Gender Impacts of Genetically Engineered Crops in Developing Countries

FINAL TECHNICAL REPORT

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1. **Executive Summary**

Literature reviews and field research studies implemented by IFPRI and other research teams who have examined the socio-economic issues and consequences related to and resulting from the adoption of Genetically Engineered (GE) crops have shown that these crops can have a positive but variable economic impact on smallholder farmers and other actors in the agricultural sector. Furthermore, there are significant gaps in knowledge as related to broader social concerns including gender and food security issues. As a consequence, there is a pressing need to empower developers and other relevant stakeholders to conduct appropriate and robust assessments on scientific and other socio-economic issues of concern and for decision makers to have appropriate information.

To address the perceive gender adoption knowledge gap IFPRI implemented the current project examining gender and biotechnology in developing countries. The project had two objectives. The first was to examine the gender differentiated issues that may affect adoption and use of GE crops in developing countries. The second was gender differentiated impacts derived from the adoption of GE crops in developing countries. The findings in this study will help inform agricultural policy design by encouraging gender sensitive policies that will direct agricultural innovations to women and men farmers equally, for beneficial impacts to the overall economy. The findings will help demonstrate the importance of developing technology traits suited specifically to the needs of women farmers. Overall, the study will provide valuable information to other nations moving towards post-commercialization of GE crops and other biotechnologies that may be released in developing countries.

IFPRI's research conducted in this project has confirmed the gender knowledge gap especially as there are few publications and research activities with a focus on gender issues. The IFPRI team has drawn significant lessons relevant to this project through a literature review of the gender issues related to technology adoption with a focus on improved seed adoption and use that will enlighten the discussion of gender and biotech issues in developing countries.

Results from our field work in both Burkina Faso and the Philippines, along with a completed pilot study conducted in Colombia with Bt cotton funded by another investor, have shown that women are an integral part of the cotton and maize productive systems in these countries. As such, women farmers are productive engines to society and are also profitable clients to any public or private sector developer. Women farmers have been quite ignored by these stakeholders in the past. As with any other technology, women may face limiting factors such as access to information, credit, and control of land, but there exist some common underlying features with the potential for gender equality that will allow unleashing benefits for the society as a whole, and for women and their families in particular. Invisible threads interlink women with their environmental and productive environment

Any activity which offers a focus on gender provides a new dimension to understanding adoption patterns of GM cotton and maize in developing countries. Addressing the gender dimension becomes a matter of "efficiency" as the shift focuses on women as active participants in crops conventionally viewed as "male" crops and other crops. These views will need to consider that women and men have positive but dissimilar views about GM cotton in our study countries, but at the same time their access to technology is more limited for women, compared to men.

We believe that one way to do this is to go beyond the conventional obstacles confronting women in other areas of agriculture in developing countries such as access to credit and land to include attention to access to information and the use of GM labor saving technologies. These factors have so far been overlooked both by researchers and those commercializing these crops when in fact attention to information and targeting women is good business and will also have benefits for the society as a whole.

We expect that policy recommendations in this project will assist governments in case study countries to make sound investments and design appropriate regulatory processes for GE crop varieties and that the findings in this study will inform agriculture policy design and encourage gender and health sensitive policies that will direct agricultural innovations to women and men farmers equally. This approach will likely maximize the potential for beneficial impacts to the overall economy. The findings will also demonstrate the importance of developing technology traits suited specifically to the needs of women farmers.

2. Research problem

Our project focused on gender and its relationship to genetically engineered (GE) biotechnology adoption and use, especially as the various fundamental roles men and women play in crop production, their propensity to adopt agricultural biotechnology for crop production, input use patterns and access and the impact disaggregated by gender which have not been addressed in any detail in the literature.

The rationale behind the project built upon the fact that more developing countries will likely be commercializing GE crops over the next decade. Therefore, the gender and other broader social dimensions of GE crop adoption and their impacts are increasingly relevant issues

and thus if policy makers want to have a greater impact on poverty and food security they will need to understand how genders differ in terms of adoption behavior, access and control, attitudes, farm and household production practices and adoption impacts of GE crops.

Findings in this study will help inform agriculture policy design and encourage gender and health sensitive policies that can direct agricultural innovations to women and men farmers equally, for beneficial impacts to the overall economy. We also expect that findings will demonstrate the importance of developing technology traits suited specifically to the needs of women farmers. Overall, our study provides valuable information to other nations moving towards post-commercialization of GE crops and other biotechnologies that may be released in developing countries.

The project's rationale, mission, goal and objectives have not changed in principle since we submitted our original proposal to IDRC. What has changed is the level of sophistication by which the implementing team has been formulating the specific research questions in the countries and the ability to inform and change policies in countries during the implementation of the study. This evolution has been reflected in the first and second interim technical reports. To empower a substantial change in knowledge and policies in these countries, we believe that longer and more sustained activities building up women leadership in these and other developing countries will necessarily be the cornerstone of any set of activities that will enable change. Knowledge per se will be necessary but not sufficient in inducing change.

We are now formulating a set of proposals for additional funding that will examine gender and biotechnology issues at two distinct levels. At a research level understanding labor and input use in much more detail than what could be expected from our current project, becomes a necessity. At a policy change and stakeholder behavior level, developing women

leadership from the ground-up becomes an instrument of change. We intend on leveraging results from our concluding IDRC project not only to implement more in depth-research in the two target countries, but also to explore gender issues in other adopting countries. Furthermore, we will focus our attention after this project to conduct intensive policy communication and outreach activities of results obtained in this project.

3. Goal and key objectives

The mission of our project was to contribute to the development of robust, efficient and protective research, development, policy and regulatory systems that would enable decision making processes yielding appropriate and valuable genetically engineered crops and other biotechnologies to developing countries. We contributed to the project's mission, through our project goal which was developing and applying robust, cost effective and implementable gender and health impact assessment methods and guidelines for implementation that may become additional components in the overall socio-economic impact assessment procedures examining GE crops for technology assessment and biosafety/technology regulatory approval purposes.

The two key objectives in the proposal submitted to IDRC for this project were:

1) To examine the gender differentiated issues that may affect adoption and use of GE crops in developing countries; and

2) To examine the gender differentiated impacts derived from the adoption of GE crops in developing countries.

4. Project Methodology

Research methods and data collection strategies were different in both countries, providing a good snapshot of the reality at each site. In Burkina Faso, an in-depth qualitative data collection and analysis (in-depth and semi-structured interviews), along with field visits and observations, provided unique information that can be extrapolated to other countries with similar or lesser hardship conditions experienced during fieldwork.

Conversely, in the Philippines a balanced approach of quantitative and qualitative methods was put forth. It is worth mentioning that a participatory approach – to some extent – was pursued by the local researchers in the Philippines. The participatory strategy offered unique insights from the women farmers in relation to ways in which they were impacted and their livelihoods affected by the cultivation of GE crops from their own and unique perspective. Together, the qualitative and participatory components offered first-hand information in the examination of men and women farmers' roles, the exploration of existing farming patterns, and gender preferences for crop adoption and management strategies.

Quantitative research pursued in the Philippines encompassed an empirical approach to determine GE adoption using an appropriate econometric Model, and also yield and income impacts through a Difference in Difference (DID) model taking into account gender effects. Data collection was designed having in mind pros and cons that women farmers face in relation to the adoption of GE crops at the field level.

A recommendation to homogenize methodologies in both countries might have been advisable in order for findings to facilitate comparisons and reflect possible similarities or gaps that relate to the access and adoption of GE technology. Yet, both countries present very different stages of social and economic development which necessitated different methodological

approaches. In spite of the different policy states, some similarities were identified in that women farmers face a number of barriers to fully access and adopt GE crops in their livelihood strategies. While qualitative methods seem to be on target and have yielded a wealth of information, quantitative data collection and analysis can be pursued at a future stage with significant additional funding in Burkina Faso.

