer application, weeding, and irrigation. Unfortunately, nobody kept records

of such expenses. The farmers also did not seem to be very particular about the computation of their net income. They said that as long as they have paid off their loans to the traders and still have some money left, they were happy.

In a way, biotech corn planting has become a contract growing partnership between the traders and farmers, where the former provide all the necessary inputs, and the latter supply all the labor necessary until harvest time. Then the harvest are turned over to the traders. Such arrangement operates under the spirit of trust and patronage between the two parties.

Gross income per hectare was used for this study. And even the figures for this item were derived by computing the farmer's total harvest in kilograms (kg) and the price per kg of the harvested corn grains. Using the gross income per hectare, the farmers were almost equally distributed to those earning Php50,000 and below (45%) and those earning Php50,001 to Php100,000 (46%) (Table 6). The trend was consistent in both Pangasinan and Isabela. In Cagayan, majority were earning Php50,000 and below or lower than farmers in Pangasinan and Isabela. If associated with the source of capital, those farmers who use their personal savings or loans from banks (as in the case of Pangasinan and Isabela) tend to earn more than those depending on traders (as in the case of Cagayan).

An attempt to derive the net income was also done in selected group discussions. In Pangasinan, for example, a group of biotech corn farmers said that they could harvest about 6 t/ha. They estimated that they could earn Php30,000 from this as compared to the 4 tons they used to harvest using non-biotech corn and where they earned only Php10,000. But such amounts represented only the lump cash they got from the sales of their corn grains and have not included other expenses (e.g., labor for planting, weeding, cost of diesel for irrigation) incurred aside from those loaned out from the traders.

A member of a farmers' group in Isabela estimated that he earned a gross income of Php120,000 from his 2-hectare farm of biotech corn. Less his expenses which he estimated at Php60,000, he got a net income of Php60,000 in one cropping season from his entire hectarage.

From literature, production of biotech corn has been reported to yield from 4 tons to 12 tons per hectare with income increasing from Php10,000 to Php30,000-40,000 per year (SEARCA BIC, 2002). Based on a status report on commercialization of biotech corn, a farmer could earn a net income of Php21, 599 per hectare compared to only Php11,467 per hectare from non-biotech corn (APCoAB, 2005). What all these figures illustrate is that income from biotech corn, whether gross or net, are undeniably substantial.

Farming Activities Performed by Household Members

Biotech corn farming may be considered a family affair in the study areas since able members of the entire household were all involved in the farming activities. Based on the extent of involvement, it appears that most of the activities were being undertaken by men (Table 7).

Biotech corn farmers were mostly male household heads who undertook the major activities in corn production. These included land preparation, seedling purchase, planting, weeding, fertilizer application, harvesting, and marketing. Wives and able children provided the additional labor force in these activities. Wives though took the major role in preparing the food for laborers. Children were tapped only during their off-school days, thus, their minimal involvement in corn farming activities.

To complement their manpower requirement, farmers reported hiring farm labor especially during land preparation, weeding, fertilizer application, irrigation, and harvesting. This is where they needed additional capital, which they usually source from their personal savings, and minimally from their other sources of income.

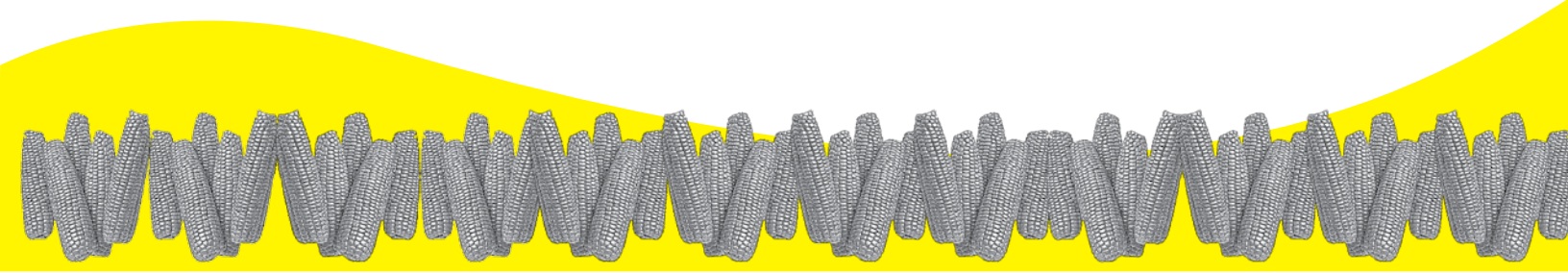


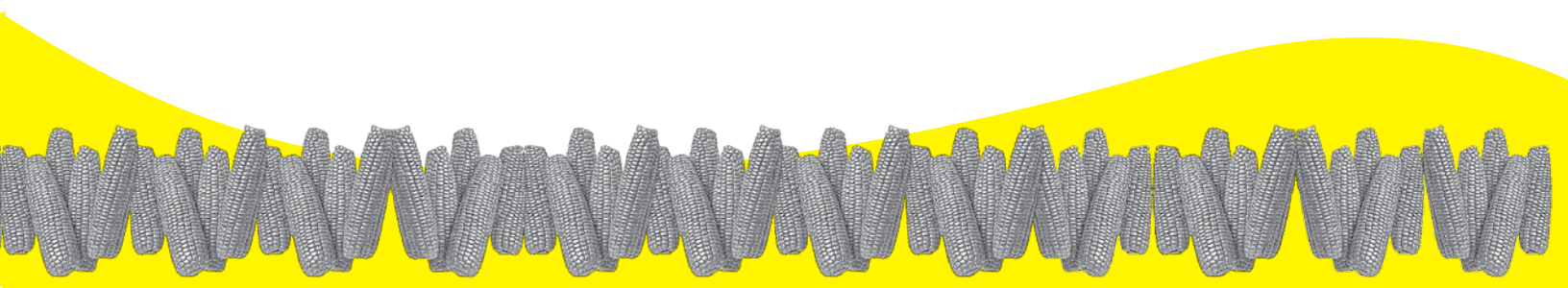
Table 6. Sources of capital, marketing of produce, and gross income

Farming Profile	Pangasinan		Isabela		Cagayan		Total	
	Freq (n=101)	%	Freq (n=103)	%	Freq (n=105)	%	Freq (n=309)	%
Source of capital								
Own money or savings	42	42	30	29	33	31	105	34
Loan (institution/bank)	56	55	32	31	3	3	91	29
Individual money lender	21	21	7	7	4	4	32	10
Relative	13	13	8	8	3	3	24	8
Trader	10	10	38	37	84	80	132	43
Friend	2	2	0	0	0	0	2	1
(multiple response)								
Marketing of produce								
Trader								
Cooperative	77	76	100	98	104	99	281	91
Market	36	36	0	0	1	1	37	12
(multiple response)	1	1	3	3	0	0	4	1
Gross income								
PhP 50,000 and below	39	39	43	42	58	55	140	45
PhP 50,001 – PhP 100,000	49	48	52	50	40	39	141	46
PhP100,001 and above	6	6	7	7	5	18	6	38
No answer	7	7	1	1	2	2	10	3

Table 7. Farming activities performed by household members

Farming Activity	Father	Mother	Children
Land preparation	H	L	L
Buying/preparing the planting materials	H	L	L
Planting	H	M	L
Weeding	H	L	L
Fertilizer application	H	M	L
Harvesting	H	M	L
Irrigating	L	L	L
Preparing food for farm workers	L	L	L
Drying	L	L	L
Marketing	H	L	L
Inventory	L	L	L

Legends: H=High M =Moderate L= Low



Adoption of Biotech Corn

Varieties of Biotech Corn Planted

The corn varieties planted by farmers could be differentiated depending on the biotechnology or agronomic trait found in the biotech corn. They may be categorized as: (a) Bt corn – resistant to the corn borer; (b) herbicide tolerant (HT); and (c) stack trait (Bt/HT) – resistant to both corn borer and herbicide.

Farmers were highly dependent on what the seed suppliers and traders supplied to them. So when asked about the corn variety they plant, majority cited Bt corn. There were instances when instead of identifying the exact name of the biotech corn variety, they cited the name of the seed suppliers – Monsanto, Pioneer, Syngenta, Cornworld, Cargill, SMC, and Bioseed – which are generally into biotech corn distribution. Thus, results of the survey to discern the varieties that farmers plant was considered inconclusive. This is because based on the data released by the Bureau of Plant Industry, the stacked trait biotech corn was the most predominant varieties released in the Philippines occupying 545,000 hectares as compared to 12,000 hectares Bt and 86,000 hectares HT (James, 2011). However, results of the present study put Bt corn as the most predominant variety planted in the areas surveyed. This confirms the fact that farmers are not familiar with the corn varieties they are planting.

Number of Years Engaged in Planting Biotech Corn

Data gathered indicate that the farmers' experience in planting biotech corn averaged 3 years. The frequency distribution in Table 8 shows that about one-third (35%) were into it for 1 to 3 years. This was followed closely by those who had been using biotech corn for 4 to 6 years (31%). Comparing the trends between provinces, those from Pangasinan (45%) have been using biotech corn longer (4-6 years) than those from Isabela and Cagayan. Since biotech corn has been planted in the Philippines for 9 years, farmers who signified in the survey that they planted these crops for more than 10 years (23% in Isabela, 41% in Cagayan) could mean that they are not sure of the varieties they planted.

Factors Considered in the Adoption of Biotech Corn

The farmers considered a number of factors when they adopted biotech corn. These were a combination of economic, agronomic, and social factors (Table 9). Most of these factors, though would redound to economic consideration.

The topmost factor considered by the majority was economic: higher income derived from biotech corn (62%). This was the trend specifically in the provinces of Isabela (55%) and Cagayan (85%). But in Pangasinan, the most valued reason was agronomic in nature: the resistance of the crop to insect pest or borer (60%), which actually ranked second on the overall rating of factors.

The elaboration given by the farmers interviewed gave an interesting twist because they reasoned out that the corn being resistant to borer enabled them to sleep soundly and be freed from worries that endlessly haunted them in the past. This is not directly an economic reason, of course, but the assurance of a good crop providing peace in their lives is a priceless benefit in itself.

Among the other factors considered but of lesser percentage were the reduction of time spent for maintaining the crops (17%) and the availability of financial assistance from traders (13%). The use of biotech corn practically removed the time spent for applying pesticides. With this benefit, they could now spend more time on other productive activities such as attending trainings. Likewise, the availability and accessibility of inputs and capital from traders are plus factors as they relieve the farmers of the worries on where to source their capital from. It also gives

Table 8. Number of years planting biotech corn

Number of years	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq (n=101)	%	Freq (n=103)	%	Freq (n=105)	%	Freq (n=309)	%
3 years and below	33	33	41	40	34	32	108	35
4-6 years	45	45	28	27	22	21	95	31
7-9 years	17	17	10	10	5	5	32	10
10 years and longer	4	4	24	23	43	41	71	23
No answer	2	2	0	0	1	1	3	1

them a sure market for their produce, an important factor that practically sustains their production.

Though not significant in terms of number, a few (9%) noted "pakikisama" as a social factor for adoption. This implies that among some farmers, not everything is economic; smooth interpersonal relationship is still a value that can work very positively in the diffusion or uptake of technology. Also, another interesting factor that came out serendipitously was that biotech corn is not prone to theft. What most farmers and people around the farms knew was that the crop was primarily meant for animal feed, and this gave an impression that biotech corn is not fit for human consumption.

During the group discussion, one important factor mentioned by some of the farmers had something to do with the risk of being an "isolated case." That is, they explained that if everybody else around their farms are using biotech corn, and their farm is left alone planted with non-biotech varieties, they believe that there is a very high likelihood that the pests will concentrate in their farms and damage them. Hence, they consider it a better option to ride with the tide and also to plant biotech corn in the end "by force of circumstances."

Mode of Adoption of Biotech Corn

For this study, mode of adoption was categorized into two : (a) *en toto* or full adoption, if the farmers adopted in full the recommended practices for growing biotech corn, and (b) partial adoption, if they adopted only some or modified the recommended practices.

Nearly half (47%) of the adoptors followed the procedures in using any biotech corn varieties (Table 10). These consisted of the steps for land preparation, planting, and maintenance that are also followed for cultivating other conventional or non-biotech corn varieties, except application of pesticides which is totally omitted.

Those from Isabela (56%) and Cagayan (53%) exhibited better compliance than farmers from Pangasinan. In the latter, many farmers (41%) modified some of the steps prescribed for cultivating biotech corn. In particular, farmers modified the planting distance between corn plants from "75 cm x 20 cm" to "60 cm x 20 cm." They believed that planting corn plants close to one another will give higher yield as the use of space is maximized. According to some farmers who tried it, such modification works.

Table 9. Factors considered by farmers in their adoption of biotech corn

Factor	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (n=309)	%
Economic								
Higher income	47	47	57	55	89	85	193	62
Availability of financial assistance from traders	13	13	19	18	8	8	40	13
Cheaper planting materials	4	4	1	1	0	0	5	1
Lesser/easier work	13	13	36	35	5	5	54	17
Agronomic								
Resistance to pests	60	60	34	33	25	24	119	38
Resistance to drought	8	8	13	13	1	1	22	7
Good quality of produce	7	7	8	8	11	11	26	8
Social								
Pakikisama" (camaraderie with other farmers)	12	12	11	11	4	4	27	9
Have witnessed the success of other farms	5	5	0	0	2	2	7	2
Have witnessed the success of other farms	5	5	0	0	2	2	7	2
Cheaper planting material	4	4	1	1	0	0	5	2
Others								
No other sources of income; no other seeds available; produce is not prone to theft; modern technology; lesser farm inputs	2	2	8	8	2	2	8	4

** Multiple responses*

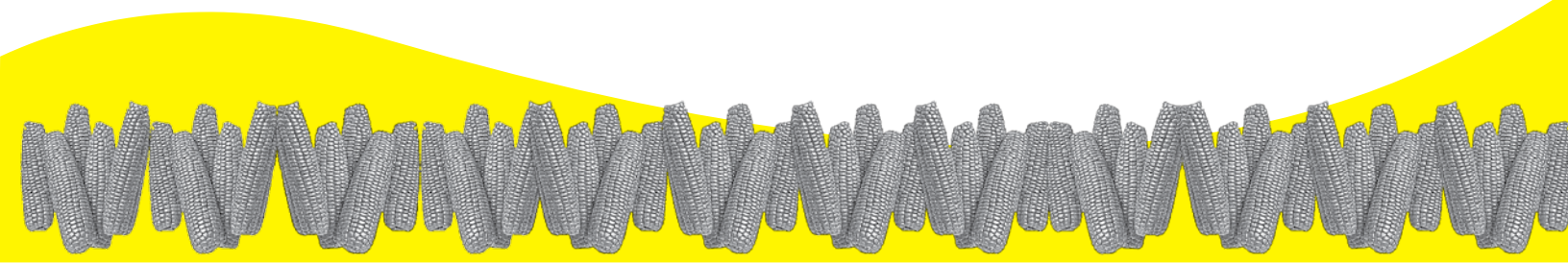


Table 10. Farmers' mode of adoption of biotech corn

Mode of Adoption	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq (n=101)	%	Freq (n=103)	%	Freq (n=105)	%	FREQ (n=309)	%
Full adoption (en toto)	32	32	58	56	55	53	145	47
Partial/Modified adoption of technology	41	41	26	25	32	30	99	32
Did not follow the required procedure	28	27	19	19	18	17	65	21

About one-fourth did not follow the entire recommended practices for growing biotech corn because of two reasons: first, they were not aware of such practices (i.e., prescribed spacing), and (2) they had limited capital for purchasing the inputs such as fertilizers and herbicides.

