ADOPTION AND UPTAKE PATHWAYS OF GM/BIOTECH CROPS BY SMALL-SCALE,RESOURCE-POOR FARMERS IN THE PHILIPPINES

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HIGHLIGHTS

This study was conducted to analyze the dynamics of adoption and uptake pathways of biotech crops among small-scale, resource-poor farmers and the changes these have brought about in the farmers' lives. It is focused on biotech corn, the only approved biotech crop for commercialization in the country at the time of study. Adoption here refers to how the famers acquire and eventually apply the knowledge and practices pertaining to the planting of biotech corn. Uptake pathway refers to the process that captures how biotech corn is introduced, adopted, disseminated, and shared by the farmers to others.

Objectives

The specific objectives of the study are as follows:

1. Describe the farmer-adoptors of biotech corn in terms of their socio-demographic characteristics and farm profile;
2. Analyze the biotech corn adoption patterns in terms of:
    - factors considered in adoption
    - mode of adoption
    - desire to continue planting biotech corn
    - awareness and willingness to plant other biotech crops
    - preferred characteristics of future biotech crops;
3. Assess their uptake pathways of biotech corn in terms of :
    - first information received on biotech corn
    - sources of information
    - attendance in trainings and workshops
    - sharing of knowledge on biotech corn
    - access to facilities and support services
    - results of Innovation Tree analysis;

Full report is available at http://www.isaaa.org/programs/specialprojects/templeton/adoption/philippines/Philippines-Adoption%20and%20Uptake%20Pathways.pdf.

4. Enumerate the benefits derived and problems encountered in the adoption of biotech corn;
5. Determine the relationship between farmers': socio-demographic characteristics and mode of adoption; and farm profile and mode of adoption of biotech corn; and
6. Formulate recommendations by which the adoption and uptake pathways of biotech corn among small-scale and resource poor farmers may be enhanced.

Methodology

A total of 409 biotech corn farmers from three major corn-producing provinces of Pampanga, Iloilo, and South Cotabato in the Philippines were randomly selected as respondents for the study. Data were gathered using survey, focused group discussions (FGD), and key informant interviews (KII). The survey made use of a structured interview schedule designed to gather the respondents' socio-demograpic characteristics, farm-related profile, and the "what, who, why, and how' of their adoption. FGD employed the Innovation Tree technique to enable respondents to visualize and analyze the way in which an innovation is spread over time among their community members. The method also probed on the socio-economic benefits and changes the farmers value the most in adopting a biotech crop.

A number of KIIs were done with the provincial and municipal agriculturists as well as extension workers who went with the research team to the field. Background data on information about corn production and farmers' socio-economic conditions, adoption behavior, and local networks were also explored with them. Likewise, a number of financiers and/or traders were interviewed to find out more about the financing schemes and marketing systems prevailing in the area as these relate to the farmers' adoption behavior and uptake pathways. In a few cases, side interviews were done with non-adoptors of biotech corn whenever they could be found in the area.

Quantitative data derived from survey were analyzed using descriptive statistics (i.e., means, frequencies, percentages) and simple inferential statistics (i.e., correlation and tests). The data generated from FGDs, particularly from the Innovation Tree exercises, were summarized using flowcharts to depict the overall shape and direction of the uptake pathways between different farmer groups. Data from KIIs, were documented as narratives to support the analysis of quantitative data. Whenever appropriate, FGD and KII results were also used to explain some patterns and trends observed in the study.

To determine the relationships between selected variables, the following null hypotheses were subjected to Spearman's Correlation Coefficient for variables on ordinal scale, and the Chi-Square Test of Independence and Cramer's V test for variables on nominal scale.

- There is no relationship between farmers' socio-demographic characteristics and their mode of adoption of biotech corn.

- There is no relationship between farmers' farm-related profile and their mode of adoption of biotech corn.

Findings

Socio-Demographic Characteristics

Majority (52.8%) of the biotech corn adoptors belonged to the 41-60 years old bracket. Mean age was 48, implying that biotech corn adoptors are in their physically-able stage to carry out strenuous farm work. They were also males (74.1%) and already married (85.1%), typical of farmers in the country. The average family size was 3, with number of children among many ranging from 1 to 3 (40.6%). This suggests that farm families of biotech corn adoptors are small compared with typical farming households having an average of 5-6 children. They were also relatively better schooled with close to half having attained high school level of education (43.3%). As a good indicator of their propensity to adopt, 66.5% were members of organizations, most of which were related to farming.