In the Philippines, the fieldwork was conducted in the two geographically distant sites including the Barangay Cabisera 5 in Isabella (Northern Luzon) and Barangay Olympog in South Cotabato (Mindanao). Quantitative research included survey estimation strategies such as gender differentiated adoption, estimation of econometrics/statistical models, and other indicators and approaches to impact assessment. Qualitative data collection and analysis included Small Group Discussions (SGD) with four participant groups in each village disaggregated by sex and adoption state.

The research built upon a pre- existing survey which gathered information obtained through a portfolio of 466 respondents conducted in the same region during the period of 2006-2007. The current project implemented and analysis yielding results from a survey with 278 respondents in two sites (Isabela 193 and South Cotabato 85) for the 2011- 2012 period. Also, 65 corn farmers participated in expert opinion interviews in both Barangays, apart from context scanning assessment and face-to-face in depth interviews with pre-tested questionnaires.

In Burkina Faso, a well thought out strategy included the comparison of two very distinctive cultivation regions: an industrialized production pattern and a diversified production strategy (organic, conventional and Bt cotton). Data obtained through interviews and observations with farmers in Tiefora, Hounde, Karransso-viegue, Bereba, Bikuy and Dano provided significant insights of enabling opportunities or existing constraints and were

confirmed with other information obtained through short household surveys. These surveys also detailed patterns in relation to organizational membership, gender, ethnicity, production history, the access to land and labor.

Project Activities

Table 1a (in the Appendix) describes the activities conducted during the project implementation for project management. In turn, Table 1b (in the Appendix) describes the research and policy outreach activities performed during our project. As will be seen in the description of outputs in a subsequent section, the number of policy outreach, communication and publication development completed during the implementation of the current project is not reflected in these two tables. After completing the activities described in the proposal, the research team has developed a deeper understanding of the research questions. This has been reflected in a set of proposals written for additional funding with support from the current project. Although, some of these proposals have been funded, others have not.

We expect to submit the unfunded proposals to other donors, especially those focused on examining in greater detail labor invested in conventional and biotechnology crops disaggregated by gender, and the impact that the potential adoption of a labor saving technology (such as those crops with herbicide tolerance or insecticide resistance) may have on labor patterns. In our experience during the implementation of this survey this has been largely one of the many invisible threads that have characterized agricultural production, not only in Burkina Faso or the Philippines, which may have an impact on women farmers, but in other developing countries.

5. Project Findings and Outputs

Key Findings

The Philippines case study

- Quantitative analyses show that the gender of maize producers is not a determining factor in the adoption of GMO varieties. The more important determining factors according to this analysis are maize area, farming experience, seed price, and distance from seed source.
- Qualitative analysis show that women tend to manage the whole household and farming finances but their main priority is the household immediate needs. This implies that there may be issues with decision making in the explicit farming context. For example, if money is tight women may choose not to apply optimal input levels in order to cover household expenses.
- Both the qualitative and the quantitative assessment show that there may be some labor specialization but that this is actually born out of necessity. Household members can and do complete specific tasks when needed.
- Farmers in Isabela in northern Luzon tend to produce maize as a monocrop. This may expose them to a financial risk as farmers may endure imperfect financial market conditions where local financiers may exercise localized monopolist positions. In contrast, farmers in Mindanao tend to be diversified producing multiple crops which may be a response to monsoon type weather. This may be a successful strategy to manage not only weather but also financial risk. More studies need to be done to explore more in depth not only individual farmer characteristics but also their context.
- Regression results show that using GMO varieties significantly decrease the labor-days of hired female labor in the farm. This was expected since more than 70 percent of the producers were using the stack variety with the herbicide tolerance trait. Considering that

more of the hired female workers are concentrated in the weeding operations, the use of herbicides to control the weeds has lessened the need for hired labor.

Burkina Faso case study

- In the areas where research was conducted, there were no women cotton farmers, other than those planting low-yielding organic cotton that has been promoted and funded by international NGOs and require no access to modern inputs . Modern inputs, including Bt cotton, can mainly be accessed through village farmers' groups (GPCs) that are provided with these inputs by the national cotton farmer association (UNPC) and the cotton industry association (SOFITEX.) Since in our study areas women appear to have no rights of alienation to land or even access to their own land, and land being the main collateral accepted by GPCs, women are unable to formally join those GPCs making them ineligible to access GPCs/UNPC/SOFITEX funneled inputs, including Bt seeds.
- Women participation in cotton production is, nevertheless, widespread and concentrated in tasks that are time consuming but socially undervalued, such as planting, weeding, harvesting, and fetching water for pesticide applications. Successful male farmers count with a secure supply of family labor (wives and children) to fulfill the high labor peak times, particularly planting and harvesting.
- The benefits of Bt technology to women and children are related to the reduction of insecticide applications. In Burkina Faso the reduction of insecticide application has been done according to guidelines and the number of insecticides provided by GPCs to their members that plant Bt have been reduced from 6 (for conventional cotton) to 2(Bt cotton). We have estimated that the reduction of one insecticide would represent saving a woman 3 trips to the source of water, assuming that in each trip a woman carries 5.2

gallons of water. The effects of this savings over women's health and their overall welfare is yet to be estimated and would need to take into account the actual distance/time women spend fetching water and what women are actually doing with this saved time.

Project wide findings

- We have identified the need to further refine the integration between qualitative and quantitative approaches to research. In our opinion, a useful sequence that is likely to yield quite significant output and research outcome is having a sequential approach where qualitative field approaches help to define the research questions and important gender issues in a first step. In a second step, implementing teams can perform quantitative and additional qualitative approaches to address these issues in greater detail.
- If conventional quantitative and even qualitative research approaches reach conflictive or non-conclusive results, additional qualitative approaches such as small group discussions can help identify those invisible threads and the inherently complex dynamics which characterize households and agricultural productions in developing countries.
- When comparing the different gender issues which may affect (or be affected by) agricultural production and technology adoption in quite different countries such as Burkina Faso and the Philippines (including Colombia and South Africa), one of the key findings is that even though the gender literature emphasizes the relationship between gender and asset control, this relationship may in fact be more complex than these two issues. Our experience in these countries seem to point out that even when women may have access and even control of productive assets, other issues related to the agricultural

production of the household may impinge of production decisions. Furthermore, there may be different decision making rules that differ between genders.

- Gender differentiated knowledge access and use is quite complex. As described in all the studies conducted, women farmers may indeed have different pathways by which to access information and knowledge about technology and markets. Thus, the need exist of re-examining current approaches to technology development and transfer and extension/producer education efforts done by the public and the private sector which are sensitive to these differences.

Research

Research reports

1. "Field Report on Gender and GM cotton in Burkina Faso" Isidore Lobnibe, Patricia Zambrano and Patricia Biermayr. ◘[1]
2. "Gender Impacts from the Adoption of Genetically Modified Maize in the Philippines." Jose M. Yorobe, Jr. and Daylinda B. Cabanilla. Final report submitted to the International Food Policy Research Institute (IFPRI) as part of the IFPRI-IDRC Project on *Gender and Health Impacts from the Adoption of Genetically Engineered Crops: Supporting Biotechnology and Biosafety Decision Making in Developing Countries*.
3. "Gender and Biotechnology Relevant Policy Issues for Burkina Faso and The Philippines: A Report of Research Activities Conducted Though IDRC's Support." 2013. A report by Patricia Biermayr-Jenzano on the project funded by International Development Research Center (IDRC) and executed by the International Food Policy Research Institute (IFPRI).
4. "Evaluation Report for the Project Gender and Health Impacts of Genetically Engineered (GE) Crops in Developing Countries" (Burkina Faso and the Philippines)". 2013. A report by

[1] Outputs previously submitted to IDRC are marked with a ◘.

Patricia Biermayr Jenzano on the project funded by International Development Research Center (IDRC) and executed by the International Food Policy Research Institute (IFPRI).