Some farmers just heard about biotech corn, specifically Bt corn, from their peers or relatives. They have not been exposed to seminars, trainings, or communication materials about the use of the crop. In Pangasinan, this was signified by the fact that farmers called biotech corn as "Betty corn" having heard only about it from the verbal discussions with their peers. As most of the packages of the biotech corn seeds being distributed by the traders had no accompanying manual or guide, the farmers had no other material to refer to concerning biotech corn. They merely relied on information from their co-farmers who, just like them, had very limited exposure to the knowledge and information about the subject. *"Mais na di inuuod"* (corn that cannot be infested by borer) was the common thing known among the farmers about biotech corn.

Another reason for not complying rigorously with the requirements was the lack of sufficient capital especially for labor cost needed in land preparation, fertilizer application, and weeding as well as for the cost of diesel fuel for irrigation pumps. Instead of constant weeding, for example, they will do less and carry out only those that can be afforded by their available farm labor budget.

Benefits from Adoption of Biotech Corn

There were three outstanding reasons given by majority of the farmers for adopting biotech corn: (a) higher income (84%), (b) improved quality of produce (79%), and less labor input (67%) (Table 11). The last two contribute to higher income. This result is consistent with the earlier report on the economic impact of biotech corn in the Philippines (Yorobe and Quicoy, 2006). The higher income was primarily from higher yield since the dramatic losses caused by the insect borer has been averted. The reduction in farm input expenses was noted since no more pesticides were used. Somehow, the quality of corn seeds produced was comparably better than the non-biotech corn. The biotech corn seeds had no dark spots, more consistent size, and cleaner appearance.

Other benefits derived were the lesser risk it poses to theft, as people perceived biotech corn as fit only for animal feed. The better quality of grains produced also commanded higher demand from buyers making biotech corn more saleable. The provision of inputs from traders, which was common in all provinces, was another gain for the farmers. They noted that at least they are assured of the necessary inputs every cropping season, as well as buyers for their harvest during their second season.

On the social side, biotech corn served as a trigger for farmers to discuss more frequently about their

farming experiences. As many did not have formal seminars and trainings on its proper cultivation, farmers tried to fill up the gap by learning from each other's farm experiences. The most common technique was for them to observe an adjacent farm planted with biotech corn and a neighboring farm using non-biotech corn. Then together, they talked about their observations in informal gatherings and come up with decisions and suggestions for improving their current practices. Oftentimes, such discussions and collective learning paved the way for other farmers to shift to biotech corn.

Farmers talk about their information sources on biotech crops

Uptake Pathways of Biotech Corn

Sources of Information on Biotech Corn

Biotech corn farmers obtained their information from interpersonal and mass media sources. Person sources, however, were relied on more than mass media as shown in Table 12. Among the person sources, the most frequently sought were the company seed suppliers and/or traders (44%) and fellow farmers (25%). As reported by the farmers, the seed suppliers usually provide them the necessary seminars and trainings as well as demonstrations pertaining to the cultivation of biotech corn. These activities are actually part of the suppliers' marketing package for the biotech corn seeds.

The company seed suppliers as the prime source of information about biotech corn was consistent for Isabela (63%) and Cagayan (37%). In Pangasinan, this was outdone by fellow farmers (36%).

Table 11. Benefits from adoption of biotech corn

Benefits	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (n=309)	%
Higher income/profit	89	89	83	80	88	84	260	84
Improved product quality	88	88	79	77	77	73	244	79
Less laborious	84	84	90	87	34	32	208	67
Others : - less prone to theft and hazards - environment-friendly - sells easily - less farm inputs - support services available - subject of information exchange among peers								17

** Multiple responses*

Table 12. Sources of information on biotech corn

Source of Information	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (n=309)	%
Person Sources								
Company seed suppliers/ traders	31	31	65	63	39	37	135	44
Fellow farmers	36	36	15	15	25	24	76	25
DA Technicians	5	5	22	21	24	23	51	16
Others (relatives, agric suppliers, brgy officials)	9	9	6	6	7	7	22	7
Mass media								
Flyer/pamphlet	26	26	9	9	18	17	53	17
Others (magazines, radio, TV, posters, packaging labels of seeds and fertilizers)	26	26	6	6	13	12	45	14

** Multiple responses*

Biotech corn adoptors have the habit of freely sharing whatever new things they learn about farming to their peers. They believed that as a small community having the same occupation for subsistence, they should care how each of them could help enhance their quality of life – a shared lifeworld syndrome.

Though to a lesser extent, mass media was also used as sources of information but information from these were more passively received than actively sought. Of these, the free flyers and brochures (17%) given out to them by seed suppliers were most popularly used. Other person sources identified but to a much lesser extent were the DA technicians (16%), relatives (2%), agricultural suppliers (2%), and barangay officials (0.97%).

People with Whom Farmers Shared Knowledge

Most of the biotech corn farmers (66%) shared their information and knowledge about the crop to their fellow farmers and to a lesser extent to their relatives (17%) who were also farmers like themselves (Table 13). This is actually typical in farming communities in the Philippines where strong peer and kinship systems prevail. Having a common stake in their livelihood, or a shared lifeworld, farmers tend to share with one another those knowledge that they think can be of benefit to everyone.

Though only a handful (12%), there were some who kept the knowledge to themselves and did not share it with anybody else. In communication lingo, this is called "information sink." This occurred in instances when they live quite far from the other farmers.

Information Shared to Others

Farming practices and benefits. Information shared to fellow farmers and relatives were related to farming practices (42%) and benefits derived from using biotech corn (32%) (Table 14). The phenomenal increase in the income of biotech corn farmers was a favorite topic as they have never experienced this in their farming before. They also compared notes on the arrangements made with traders on capital provision and the product marketing to ensure that they had mutual benefits.

Lessons learned. Since many of them had no adequate knowledge on biotech corn and its

Table 13. People with whom farmers shared their knowledge

Item	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* n=103	%	Freq* (n=105)	%	FREQ* (n=309)	%
Fellow farmers	94	94	51	49	58	55	203	66
Relatives	19	19	13	12	22	21	54	17
Others (technicians, laborers)	1	1	1	1	2	2	4	2
Nobody	20	20	43	42	30	28	36	12

** Multiple responses*

accompanying cultural practices, they tried to learn from each other on ''what works and what does not." Generally, biotech corn farmers used the cultural practices for conventional corn varieties, except that they no longer spray pesticides for the corn borer.

Some farmers tried to experiment by modifying the spacing from the prescribed 75 cm x 20 cm to 60 cm x 20 cm and reported having higher yield by maximizing the space. Farm-based local "experiments" served as their collective venue for learning and observations from these were shared and discussed with fellow farmers.

Loan procedures. Other information that were talked about, though to a lesser extent, had something to do with loan procedures. Farmers were interested on how they may avail of possible loan, and they solicited this information from their fellow farmers who have experienced such transactions. These information enabled them to compare notes and later choose the lender who would give them better arrangements.

Anecdotes. Of interest, too, were the anecdotes and narratives shared about the beliefs, problems and risks associated with biotech crops. Many of these have been circulating among their peers without the

Table 14. Information shared by farmers to others

Kind of Information	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* n=81	%	Freq* n=60	%	Freq* n=75	%	FREQ* (n=216)	%
Farming practices	32	40	21	35	38	51	91	42
Benefits and advantages of biotech crops	24	30		40	21	28	69	32
Others - loan procedures - problems and risks of biotech crops - observations in the field	9	11	4	7	3	4	16	7
Did not specify	25	31	16	27	22	29	41	19

** Multiple responses*

benefit of proofs or scientific explanations. When summed up, these anecdotes capture the farmers' worries concerning biotech corn's effect on health. Selected items are listed below.

- *Sinisikmura, nakakasira ng tiyan o kinakabagan ang kumakain ng biotech corn. (Biotech corn causes stomach trouble when eaten.)*
- *Makati yong halaman kasi mabalahibo. (The plant causes itchiness because of its hairy stalks and leaves.)*
- *Ang biotech corn ay nakaka-cancer dahil may pinasok ditong kemikal para hindi ito atakihin ng uod. (Biotech corn may cause cancer because chemicals have been incorporated to it so as not to be infested by borer.)*
- *Kapag ipinakain sa kambing ang biotech corn, namamatay ang mga anak nito o kaya ay nawawalan ng balahibo. (If biotech corn is fed to goats, its offsprings die or shed its hair.)*
- *May kemikal ang biotech corn na pwedeng maipasa sa mga tao kapag ito ay kinain. Ito ay nagpapahina ng resistensya ng katawan at nagiging sanhi ng sakit. (Biotech corn contains chemicals. So when eaten by humans, it can lower the body's resistance and may cause illness.)*
- *Inuubo ang mga hayop kapag nakakain ng dahon ng biotech corn. (Leaves of biotech corn when used as feed induces coughing in animals.)*
- *Kinakain ng daga ang halaman ng mais kapag ito ay anim na araw na gulang na. (Six-day old biotech corn plants are usually eaten up by rats.)*
- *Matigas at masama ang lasa ng biotech corn kapag kinain. (biotech corn has hard grains and tastes bad when eaten.)*

Attendance in Seminars and Trainings

Biotech corn farmers were almost equally divided into those who (a) have attended seminars and trainings (49%) and those who (b) have not attended (51%) (Table 15). Majority of farmers (74%) in Isabela attended these activities. This is because Isabela has been one of the sites in the field location trials of biotech corn before the crop was approved for commercialization in 2002.

In Pangasinan and Cagayan, majority (61% and 66%, respectively) have not undergone any training or seminar on biotech crops. Hence, in Pangasinan, farmers would usually talk about "Betty corn" and in Cagayan, they called the crop "yellow corn" even if not all yellow corn are biotech corn. These local labels reflect the farmer's lack of familiarity with the word "Bt corn" as well as biotech corn. If the goal is to enable farmers to decide based on informed choice, they must be exposed to information about biotech crops individually and collectively.

Farmer identified biotech corn as Betty corn

Table 15. Attendance in seminars and trainings on biotech crops

Attendance to Trainings/ Workshops	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq (n=101)	%	Freq (n=103)	%	Freq (n=105)	%	FREQ (n=309)	%
Has not attended	61	60	28	27	69	66	158	51
Has attended	40	40	75	73	36	34	151	49

Organizations that Conducted Seminars and Trainings

The findings show a strong message that adoption and uptake of biotech corn are being carried out to a great extent by private and seed business companies. Trainings, seminars, and workshops on biotech corn were provided by the seed companies (56%) (Table 16). The trend was consistent in the three provinces. These activities were usually conducted as part of the companies' marketing strategy and package for biotech corn seeds.

The seed companies were followed by the municipal governments or LGUs (35%) through their Municipal Agriculture Offices (MAO). Other institutions' presence and participation in this aspect was negligible and a few respondents could not remember who administered such trainings.

This is understandable as biotech corn is heavily a private-driven technology. The biotech corn seeds are their primary products, thus, seed companies need to provide the necessary trainings, workshops, and other non-formal education activities related to adoption of the crop.

As reported, some LGUs were also investing on biotech corn training but not as a priority because of lack of resources. So if adoption of biotech corn would be scaled out, the private seed companies could be tapped as partners with a bigger role to play in a public-private extension scheme.

Contacts who Convinced Farmers to Adopt Biotech Corn

Table 17 indicates that farmers encountered multiple contacts who influenced them to adopt the biotech crop. These included their co-farmers, seed suppliers/traders, relatives, members of cooperatives, DA technicians, and barangay officials in that order. The most influential people in terms of biotech corn adoption were their co-farmers (35%), the seed suppliers/traders (31%), and relatives (14%).

Understandably, co-farmers or peers have strong influence on biotech corn adoption. Being in the same trade and socio-economic circle, they have learned to trust and care for each other's interest and welfare. Approximating a second family, their peer system in a way creates a "shared lifeworld" where their goals, interests, and ways of accomplishing things become unified and fulfilled. So, a decision of one usually becomes the decision of the rest of the group.

Table 16. Organizations that conducted seminars and trainings on biotech corn

Group Organization	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq (n=40)	%	Freq (n=75)	%	Freq (n=36)	%	FREQ (n=151)	%
Seed companies	27	67	37	49	19	53	83	56
Municipal governments	8	20	28	37	17	47	53	35
Others (Cooperatives, ISAAA, academe)	4	10	1	2	0	0	3	2
Can't remember	1	3	9	12	0	0	10	7

Table 17. Contacts who convinced farmers to adopt biotech corn

Contact	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (309)	%
Fellow farmers	51	51	20	19	37	35	108	35
Seed suppliers and/or traders	24	24	40	39	32	31	96	31
Relatives	13	13	12	11	17	16.	42	14
DA technicians	2	2	12	11	19	18	33	11
Cooperatives	9	9	0	0	0	0	9	3
Barangay officials	0	0	5	5	2	2	7	2
No contact/ Own decision	6	6	2	2	5	5	13	4

** Multiple responses*

The seed suppliers merely sell the seeds needed for planting. The traders, on the other hand, are significant in the farmers' lives because they are the ones who provide the needed starters and capital for biotech corn planting. In most instances, the seed suppliers also act as traders. As part of the deal, they also take care of buying the farmers' produce. Hence, they have a lot to say and do with the farmers' agricultural performance.

Similarly, relatives were among those who could convince the respondents to adopt biotech corn. Farmers trust and place high value to their suggestions and recommendations as a typical part of the kinship system among Filipinos.

Per province, co-farmers topped the list in Pangasinan and Cagayan as influentials in adoption while traders stood out in Isabela. Those with the least influence were the cooperatives (3%) and barangay officials (2%). While DA technicians or extension workers came out in the picture, their influence was low as noted by only 11% of the respondents. Seldom did the farmers make a decision to adopt biotech corn on their own without outside influence (4%).