Corn farming could be considered as men's major undertaking with them performing major role in all farm activities. The women's major role was only in food preparation for farm laborers and, to a certain extent, some assistance in budgeting. Children, on the other hand, had very minor involvement in farm activities. This result negates findings of earlier studies indicating children as additional farm hands.

Farm-Related Profile

Biotech crop adoptors have been farming at an average of 23 years, with farm size ranging from 1 to 2.9 hectares (41.8%) or an average of 2.7 hectares. Many of these farms were located in upland areas (51.1%), followed by those in lowland and plain areas (38%). Ownership of farm lands planted to corn were at a high 60.9%.

Farmers had varied sources of farm capital: individual money lenders or financiers, traders, relatives, friends, own savings, and banks. Among these sources, the ones that stood out were the individual money lenders they called "financiers" (50%) as well as the traders (25%). In frequent occasions, the financiers also doubled as the traders who bought their corn upon harvest as part of their loan arrangement or credit deal. Sometimes, the traders were not financiers but were only involved as buyers of their harvest. Their market outlet was primarily the traders (87%).

It should be emphasized at this point that financiers and traders performed two important roles in the corn supply chain: they provided farmers the necessary inputs in cash or in kind (seeds, fertilizers, shellers, etc.) during the cropping season and acted as contracted "market" or buyers of the farmers' produce. These are two crucial stages in the corn supply chain that have not been successfully met by farm cooperatives or any government farming assistance in the past and until now, but which these financiers and traders have amply met through the years. Unless there are alternatives to this credit system, it shall remain as the corn farmers' preference in sustaining their venture.

Farm income remained a problematic data to gather as indicated also in the seminal study on biotech corn adoption and uptake pathway among farmers conducted in 2011-2012 (Torres et

al., 2012). Farmers did not keep record of their farm income and expenses. Anything left after the financiers/traders have collected their loaned money was the amount they considered income. The expenses used for farm labor, food, gasoline, transport, and miscellaneous items were never included in their computation.

To give a better picture of the farmers' income configuration, in-depth interviews among 3-5 farmers per site were conducted. Based on these, net income was subsequently computed. A typical small-holder farmer would, thus, have the following income figures:

Configuration of Net Income for Lowland Farm (At 1 USD= ₱40)

Assumptions:

Harvest:	6 tons/ha = 6,000 kg/ha
Selling price :	Php 12.50/kg (USD 0.31/kg)
Total Sale:	**Php 75,000/ha (USD 1,875)**

Expenses:

Farm labor:	Php 9,850/ha (USD 246.25)
Farm inputs:	Php 32,400/ha (USD 810)
Others (rental, food, etc.)	Php 12,200/ha (USD 610)
Total Expenses:	**Php 54,450/ha (USD 1,361.25)**

Net income: **Php 20,550/ha** (USD 513.75/ha)
Average farm size: 2.7 ha
Total Income: Php 20,550 x 2.7 ha. = Php 55,485 (USD 1,387.12)

Configuration of Net Income for Upland Farm (At 1 USD= P40)

Assumptions:

Harvest:	100 cavans/ha = 7,000 kg/ha
Selling price :	Php 11.00/kg (USD 0.30/kg)
Total Sale:	**Php 77,000/ha (USD 1,925.00)**

Expenses:

Farm labor:	Php 19,770/ha (USD 494.25)
Farm inputs:	Php 23,600/ha (USD 590.00)
Total Expenses:	**Php 43,370/ha (USD 1,084.25)**

Net income: **Php 33,630/ha** (USD 834/ha)
Average farm size: 2.7 ha
Total Income: Php 33,630 x 2.7 ha. = Php 90,801 (US$D 2,270)

In terms of expenditures, biotech corn farmers with lowland farms would spend 60% of their farm expenses on farm inputs (seeds, fertilizers, weedicides), 18% for farm labor, and the rest for other expenses like food, rentals, and irrigation. For those having upland farms, 54% of expenses would go to farm inputs and 46% to farm labor.