5. Zambrano, P., Maldonado, J. H., Mendoza, S. L., Ruiz, Fonseca, L.A., and Cardona, I. 2011. Women cotton farmers: Their perceptions and experiences with transgenic varieties. IFPRI Discussion Paper 01118. Washington, D.C. International Food Policy Research Institute (IFPRI).

Papers published in scholarly journals

1. "Transgenic Varieties and Gender: The Case of GM Cotton in Colombia and Burkina Faso" Patricia Zambrano, Isidore Lobnibe, Jorge Maldonado. Paper submitted to *GeoForum* at the Association of American Geographers. ◘
2. Zambrano, P., M. Smale, J.H. Maldonado, & S.L. Mendoza. 2012. Unweaving the Threads: The Experiences of Female Farmers with Biotech Cotton in Colombia. *AgBioForum*, 15(2), 125-137. Available on the World Wide Web: http://www.agbioforum.org.

Proposals and concept notes developed for additional funding for gender and biotech research

The project help the research team develop the following proposals for funding:

1. Proposal "GM maize and women in South Africa" submitted to USAID and US Department of State for US$50,000. *Funded*. ◘
2. Proposal "Global Value Chain, Information Flows and GM Cotton Impacts in Burkina Faso, South Africa and Kenya" submitted to the Templeton Foundation for US$ 200, 000 as a planning proposal leading to a larger project in the range of 1-2 million US$ in their next planning and funding cycle. This proposal incorporates gender and the value of information as it affects the cotton value chain. *Funded.* ◘
3. Proposal "Empowering women as agricultural technology decision makers" proposal submitted to the new CRP2 fund mechanism within the CGIAR. *Not funded but plan to submit to other donor.* ◘
4. Proposal "Empowering Women as Decision Makers and unleashing women farmers' potential as GE crop users" proposal submitted to USAID Annual Program Statement "APS No: APS-OAA-11-003 -- Innovations in Gender Equality (IGE) to Promote Household Food Security Program. *Not funded but plan to submit to other donor.* ◘

Special issues published in scholarly journals

The following special issue and article does not have an explicit focus on gender and biotech impact assessment and/or are not one of the two target countries selected for the project. Nevertheless, funding from IDRC helped fund time for Jose Falck-Zepeda and Patricia Zambrano to work on developing the gender paper in Colombia and the development of the special issue itself. The original project that developed the content for this special issue was another IDRC funded project granted to IFPRI and to which all researchers belonged to the research team in that project.

"Farmers and Researchers Discovering Biotech Crops: Experiences Measuring Economic Impacts among New Adopters" A Special Issue of *AgBioForum*, Melinda Smale and José Falck-Zepeda, Guest Editors, Vol 15, Number 2, 2012.

- Smale, M. Rough Terrain for Research: Studying Early Adopters of Biotech Cops. *AgBioForum*, 15(2), 114-124. Available on the World Wide Web: http://www.agbioforum.org.
- Zambrano, P., M. Smale, J.H. Maldonado, & S.L. Mendoza. Unweaving the Threads: The Experiences of Female Farmers with Biotech Cotton in Colombia. *AgBioForum*, 15(2), 125-137. Available on the World Wide Web: http://www.agbioforum.org.
- Falck-Zepeda, J., A. Sanders, C. Rogelio Trabanino, & R. Batallas-Huacon. Caught Between Scylla and Charybdis: Impact Estimation Issues from the Early Adoption of GM Maize in Honduras. *AgBioForum*, 15(2), 138-151. Available on the World Wide Web: http://www.agbioforum.org.
- Yorobe, Jr. J.M. & M. Smale. Impacts of Bt Maize on Smallholder Income in the Philippines. *AgBioForum*, 15(2), 152-162. Available on the World Wide Web: http://www.agbioforum.org.
- Gouse, M. GM Maize as Subsistence Crop: The South African Smallholder Experience. *AgBioForum*, 15(2), 163-174. Available on the World Wide Web: http://www.agbioforum.org.

- Birol, E., M. Smale, & J.M. Yorobe, Jr. Bi-Modal Preferences for Bt Maize in the Philippines: A Latent Class Model. AgBioForum, 15(2), 175-190. Available on the World Wide Web: http://www.agbioforum.org.
- Smale, M., P. Zambrano, R. Paz-Ybarnegaray, & W. Fernandez Montaño a Case of Resistance: Herbicide-tolerant Soybeans in Bolivia. *AgBioForum*, 15(2), 191-205. Available on the World Wide Web: http://www.agbioforum.org.

Planned publications and other outputs

Journal articles

1. Hiding in Plain Sight: Women and GM Crop Adoption" Patricia Zambrano, Isidore Lobnibe, Daylinda B. Cabanilla, Jorge H. Maldonado, and Jose Falck-Zepeda. Paper planned for submission to Science or World Development October 2013.
2. Gender and the Adoption impacts from Bt maize adoption in the Philippines. Jose Yorobe, Jr., Daylinda Cabanilla, Patricia Zambrano and Jose Falck Zepeda. Paper planned for submission to Agricultural Economics October 2013
3. Gender and seed technologies: Lessons for agricultural biotechnology research and innovation. Patricia Biermayr-Jenzano, José Falck-Zepeda and Patricia Zambrano. Paper planned for submission to Research Policy November 2013.

Program for Biosafety Systems (PBS) Policy Notes

1. Gender Considerations in the Adoption of GM Crops in Developing Countries. Patricia Biermayr-Jenzano, Jose Falck-Zepeda and Patricia Zambrano.
2. Gender and biotech adoption in the Philippines. Jose Yorobe Jr., Daylinda Cabanilla, José Falck-Zepeda, Patricia Zambrano and Patricia Biermayr-Jenzano.
3. Gender and biotech adoption in Burkina Faso. Isidore Lobne, Patricia Zambrano and Patricia Biermayr-Jenzano.
4. Hiding in plain sight: Women and GM crop adoption in Burkina Faso, Philippines and Colombia. Patricia Zambrano, Isidore Lobne, Daylinda B. Cabanilla, Jorge H. Maldonado, and Jose Falck-Zepeda.

Policy communications and outreach

Conference presentations

1. "Hiding in Plain Sight: Women and GM Crop Adoption" Patricia Zambrano, Isidore Lobnibe, Daylinda B. Cabanilla, Jorge H. Maldonado, and Jose Falck-Zepeda. Paper presented at the 17th ICABR Conference: Innovation and Policy for the Bioeconomy, Ravello (Amalfi Coast – Italy), June 18-21, 2013.
2. "Gender and transgenic cotton Colombia and Burkina Faso" Patricia Zambrano and Isidore Lobnibe. Presentation made by Patricia Zambrano at the Annual Meeting of the Association of American Geographers, in the side session "Genetically Engineered Geographies in the Global South" organized by Brian Dowd-Uribe, Columbia University, February 24, 2012 New York City, New York. ◘

Special events in conferences

1. October 1-5, 2012, a project team consisting of Jose Falck-Zepeda and Patricia Zambrano participated in the COP-MOP6 of the Cartagena Protocol on Biosafety in Hyderabad, India by organizing a side event at the meeting with a focus on socio-economics assessments and biosafety/biotechnology decision making additional side events in other conferences in the near future that will include gender and biotech.

Figure 1 Team members at the COP-MOP5

2. August 18-24, 2012 Jose Falck-Zepeda, Patricia Zambrano and Patricia Biermayr delivered a side event at the International Association of Agricultural Economics (IAAE) in Rafain Convention Center, Foz do Iguaçu, Brazil. The focus was on the gender and public health impacts from GM crop adoption in developing countries. Jose Falck-Zepeda and Patricia Zambrano organized the side event "Gender, Public Health, Nutrition and Biotechnology - A symposium on issues and views" at the IAAE conference Iguaçu Falls, Brazil, August 19-24, 2012.