These findings imply that for adoption and diffusion of biotech crops to a wider number of farmers, those who would play a significant role are their fellow farmers and relatives.

Traders, on the other hand, provide the necessary inputs to the farmers, who then sell their produce to these traders. This mutual partnership, despite being asymmetrical in terms of power, ensures that whatever the traders (the provider) would provide in terms of seeds, fertilizers, and information would most likely be received or accepted by the farmers (the recipients). Farmers trust the traders because, logically, the traders cannot afford to let the farmers lose because that loss will also redound to them. As such, the typical farming extension and outreach system for biotech crops should include the traders in the big picture because they are among the frequent and influential contacts of farmers. Locating and identifying them should perhaps be the first move as they are oftentimes left unknown and unnoticed in the agricultural extension system.

Support Services for Biotech Corn Cultivation

Majority of the respondents (68%) got no support or assistance in their adoption of biotech corn (Table 18). A few were able to get farm inputs (17%) and financial or loan assistance (11%), respectively. Very negligible was assistance received in the form of farming information, advice, equipment, and field demonstration.

Table 18. Support services for biotech corn cultivation

Support Service	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* n=309	%
Farm inputs	12	12	12	12	30	29	54	17
Financial assistance/loan	22	22	9	9	3	2	34	11
Information on farming practices	5	5	8	8	2	2	15	5
Others (machinery, equipment, advice, field demo)	3	3	4	4	0	0	7	2
None	68	67	70	68	71	68	209	68

** Multiple responses*

This means that biotech corn farmers are a neglected lot when it comes to provision of support services, especially from the government's end. Thus, substantial assistance, such as those given to rice farmers, must be extended to them to enhance their efforts to scale out the use of biotech corn and contribute to poverty reduction and food security.

People/Groups/Institutions Providing Support Services

The few support services and assistance extended to the biotech corn farmers were being provided primarily by the LGU or the municipal governments (15%) (Table 19). Contributing also to the effort but to a much lesser extent were the cooperatives (8%), seed suppliers/traders (8%), barangay councils (2%), and relatives (1%). Taken collectively, their current level of support is still not substantial enough to meet the needs of the biotech corn users.

Table 19. People/groups/institutions providing support services

Group/ Individual	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=33)	%	Freq* (n=32)	%	Freq* (n =34)	%	FREQ* n=99	%
Municipal governments	3	3	16	15	26	25	45	15
Cooperatives	24	24	0	0	0	0	24	8
Seed suppliers/Traders	4	4	13	13	7	7	24	8
Barangay councils	1	1	2	2	2	2	5	2
Relatives	1	1	1	1	0	0	2	1

** Multiple responses*

Support Services Needed by Biotech Corn Farmers

Support services needed by the respondents may be summed up into two major items: farm inputs and capital (both 38%) (Table 20). Since planting of biotech corn is a costly venture compared to planting of conventional varieties, then the affected corn farmers will certainly be highly concerned about the needed capital.

Other services needed also included equipment and facilities (i.e., irrigation, sheller, dryer, transport, etc.) to enable them to gain maximum benefits. Irrigation, for instance, was critical for the growth of the crops. They wished that the government would provide them this facility as it eats up a lot of their resources (i.e., money for diesel, time for supervising water supply, energy for labor).

Information on farming especially on cultivation of biotech corn was another concern because many of them did not have the chance to attend seminars and trainings. As a farmer noted *"Ang pamamaraan ng aking pagtatanim ay ayon sa bali-balita lamang. Walang paliwanag mula sa nagbenta ng seeds."* (What I follow in planting biotech corn is practically based on hearsay. The seed supplier did not give us any information on how to use the seeds.)

Problems Encountered with Biotech Corn

Majority of the respondents (54%) did not specify any problem related to planting biotech corn. Only a few (at most 13%) noted some concerns (Table 21). These have something to do with biotech corn being perceived as hazardous to human health and the environment and the higher capital required when farmers venture into it.

Despite being adoptors of biotech corn variety, still few farmers, especially from Pangasinan and Cagayan, thought that biotech corn was not fit for human consumption. These farmers also thought that biotech corn can cause certain illnesses and abnormalities. They were usually hearsays and anecdotal stories from their fellow farmers. However, these stories have never been fully documented and proven by scientific studies.

The issue on higher capital requirement was common among the three provinces. This actually pertains to the fact that the price of biotech corn seeds (Php3,500 – Php3,900 per 8 kg bag) is almost three to four times that of the conventional variety (Php2,500 per 20 kg bag). This is a fact that could not be changed. Nonetheless, many other farmer-adoptors viewed

Table 20. Support services needed by biotech corn farmers

Support Service	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (n=309)	%
Farm inputs	25	25	37	36	55	52	117	38
Capital	55	55	33	32	28	27	116	37
Equipment and facilities	24	24	13	13	10	10	47	15
Information on farming practices	2	2	24	23	14	13	40	13
Price regulation	4	4	15	15	6	6	25	8
Water supply	5	5	7	7	1	1	13	4
Others (field demo, soil testing, insurance, quality assurance)	2	2	2	2	2	2	6	2

** Multiple responses*

Table 21. Problems encountered with biotech corn

Problem Encountered	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (n=309)	%
Hazardous to health	20	20	0	0	21	20	41	13
More capital requirement	8	8	16	15	16	15	40	13
Poor product quality	9	9	7	7	10	9	26	8
More laborious	2	2	1	1	20	19	23	7
Hazardous to the environment	3	3	14	13	6	6	23	7
Infected by pests	2	2	3	3	13	12	18	6
Others (inadequate irrigation, loss of traditional varieties in the long run, no standard selling price, takes longer time to grow, more expensive seeds, lack of seed supply)	9	9	5	5	9	8	23	7
None	47	47	73	71	48	46	168	54

** Multiple responses*

the additional cost for seeds as something that they could easily recover from the higher yield that they would get from using biotech corn. So on the whole, the benefits still outweigh the farmers' concern about higher capital.

Responses on poor product quality and insect pest infestation were also reported. This could be attributed to having farmer-respondents who could not distinguish between biotech corn and other "yellow corn" varieties during planting, as in the case of some respondents from Cagayan. This inability to recognize biotech corn from non-biotech corn is a difficulty that needs to be addressed so that farmers will be able to acquire and plant only quality biotech seeds.

Other minor problems reported about biotech corn include inadequate irrigation, loss of traditional varieties in the long run, no standard selling price, longer time to grow, more expensive seeds, and lack of seed supply.

Desire to Continue Planting Biotech Crops

The respondents were asked directly if they would continue using biotech corn and/or other biotech crops such as biotech eggplant and biotech cotton in the future. This was done to explore future production and markets of biotech crops.

There was an overwhelming response (90%) to continue using biotech corn and other biotech crops in the future (Table 22). And the desire was consistently high in the three provinces. Nonetheless, a few (8%) made a clarification that it depends on the situation. That is, if the government will ban its use, then they will follow. They look up to the government as the ultimate policy- and decision-maker, hence, whatever it considers good for the citizenry, they feel obliged to follow.

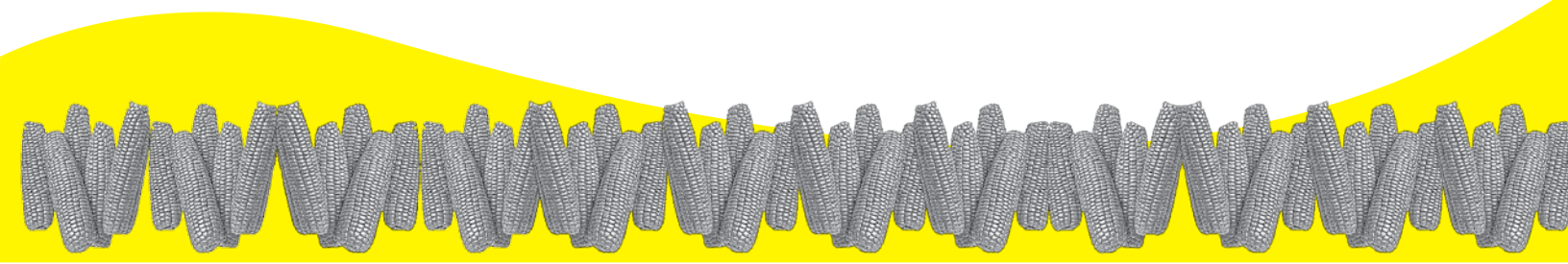


Table 22. Respondents' desire to continue planting biotech crops

Desire to Continue	Pangasinan		Isabela		Cagayan		TOTAL	
	Freq* (n=101)	%	Freq* (n=103)	%	Freq* (n=105)	%	FREQ* (n=309)	%
Will continue	94	94	93	90	90	86	277	90
Will not continue	2	2	3	3	1	1	6	2
Depends on situation	5	4	7	7	14	13	26	8

Uptake Pathways and Changes in Farmers' Lives: Results of the Innovation Tree Exercise

Uptake Pathways

The Innovation Tree is a method that helps visualize and analyze the way in which an innovation like biotech corn spreads over time between and among community members. Using an FGD, it is a useful technique for probing the different factors that influence the adoption, diffusion, and modification of an innovation.

The number of Innovation Tree exercises varied per province: four in Pangasinan, two in Isabela, and three in Cagayan. Isabela has the least because during the study, the farmers were busy irrigating their corn farms. They could only answer questions in the survey and could not anymore give the researchers another 1-2 hours for the exercise as this would mean loss of substantial amount of time critical for irrigating their farms. Farmers used pumps run by diesel to provide irrigation to their corn farms, hence, it has to be supervised.

The results of the Innovation Tree exercise are summarized using flowcharts. Arrows used in the figures were coded as follows:

- Thick black arrows represent the flow of information between and among participants in the FGD using Innovation Tree exercise.
- Thin black arrows represent the flow of information from FGD participants to other farmers not present in the exercise but whom the participants convinced to adopt Bt corn.

Actors or players in the Innovation Tree were also color-coded:

- Black for FGD farmer-participants
- Red for seed companies and their technicians
- Blue for ambassador of seed companies
- Green for individuals not present in the FGD but who influenced the farmer to adopt biotech corn
- Gray for individuals not present in the FGD but whom the farmers convinced to adopt biotech corn

Pangasinan

a. Brgy. Caaringayan, Laoac, Pangasinan

Figure 2 shows the biotech corn adoption and uptake pathway of 12 farmers who participated in the Innovation Tree exercise in this area. As depicted, it was the seed company technicians or seed suppliers of Monsanto and Pioneer in separate occasions who directly influenced more than half (7 out of 12) of the farmers to plant biotech corn. Influence to adopt also came later from traders of buying stations and farmers of adjacent farms.

The uptake pathway started through a field demonstration in one of the farms in 2002.

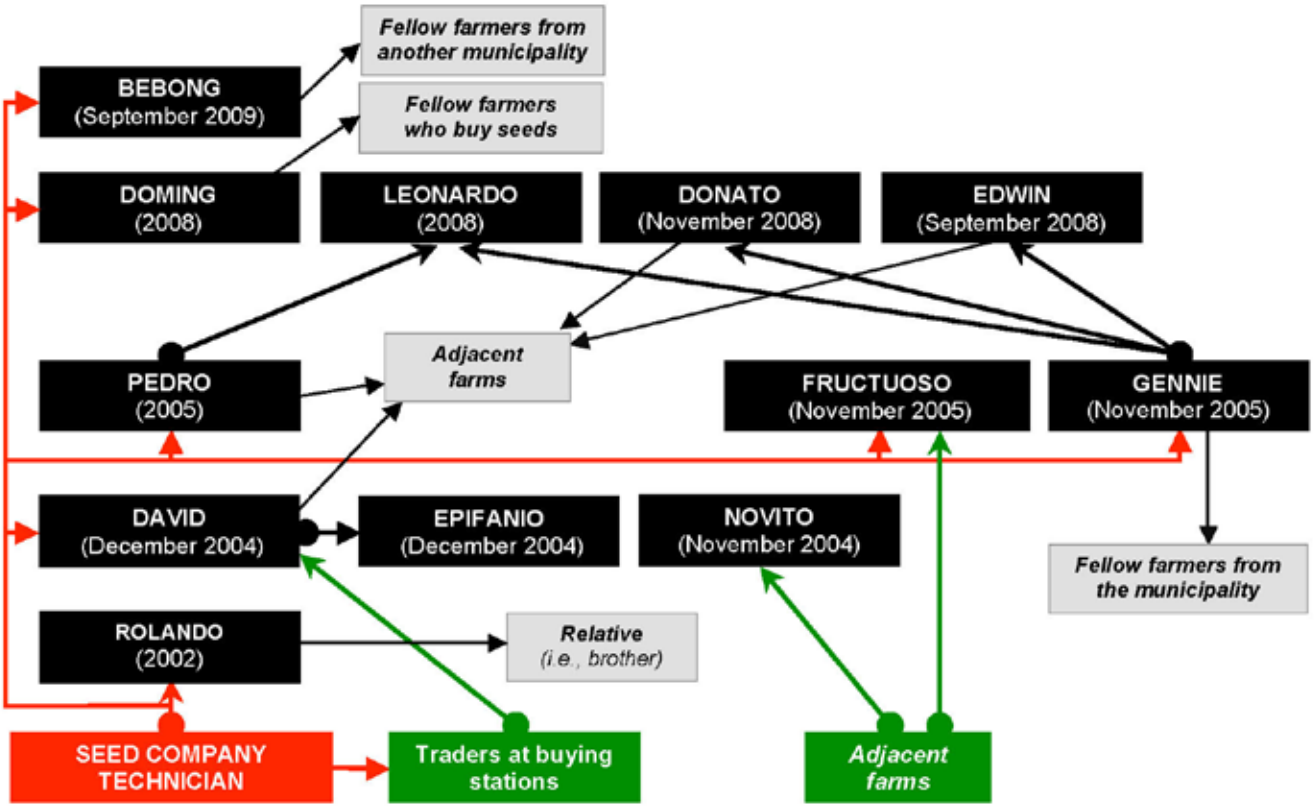


Figure 2. Uptake pathway of biotech corn among farmers in Brgy. Caaringayan, Laoac, Pangasinan

Several meetings were held by the technicians of seed companies explaining the characteristics and advantages of biotech corn. Out of this exposure, farmers started adopting biotech corn but at various times.

