Journal of Environmental Science and Management 16(1) 63-71 (June 2013)
ISSN 0119-1144

Farmers' Participatory Seed Production of IPB-bred Varieties in Relation to Climate Change Adaptation

Josefina O. Narciso[1*], Pablito M. Magdalita[1*], Reynaldo B. Quilloy[1], Marilyn M. Beltran[1], Rudy S. Navarro[1,2] and Maria H. Magpantay[1,2]

ABSTRACT

The participation of farmers residing in agrarian reform communities towards the use of selected IPB-bred vegetable and peanut varieties was assessed. Purposive sampling of 18 pre-selected farmers was done and were trained on seed production and cultural management practices of these varieties at the Institute of Plant Breeding. After the implementation of seed production activities in their respective places, it was found that there was a dramatic increase in the amount of vegetable and peanut seeds produced in Antique, Samar, Davao del Sur and South Cotabato. The amount of seeds produced by farmer participants from Samar was highest at 96.2 %. In contrast, the farmer participants from La Union produced the lowest amount of seeds. In relation to climate change adaptation, based from survey, the farmers will be considering a few adjustments in the future implementation of farming activities like adjustments to be made in the planting calendar of these varieties by the farmer participants due to heavy rains occurring starting September every year. Also, farmers will implement utilization of the legume residues for composting to produce organic fertilizers which was considered by all (100 %) farmer participants. The peanut that can fix nitrogen from the air were also considered for crop rotation by majority (83.33 %) of the farmers in order to lessen the use of inorganic fertilizers causing soil acidity. Further, the farmers indicated that peanut will be utilized for sequential cropping after rice to bring back soil fertility. All farmer participants from Antique, Samar, Davao del Sur and South Cotabato indicated the further adoption of the IPB-bred varieties in future production system. There was a highly significant association of the farmer participants' selected demographic variables with the amount of seeds produced.

Key words: *adoption, farmer participation, IPB-bred varieties, peanut, vegetables*

INTRODUCTION

The participation of the farmers in the cultivation of new varieties developed by plant breeders is crucial in their successful adoption and commercialization. This is in conjunction with the ultimate objective of plant breeders that their improved varieties be known and used by farmers, growers and seed producers. In order to attain these objectives, a straightforward strategy is to involve the farmers directly in the growing and seed production of the newly developed varieties in order to disseminate the technology. A typical approach to technology dissemination to target prospective clientele is using the Participatory Extension Approach (PEA). *Hess* (*2007*) defined the "participatory" part of this approach as: farmers are the principal decision-makers in defining goals, planning, implementing, and evaluating development activities. For instance, *Woodward, Brink and Berger* (*1999*) utilized the participatory extension approach for the successful implementation of biotechnology projects in Africa. A similar approach known as the Farmer Participatory Breeding (FPB) that includes the cooperation and participation of farmer cooperators in variety development of perennial fruit crops has been implemented to hasten variety development (*Magdalita, Dayap and Valencia 2011*).

In the Philippines, plant breeding activities especially in the aspect of multiplication of breeder seeds also employs the participation of farmers. For example, at the Crop Science Cluster (CSC)-Institute of Plant Breeding (IPB), College of Agriculture (CA), University of the Philippines Los Baños (UPLB), new varieties of corn, peanut, soybean and vegetables have been multiplied by farmer-cooperators in their own farms and by cooperating government units to produce foundation seeds for distribution (*IPB 2006; CSC 2008*). In rice breeding, farmer-cooperators in Quezon and Batangas, Philippines participated in the varietal selection for specific traits of interest like high grain yield, phenotypic acceptability, early maturity, resistance to pests and diseases and suitability for rainfed conditions (*CSC 2010*). Similarly, as a support to maize breeding, farmers in Isabela, Nueva Ecija, Camarines Sur, Camarines Norte, North Cotabato and Bukidnon participated in the on-farm trial testing of selected IPB-bred corn varieties intended for high yield, resistance to major diseases and pests, improved grain quality and tolerance to drought as a response to the challenges of climate change (*IPB 2006*). In varietal improvement of fruit crops to shorten the long breeding cycle, farmers have been involved in the on-site selection and evaluation of outstanding tree genotypes resulting to the release of fruit varieties like the 'Mapino'