3. 11-15 October 2011, Jose Falck-Zepeda and Patricia Zambrano lead IFPRI and Program for Biosafety Systems (PBS) participation at the COP-MOP5 in Nagoya Japan. The side event discussed not only the experience with socio-economic assessments –including the IDRC-IFPRI phase I case studies and bECON- but also introduced the gender project.

Project Outreach

1. September 19, 2012. Jose Falck-Zepeda made the presentation "Socioeconomic considerations in the Context of the Cartagena Protocol on Biosafety and National Regulations" made at the ISBGMO Conference, St. Louis, Missouri.
2. July 23-24, 2012. Patricia Zambrano and Jose Falck-Zepeda invited to speak on socio-economic issues and biotechnology including a description of our work with gender in Colombia and Burkina Faso and the Philippines at Pioneer Hybred Seed Company in Des Moines Iowa.
3. June 15, 2012, Patricia Zambrano was invited as a presenter on the side event "Best practices and technology opportunities for farmers in South America" organized by Crop Life International at the Rio+20 Conference in Rio de Janeiro, Brazil. Debates on agriculture often pit smallholder agriculture versus large-scale agriculture. However this vision fails to take into account the variety of agriculture systems that co-exist around the world and the technologies and best practices that can be shared by farmers at different scale. The roundtable discussion will present a study on best practices in agriculture in Latin America as a basis for discussion regarding which practices can be shared and scaled up to improve sustainability and enable smallholder farmers to take advantage of market and regional integration opportunities.
4. May 26 and 27, 2012, Jose Falck-Zepeda made the presentation "Socio-economic considerations of GM crops in the context of the Cartagena Protocol on Biosafety-CBD and National Regulations" at the Agricultural Biotechnology High Level Policy Dialogue as part of the Second Senior Official Meetings (SOM2) of the Asia Pacific Economic Cooperation (APEC) in Kazan, Russia. Included gender as an important component of technology assessments.

5. March 6-7, 2012, Jose Falck-Zepeda made the presentation "Socio-economic consideration and biosafety in developing countries" Presentation made at the VALGEN Workshop "Bioproducts and Crops Regulation: Challenges and Opportunities" in Vancouver, Canada.
6. January 2012. Jose Falck-Zepeda, Patricia Zambrano and Judy Chambers (IFPRI Program for Biosafety Systems Director) were invited to do a presentation at Monsanto headquarters in St. Louis Missouri, to describe work being done at the Program for Biosafety System and at IFPRI as related to biosafety, socio-economics and other areas related to GE crops. Patricia Zambrano and Jose Falck-Zepeda presentation introduced the gender and biotech project in Burkina Faso.
7. June 2011, Jose Falck-Zepeda organized a Policy Roundtable on Socio-Economic Issues at the ICABR 2011 Conference "Socio-Economic Considerations, Biosafety, Biotechnology and Decision- Making. "In the side event gender was discussed as part of the technology assessment process and the IFPRI gender and biotechnology project was introduced to the ICABR community.

Capacity

Capacity development and policy activities

1. Presentation of project results conducted in Ilagan, province of Isabela, Northern Luzon, Philippines

Figure 2 Presentation of results at city of Ilagan

Team members in the IDRC funded project "Gender and Biotechnology in Developing Countries" led by Jose Falck-Zepeda, in close collaboration with their partners at the Department of Agricultural Economics and the Department of Social Forestry-College of Forestry and Natural Resources of the University of the Philippines Los Baños, organized a preliminary results workshop to present results to the communities in the Province of Isabela in northern Luzon involved in the field survey collecting knowledge about the adoption of insect resistant/herbicide tolerant maize in the Philippines.

The workshop organized with the Provincial governments and with the provincial the Department of Agriculture of the brought together more than 50 producers region. Dr. Jose Yorobe Jr. and Dr. Daylinda described the objectives of the study and the

Figure 3 Presentation of results with participating farmers

and Local officials of Philippines, from the Cabanilla results from the study. After their presentations, producers contributed to our knowledge of their issues by responding to additional questions which helped refine the analysis and to verify results from our study.

2. Seminar on gender and biotech at the Department of Agriculture in the Philippines

This activity served as a validation of results and was a preamble to the presentation of preliminary results at a roundtable organized at the Department of Agriculture. Results from this project will help advance the socio-economic and gender assessment policy formulation in the country as part of innovation and technology decision making processes.

3. SEARCA seminar in the Philippines

Jose Falck-Zepeda, Patricia Zambrano and Patricia Biermayr-Jenzano participated in closing events for IDRC project on Gender and Health in the Philippines. The team delivered presentations at SEARCA/SEAMEO (Los Baños) and at the Department of Agriculture (Makati City, Philippines), Los Baños and Manila, Philippines. Nov28 - Dec 8, 2012.

Other capacity activities

1. Gender and biotech Mendeley database is available to all interested parties.

2. bECON, the economic impact of GM crops database developed by IFPRI, partially with IDRC funding, has been shared with other projects and stakeholders.
3. Jose Falck-Zepeda has been invited by the Value Addition to Genomics and GE3LS (VALGEN) project, funded by Genome Canada, which is being implemented by University of Saskatchewan, University of Ottawa, and other higher learning institutions in Canada and a member of its Scientific Advisory Committee to interact on the socioeconomic impact assessment experience including our gender work.
4. Jose Falck-Zepeda and Patricia Zambrano were invited by the LAC-Biosafety project, funded by UNEP-GEF and the World Bank, led by CIAT Colombia to present on socio-economic issues and gender.

Outputs not completed

We decided not to pursue an IFPRI Research Report (now known as IFPRI Monographs) as the time burden to complete such publication is longer than previously expected and would fall outside the timeline of the current project. We decided instead to pursue more policy outreach and additional scholarly publication and other communication activities and perhaps even develop later a book with the health component of this project lead by Dr. Jikun Huang at CCAP-China and the public policy project led by Dr. Linda Peñalba. More discussions will be needed to secure this potential output. This will also require more funding by IDRC and/or another donor.

6. **Meeting of Project Objectives**

Objective i) To examine the gender differentiated issues that may affect adoption and use of GE crops in developing countries **(4 –Fully met)**

Objective ii) To examine the gender differentiated impacts derived from the adoption of GE crops in developing countries (**3 – Met)**

We addressed these two objectives through field work in the Philippines and Burkina Faso, in addition to comparing and contrasting the experiences in these two countries with a pilot case study conducted in Colombia, and with experiences with GE crops and other technologies

in developing countries. The research methods pursued in both countries were well stated sound mixed approaches (qualitative/quantitative) in the Philippines and a qualitative approach in Burkina Faso.

Country teams prepared reports for each country, peer reviewed publications and other outputs along with policy outreach strategies – presentations and upcoming policy briefs – are part of the outreach and dissemination process to broaden the impact and influence to a larger stakeholders' group of policy makers, researchers, government representatives, as well as the private sector.

7. Project Outcomes

Literature reviews conducted at IFPRI identified published research showing that small farmers in developing countries have benefited from the adoption of GE crops (Smale, *et al.* 2008). However, these same assessments have shown that these benefits varied significantly in relation to crop, geography, households and other production context. The studies in Burkina Faso and the Philippines reinforce the need to avoid generalizations. Considerations of issues closely related to regulatory country frameworks, crop development, crop diffusion, require further studies at the local and regional level.

The observed heterogeneity points to the need of conducting in-depth assessment. While the findings of this research are circumscribed to the case study countries, this information is indicative of important drivers that enhance both male and female farmers' livelihoods and can be put into context in other countries at the same stage of adoption. The research builds upon a growing conceptual framework that emphasizes the need to find suitable strategies, reaching out to the farmers through knowledge sharing avenues, while tapping into potential benefits not confined to crop higher yields alone.

From a strict development point of view and taking into account a sound approach to gender, the impact of this research is highly relevant and unique in its aims to find points of entry to support women farmers to access and use GE technology, while trying to understand the ways in which they benefit from this adoption. Other outcomes that are worth mentioning besides increases in crop yield include potential savings in time and labor, health related benefits (chronic and acute effects of pesticide poisoning) and possible investments of cash received for crops sold at the markets being directed to household food security.