The first generation of biotech corn adoptors is represented by Rolando. It was the earliest adoption as it occurred in 2002, the same year biotech corn was approved for commercialization. Then it took another two years (2004) for David; three years (2005) for Pedro; six years (2008) for Doming; and seven years (2009) for Bebong, the fifth generation of adoptor. The most number of participants belonged to the fourth generation of adoptors (2008). Hence, it could be said that biotech corn farmers in this area adopted the technology within a span of eight years.

Though farmers were convinced that biotech corn performed better than their conventional varieties in terms of yield and profit, it took some of them several years before they finally adopted because of lack of capital. Biotech corn seeds cost about Php3,500 - Php3,900 per bag (about 8 kg) as against the Php2,500 per bag (20 kg) of the conventional variety. This means that farmers would need about 2.5 bags of biotech corn seeds that would cost Php8,750 - Php9,750 per 8 kg bag. This cost is three to four times higher than that of the conventional varieties.

The latest adoptor, Bebong, was an owner of a buying station who learned about biotech corn from company seed technicians while he was in Mindanao. But he started biotech corn only when he migrated to Pangasinan. As a buyer of corn seeds, he tried to convince the farmers from other towns to cultivate biotech corn. Understandably, he had a big stake in the corn business as a buyer. Thus, buyers should be considered important actors in the dissemination and diffusion process of biotech corn.

Aside from the technicians of seed companies and trader-buyers, fellow farmers or peers also influenced other farmers to shift from conventional corn varieties to biotech corn. This pattern was evident in all generations of biotech corn adoptors in this part of Pangasinan.

As to dissemination flow, adoptors shared the technology to fellow farmers who were either relatives or friends and to those who purchased their (farmers') corn seeds. The most immediate ones to whom they shared biotech corn were those in their adjacent and neighboring farms. This spatial factor was important in the uptake pathway because farmers could readily compare the performance of biotech corn right in their respective farms. This reinforces the earlier assumption in the technology adoption process that farmers tend to believe what they see. Hence, field demonstrations and trials may be considered important strategies for biotech corn uptake among farmers.

b. Brgy. Luyan, Mapandan, Pangasinan

The uptake pathway among 13 farmers in Mapandan, Pangasinan depicts another pattern (Figure 3). Here, the most influential actor who initiated the uptake pathway was an outstanding biotech corn farmer herself, Rosalie Ellasus. She was considered an 'ambassador' in her area. An ambassador, as referred to by farmers, is a "local person who serves as the farmers' primary link with the seed companies." S/he persuades farmers to adopt biotech corn, informs them of the characteristics and advantages of biotech corn, sells biotech corn seeds, buys farmers' produce, and supplies other farm inputs.

Rosalie represents the first generation of biotech corn adoptors who immediately planted the crop in 2002. But farmers in her area first learned about biotech corn in 2005 through the San Jacinto Kasakalikasan

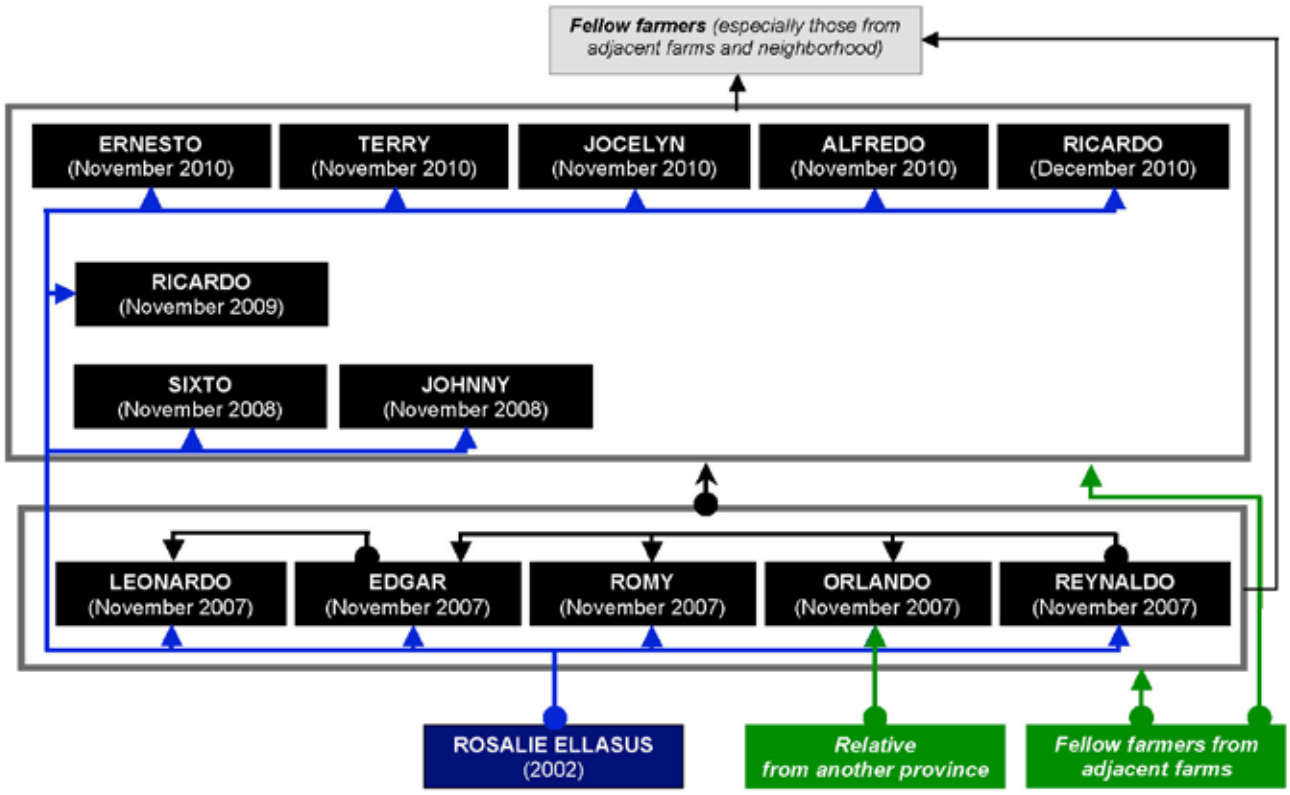


Figure 3. Uptake pathway of biotech corn among farmers in Brgy. Luyan, Mapandan, Pangasinan

Multi-purpose Cooperative, which she chaired. However, it took two years (2007) before these second generation of farmers ventured into it. The main reasons cited were the lack of information on biotechnology crops and reluctance of farmers in the barangay to adopt it for fear of incurring losses. This suggests the importance of information and knowledge about the technology before farmers would adopt it.

According to the 2008, 2009, and 2010 adoptors, those who influenced them to use biotech corn in their farms included Rosalie, the 2007 early adoptors, and other farmers who had adjacent farms planted to the crop. While many other farmers also wanted to try biotech corn, lack of sufficient water supply and irrigation prevented them from doing so. Reynaldo, one of the second generation adoptors, attested that he tried to persuade many farmers as early as 2007 to shift to biotech corn. But they were only able to do it a few years later when the water supply issue was addressed by an irrigation system.

Aside from Rosalie, it took also relatives and fellow farmers from adjacent farms to convince two of the five second generation biotech corn adoptors. This implies that kinship and the peer systems are indeed significant factors in pushing the uptake of biotech corn. From then on, there were succeeding generations of adoptors each year influenced by the early adoptors in 2007. As in other areas, information flowed to their fellow farmers in the neighboring farms.

The participants in the exercise were one in saying that they usually tend to replicate successful farming practices, including the adoption of modern varieties and biotech crops. Hence, by the end of 2010, almost all corn farmers in the barangay had already abandoned the conventional varieties, which are prone to corn borer attacks, and had totally switched to biotech corn.

Knowledge and information sharing between and among farmers focused on sources of seeds, yield potentials, and resistance to pests, among others. They engaged in discussions about these matters during house and farm visits to their fellow farmers, informal conversations, and drinking sessions.

c. San Jacinto, Pangasinan

A peculiarity of the area is that this is the hometown of Rosalie Ellasus, an outstanding biotech corn farmer and chairman of the San Jacinto Kasakalikasan Multipurpose Cooperative. Rosalie is also a two-term councilor of the municipality. Fourteen participants in the Innovation Tree exercise were members of the cooperative.

As can be gleaned from Figure 4, Rosalie was the earliest biotech corn adoptor in 2002 and the most influential in the uptake pathway for this group. As chair of the cooperative, she was able to convince many farmer-members of the cooperative to plant biotech corn. Hence, immediately in the succeeding year, many second generation farmers followed suit. These adoptors also immediately shared the technology to their friends, relatives, and neighbors such that during the planting season in November of the following year, farmers were already planting biotech corn instead of the conventional variety. From 2002, uptake of biotech corn occurred every year until 2006 with some apparent gap in 2007 to 2009.

Kinship again was an important factor. For example, Leonardo became a biotech corn farmer in 2003. He then convinced his father and two brothers (Francisco and Nick) to follow suit. Another farmer, Johny, was in the same biotech corn seminar attended by Leonardo and organized by Rosalie in 2002. He started planting biotech corn four years after (2006) because he had second thoughts about it earlier.

In the uptake pathway, it was evident that relatives and fellow farmers especially in adjacent farms, served either as conduits for favorably influencing adoption or as recipients of information or knowledge shared. Uptake pathway, in fact, revolved around relatives and friends acting as sources or receivers of information on biotech corn.

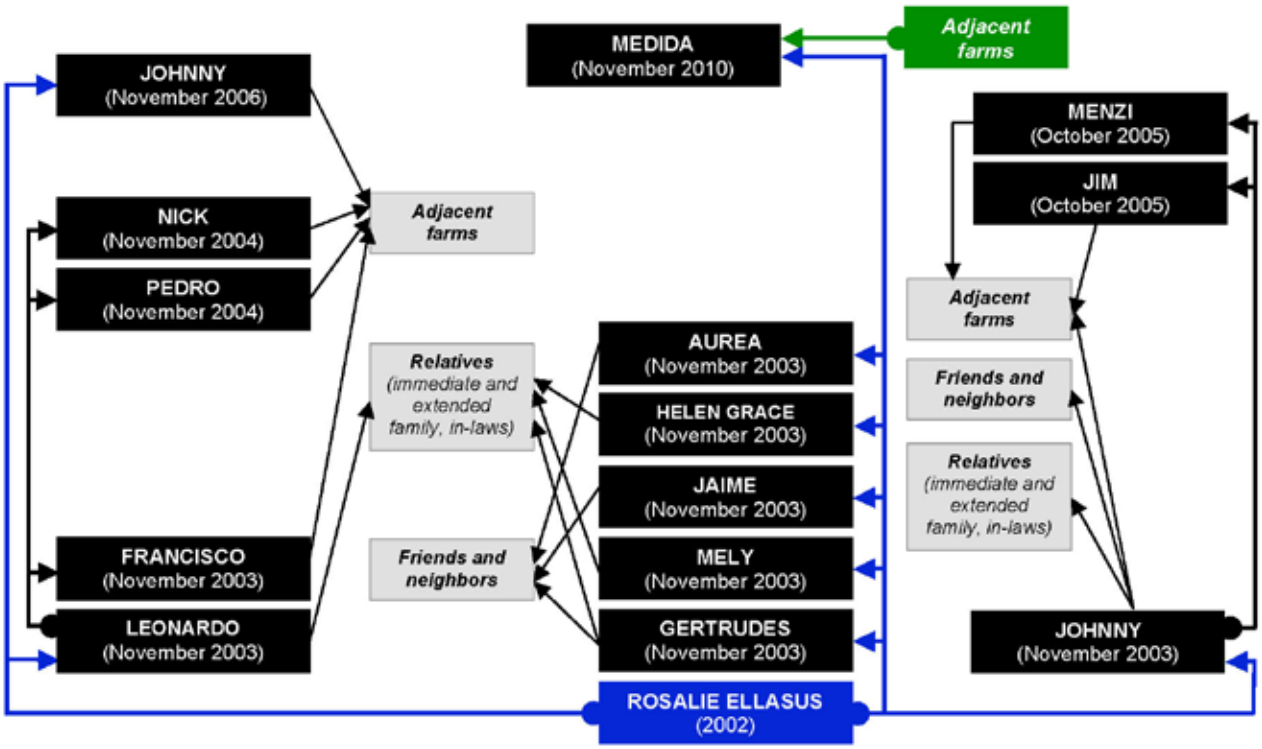


Figure 4. Uptake pathway of biotech corn among farmers in San Jacinto, Pangasinan

d. Brgy. Dumayat, Binalonan, Pangasinan

Another configuration of uptake pathway among 13 farmers is shown in Figure 5. In the case of Binalonan, the biotech corn adoptors used the technology rather late. The first generation of adoptors did so only in 2007, five years after the commercialization of the crop. The uptake pathway was initiated by the seed company technicians of Monsanto and Pioneer.

According to Juanito, he started conversations with the technicians of Pioneer, a multinational seed company in the Philippines, who frequently visited their barangays in 2007 to convince farmers to plant biotech corn. Together with two other farmers, Irineo and Edwin, they tried out biotech corn in November, two months after their initial contact with the seed technicians. Edwin also attended a seminar by Monsanto on biotech corn.

This first try gave the first generation of adoptors good results such that other farmers in adjacent farmers also shifted to biotech corn in the next planting season.

The second generation of adoptors in 2008, such as Jomar and Bong, were influenced mostly by their fathers. Daniel, for example, was a 2009 adoptor who had known about biotech corn even before 2007. But he preferred using the conventional varieties until it became apparent that his son and fellow farmers, some of whom he influenced to adopt biotech corn earlier, were enjoying higher incomes. Similarly, Edgardo was a retired master sergeant who planted biotech corn in 2010 upon seeing that the farmers in his barangay using this variety were earning higher incomes.

The Binalonan farmers were one in saying that information on biotech corn often spread through informal conversations (i.e., during drinking sessions, *sabi-sabi* or hearsays) as well as direct observation of adjacent farms planted to biotech corn.