[1] Crop Science Cluster-Institute of Plant Breeding, College of Agriculture, University of the Philippines Los Baños, 4031, College, Laguna, Philippines jonarciso@yahoo.com and pmmagdalita@yahoo.com (*corresponding author).
[2] Retired

chico (*Magdalita, Villegas and Aquino 2001a*) 'Aguinaldo' soursop (*Magdalita, Villegas and Aquino 2001b*), 'Roja'(M*agdalita and Valencia 2009a*) and 'Amarillo' rambutan (*Magdalita and Valencia 2009b*) and 'Mabini' jackfruit (*Valencia and Magdalita 2010*). In this approach, extension tools combining farm visits, discussion meetings, training and provision of printed materials dealing on cultural management practices were implemented to benefit the farmer participants.

Local plant breeders pursue the dissemination of their varieties through various unstructured strategy like on-farm trials and farm demonstration by providing free seeds and seedlings of the newly developed variety/ies to interested parties who are willing to grow and manage the crop. Actual farm visit to assess the agronomic performance and yield of the new variety/ies, and confer with the farmer cooperator regarding their feedback with the new variety are being conducted by the technology developers.

The dissemination of new plant varieties by the CSC-IPB, UPLB-CA can be facilitated by external funding from local and foreign sources. The external support need to complement the objectives of CSC-IPB to disseminate its technologies. In this regard, UPLB through the IPB Extension and Communication Section forged a collaborative undertaking with the Department of Agrarian Reform (DAR)-Asian Development Bank-Agrarian Reform Communities Project in order to promote the utilization of IPB-bred vegetable and peanut varieties to farmer beneficiaries of DAR.

This study presents and discusses the outcome of farmers' participation on seed production of IPB-bred varieties and provision of training on cultural management of the crops to be planted by farmer participants and its relation to climate change, the profile of farmer participants and the association of farmers' profile with the amount of seeds produced, including the provision of some recommendations regarding the issues and concerns raised in the conduct on the farmer participatory breeding involving selected IPB-bred varieties. The objectives of the study are to: implement the adoption and use of selected IPB-bred vegetable and peanut varieties by the farmer beneficiaries of DAR; and find out what is the relation of actual seed production activities to adjustments in agricultural cropping system of farmers in relation to climate change adaptation.

MATERIALS AND METHODS

The study was anchored on the General Systems Theory that has been used in a wide range of disciplines (*Razik and Swanson 2001*). Briefly, the theory describes how to break whole things into parts and then learn how the parts work together in "systems". Systems are hierarchical in nature and are composed of interrelated subsystems that work together in such a way that a change in one element could affect other subsystems, as well as the whole. All systems are marked by a dynamic interaction and interdependence among the component parts which are the input, process, output, and feedback (**Figure 1**). Boundaries separate the components of the system from each other and from their environment. The input is the energizer and the operating materials of the system, while the throughput or the process is the method by which the system converts energy input from the environment into products that are usable by the system and by the environment which are referred to as output. In order for the system to survive, it maintains a balance through a feedback system.

In this study, the inputs are the farmer participants and their profile and the technology developed by IPB like the seeds of improved varieties of selected vegetable crops (bittergourd, pole sitao, eggplant, cucumber, tomato) and peanut, including a hands-on training of the farmer participants on the cultural management and seed production of the above mentioned crops (**Figure 1**). There were 18 farmer participants pre-selected by the DAR-ADB-ARCF (Department of Agrarian Reform-Asian Development Bank-Agrarian Reform Communities Project) personnel based on the capability of the farmer participant to go into seed production. This study was conducted in five places including: Antique, Davao del Sur, Koronadal City, La Union and Samar. There were two farmer participants for Antique, three for Davao del Sur, three for Koronadal City, six for La Union and four for Samar. As beneficiaries of the DAR, the respective Agrarian Reform Program Officers (ARPO) who have direct knowledge of the farming conditions of the beneficiaries, participated together with the IPB personnel in the identification of the farmers who were involved in the training.

The farmer participants were involved in the decision making as to which crops and varieties are to be grown, modification of the standard cultural management practices depending on their available resources and preferred planting schedule as influenced by climate variability in the area.