The relevance of this research goes beyond exploring the contextual situation of the countries where research took place, as it identified potential improvement in women farmers' livelihoods by adopting an innovative technology such as GE crops. The findings in the current project provided needed information that will need to be urgently diffused even more through local networks and regional organizations in order to facilitate engagement with different stakeholders. We now describe outcomes identified during the implementation of the project. As with conventional outcome mapping exercises, a reasonable expectation from any specific project is to contribute to achieving low and moderate outcomes, while the high outcome level becomes a desired state of nature.

The literature on the social and economic impact of genetically modified (GM) technologies is extensive and continues to grow, particularly for countries where the technology has been commercialized. Despite this increasing interest, researchers, with few exceptions, have failed to address the gender dimensions of the adoption of these technologies. Our own literature review during this project has confirmed this fact. Experiences in both Burkina Faso and Colombia show that as with any technology, women may face limiting factors such as access to information, credit, and control of land, but there exist some common underlying features with

the potential for gender equality to unleash benefits for the society as a whole, and for women and their families in particular. Women farmers are productive engines in society and are also profitable clients of enhanced technologies. A focus on gender provides a new dimension to understanding adoption patterns of GM cotton and thus important lessons for technology conceptualization, R&D and technology deployment. In the end gender is a matter of production and innovative "efficiency" thus addressing gender issues can and will improve social returns to investments for R&D and innovative capacity.

Experiences in both countries have shown that women are active participants in crops conventionally viewed as "male" crops. Furthermore, women and men have positive but dissimilar views about GM cotton and have more limited access to technology compared to men. In contrast, in the Philippines women have an active role in managing the finances in the household and for productive activities such as cultivation of Bt maize. Yet, there are significant ways in which maize is cultivated between regions, whereas Isabela province in Northern Luzon tends to be commercial cultivations, in Mindanao tends to fit within a more diversified and smaller production units.

Results from our study re-confirm results from other studies in that women are an important factor in the productive process. Yet, the need exist to tailor not only the specific technology for deployment, but also the approach by which new technologies, crops and traits are identified as limiting and the process by which they are deployed to all farmers with a specific and practical understanding of an important client segment that women are in production value chain. We believe that one way this is to go beyond the study of conventional obstacles confronting women in other areas of agriculture in developing countries such as access to credit and land to include access to information and the use of labor saving technologies such as those

that GM can bring to the productive process. In both Colombia and Burkina Faso this factor has so far been overlooked both by researchers and those commercializing these crops. In the end, increasing significantly attention to addressing the role of information and knowledge while explicitly targeting women is good business that will also provide benefits for the society as a whole.

Field building

The project has contributed to testing of quantitative and qualitative methods which have been used in a set of field studies as related to gender and GE crop adoption and use. Our expectation is that additional intensification of our policy outreach and communication activities after the conclusion of the current project, we expect to address the moderate and to contribute to the high level outcome significantly.

Indicative evidence

- We have thoroughly searched the literature and have verified that there is very few literature on the relationship between gender and GE crops
- We have developed a literature review document on the relationship between gender and improved seed technology to identify issues relevant to the discussion of GE crops. Literature has been made available through Mendeley and will be made available through IFPRI's Knowledge Libraries. We will also publish this review in a scholarly journal publication.
- We have conducted a side event on gender and public health assessments as related to GE crops at the International Association of Agricultural Economists in Iguazu Falls, Brazil, August 2012. This is the premier venue for economists involved with international development and developing countries.

- We have established several contacts with relevant organizations and persons to disseminate work done by the team including FAO, ICABR, VALGEN, LAC BIOSAFETY, USDA and USAID.

Partnerships and networking

The project achieved an impact by improving project partner's capacity to implement field studies incorporating gender as related to GE crop adoption and use. The implementing team is being recognized as knowledge source to gender and biotech issues and by contributing to different stakeholders understanding and decision making capacity. Some in-country discussions are starting to include gender, the concluded project contributed to this process. Our expectation is that additional intensification of our policy outreach and communication activities after the conclusion of the current project, we expect to address the moderate and to contribute to the high level outcome significantly.

Indicative evidence

- Established a link with the UP-LB Public Policy led project financed by IDRC in visits by Jose Falck-Zepeda and the research team
- Conducted a joint results synthesis workshop in the Philippines with the UP-LB Public Policy project also funded by IDRC. We also conducted a seminar under the SEARCA/SEAMEO cycle of presentations.
- Identified the following derivative proposals for further work in Burkina Faso and other cotton adopting countries. We have plans to expand the current coverage to other countries, crops and traits in Latin America, Asia and Africa in order to pursue additional resources to conduct research in those issues and questions identified in the concluded project.
    - Concept note "Burkina Faso: Measuring Bt cotton direct and indirect benefits to women" was developed by Patricia Zambrano. This note proposes a detailed examination of labor used and saved from the reductions in the number of pesticide

sprays and labor required to carry the water needed to conduct such sprays. This would also include an examination of how this labor is used. Concept to be submitted to a donor.

- Concept note "From "women's cotton" to coton-bio in Burkina Faso: What are the gender-related policy lessons?" was developed by Patricia Zambrano. The concept note explores the beneficial direct and indirect effects that organic cotton has created for women to access the opportunities of cash crops, even if limited, shows that there exists channels to make it possible for women farmers to become not only organic cotton, but also potentially conventional and Bt producers. The objective of the proposed research is to identify the specific circumstances that can enable women to be direct beneficiaries of cotton production and particularly of Bt cotton. In a society where women have limited access to land, given the fact that patrilineal groups dominate and administer land and where the senior male household member has all privileges, it is enlightening to confirm that women can begin to take some control of their fruits of their labor, even under these restrictions that land and cultural norms have imposed upon women. Concept to be submitted to a donor.
- Proposal "GM maize and women in South Africa" funded by USAID and US Department of State for US$50,000. Proposal granted - review of existing data set will start soon, field work later this year.
- Proposal "Global Value Chain, Information Flows and GM Cotton Impacts in Burkina Faso, South Africa and Kenya" submitted to the Templeton Foundation for US$ 200, 000 as a planning proposal leading to a larger project in the range of 1-2 million US$ in their next planning and funding cycle. This proposal incorporates gender and the value of information as it affects the cotton value chain. Planning proposal granted, developing a full proposal for further work.
- "Empowering women as agricultural technology decision makers" proposal submitted to the new CRP2 fund mechanism within the CGIAR. The activity will develop and deliver a multi-layered, action-oriented approach to empowering women as decision makers in the adoption and implementation of innovative agricultural technologies. The approach will comprise three complementary components; an empowerment strategy and process, best practice guidelines, and supporting awareness-building and

communications materials. Focus will be on agricultural technologies that benefit women and their families, such as labor saving, yield increasing, and nutritionally-enhanced crop biotechnologies. A key institutional output will be a multi-stakeholder partnership among organizations focused on women in development, women's leadership roles, women in science and empowering women's roles in community and household decision making. Project funding not granted due to CRP2 funding limitations, will submit to other donors identified.

- "Empowering Women as Decision Makers and unleashing women farmers' potential as GE crop users" proposal submitted to USAID Annual Program Statement "APS No: APS-OAA-11-003 -- Innovations in Gender Equality (IGE) to Promote Household Food Security Program. Project funding not granted but will submit to other donors identified.