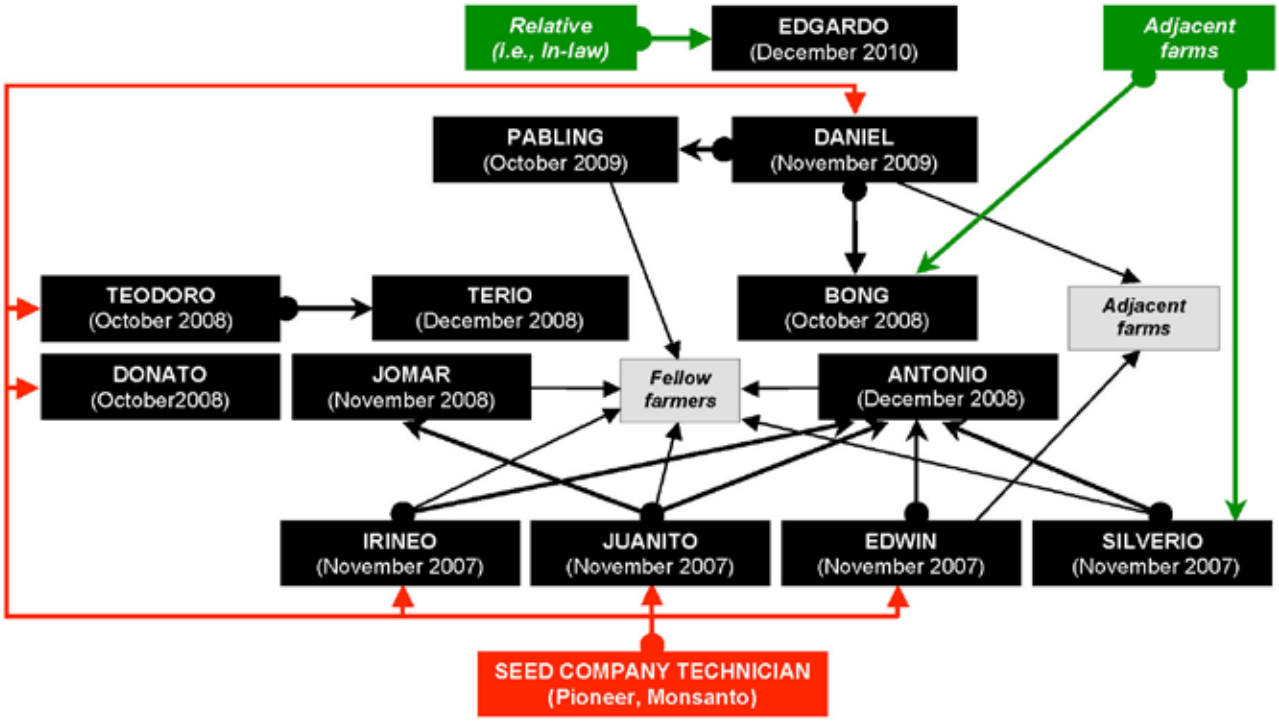


Figure 5. Uptake pathway of biotech corn among farmers in Brgy. Dumayat, Binalonan, Pangasinan

Isabela

a. Brgy. Yeban Sur, Benito Soliven, Isabela

Quite different from their Pangasinan counterparts, farmers who participated in the Innovation Tree exercise in Benito Soliven, Isabela reported adopting biotech corn as early as 2000 when it was being field tested in the area.

Lydia, a female farmer, learned about the technology in 1999 from a seed technician of Monsanto (Figure 6). She was made "ambassador" of Monsanto in their barangay. Since then, she has been introducing the technology to other farmers. In fact, all nine participants in the Innovation Tree exercise have heard about biotech corn from Lydia.

Farmers in the area were all early adoptors, having been engaged in the technology as early as 2000 as participants in the biotech corn field trials and even before biotech corn was approved for commercialization in 2002. They were readily convinced of the merits of the technology in terms of ease of planting, better grain quality, and the generation of higher income.

Despite the presence of very early adoptors, there were also farmers in the group who adopted quite late in 2007 and 2010. They were reluctant to plant biotech corn at first and would rather adhere to the "wait-and-see" attitude. They wanted to ensure that their capital would not go to waste because it was indeed a lot more than that for the conventional corn variety they used.

Others said that since everybody else in the community was using biotech corn, they had no other choice but to follow suit. Otherwise, their farms could be swarmed with corn borers as adjacent farms would no longer be infested by this pest.

Also, they noted that conventional corn varieties are now hardly available in the market, having been replaced already by biotech corn varieties.

As usual, knowledge about biotech corn were shared mostly to their farmer-relatives.

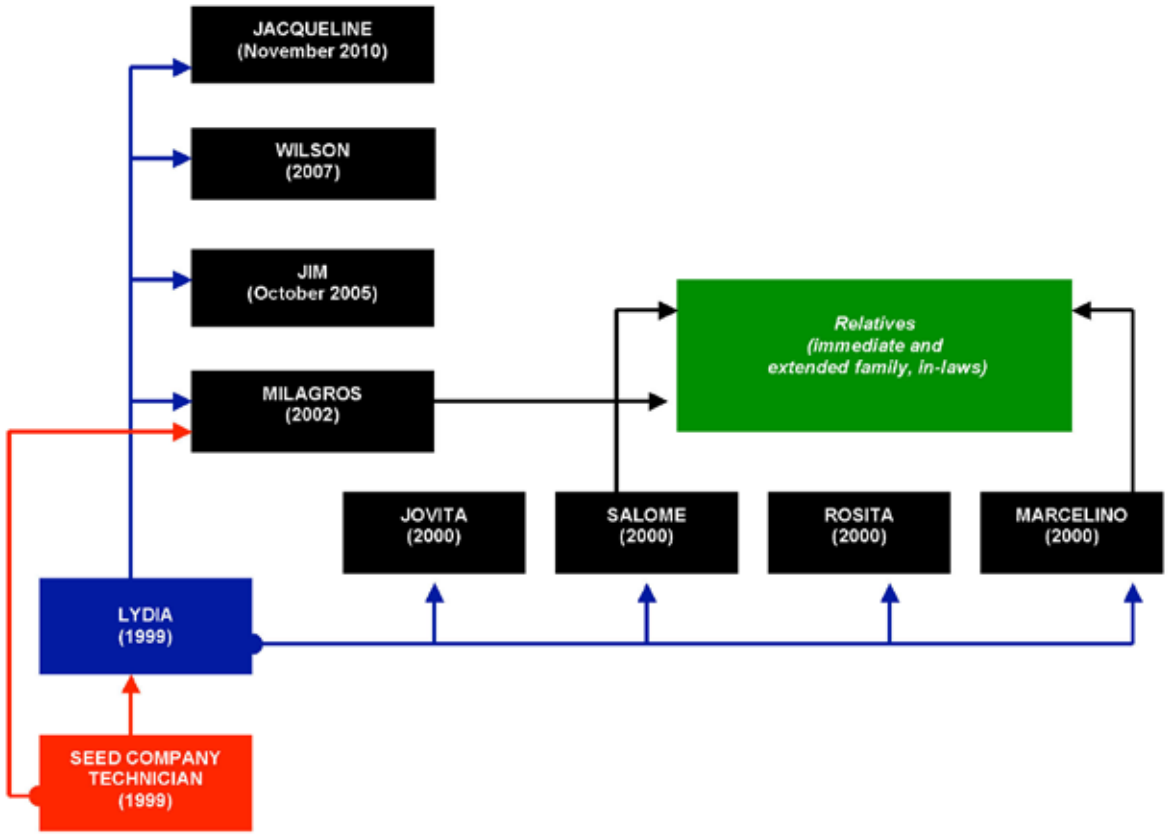


Figure 6. Uptake pathway of biotech corn among farmers in Brgy. Yeban Sur, Benito Soliven, Isabela

b. Brgy. Surcoc, Naguilan, Isabela

Biotech corn was introduced in the area in 2004 through a farmers class conducted by a technician from Monsanto, a seed company (Figure 7). The early adoptors were women participants in that class. They were persuaded that the biotech corn variety was resistant to pests and would, therefore, assure them better yield and income.

Marisa, for example, was a participant in that class and one of the early adoptors. At first, she was undecided to adopt the biotech crop. But since her mother-in-law, Elisa, was planting biotech corn, she gained the courage to try it also. Both became successful in their first try. This encouraged their co-farmer, Jenny, to try it out also.

The cooperative, where most of the farmer-participants were members, also reinforced the call for farmers to shift to biotech corn. This was because it provides small loan to the farmers and also buys their corn. With biotech corn, the cooperative is better assured of farmers' repayment and better quality corn grains as well.

Another farmer, Rodolfo, also attended the seminar. But he was not able to apply the technology at once because he stayed in Nueva Ecija for a while. But upon coming back to Isabela in 2008, he planted biotech corn. At that time also, most farmers in the community were already planting biotech corn.

Other farmers in the flow chart, especially those who adopted later, were convinced by relatives, friends, and neighbors. The latter shared their testimonies about better quality of grains and higher yield because of the non-infestation of borers. That's why the biotech corn variety has become popular in the area as *"mais na di inuuod"* (corn that is not infested by borer).

But the uptake pathway would not be complete without the presence of traders who provided the needed capital for the new venture. They gave the farmers the enabling support to adopt biotech corn. Even if the farmers were so convinced of the advantages of biotech corn, they needed capital to realize their intention to actually plant it.

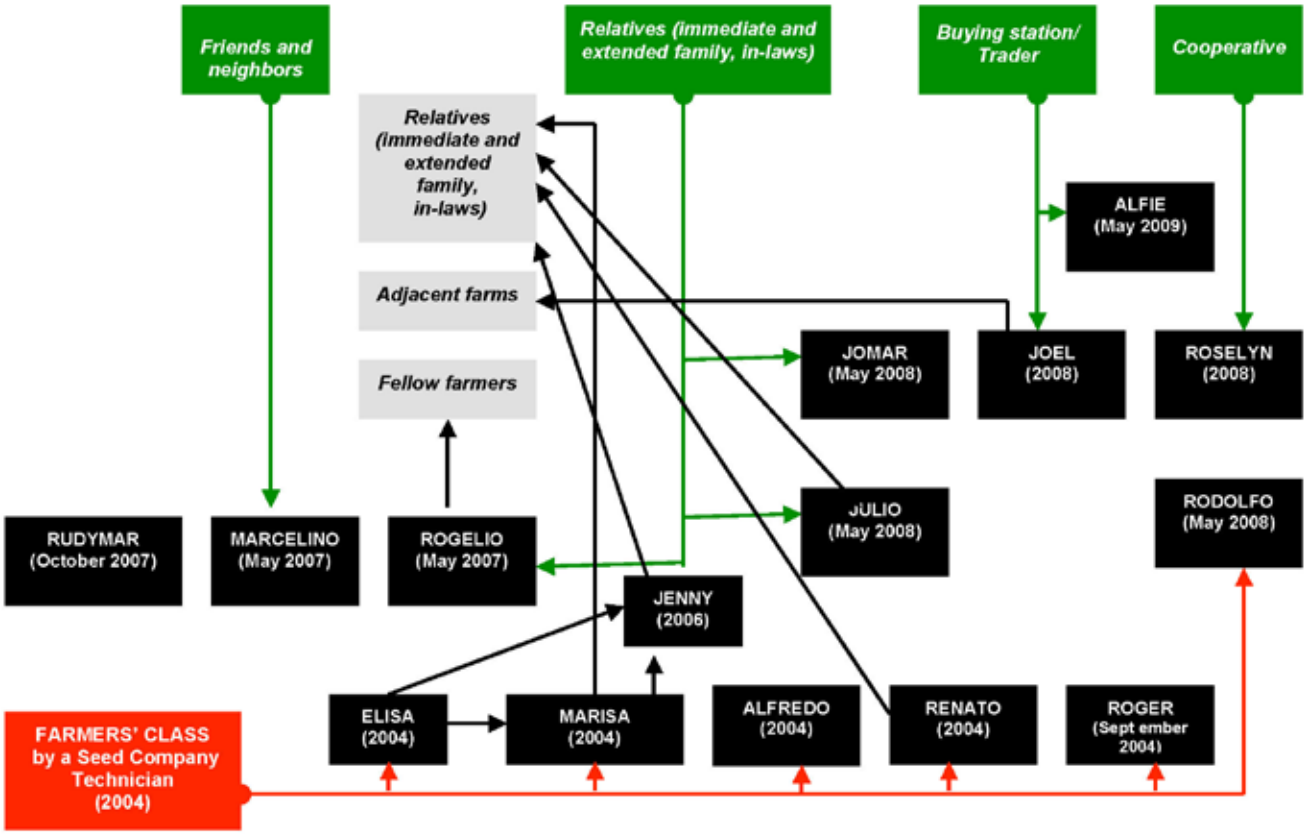


Figure 7. Uptake pathway of biotech corn among farmers in Brgy. Surcoc, Naguilan, Isabela

The farmers would later pass on their knowledge, observations, and experiences to their siblings, parents, in-laws, and co-farmers in adjacent farms. Rogelio, a farmer who was also a barangay official, felt that it was his obligation to help his community members progress, thus, he shared his success with biotech corn to the farming groups in the community.

Cagayan

a. Brgy. Bauan West, Solana, Cagayan

Ten biotech corn farmers participated in the activity. They represent six generations of adoptors. The earliest adoptors (Arnold and Maria) began planting biotech corn in 2002, while the latest adoptor (Peter) began planting only in 2011. It took three years before the succeeding generations of adoptors followed suit. All farmers said that they bought their seeds from Pioneer Hi-Bred.

The uptake pathway in this area was started, not by the technicians of seed companies, but by the Regional Field Unit of the DA. Figure 8 shows that Arnold and Maria were the earliest adoptors in the area. Arnold first learned about biotech crops during the seminar for farmers conducted by the DA in Tuguegarao, Cagayan. During this seminar, he came to know that biotech corn would give him high yield and income, and less production cost. Indeed, after his first harvest, the promise came true. So he informed and convinced his cousin (also a corn grower) to plant biotech corn.

Maria, on the other hand, did not know anything about biotech corn. However, she was one of the earliest adoptors because all her farmer-friends who were early adoptors convinced her to buy biotech corn seeds from the traders.