The process dealt on the use of a questionnaire that consisted two parts. First were structured questions on the demographic profile of the farmer participants that included age, gender, civil status, and educational attainment, and second were unstructured questions on the various aspects of crop production and management including the amount of seed produced of these above-mentioned crops. The questionnaire, being the main instrument in gathering data, was supplemented with interviews, technical visits to monitor the seed production areas and seed processing where technical assistance and recommendations were given to the farmers.

The output of the system was the result of seed production activities by the farmer participants after adoption of the IPB-bred crop varieties (**Figure 1**). The amount of seeds produced was assessed. In addition, the association of profile of the farmer participants with the amount of seeds produced was also assessed. Finally, a feedback system (**Figure 1**) that was made possible through another survey and personal interview were used to determine the impact of the transferred technologies on the farming system taking into consideration the implications to climate change adaptation.

Training of Farmer Beneficiaries

A training course on the standard seed production practices of bittergourd, eggplant, pole sitao, cucumber, tomato and peanut were conducted at the Institute of Plant Breeding, College of Agriculture, University of the Philippines Los Baños to transfer efficiently and systematically the technologies to the farmer beneficiaries. To capacitate the farmer participants, they were trained to implement standard cultural management practices for seed production. *Hagmann et al.* (*1999*) emphasized that farmers' capacity to adapt new and appropriate technologies can be enhanced through a participatory training approach. The same strategy was implemented by *Pokorny, Guilhermina and Westphalen* (*2005*) for public extension activities in the Amazon. In the present study, aside from the lectures provided, they were supported with hands-on exercises on planting, pest and disease identification and control strategies, crop harvesting, seed processing and proper storage.

A leveling off was conducted to initially determine the participants level of knowledge on crop production before the training, and to determine their needs that the training has to meet. Survey forms were distributed to get a clear picture of the current technical know-how the participants have and how the technologies disseminated through the training could have impacted the farming activities and living conditions.

Seed production

Immediately after the training, the participants, together with the DAR staff met to plan out for the crops and the size of area to be planted to determine the amount of seeds that will be planted. Vegetable and peanut seeds were sent to the participants prior to their desired planting dates. Seed production of vegetable and peanut was done in Koronadal City, South Cotabato, Davao del Sur, Antique, La Union and Samar. The amount of seeds obtained after harvest was determined for each area. The initial list of planting dates and crops to be planted submitted to the IPB Technical Staff served as the basis in the scheduling of the monitoring visits.