Capacity building

Through literature reviews and the knowledge developed during the implementation of the project, we have identified a set of core issues as related to gender and GE crops adoption and use. These issues have been communicated to relevant stakeholders in the Philippines and to some extent in Burkina Faso. We have also communicated these to the international community and different stakeholders. Our expectation is that additional intensification of our policy outreach and communication activities after the conclusion of the current project, we expect to address the moderate and to contribute to the high level outcome significantly

Indicative evidence

- January 2012. Jose Falck-Zepeda, Patricia Zambrano and Judy Chambers (IFPRI Program for Biosafety Systems Director) were invited to do a presentation at Monsanto headquarters in St. Louis Missouri, to describe work being done at the Program for Biosafety System and at IFPRI as related to biosafety, socio-economics and other areas related to GE crops. Patricia Zambrano and Jose Falck-Zepeda presentation introduced the gender and biotech project in Burkina Faso.
- February 24, 2012. Patricia Zambrano invited to present at the AAG Annual Meetings in New York City in the side session "Genetically Engineered Geographies in the Global

South" organized by Brian Dowd-Uribe, Columbia University. Patricia presented "Transgenic Varieties and Gender: the Case of GE Cotton in Colombia and Burkina Faso."

- June 15, 2012, Patricia Zambrano was invited as a presenter on the side event "Best practices and technology opportunities for farmers in South America" organized by CropLife International at the Rio+20 Conference in Rio de Janeiro, Brazil. Debates on agriculture often pit smallholder agriculture versus large-scale agriculture. However this vision fails to take into account the variety of agriculture systems that co-exist around the world and the technologies and best practices that can be shared by farmers at different scale. The roundtable discussion will present a study on best practices in agriculture in Latin America as a basis for discussion regarding which practices can be shared and scaled up to improve sustainability and enable smallholder farmers to take advantage of market and regional integration opportunities.
- May 26 and 27, 2012, Jose Falck-Zepeda made the presentation "Socio-economic considerations of GM crops in the context of the Cartagena Protocol on Biosafety-CBD and National Regulations" at the Agricultural Biotechnology High Level Policy Dialogue as part of the Second Senior Official Meetings (SOM2) of the Asia Pacific Economic Cooperation (APEC) in Kazan, Russia. Included gender as an important component of technology assessments.
- July 23-24 Patricia Zambrano, Jose Falck-Zepeda invited to speak on socio-economic issues and biotechnology including a description of our work with gender in Colombia and Burkina Faso and the Philippines at Pioneer Hybred Seed company in Des Moines Iowa.
- We have submitted and have received an acceptance to conduct a side event on gender, public health, and nutrition assessments as related to GE crops for the International Association of Agricultural Economists in Iguazu Falls, Brazil, August 2012. This is the premier venue for economists involved with international development and developing countries.

Policy influence

We are in the process of formulating a refined strategy designed to achieving the low outcome level described in the policy outcome table above. This will include the strategy and tactics to intensify our policy outreach, communication and other activities with relevant

stakeholders. We expect that post project activities will help develop policy influence in partner countries and in others relevant forums and stakeholders.

8. Lessons Learned

Strategic lessons

There are important reasons for pursuing a gender perspective and analysis in the adoption of GM technology. As results from our project show, even though the number of studies exploring GM adoption has grown exponentially, social concerns, gender implications and women's welfare have been for the most part neglected with few exceptions. Notwithstanding, there seems to be a renewed interest in the inclusion of a gender analysis in recent times as part of a major effort to acknowledge the role of gender in agricultural development as a driver of reaching food security and growth. The well documented pieces of research previously analyzed and the in-depth case studies shed light on some important distinctions about men and women farmers' issues that directly affect their capability to adopt the new GM technology.

What follows is a summary of qualitative benefits and gains in the adoption of GM technology identified during the implementation of our project. These outcomes have been reported by women farmers in our study and in studies identified in our literature review.

- Increased crop yield and consequently access to more income. Income may be directed to household food security, health and children's education. The extra cash may also be invested in other productive means such as cultivation of other cash crops or productive assets.
- Economic savings due to the reduction in the number of pesticide spraying. This is perhaps one of the most often reported positive outcomes for both men and women farmers.
- Reduced field labor that included weeding, fetching water, preparing pesticides and others, resulting in substantial time saved especially by women. Women may then invest their free time in other income generating activities while attending other households' chores – children and the elderly. This may open the possibility of women undertaking advantage of possible educational opportunities and leisure

- There are potential positive health implications derived from the reduced number of pesticide applications for some GM crops, as this development diminishes the probability of pesticide poisonings and/or being affected by undesirable side effects
- The possibility of negative environmental impact decreases. This outcome has an important implication in relation to public health improvement as a direct result of the decrease in pesticide use through less pollution of soil and water bodies and reduced impact on non-target insects)
- Potential decline in pest infestation in the cultivated area reaching an environmental balance that benefits other crops also tended by women. GM technology has been included as part of integrated pest management (IPM) strategies in some countries (e.g. Bt cotton in China)
- Consensus that the adoption of GM crops may lead to environmentally sound and soil conservation techniques (low-till) that are beneficial for all farmers
- Personnel management implications in terms of time and cash. The supervision of field workers lessens due to the reduced number of pesticide applications and also other selective field chores diminish under field conditions.
- Empowerment due to mastering new technology and economic gains for the women themselves and their families.

Project management lessons

Burkina Faso

- All the planned field work was completed in Burkina Faso. During the implementation of our project, we started developing a more detailed follow-up to the first round field research activity focused on examining the relationship between labor and water use. With the resources available in the project we could not implement this activity as we realized that in order to measure the relationship between labor, water use and drudgery that would yield representative lessons of the situation in Burkina Faso it would need substantial resources to implement.
- The relationship between labor, water use and drudgery, was identified as an important impact from Bt cotton adoption in Burkina Faso especially as women have to carry the water to conduct pesticide knapsack sprays in the field. Since water has to be carried to the

spray site and thus is a burden to women and children who do this work. We are developing a funding proposal that will allow us to conduct field data collection to quantify labor used on this practice as part of an in-depth study.

- The political situation in Burkina Faso as related to Bt cotton is complicated as there have been a couple of reports of failures and abandonment by the cotton authority of Burkina Faso of the Bt cotton technology by NGOs, which have later been proven false. In addition, there have been significant tensions between different actors in the cotton value chain including those involved with planting Bt, conventional and organic/fair trade cotton. These tensions have drawn serious sensitivities within government and with different actors in terms of discussing Bt cotton and any issue related with its cultivation.
- These political developments will require a more nuanced policy outreach approach. This will necessitate broader consultation to identify an approach that will allow effective policy outreach and to navigate this new political development. This approach is likely to develop an enhanced contribution to the policy debate in the country, but this will be a challenge given the current unrest and tensions between the different stakeholders.

The Philippines

Field work and subsequent data analysis was also completed in Philippines. We have presented results to different stakeholders including many producers involved in the survey. As a side note, the Philippines is a case that highlights our attempt at addressing a latent ethical issue where participants in surveys are owed a reporting of findings in any study. We have also completed policy outreach activities while interacting with other policy research teams including one currently being funded by IDSRC at the School of Public Policy under the leadership of Dr. Linda Peñalba.

Policy implementation recommendations

Several recommendations can be drawn from the literature. These conclusions support the case for gender analysis in GM adoption studies and perhaps for broad productivity

enhancing policies that may be implemented in developing countries. Nonetheless, broad generalizations should be considered carefully, as much of the research presented here is highly contextualized. First, special attention should be paid to the absence of gender analysis and lack of disaggregated data across studies including regions, crops, and social and environmental contexts. These gaps underlie the need to include a gender lens throughout research and project/program design and policy proposing the collection of both quantitative and qualitative data to reinforce the understanding of bottlenecks that prevent women farmers from adoption of GM technology at the household, community and market levels along with needed points of entry for government intervention.

The analysis should also be helpful to understand women's priorities and desires to experiment with crops that have particular value for their local contextual households and environments. The importance of addressing pervasive barriers, including accessibility of seed, inputs (fertilizers, etc.), information, credit and critical management issues might not differ dramatically from the aspects that pertain to the cultivation of improved varieties, however, costs and regulatory issues related to the cultivation of the new GM crops raise a new bar for women farmers and need to be addressed. Attention to these constraints can make a big difference in the welfare of women farmers with a potential new avenue to access food security and cash. The following are relevant recommendations for addressing social and structural policy issues related to the gender and biotechnology debate in order to enhance women's access to GM technology.