The late adoptors of biotech corn started to plant after they have seen the increase in income of the farmers in adjacent farms and those of their

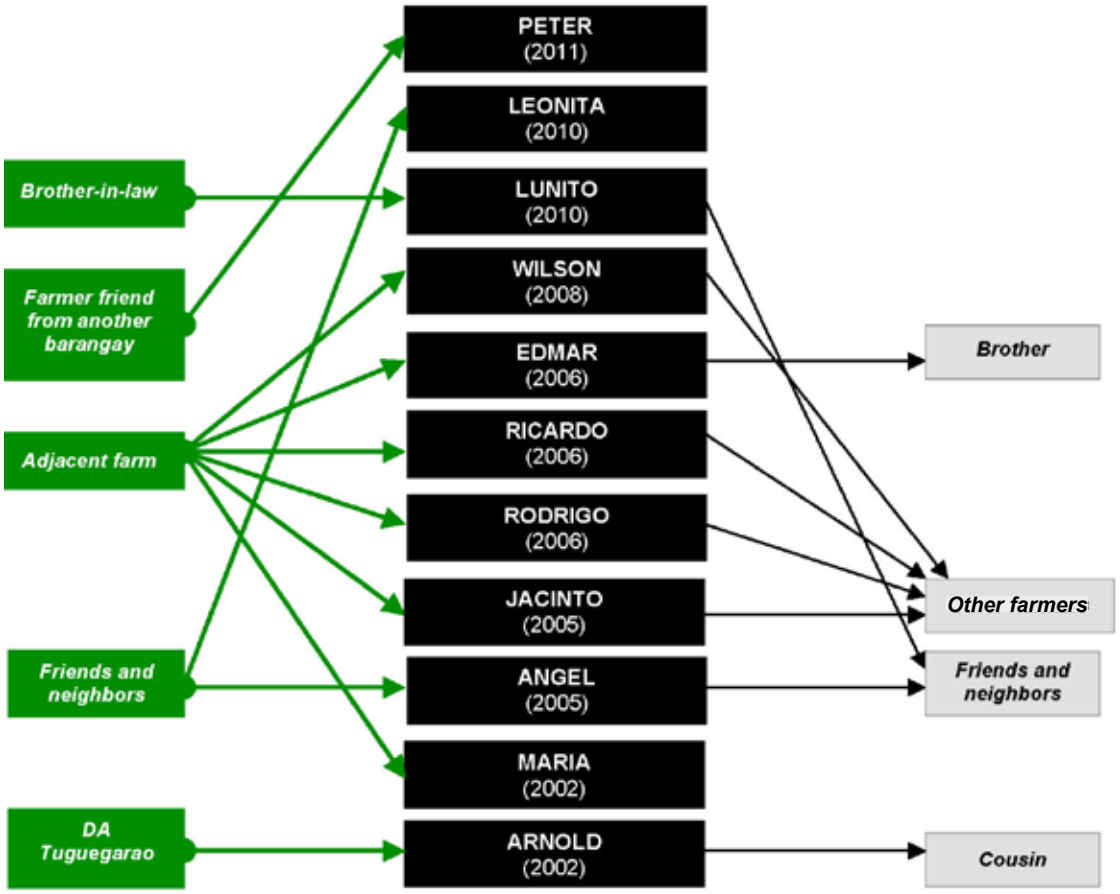


Figure 8. Uptake pathway of biotech corn among farmers in Brgy. Bauan West, Solana, Cagayan

friends, neighbors, and relatives. Most of them have attended seminars conducted by technicians of seed companies such as Pioneer Hi-bred, but they had second thoughts in planting biotech corn. They were reluctant to plant because they were afraid of incurring yield losses. However, after experiencing the increase in yield and income in their first harvest, they passed on the knowledge regarding biotech corn to their friends, neighbors, relatives, and co-farmers.

Peter was one of the late adoptors. He was convinced by a farmer-friend from another barangay to plant biotech corn because it offers many benefits such as resistance to pest, improved quality of produce, and higher income. He said that most of the corn growers in their barangay were already planting biotech corn so there was no need for him to convince them. In general, farmers tend to replicate successful farming practices of their fellow farmers. By the end of 2010, almost all the farmers in their barangay were already biotech corn converts.

b. Brgy. Iraga, Solana, Cagayan

Figure 9 shows six generations of biotech corn adoptors, that spans a period of eight years, from 2002 to 2009. The earliest adoptors of biotech corn for this group of farmers was Mary, followed by Tony. Both of them were convinced by the seed supplier in Tuguegarao, Cagayan. Mary adopted the technology in 2002. At that time, biotech corn seeds were the only available seeds sold by the supplier, so they had no other choice. She convinced her farmer friends and neighbors, including Tony, to plant biotech corn.

Tony adopted the technology in 2005, three years after Mary. He had second thoughts at first, and he wanted to make sure that biotech corn would indeed give him more profit. Upon seeing the results in his very first harvest, Tony, together with Mary, convinced the other farmers in their barangay to plant biotech corn.

All participants in the Innovation Tree activity emphasized that technicians from the seed companies such as Monsanto and Pioneer Hi-bred regularly conduct meetings since 2002 to update the farmers on new seed varieties, new technologies, and techniques in planting and harvesting. However, the late adoptors only began planting biotech corn in 2006 to 2009. They were convinced by Mary, Tony, and other co-farmers to adopt the technology. They shared to their fellow farmers that biotech corn is resistant to corn pests, thus, reducing their expenses in pesticide application. This means less production cost and higher income.

The late adoptors (2006 to 2009) were reluctant in planting biotech corn at first because it was "something new" to them. They wanted to observe first the experiences of the early adoptors in the nearby farms. They did not immediately adopt because biotech corn seeds were quite expensive when it was first introduced to them. Most of their capital was loaned from the traders or seed suppliers. Like Tony, these late adoptors wanted to make sure that biotech corn would give them higher income and not pose any danger to their health. Informal meetings served as the primary venue in the community where farmers shared knowledge on biotech corn to others.

c. Brgy. San Vicente, Iguig, Cagayan

There were 11 participants in this exercise from this barangay. As depicted in Figure 10, there were also six generations of biotech corn adoptors. The earliest ones were Vilma and Nelson who started planting right away in 2002. The uptake pathway was started by the traders who convinced Vilma and Nelson to plant biotech corn. These traders were also corn growers and served as the primary sources of capital for other farmers in the community. The farmers usually loan their capital, buy their seeds from, and sell their harvest to these traders. This implies that somehow they have already established some form

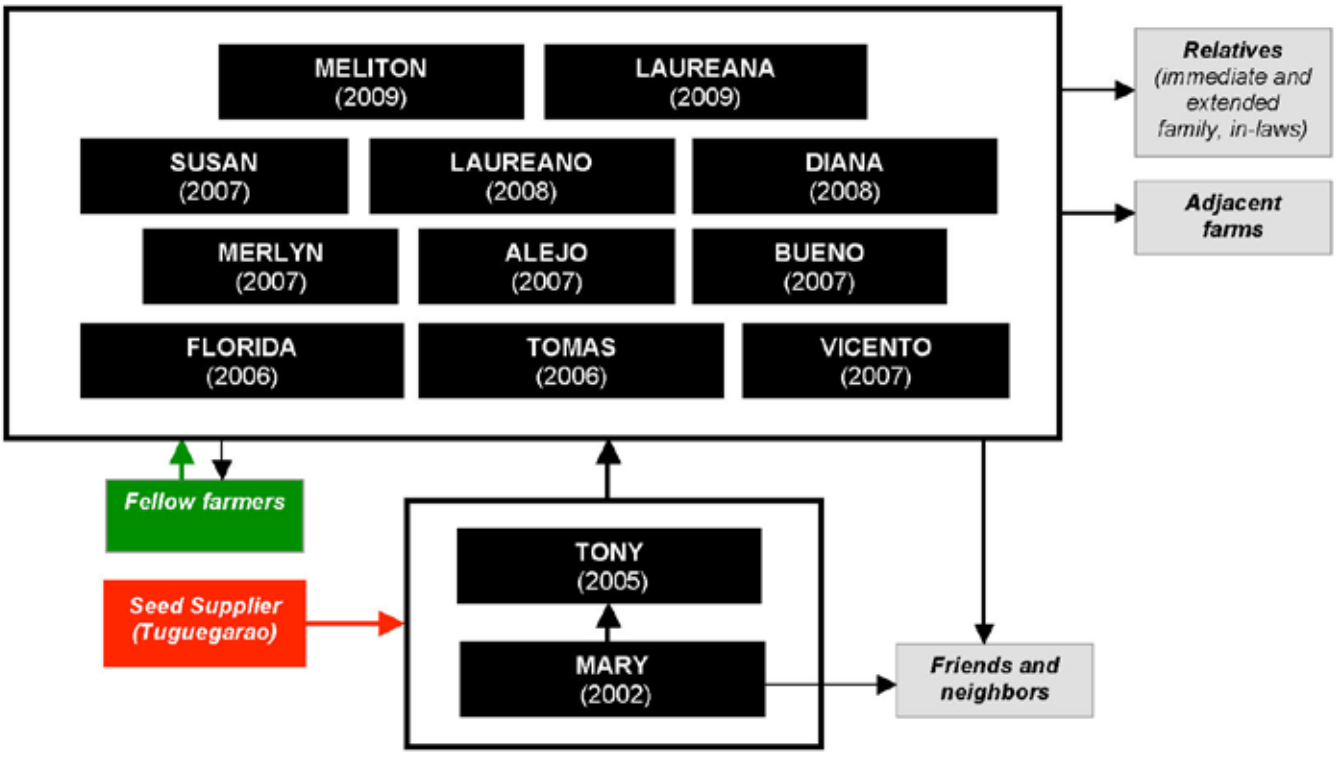


Figure 9. Uptake pathway of biotech corn among farmers in Brgy. Iraya, Solana, Cagayan

of relationship with one another. They have also learned to trust each other.

Vilma and Nelson began planting biotech corn in 2002 because they trusted the technology and the persons who promoted the technology (i.e., traders). They said that all they wanted then was to increase their income so they took the risk in planting biotech corn. Vilma introduced biotech corn to her sister, Rebecca, a second generation adoptor who started planting in 2005.

Meanwhile, Luzviminda began planting biotech corn in 2003, one year after Vilma and Nelson adopted the technology. She wanted to observe first if biotech corn could indeed increase farmer's yield and income. Then she convinced Romeo, a neighbor who then started planting in 2006 as a third generation biotech corn adoptor. Like Luzviminda, Romeo and Rebecca were reluctant at first to plant biotech corn. Thus, they first observed the experiences and success stories of the early adoptors before actually adopting the technology.

The late adoptors (2008 to 2010) knew about biotech corn technology since 2002, but they did not immediately adopt the technology because of lack of capital. They also wanted to make sure that biotech corn would increase their income. The successful experiences of the early adoptors gave them enough evidence and confidence, to finally shift to biotech corn. In addition, their barangay captain, who has been successful in planting biotech corn, convinced them to adopt the technology. This indicates that local leaders such as the barangay captain wields a strong influence in technology uptake among the villagers. Oftentimes, these leaders are perceived as experienced, reliable, and trustworthy.

In the same vein that they have been influenced by their relatives and fellow farmers to adopt biotech corn, farmer-adoptors also share and disseminate information and knowledge about biotech corn.

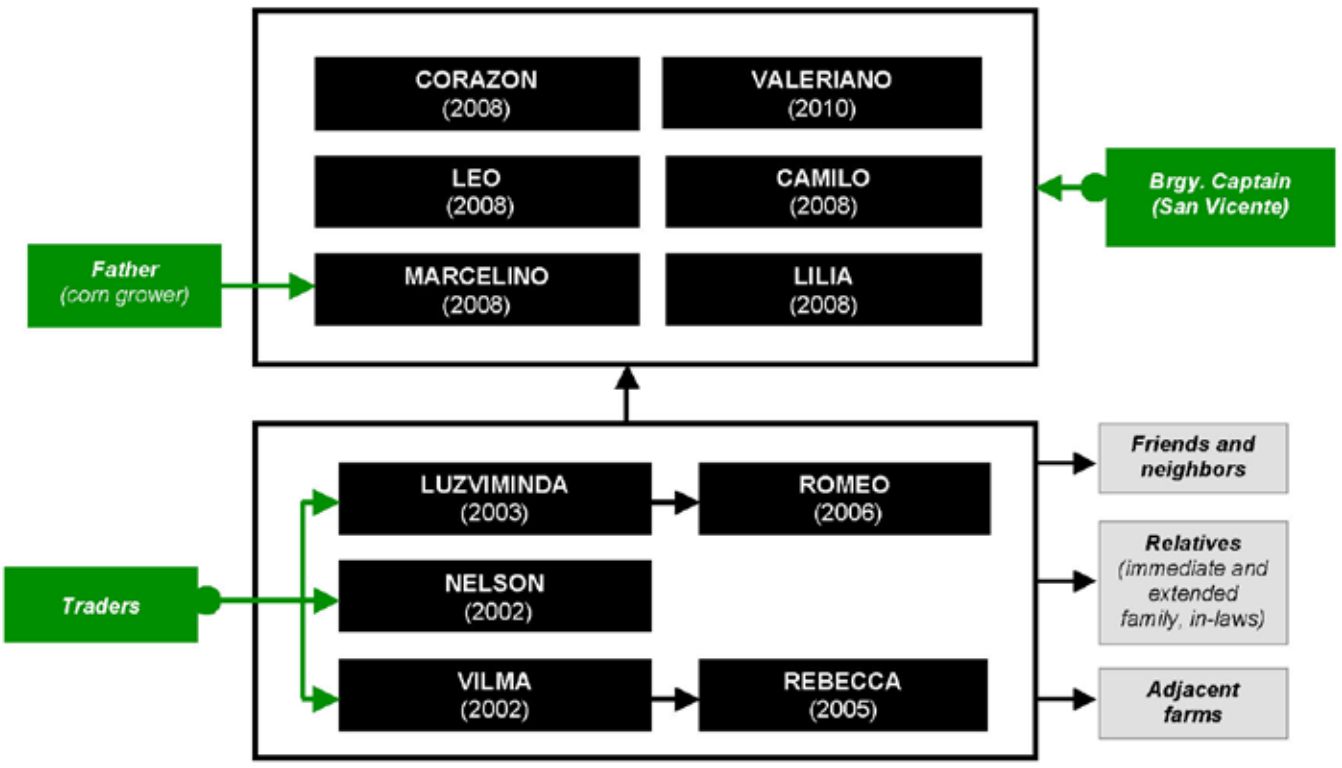


Figure 10. Uptake pathway of biotech corn among farmers in San Vicente, Iguig, Cagayan

Synthesis of Results: Innovation Tree Exercise

On the whole, the uptake pathway of biotech corn is a process where multiple actors are involved. The uptake has been initiated mostly by technicians of seed companies such as Monsanto and Pioneer Hi-Bred. They were the ones who conducted demonstration (demo) farms in chosen barangays with local farmer cooperators. They also introduced the farmers to seed buying stations and held pre-orientation seminars on biotechnology in general and on biotech corn in particular. Because they have a product to sell, they took the initiative to demonstrate and explain such in a proactive manner. Many farmers were introduced to biotech corn through these demo farms.

Other farmers who were not aware of such demo farms got to know the crop through fellow farmers, relatives, neighbors, and friends (Figure 11).

As to their sources of information, the participants usually sought information from their fellow farmers. They did not seek much information on how to plant biotech corn. Instead, they relied on the cultural practices which they used for conventional corn varieties. In the course of cultivating biotech corn, they would observe and discuss their experience with fellow farmers to learn more about it.

People who influenced farmers the most to adopt biotech corn included their fellow farmers and relatives, especially those whose farms were adjacent to theirs, thus observable.