Adoption of Biotech Corn

Farmers have been planting biotech corn for an average of 7 years, with 46.5% having adopted the crop from 6 to 10 years now. This implies that farmers did not immediately adopt biotech corn when it was approved for commercialization in 2003. It took them about 3-4years later to embark on planting the crop. Reasons cited for late adoption were: lack of farm capital, wait-and-see attitude, and lack of information on management practices of biotech corn.

The very first information received about the new crop was benefits derived in terms of higher yield and better income (71.6%) due to its pest resistance. This in fact overshadowed their need for information about the recommended farming practices for the new corn variety (13.2%), if there were any.

The most influential persons that convinced farmers to adopt were their co-farmers or peers (91.9%). They were the bearers of good news to their fellow farmers.

a. Facilitating Factors

Farmers gave multiple reasons for adopting biotech corn. Among those that stood out and considered facilitating factors for adoption in decreasing order of importance were: high income, pest resistance, good grains quality, available financing, lesser production cost, and availability of seeds.

During informal interviews, an important reason for adoption that some farmers mentioned was gaining peace of mind. This response might have not been listed in their completed questionnaire but is socially significant in that it is indeed a motivator for adoption. Interviewed farmers elaborated that since biotech corn has become more popular as crop for feeds and not food, seldom were they stolen for food. Furthermore, the fact that they have traits that ensure zero borer attack, farmers said that they can sleep well in the night, assured of a good harvest. Indeed, no price tag can be attached to these psychological benefits.

A few cited some compelling factors that gave them no other option but to adopt biotech corn: only biotech corn seeds were available in the area; traders were only buying biotech corn produce; and fear that their farms would be swarmed by insect borers if their neighboring farms were all planted to borer-resistant corn variety.

Varieties planted were those with stacked trait (IR/HT; 51%), herbicide resistant (HT) (33.7%), and lastly Bt corn or IR (10.8%). There was a tendency for farmers to adopt the latest variety believing it must be better than the older ones. Bt corn adoption dwindled through the years.

According to corn experts, the recommended practices for cultivating biotech corn follow that of the typical corn of any variety. In the study, 64% were not sure that these were the correct recommended practices for biotech corn. A considerable percentage (32%) adopted some modifications particularly on plant spacing. That is, instead of the recommended 70cm x 30 cm, they just used 60cm x 20cm and testified that they got higher yield from being able to have more corn planted in their farms.

Facilities accessed for their corn production included big tractor for land preparation especially in lowland farms (50.4%); corn dryer (37.9%); hand tractor (35.5%); and water pump for irrigation (29.3%). Post-harvest facilities such as storage were not available (22.5%). Hence, farmers indicated demand for such facilities as these will help them sell their corn grains at higher prices.

As discussed earlier, increased income was the topmost benefit derived by farmers from biotech corn farming. Such income they disposed of for their daily expenses (78.7%), children's education (60.9%), farm capital (46.7%), and purchase of home appliances, utilities, and vehicles (46%). One highly observable phenomenon was the investment on a motorcycle, both for upland and lowland corn farmers. They considered this as very

important for their mobility. Somehow the motorcycle serves as their family vehicle, transporting humans, produce, goods, farm implements, and even hardware for their house construction.

b. Support Services Needed

The farmers identified the support services they still need in biotech corn production as follows: farm equipment (46.0%); farm inputs (42.1%); buying price regulation (28.9%); and in the heart of these is financial assistance (27.6%). They looked upon the government as the institution which should rightfully provide such needs to them.

c. Problems and Constraining Factors

During the early years of adoption, the farmers thought they have a "magic" crop that would not give them any trouble at all. In later years, they found out that biotech corn have also their weaknesses. These, as cited by less than a majority, included the following: occurrence of fungal/bacterial diseases and other pests (31.8%); expired seeds that did not germinate (19.8%); high cost of inputs (16.1%); low buying price of traders (8.1%); and lack of own capital (6.8%).