1- Capacity development initiatives to improve women farmers' access to information and extension should be prioritized. Targeting women through non-formal –extension and education- strategies are an imperative. This is not different from the adoption of other agricultural techniques, but plays an important role in the adoption and proper handling of

GE technology. Publicly funded educational efforts and a more prominent role of NARS in spreading the technology can facilitate women farmers' learning opportunities. While informal education is essential, as has been highlighted in our case studies in Burkina Faso and the Philippines, there is a need to recognize time limitations and cultural barriers to attend technology transfer activities such as field days which has been the traditional approach. If the desire is to target more women farmers, then looking for alternatives such as women-only events conducted at culturally acceptable places such as church, chief household, schools, and community centers become a viable approach.

2- Development of adequate and easy to follow materials using local languages which are adapted to their cultural context can be developed and tested in order to enhance technology diffusion. Women farmers who have been provided with guidelines and training materials to handle new GE technology have shown to be thorough, following this information when provided. This was a salient feature of the experience in Colombia with insect resistant cotton.

3- Technology deployment agencies are advised to convey realistic messages in relation to the potential of GE crops to perform and tackle important, biotic or abiotic problems, which in general, are not easily addressed through conventional plant breeding or other pest control methods. Women farmers may be more likely to farm on marginal plots which severely disadvantage their productive capability and may affect disproportionally their intake of GE crops.

4- At the national level, governments are advised that the need of building a consensus about GE diffusion strategies and promote information sharing including crop choices is critical. In this respect the inclusion of women's crop choices, not only those focused on commercial or

market crops are a must. Coordination strategies between public and private sectors with a focuses on broader agriculture, health, and environment are central to leveraging cross-sector synergies, taking into consideration small farmers' needs.

5- Experience with other seed and vegetative materials diffusion has shown that participatory methodologies can be part of any strategy when developing GE crops. Women's inclusion in well-known and effective approaches such as farmer's field schools and farmer-to-farmer initiatives provide breeders with a unique lens to learn from drivers of adoption and traits selection to be considered when crops are being developed.

6- Marketing strategies that provide with a small quantity of seed can help stimulate adoption of GM seeds by women farmers. Small seed packages have shown, for example to be very effective in the adoption of improved varieties, alongside with inputs offered in affordable quantities in Africa. Further study is needed to refine this approach for the case of GE crops.

7- The development of contextual technical guidelines including appropriate diffusion strategies, which take into consideration regulatory aspects and other issues, related to crop accessibility and adoption by small farmers –particularly women farmers- will need to be developed. This should not be a simple "check list" but must reflect those opportunities and constraints in relation to regulatory frameworks and guidelines for small farmers to be able to comply with regulations such as the case for crop resistance management strategies such as refugia.

8- Developing countries that are at various stages of adoption need to invest in the development of production enhancing assets and regulatory frameworks besides regulatory policies. This approach will likely emphasize the role of GM technology to address food insecurity. Gender implications in this respect are paramount to enhancing the "menu" of crops to be improved

and released, and also to redesign the commercial agenda of both public and for profit sectors.

Finally, there is a need to focus on the gender aspects related to biotechnology development and adoption. This does not only imply focusing on the selection of a few particular crops relevant to a specific gender, but more broadly on the exploration of how biotechnology is developed and regulated in research institutions and political structures alike in individual countries. Oftentimes, the most profitable crop options might not be the most beneficial for women farmers in relation to time constraint and labor, even though cash gains might be higher. In this regard, aspects enhancing women's welfare –access to land, inputs, technology and labor- still play an important role and will not be resolved through the adoption of GM technology alone. A detailed analysis of biotechnology processes and considerations, as part of socio-economic assessments in biosafety regulatory process, should systematically pursue inclusive options for women farmers. In this way, women farmers may be able to embrace the technology, improve production and achieve food security, while empowering them to become active contributors to the biotechnology debate.

9. Ethical considerations

The main ethical issue raised by several stakeholders especially in the Philippines was the ethical obligation of reporting the results of the survey to farmers that participated in the survey and other relevant stakeholders. We organized a half day presentation of results with farmers jointly with the provincial and local governments in order to communicate preliminary results from the survey. These were conducted in an official language (Tagalog) by our national partners Dr. Yorobe and Dr. Cabanilla. We also presented results from our survey in a findings meeting co-

organized with Dr. Linda Peñalba of the UP-Public Policy and at seminars with SEARCA/SEAMEO and in the Department of Agriculture. More public communication efforts will need to be implemented to diffuse the results from this study.

10. Overall Assessment and Recommendations

Partnerships with Canadian organizations

The project leader, Jose Falck-Zepeda is a member of the Scientific Advisory Board of the project Value Addition through Genomics and GE3LS (VALGENTM). As indicated in its description page, VALGEN is research project is co-led by Dr. Peter W.B. Phillips, a professor with the Johnson-Shoyama Graduate School of Public Policy at the University of Saskatchewan and Dr. David Castle, Chair of Innovation in the Life Sciences at the University of Edinburgh. The project answers three critical questions about the future of genomics: Who owns it? Who controls it? Who wants it? Our project has enabled Jose Falck-Zepeda to interact with many of the staff members and researchers of the VALGEN project facilitating the discussion on socioeconomic considerations as part of a biosafety regulatory and technology decision making process that may consider gender considerations as a cross cutting issue.

Contributions to development

Gender has long been an important analytical category in furthering our understanding of technology innovation in the developing world. Research into the dynamics of gender in agriculture technology adoption, gender division of labor and spheres of responsibilities and authority, accorded to men and women in their respective contributions to the reproduction of the domestic unit has long attracted the attention of scholars and policy makers. In particular, the long recognition that cash cropping can bring about changes in gendered division of rights over

land, labor, and products and in the nature of the domestic unit makes it somewhat surprising that with few exception, researchers have not considered gender in their assessment of the impact of GM crop adoption.

This report has sought to shift and expand the contours of studies into the impact of GM crop adoption by calling attention to the inclusion of gender in ongoing socioeconomic analysis of the technology. It has also put forward new research questions arising from field observations and extended conversations held with cotton farmers in Colombia and Burkina Faso, and maize farmers in the Philippines using qualitative research instruments that allowed us to capture the voices and opinions of ordinary men and women farmers who are not always necessarily heard or taken into account using traditional survey questionnaires. Not taking into account the details behind the decision making and differentiated roles of men and women can bias the seemingly robust results of many econometric work on adoption and impacts of the technology.

There are distinct characteristics in the cotton sectors of Colombia and Burkina Faso, and maize cultivation in the Philippines because of economic background, cultural norms and their respective histories, but the overall conclusion of this comparative study is that women's participation as cotton and maize farmers in their own right remains limited, even though they are often involved in multiple key operations in the production process, along with other family members. In all countries, opportunities exist and we did find some successful women farmers, especially in Colombia, who have taken advantage of the technologies that have been made available to them. The challenge for researchers and policy makers is how to translate this experience to involve more women participation as successful and independent cotton farmers.

We believe that one way to do this is to go beyond discussions of the conventional obstacles. In presenting these findings, we recognize that it is perhaps too early to overgeneralize

the gender impact of GM crops in these three countries, hence the call for further quantitative analysis to validate these results. Moving forward, we propose the incorporation of gender in traditionally male managed crop systems such as cotton as well as combining qualitative and quantitative methods in order to address and produce more solid research questions and results. In both Colombia and Burkina Faso this factor has so far been overlooked and has just started to be taken into account in the Philippines by researchers and those commercializing these crops. Attention to information and targeting women as clients of the technology can translate not only into good business but can also can benefit women's families and society as a whole.