To a lesser extent, local officials such as the barangay captains, also took part in the process.

The relatives and fellow farmers were the same group with whom they shared information and knowledge.

Eventual full adoption and uptake were facilitated by the traders who provided the much needed capital and sure market for the farming venture.

Another set of actors who played an important role in the uptake pathway were the "ambassadors." Though few in numbers, they were local farmer leaders who diligently visited farms and barangays to introduce the biotech crop, attest to its benefits, and offer technical assistance.

In terms of biotech corn, farmers have had four to six generations of adoptors since its commercialization in 2003 as reckoned on a yearly basis. There was, however, no consistent pattern that technology uptake would occur every year. In the different cases presented, gaps in adoption could take at least a year or at most five years. Reasons for delayed adoption were as follows:

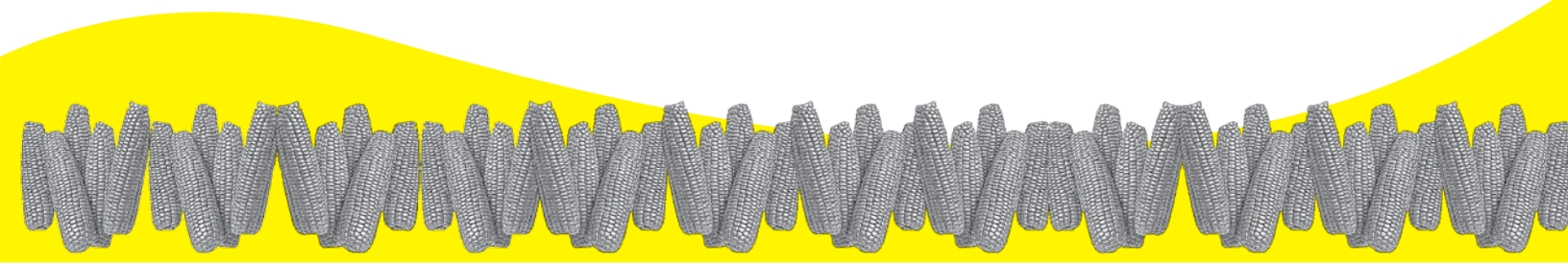
- Insufficient capital
- Lack of support facilities like irrigation
- "Wait-and-see" attitude
- Lack of prior experience on a new technology like biotech corn
- Lack of information about biotechnology
- Fear of incurring losses

Reasons for adoption, on the other hand, were the following:

- They have fool-proof assurance of high yield and better income.
- Fellow farmers and relatives are already adopting the technology, and they would not want to be left behind.
- There are no longer other corn seed varieties available or are being sold by the seed companies.
- They would not want their farms to be infested by corn borers once the adjacent farms are planted to biotech corn that are already resistant to such pests.

In general, adoption of biotech corn was scaled out when the following conditions were present:

- Many farmers are introduced to biotech corn.
- Fellow farmers, relatives, neighbors and friends attest to the benefits of biotech corn.
- Seed suppliers are accessible.
- Traders who would loan out capital are present.



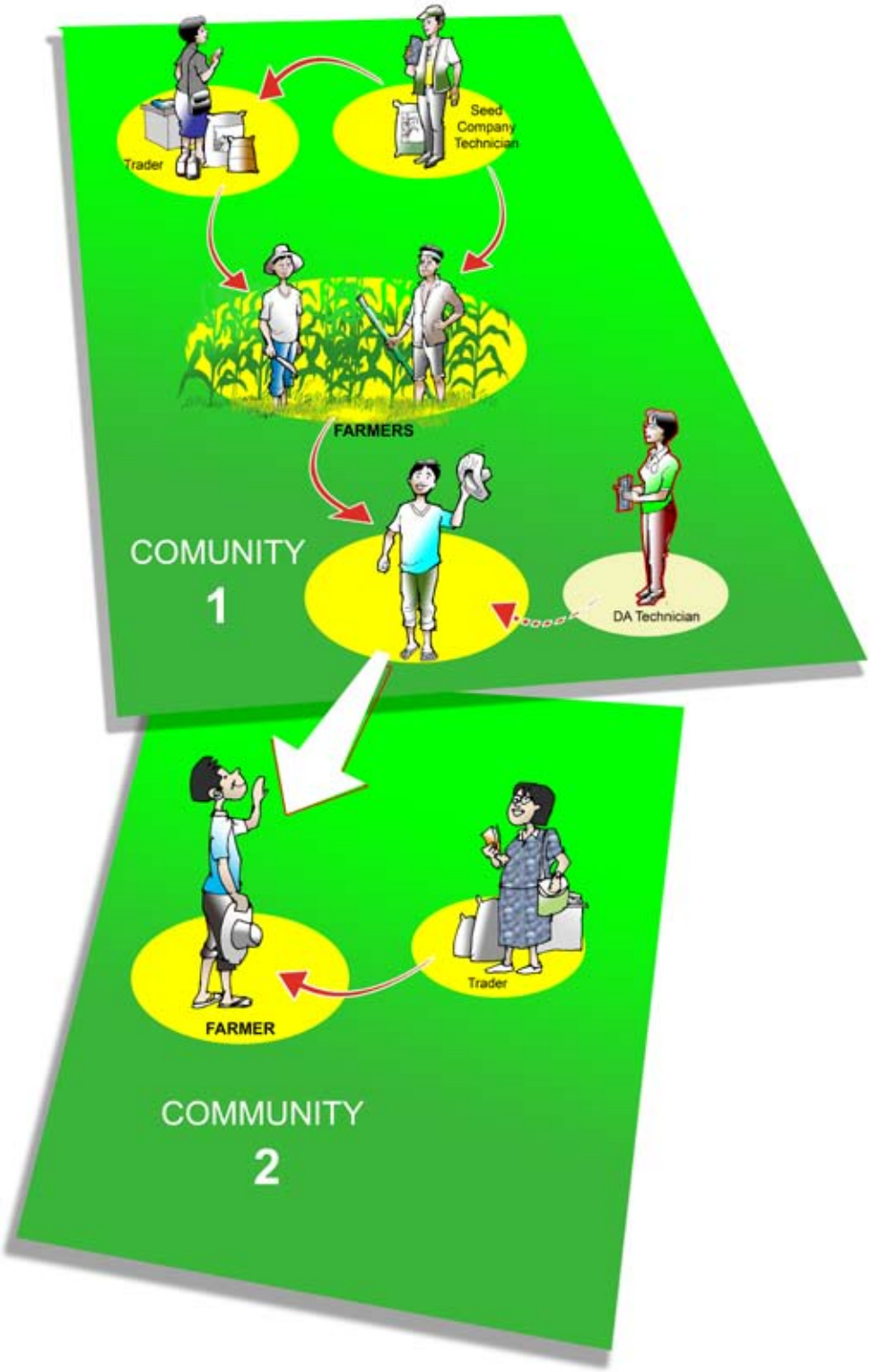


Figure 11. Overall pattern of uptake pathway of biotech corn among farmers

The presence of a farmers' cooperative also facilitated the uptake of the biotech corn technology for several reasons:

- It introduced and promoted biotech corn to its members.
- It served as supplier of biotech corn seeds and buyer of corn grains.
- It provided loans to the farmers for cash, seeds, fertilizers, and weedicides.

Changes in Farmers' Lives

During the FGD for the Innovation Tree exercise, the farmer-respondents were asked to share the changes in their lives brought about by their adoption of biotech corn. As expected, the foremost response was increased income. This was probed further by asking the farmers the concomitant changes of having higher income. Their responses, all favorable and reflective of certain improvements in their lives, were as follows:

- Able to pay their loans and debts
- Able to send their children to college
- Acquired home appliances (e.g., TV, computers, refrigerators), vehicles, and even house and lot
- Able to support other family members and relatives
- Peace of mind (assurance of harvest as there are no more pests; lesser incidence of theft)
- Farming activities made easier/simpler
- Able to engage in other livelihood activities (e.g., driving public transport vehicle, livestock raising)
- Able to engage in other productive and activities (trainings and seminars)

Repayment of loans and debts

The reported average income of Php30,000 per hectare was indeed far above the usual income of only Php10,000 per hectare using the non-biotech corn variety.

Such substantial increase has enabled the farmers to repay their loan from the traders who provided them the capital inputs mostly in kind. Whereas they used to be perpetually in debt when they were still using the conventional variety, their shift to biotech corn enabled them to break free from such a vicious cycle. The farmers are now able to settle fully their debt each harvest time with the traders who also serve as their patron-buyers or market. This in a way has helped improve their credit-worthiness, making it easy for them to access and avail of credit especially from the traders who have become familiar with their production record and repayment history.

Sending children to schools

With the additional income, a number of biotech corn farmers can now send their children to school and even to college. During the FGDs, some farmers reported having children still pursuing college or have already finished college.

Acquisition of appliances and properties

Likewise, some were able to buy modern home appliances (e.g., TV, refrigerator, computers). An exceptional few acquired new vehicles and house and lot.

Assistance to family and relatives

Noteworthy was that the biotech corn farmers spilled over their financial benefits to their family members and relatives. They themselves became providers of financial assistance and credit to other family members in need. This means that benefits from biotech corn have far reaching effects on the kinship system among the Filipino farmers.

Peace of mind

A non-material but valuable change among the farmers brought about by the adoption particularly of biotech corn was having peace of mind throughout the corn cropping season. Before, they used to spend considerably for pesticides to control corn borer yet

they still experienced crop losses and even total crop failure due to this pest. But their experience with biotech corn gave them fool-proof assurance that the crops would not be infested and would grow to full harvest stage.

Farming made easier and simpler; engaging in profitable activities

Planting biotech corn has absolved the farmers from spraying pesticides to the crops, an activity that used to eat up a substantial portion of their money, time, and effort. Having been freed from one major activity, they now have time to engage in other profitable activities such as pursuing other livelihood activities and attending trainings and seminars. Other livelihood activities include driving tricycles or raising livestock.

Decreased consumption of corn as food

Engaged in planting biotech corn without much knowledge about it, farmers avoided consuming these for food. They believed that biotech corn was meant only for animal consumption, an information that has circulated unchallenged within their circle. This belief has lingered for a time because they had no other sources of information to clarify or belie the matter.

Relationship Between Farmers' Characteristics and Mode of Adoption

Socio-demographic characteristics and mode of adoption

Strength of relationship between socio-demographic characteristics and of the biotech farmers and their mode of adoption, whether full or partial, was tested using the Goodman-Kruskal tau. Results indicate very weak relationship between and among variables (Table 23). This suggests that socio-demographic characteristics such as age, gender, civil status, etc. had very weak influence on the farmers' adoption behavior.

Table 23. Relationship between socio-demographic characteristics and mode of adoption

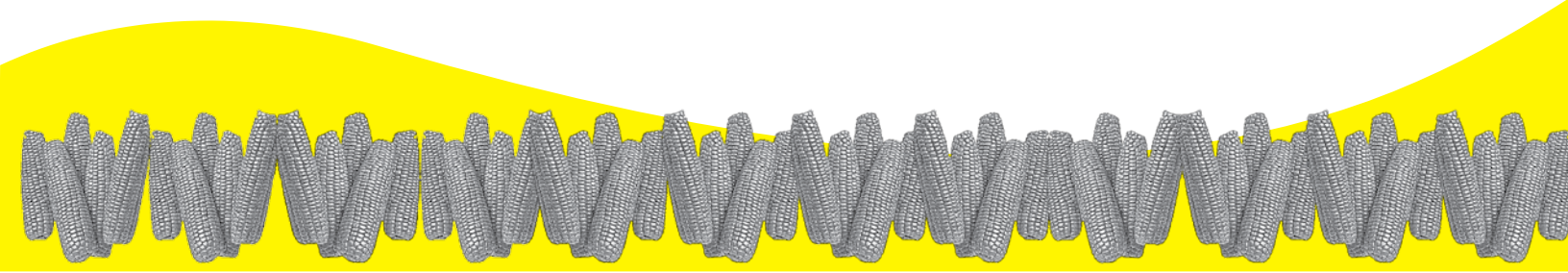
Socio-demographic Characteristic	Value of tau	Degree of Relationship
Age	0.009	Very weak
Gender	0.011	Very weak
Civil status	0.011	Very weak
Number of children	0.01	Very weak
Educational attainment	0.018	Very weak
Religion	0.026	Very weak
Membership in organization	0.003	Very weak

Farm-related profile and mode of adoption

Using the same test, results also indicate very weak relationship between farm-related variables (e.g., number of years farming, farm size, source of capital, etc.) and mode of adoption (Table 24). In other words, farm variables were less likely to influence the adoption behavior of biotech corn farmers.

Table 24. Relationship between farm-related characteristics and mode of adoption

Socio-demographic Characteristic	Value of tau	Degree of Relationship
Number of years farming	0.018	Very weak
Farm size	0.008	Very weak
Source of Capital		
- own money/savings	0.016	Very weak
- borrow from relatives	0.003	Very weak
- borrow from institution	0.005	Very weak
- individual money lender	0	Very weak
- trader	0.004	Very weak
- friend	0.002	Very weak
Market of produce		
- trader	0.002	Very weak
- market	0.009	Very weak
- cooperative	0.002	Very weak
Income per harvest	0.016	Very weak
Number of years using biotech crop	0.019	Very weak



SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Findings

Socio-demographic Characteristics of Biotech Corn Farmers

Biotech corn farmers were generally older with an average age of 47 and were males, married, and have four children. They have either reached high school or have completed it. They were full-time farmers and very few were engaged in other secondary income sources. Majority were members of organizations.

Farm-Related Profile

Biotech corn farmers were seasoned cultivators who have been farming for an average of 23 years. They tilled an average farm size of 2.17 hectares. Their farm capital, in cash or in kind, was sourced mostly from traders who also act as contract buyers of their corn grains.

Annual gross income from biotech corn averaged Php137,856.00 for entire farm hectarage and net income ranged from Php30,000 to Php40,000 per hectare. Farming activities were carried out by the entire family members, with the husband taking on most of the activities.

Adoption of Biotech Corn

Experience in planting biotech corn averaged three years. Its adoption was influenced primarily by economic consideration, i.e., higher income. This was complemented by agronomic (resistance to pest) and social factors (*pakikisama*). The ease of obtaining dependable loans from the traders and having the latter as their assured markets further encouraged them to adopt biotech corn. Mode of adoption involved full compliance with recommended practices with some modification or reduction of space between plants to maximize profits.

The main benefit derived from biotech corn adoption was higher income. This was due to better production brought about by the absence of insect infestation, less labor and cost input, and improved grain quality.