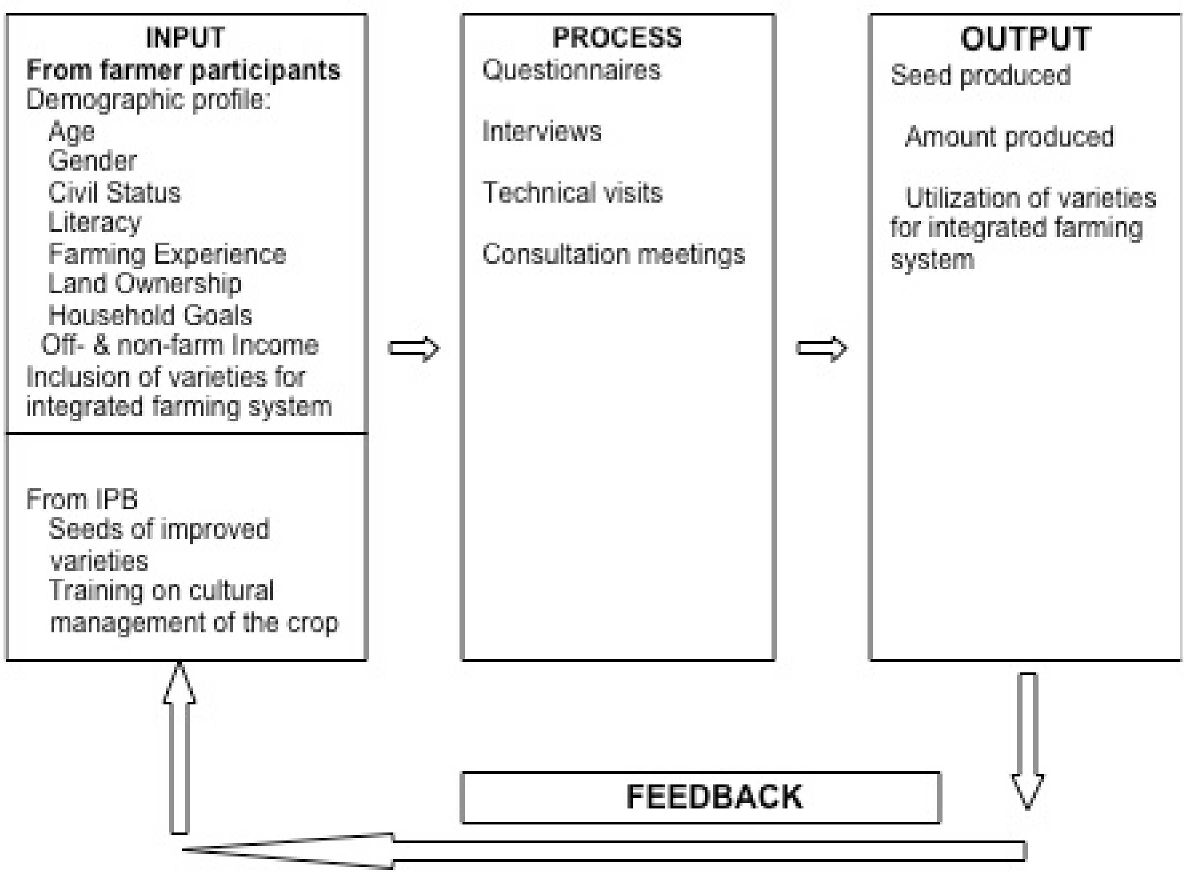

Figure 1. The modified General Systems Theory used in assessing the Farmer Participatory seed production of selected IPB-bred varieties.

Feedback

IPB project staff assessed the different farms involved in vegetable and peanut seed production during actual on-site visits. This was necessary to gather relevant information on the outcome of the participatory seed production activities of the beneficiaries. In addition, survey questionnaires were distributed to the farmer participants to determine further the growing or adoption of the varieties and their future distribution to other farmers.

Statistical analysis

The descriptive statistics using frequency count and percentage were used to describe the different variables for this study. Using purposive sampling, 18 farmer participants who actually participated in seed production training as beneficiaries of the DAR were chosen as samples. Finally, Chi-square test was used to test the association between selected demographic variables with the amount of seeds produced by the farmer participants.

RESULTS AND DISCUSSION

Profile of Respondents

Table 1 summarizes the demographic profile of the farmer participants. Majority (61.1 %) of the participants were in the age bracket of 41-50 yrs old followed by those in the age bracket >22 yrs old (22.2 %), while the least were in the bracket 61-65 yrs (5.6 %). This may suggest that seed production is an attractive activity for the adults 41-50 yrs old. Almost all (94.4 %) of the participants are male and there was only one (5.6 %) female. This conforms to the traditional practice in most rural farming communities, wherein tilling the land is an occupation dominated by males. However, since the selection of the farmer participants in seed production in this study is based on their capacity to perform the job, it is realistic to involve a female farmer participant. Seventeen (94.4 %) were married/widower while only one (5.6 %) was single. Half of the participants (50 %) were college graduates, six (33.3 %) had high school diploma while three (16.6 %) were elementary graduates. This suggests that many of the farmer participants had a high level of literacy which may be advantageous towards understanding modern agricultural management practices and receptivity to new farming technologies and innovations.

More than half (55.6 %) of the farmer participants had more than 10 years farming experience, while five (27.8 %) had 4-10 years farming experience. This suggests that majority of the farmer participants have been engaged in farming as part of their rural life for many years, since agriculture is still the backbone of the rural communities. In terms of land ownership all 18 (100 %) farmer participants are tenants. With regards to household goals, nine (50 %) of the farmer participants involved in the seed production aimed to attain food sufficiency for their family, five (27.8 %) would like to send their kids to school, while only four (22.2 %) aimed to increase their family income. Eight out of the 18 (44.4 %) earned other income from their salaries as government employee, seven (38.9 %) from carpentry works while only three (16.7 %) also earned by vending. These results may suggest that aside from farming, the participants' other main source of income is their employment in the government.