d. Desire to Continue the Adoption of Biotech Corn

An overwhelming majority (93.2%) expressed their intent to continue adopting biotech corn and this was primarily due to both material and non-material benefits they derive from it. Equally important, however, was finding out why the remaining nearly 7% were out of the adoption picture. A few farmers who were not able to repay their loan were "blacklisted" by their financiers. With no capital, they could no longer avail of the expensive inputs, so they stopped. Others were discouraged by their initial try with seeds that did not germinate; so they backed out. Still others opted to go back to planting their white corn variety which according to them requires lesser capital, takes shorter time to harvest, edible for human food, and enables them to earn equal to or even higher than the biotech corn. They can also easily produce the needed seeds for their next cropping season from their harvest.

e. Awareness of and Willingness to Plant Other Biotech Crops

Other biotech crops in the pipeline for commercialization in the Philippines include Bt cotton, Bt eggplant, and Golden Rice. High percentage of respondents (80%) were not aware of such crops. Despite this, majority of the farmers (60%) indicated their willingness to plant such crops once they are approved for commercialization. It could be that farmers are basing their positive decision on their experience with biotech corn.

f. Crop Characteristics that Farmers Want Scientists to Develop

Biotech corn farmers would like scientists to develop crops that are resistant to pest and drought and with bigger stems.

Uptake Pathways of Biotech Corn

a. Sources of Information

Farmers have multiple sources of information on biotech corn, but these were dominated by interpersonal sources; mass media were barely used as information sources. Seed suppliers/traders ranked as the topmost (56.2%) information sources; followed by DA technicians (34.0%); and then by their co-farmers (30.3%). It should be clarified at this point that while seed suppliers/traders were considered primary information sources, it was their co-farmers who influenced them to adopt biotech corn.

b. Trainings Attended

Majority of the farmers (66.5%) claimed to have attended trainings on biotech corn. And nearly 50% indicated interest to attend more trainings. In most cases, trainings were conducted by private companies (73.2%) that supply the seeds such as Monsanto, Syngenta, and Pioneer. An issue here was the failure to explain to the farmers that farming practices for biotech corn simply follow that of any typical corn variety. Farmers thought that since biotech corn is a "special" variety, then there must be cultivation practices unique to it.

c. Knowledge Sharing

Knowledge about biotech corn was shared first and foremost to their co-farmers (67.7%). This can be explained by their shared lifeworld system. This means that whatever they think would benefit themselves should also be shared to their colleagues. For them, farming information is a common good they must share.

Uptake pathway refers to the process that captures how the biotech corn was introduced, adopted, disseminated, and shared by the farmers themselves to others.

d. Innovation Tree Analysis

Using the Innovation Tree method, information about biotech corn was found to be first brought to the farmers' attention by the seed company technician. Through community meetings, the technician explained about biotech corn's advantages especially in terms of higher income and tried to prove this by establishing a demonstration farm in the village. Farmers were then asked to observe the performance of the crop in the demo farm. Based on their own observations and learnings, farmers then decided to try the corn variety themselves. At this point, seed company technicians connected the farmers to financiers in the area; or the farmers themselves, through their local networks, sought out these financiers. Local-based cooperatives also participated in the endeavor by offering loan for capital or inputs at low cost to the farmers. In most cases, the financiers provided all the needed farm inputs in cash or in kind (seeds, fertilizers, etc.) on loan basis. They also acted as the buyers/traders of the farmers' harvest at a price they set for farmers.

As transactions between and among farmers, financiers, and cooperatives went along, the Municipal Agricultural Officer (MAO) monitored the activities. As farmers in one community succeeded in the biotech corn venture, they shared their experience to fellow farmers in other communities through word-of-mouth. Farmer-relatives and farmer-friends were the typical contact points. The "good news" then spread out to other nearby communities. Seed company technicians, financiers/traders, and cooperatives (whenever present in the area) then also expanded their reach to these new areas and performed the same roles. Within each community, farmers continuously shared among themselves their experiences, good or bad, and tried to learn from their own encounters with the biotech corn. A common element in their stories was the fact that their income increased two- or three-fold as they adopted the biotech corn variety.