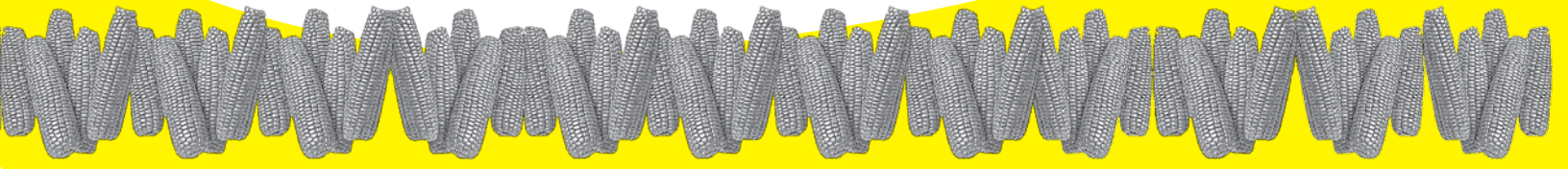
Uptake Pathways of Biotech Corn

Introduction to biotech corn has been initiated by person sources specifically the seed suppliers and fellow farmers. Governed by the "shared lifeworld" phenomenon, information and knowledge about biotech corn were then disseminated and shared to fellow farmers and relatives. These information dealt mostly on learning farming practices that would provide them maximum benefits.

Only half of them have attended seminars and trainings conducted generally by seed companies. Hence, biotech corn has become popular by other names: *"Betty corn," "mais na di inuuod,"* and "yellow corn."

People who have significantly influenced farmers to shift to biotech corn were their fellow farmers, relatives, and the traders. The latter provided the farmers their much needed capital and also served as contract buyers of corn grains. Local ambassadors also contributed to the uptake by providing information, link with seed suppliers, and technical assistance.

On the whole, there is still very limited support being extended to biotech corn farmers by the seed suppliers/traders, LGUs, and cooperatives. Capital and farm inputs were provided by traders and cooperatives. Information as well as technical assistance were extended by LGUs and seed companies.



Farmers have expressed the need for continuous assistance in capital and in access to irrigation or water supply; for the provision of corn grain dryer and for more information on better farming practices, and even in price regulation.

An insignificant number encountered problems with biotech corn, which included the much talked about risks it poses to human health and the environment. The high capital and input requirement for biotech corn as compared to conventional varieties, was also a concern. On the whole, farmers were firm in their desire to continue adopting biotech corn and other biotech crops such as biotech eggplant once these are commercialized.

Results of Innovation Tree Exercise

Based on the results of the Innovation Tree exercise, uptake pathway of biotech corn was initiated by the technicians of seed companies. They were the ones who introduced the biotech crop to the farmers through demonstration farms and seminars.

At some point in the process, the crop was further endorsed by the traders who assured the farmers of the provision of necessary capital for planting biotech corn. Farmers then observed the demo farms, compared their performance with their farms, and shared observations and experiences with one another.

The uptake pathways were also facilitated by a local ambassador who diligently visited farms to attest to the benefits of biotech corn and offer technical assistance.

Information and knowledge about biotech corn practically circulated within the farming community where they belong. This same information would get circulated in another community if their fellow farmers would be able to share the same information with their farmer-relatives or farmer-friends residing in that place.

On a yearly basis of adoption, there were from four to six generations of biotech corn adoptors in the three provinces. However, there was no consistent pattern that technology uptake would occur every year.

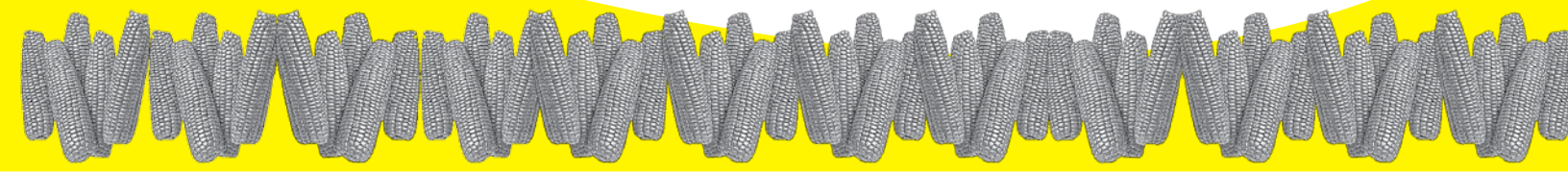
Uptake of biotech corn would be scaled out when groups of farmers are introduced at the same time to the crop (peer system syndrome); fellow farmers and relatives attest to the benefits derived (kinship system); seed suppliers are accessible; irrigation is available; and there are traders willing to loan out the needed capital.

Changes in Farmers' Lives

A major change in farmers' lives that could be attributed to the adoption of biotech corn was earning substantially higher income. This has brought about concomitant changes in several aspects of their lives and enabled them to pay their loans and debts; send their children to school; acquire home appliances; support other relatives; make farming activities easier and simpler; and engage in other livelihood sources and other productive activities. A non-material benefit and a socially significant one was having peace of mind that their crops would not be infested by corn borer nor attacked by thieves.

Conclusions

Biotech corn farmers are older and seasoned farmers with traders as their assured sources of capital and buyers. Their adoption and uptake pathways of biotech corn are strongly facilitated by peer and kinship systems as well as the shared lifeworld syndrome. The single most influential factor for adoption is the prospect for higher income. Adoption and uptake pathways are sustained by multiple actors who perform specialized roles in the process. Technicians of seed companies are usually the bearers of good news and farm demonstration, hence, they could potentially be the most effective medium for convincing farmers to shift to biotech crop. The traders provide the much needed capital and other actors such as local ambassadors, LGUs, cooperatives, and DA technicians contribute to information, capacity building, link with seed suppliers, and other technical assistance. Generally, farmers have a strong desire to continue adopting biotech crops such as biotech corn and biotech eggplant when the latter is commercialized.



Recommendations

For Extension Workers and Communication Practitioners

1. Results of the study show that seed suppliers and/or traders play an important role in farmers' adoption and uptake of biotech crops. As such, they should be considered as important partners in biotech crops extension work. Conventionally, agricultural extension has focused on local farmer leaders, barangay officials, and local government agencies as conduits of new technologies. In the context of biotech crops, it is now time to include private actors who have a very strong stake in the success of biotech crops – the seeds suppliers and traders. The MAO has to identify and locate them through the biotech crop adoptors so that they can work hand-in-hand with agricultural technicians and extension workers in educating the farmers about biotech crops.

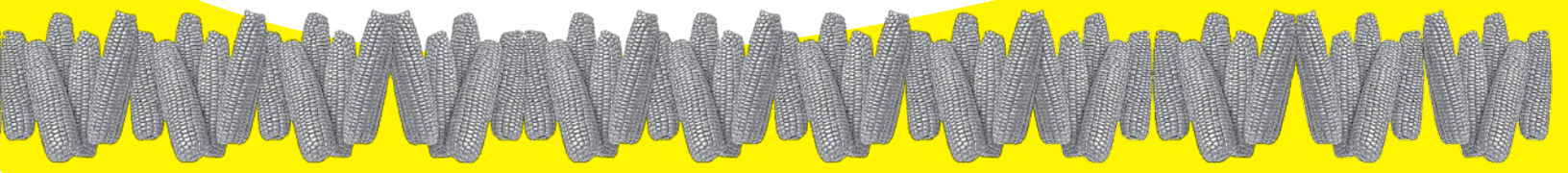
2. Biotech corn farmers have expressed strong desire to learn more about biotech crops, especially their features and required cultural practices. Without the proper knowledge, they are actually left on their own to learn and experiment on what will work and what will not. Oftentimes, they get the biotech seeds from the suppliers or traders but not necessarily the correct information of what will make these seeds produce the optimum harvest. This is actually a risky venture for the farmers who have very limited resources to invest on a "hit-and-miss" venture. Outright, they should be provided with information on the correct cultural practices to avoid malpractices. Hence, seminars and workshops on biotech crops should be conducted at the local level. Laymanized communication materials on the what's and how's of biotech crops should be produced and distributed. The academe and R&D institutions may be tapped to provide the necessary technical assistance to local farmers as part of their extension and community service functions.

3. Farmers lack the knowledge and skills in distinguishing the different varieties of biotech crops. Many are familiar only with the biotech corn variety. Hence, they are at the mercy of traders when it comes to the seed variety they will plant in their farms. While many farmers assume that they are planting corn variety resistant to corn borer, this may not really be the case, but this is not being fully explained to farmers by the traders. The extension workers may need to assist the farmers in this respect. It goes to say that the extension workers themselves should be knowledgeable on biotech crops and the different varieties that can be made available to farmers so they can make their choice.

4. Field demonstrations have been proven to work effectively among farmers trying out a new technology such as biotech corn. This gives the farmers an opportunity to observe, see things for themselves, and discuss among their peers. This even works more convincingly if there will be a "treatment farm" (where biotech variety is planted) alongside a "control farm" (farm planted to non-biotech variety). The control farm will serve as reference for comparison of results among farmers.

   A demonstration farm would, of course, require some inputs and resources. The investment on this will even be more justified than a series of information dissemination activities. It should be noted that once the farmers are convinced of what they see, the news about the biotech crop can spread by word-of-mouth to other farmers more quickly perhaps than through mass media. This facilitates adoption and diffusion among the rest of the community as demonstrated by generations of farmers shifting to the new variety. Non-adoption as indicated in the study occurs only when the farmers lack the needed capital and inputs. But certainly, the intent and desire to adopt biotech variety are there in the first place.

5. The typical tendency of farmers to engage in peer and collective learning suggests that any extension work should build up on the existing peer groups of farmers as conduit for learning. Hence, existing Farmer Field Schools (FFS)



should be tapped in introducing and educating farmers on new things like biotechnology. The elements of trust and caring for fellow farmers as well as their shared lifeworld are strong points for farmers to influence each other to adopt or not adopt certain technologies.

For Biotech Corn Suppliers and Traders

6. That there is more to biotech crops than business is a message that needs to be conveyed to the seed suppliers and traders. As major actors in the adoption of biotech crops, they need to be linked with the government agricultural extension system as partners. In as much as they are now filling the gap in farmers' education on biotech crops, they should also be given seminars so that they will be able to provide the scientifically correct knowledge about these crops. They can work together with the extension workers in providing information about biotech crops to groups of farmers at the local level. This, in a way promotes their product, while contributing to government development efforts as well.

For Policy Makers

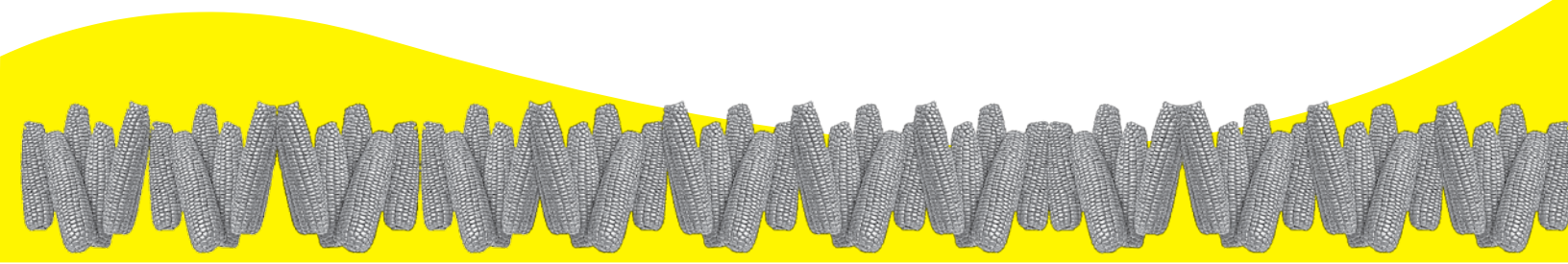
7. Support to biotech crops in field implementation is not clear. While there are government laws and policies pertinent to the use or application of biotech crops in modernizing agriculture, at the end of the day, it is the incumbent national, regional, and local leaders who call the shot. In the provinces surveyed, biotech crops such as biotech corn are not openly promoted by DA technicians for fear that they might offend the current DA leadership, which is being perceived as openly advocating for organic farming. This actually stalls whatever earlier gains have been accomplished in terms of poverty reduction in farming areas, especially those engaged in planting biotech crops such as biotech corn.

This lukewarm attitude towards biotech crops translate to lack of substantive and aggressive support to farmers planting biotech crops in terms of seeds, capital, irrigation, fertilizers, and other farm inputs. These are now being filled up by private sector. The lack of such enabling factors stalls to a certain extent the uptake of biotech crops among farmers.

For Future Research

8. Biotech farmers as warm bodies are difficult to locate on ground. While there are statistics about how many they are at the national and global level in the literature, giving them a face is another matter. Hence, there must be a systematic monitoring of who and where they are so that future studies with them as sample respondents can be facilitated. While MAO may have the list of farmers in their area, a sublist of biotech crop adoptors needs to be generated too. This can be done in collaboration with the committee on agriculture of each barangay council and the seed suppliers and traders known to the farmers in their respective areas. The list that will be generated will surely be useful for other purposes in the future.

9. The current study covers only Luzon. To see the national picture, similar studies can be done in the other major islands of Visayas and Mindanao. Given their different socio-cultural, economic and political settings, it would be interesting to know the patterns of adoption and uptake pathways of biotech crops vis-à-vis these differences.



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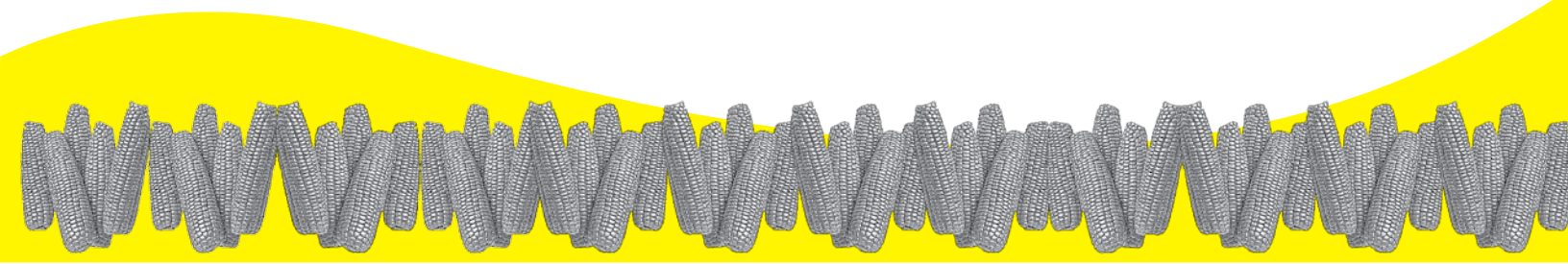

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