There was an increase in the amount of seeds produced after adoption of IPB-bred varieties in Samar, Antique,

Table 1. Profile of farmer participants in the vegetables and peanut production training.

Profile Indicator	Participants	
	Number	Percent of Total (%)
Age (yrs old)		
>22	4	22.2
30-40	2	11.1
41-50	11	61.1
61-65	1	5.6
Gender		
Male	17	94.4
Female	1	5.6
Civil Status		
Single	1	5.6
Married/Widower	17	94.4
Literacy		
College	9	50.0
High school	6	33.3
Elementary	3	16.7
Farming Experience (no. of years)		
1-3	3	16.6
4-10	5	27.8
>10	10	55.6
Land Ownership		
Tenant	18	100.0
Land Owner	0	0
Household Goals		
Increase Family Income	4	22.2
Attain Food Sufficiency	9	50.0
Send Kids to School	5	27.8
Off- & Non-Farm Income		
Carpentry	7	38.9
Government Employee	8	44.4
Vending	3	16.7

Davao City and Koronadal City (**Table 2**). This variety adoption helped the farmer participants solve their long-time problem on seed sourcing and high costs of commercial seeds being sold by multinational seed companies. Another benefit is they were able to produce "saved seeds" selected from good plants that can be used for the next cropping season. A remarkable increase in the amount of seeds produced was observed for Antique with 96.2 % increase. For Koronadal City and Samar the increase in the amount of seeds produced was 95.4 % and 94.0 %, respectively.

In the absence of traditional variety from which to compare the yield of the IPB-bred variety, yield increase could be due to the potential high yield trait of the IPB varieties. While there are changes in weather patterns especially rainfall, temperature and solar radiation (*PAGASA 2009*) during the growing period of the different varieties, they could have adjusted accordingly since they were previously tested over a wide range of environments when these varieties are still undergoing adaptability trials in different places in the country, hence their resiliency. While climate change generally affects crop productivity (*Lantican 2001*), the IPB-bred vegetable and legume varieties including 'Sta. Rita' ampalaya, 'Bituin' cucumber, 'Dumaguete Long Purple (DLP)' eggplant, 'Sandigan' pole sitao, 'Rica' tomato, 'Mistiza' eggplant, and 'Biyaya' peanut are adjustable to these conditions. For example, F_1 hybrid tomato varieties like 'Rica', 'Asunta' and 'Ara' are off-season varieties that can stand either extremely dry or wet conditions (*Narciso and Balatero 2010*) since they were bred specifically for these extreme weather conditions. This observation is similar to actual yield increase of hybrid maize under site specific nutrient management system in Samar following the farmer participatory approach (*Fulgueras, Palada and Arroyo 2011*). Furthermore, a similar yield increase of 79 % was observed by the Department of Agriculture farmer beneficiaries in Davao del Sur using certified rice seeds plus a package of cultural management technologies such as fertilization, irrigation system and postharvest facilities (*Dumayaca et al. 2011*).

In addition, the implementation of sound standard cultural practices particularly fertilization and pest control that were imparted to them during the training probably contributed to the promotion of crop growth and eventually increase the yield. A minimal increase of 47.0% in the amount of seeds produced by farmer participants from Davao del Sur was observed. This is due to the unfavorable weather conditions during the growing season in Davao del Sur like the frequent cloudy days and unforeseen outbreak of pest problems causing reduced crop yields.

On the other hand, there was a considerable decrease in the amount of seeds produced in La Union. This reduction is due to major problems in their production system such as the failure to implement the recommended cultural management practices for the different crops, including the outbreak of rodent infestation of the crop plus insufficient supply of water during the growing season. The sudden proliferation and occurrence of pests like rodents caused by a shift in temperature and increased or decreased frequency of rainfall due to climate change is often reducing crop productivity and yield (*Raymundo 2011*). In addition, lack of water during the growing season brought by climate change is generally contributory to decreased crop production (*Lansigan 2008*).