Relationship Between Socio-Demographic Characteristics, Farm-Related Profile and Adoption Mode

Among the socio-demographic variables, age and number of children significantly affect mode of adoption. As age and number of children increase, farmers tend to modify their adoption of biotech corn.

Among the farm-related variables, number of years in farming and size of farm significantly affect adoption. As the number of years farming and size of farm increase, farmers tend to modify their adoption of biotech corn.

Recommendations

Based on the findings of the study, recommendations to enhance adoption and uptake of biotech corn among small-scale and resource-poor farmers may involve the provision of material inputs, technical assistance, and policies that would support the farmers' adoption and uptake of biotech corn. These recommendations targeted per sector are as follows:

a. For Biotech Corn Farmers

1. **Professionalize farming.** Farmers should be capacitated in farm record keeping to rationalize their income and profit. They should not merely be guessing their farm income and expenses. In the long run, this would help them come up with better decisions on the use of inputs and disposal of their loaned capital .

2. **Adopt soil conservation measures.** To be included in the package of biotech corn technology should be soil conservation measures, as most farms are located in upland areas. Farmers should be made aware that sloping areas being used for corn farms would need special measures to control soil erosion. They need to protect and conserve their resource base to make their biotech corn farming enterprise sustainable.

b. Agricultural Extension Workers/System

3. **Sustain** f**armer-to-farmer education**. Farmers exhibit strong belief in themselves and are inspired by the success of their fellow farmers. Hence, farmer-to-farmer education must be promoted and sustained. People are more likely to follow the behaviors modeled by someone with whom they can identify with. The more perceived commonalities and/or emotional attachments between the observer and the model, the more likely the observer will learn from the model.

4. **Identify and tap local champions**. Champions at the local level have been identified by the farmers themselves. These local champions must be recognized and tapped as channels for uptake and adoption of biotech corn since they are being looked up to as reputable models by the farmers.

5. **Link farmers with experts**. Farmers need to be assisted in addressing the persistent crop pests and diseases, other than borer, that continuously attack their corn. Their faith on the resilience of biotech corn is being eroded by these occurrences. At the local level, seminars may be given by experts on this concern to enable the farmers to understand and solve the problem on their own. Local agriculturists should also be informed so that they could accordingly assist the farmers.

c. Policy Makers and Regulators

6. **Regulate seed quality and attend to other seed-related concerns .** Since the technology starts with the seeds, the government agencies such as DA may need to put up regulatory mechanisms so that private companies supplying the seeds would comply with certain standards. Right of the farmers to obtain good seed quality must be ensured and protected. Some policies and guidelines addressing seed expiry and other broader concerns such as the price and distribution of seeds and proper labelling of varieties need to be put in place. Farmers may also need to be oriented on how to read the seed labels so that they can protect themselves.

7. **Set** b**uying price of corn and regulate traders.** The government needs to intervene so that a minimum buying price of corn produce is set. This is to prevent the traders from abusing the farmers, especially those indebted to them in terms of capital. The LGU and the National Food Authority can help set up the local selling price of corn and do the monitoring if this is being complied with. A bigger problem is that since many of the traders operate as “underground economy”, they could hardly be monitored and be subjected to government rules and regulations. An effort to accredit or license their practice may be explored since they are already existing as important actors in the system for quite a long time.

8. **Provide marketing assistance**. Related to item 7 above, the market and buyers are very important to avoid a glut in the face of bountiful harvest of biotech corn. While this role is being performed very actively by the traders, the government may explore

setting up of alternative markets with competitive buying price of corn, so that farmers would not be trapped in a no-choice-except-trader situation.

9. **Explore alternative credit systems.** Alternative credit systems for the farmers need to be explored to eventually ease them out of the highly asymmetrical relationship with the private financiers and traders. Farmers are now captive victims of the system because there is no alternative system that would function currently similar to the financiers/traders in the provision of capital and buying of corn produce.

d. Future Studies

10. **Study alternatives to capital sourcing.** To address the perennial problem of farmers' indebtedness to financiers/traders, an in-depth study on this practice and its alternatives should be undertaken. It would help analyze who the traders are, their unwritten codes and loaning systems, dynamics of their relations with farmers, co-traders, and other actors in the supply chain, among others.