General lessons for future projects

We completed the field work in Burkina Faso and the Philippines. As described in the first and second interim technical report, we had a slower than expected implementation pace due to climate conditions in the Philippines particularly with flooding, but also with administrative procedures to set forward contracts and research work. We have had to face some political developments in Burkina Faso. Yet this is the nature of conducting field research having a time and budget constraints in developing countries.

Understanding the complex roles that women and men have in a productive environment requires significant resources and a quite nuanced research approach. As has been discussed in other sections of this report, our preference for conducting future research would be to have a sequential approach starting from a qualitative exploratory phase to identify and refine research questions, followed by a second step that considers qualitative and quantitative approaches to research. This may be followed by a third stage where even more nuanced qualitative approaches may be used to address issues not resolved in the first and second stage. The sequential approach is likely to be time consuming with obvious budget consequences, yet coupled with a more

integrated and coordinated approach to triangulate between experiences between countries, this may help yield even better field research results.

It is our view that this project has been of enormous value not only to IFPRI as an implementing agency but also to its research partners and to our stakeholders. We have managed to highlight the importance of gender as related to the research, development, deployment, diffusion and use of GE crops but also to technology in general. The different interactions with different stakeholders, in particular partner research teams, where we have devised and implemented qualitative and quantitative research approaches has been of immeasurable value to everybody.

The potential impact of GE crops as a poverty alleviation strategy for women farmers is significant. Our project offers several knowledge-based recommendations while proposing the design of strategies that can potentially enhance small farmers' livelihoods. The findings can be categorized in two different domains but are quite interrelated. First, the need exists for development efforts focusing on structural aspects that pertain to the women farmers' access to inputs and infrastructure such as roads, transportation and storage facilities. Second, a level that considers access to knowledge related management strategies to enhance adoption, spread and utilization. Inputs and availability of seed choice (i.e. conventional vs. GE) deserves special attention as well as access to assets, land, markets, membership to cooperatives and farmers' organizations, extension services and private advisory services.

Most importantly, this research illuminated the fact that gender and health issues have not been thoroughly incorporated into socio-economic considerations and assessments and that both are interrelated and affect technology adoption. Incorporating a gender lens for the adoption of GE crops can highly empower women farmers and the communities at large in both countries

where the research was conducted while setting the stage for future more in-depth research on these topics. Another aspect that was unveiled through this field work included changes in farming practices in both countries, and that cultivation of GE crops can be considered a labor saving technology, providing women farmers with profitable alternatives by giving them higher incomes, better employment opportunities and healthier working conditions.

The next step to pursue by IFPRI and partners can include future socio-economic impact assessment (SEA) studies that focus on the gender implications of the adoption of GE crops taking into account differences at the household, intra-household, community, market, as well as traits adoption and technology development. New studies should pursue systematic gender analysis to understand how to reach potential new users in order to focus on different sets of needs by potential male and female farmers' new adopters. At the same time, the gender assessment will contribute ultimately to lowering farmers' failure rates enhancing their potential access to the existing markets.

Future research streams on gender and health should emphasize South-to-South partnerships and information exchanges for those countries that are at different stages of the adoption process. South-to-South cooperation and policy analysis have proven to be highly effective because it looks into common problems and possible strategic solutions with a possibility to disseminate this information to other countries at the regional level or in similar stages of development.

The literature review and research conducted in this project has shown that the enhancement of strategic networks that include scientists, policymakers, practitioners and farmers associations is important as these are an important cornerstone to foster change. These networks constitute a suitable channel to pursue future strategic research to follow up

implications in relation to gender, health and biotech adoption by women farmers. While the adoption of improved varieties by the women is related to accessing assets and GE seeds, we recommend IDRC and other donors invest in more in-depth inquiries in relation to the women's selection criteria and preferred choices. . IFPRI's research has brought up a timely discussion, sharing ideas and policy perspectives focused in adoption barriers and potential policy hurdles, that in the end needed to be brought to light as well as to potential areas for gender inclusion in the adoption of GE crops and other biotechnology products in developing countries.

IDRC is strongly advised to continue providing incentives for the inclusion of gender issues in its entire research investment portfolio and to focus on more case studies which will uncover more hidden threads which permeate household and communities' decision with regard to technology adoption. Furthermore, IDRC is advised to further provide resources to finance more research and policy outreach activities that will help coordinate the innovation system in order to develop better genetically engineered crops and animals, as well as other biotechnologies that are sensitive to the needs of women farmers. This process will include improved alternatives to technology deployment and product stewardship fine-tuned to addressing the specific needs of women farmers.

This research has followed one IFPRI's specific objective of identifying mechanisms and the development of methods and grounded strategies to support sustainable productivity intensification approaches that are acceptable, accessible, and cost effective to the farmers. The study has validated a set of best practices for conducting field level research which will inform future economic and social impact assessment methods addressing the adoption, diffusion and use of genetically engineered crop varieties in smallholder farming systems for the benefit of both men and women farmers alike. We will be looking forward for additional IDRC and other

donor involvement in supporting research and policy outreach in the near future. Gender and other social concerns will be, in our view, of increased significance in helping address farmer, household and community heterogeneity especially in developing countries. Addressing and even embracing heterogeneity can only help improve the innovation and the R&D system in providing better relevant technologies. Summary recommendations for IDRC include:

- Support continued development of gender focused knowledge.
- Enhance support for the development of communication materials based on the knowledge developed in this and other projects with a target client that include policy and decision makers
- Support continued knowledge transfer in international, regional and national forums. This will help mainstream the issue of gender and technology adoption
- Support funding of research in issues identified during this research project such as the impacts of GE crop adoption on labor use, drudgery and input use differentiated by gender. The case of water use and the impact of Bt cotton on water requirements due to decreased pesticide use in Burkina Faso is a very specific example of potential field research for the near future.
- Support development of more synthesis efforts through the development of special issues in journals, books and other communication materials based on the portfolio of IDRC projects examining similar issues. For example, preliminary discussions were held to develop a book based on the work done by Dr. Linda Peñalba Southeast Asia biotech policy project and IFPRI's ender and biotech project. With some relatively modest support this type of synthesis efforts can be quite powerful in deploying knowledge.

11. Appendix

Table 1a. Activities conducted during the project implementation – project management

	2010		**2011**				**2012**				**2013**			**Deliverables**	**Progress to June 30, 2013**
Activities	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2			
Project Management															
Finalize sub-contracts with UP-LB and consultant for Burkina Faso	■													2 contracts signed and approved	Completed
Identify Gender Expert	■													1 Gender expert contracted	Completed
Inception/planning meeting		■												1 meeting report	Completed
Interim reports						■			■					2 interim project reports	Completed
Final project report												■		1 project report	Completed
Develop project Teamspace/Sharepoint	■	■												Teamspace operational	Completed

Table 1b. Activities conducted during the project implementation – research and policy outreach

	2010		2011				2012				2013			Deliverables	Progress to June 30, 2013
Activities	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2			
Finalize literature review	■													1 lit review document	Completed
Catalog available methods	■													1 catalog of methods	Completed
Identify national research teams		■												2 teams established	Completed
Conduct field work			■	■	■	■								2 research reports	Completed
Compile and analyze data and results						■	■	■						2 results database	Dropbox folder
Develop publications								■	■					2 IFPRI discussion papers 4 journal articles 2 policy briefs and 1 IFPRI Research Report	Developed 2 journal articles drafts. In progress: 1 IFPRI Discussion Paper and 4 policy briefs
Present results in international for a and COP/MOP								■	■	■				Results presented at least in two international conferences and at 1 side event at COP/MOP 2012	Results presented in at least 4 international conference, multiple stakeholders and in 1 side event
Policy outreach/education/communications								■	■	■	■	■		Demonstrated networking linkages with national biosafety authority and policy units working in assessments	Activity to be continued after completion of project. Further work will be incorporated in ongoing IFPRI gender and biotech