Based on the survey conducted, because of these climate-related constraints, the farmer participants are willing to make adjustments in their planting schedule to avoid the unfavorable weather. Instead, by making these adjustments, the farmer participants will be able to take advantage of the sunny days that are favorable for land preparation and planting (**Table 3**). In La Union, November is the planned month of planting but on the next planting season it will be moved to June. In the case of Samar and Antique, October is the planned date of planting, but it will be adjusted to November in the succeeding cropping season. For Davao del Sur, the scheduled month of planting is September, but it will be moved to January the following year to take advantage of the available soil moisture that accumulated during the rainy season. In addition, for Koronadal City,

Table 2. The amount of seed produced from selected IPB-bred vegetables and peanut varieties.

Province	Number of Farmer Participants	Crop/Variety Grown	Initial Amount of Seed Received by Participants (kg)	Seed Produced (kg)	Percent Increase
Antique	2	vegetables ('Sta. Rita ampalaya, 'Bituin' cucumber, 'Sandigan' pole sitao	7.5	123	94.0
Samar	4	peanut 'Biyaya'	200	5,250	96.2
Davao del Sur	3	vegetables ('Sta. Rita' ampalaya, 'Bituin' cucumber, 'DLP' eggplant, 'Sandigan' pole sitao, 'Rica' tomato)	7.70	15	47.0
Koronadal City	3	vegetables ('Sta. Rita' ampalaya, 'Bituin' cucumber, 'Mistiza' eggplant, 'Sandigan' pole sitao, 'Rica' tomato)	7.70	167	95.4
La Union	6	peanut 'Biyaya'	220	190	-15.8

the planned month of planting is November, but it will be re-scheduled to January the following year. The adjustments that will be made in the planting calendar by the farmer participants is one of the adaptive strategies to cope up with the changing climatic conditions like too much rains starting September that happens every year. According to *Lasco* (*2010*), implementing a proper scheduling for planting is a climate-risk adaptation practice that helps the farmers cope up with climate variability and extremes at the farm level.

Table 3. Planned month of planting of peanut and vegetable varieties and the adjusted month of planting in the different selected provinces.

Province	Planned month of planting	Adjusted month of planting
La Union	November	June
Samar	October	November
Antique	October	November
Davao del Sur	September	January
Koronadal City	November	January

Association between demographic profiles and amount of seeds

Chi-square tests were done to determine the association of selected demographic variables of farmer participants namely age, gender, civil status, literacy, farming experience, land ownership, household goals and off- and non-farm income with the amount of seeds produced using the IPB-bred varieties. There is a highly significant association between the different demographic variables and the amount of seeds produced using IPB-bred varieties at 0.05 level of significance (**Table 4**). Similarly, Chi-square test showed a significant association between demographic variables of respondents and the attitudes towards understanding the benefits of modern agricultural biotechnology (*Torres et al. 2006*). Generally, the older age group ranging from 41 to 63 years old tends to produce higher amount of seeds than younger age group ranging from 29 to 36 years old.

There is a high association between literacy of farmer participants and the amount of seeds produced. Generally, farmer participants with low educational attainment (elementary and high school) produced more seeds than those with higher educational attainment. A possible explanation is, farmers with low educational attainment may be more inclined to perform farming jobs and maybe also used to hands-on activities in the farm than those with higher literacy level like the employed college graduates.

Feedback

Actual feedback gathered from the farmer participants revealed both positive and negative points regarding the peanut and vegetable varieties planted in their respective provinces. One hundred percent of the farmer participants in Davao del Sur, Koronadal City, Samar, and Antique will adopt the IPB-bred vegetable and peanut varieties in their future production systems (**Figure 2**). Peanut varieties are preferred for planting by the farmers after their rice crop. It is widely known that peanut, a legume can fix free nitrogen from the air through their nodules that can bring back fertility to the soil after growing rice.

The farmer participants were satisfied with the field performance of the vegetable and peanut varieties grown. For instance in La Union, 90 % of the participants will adopt the IPB-bred vegetable and peanut varieties. A minority (10 %) of the farmer participants will not adopt the IPB-bred varieties because they are already satisfied with the traditional farmers' varieties being grown for years in the area. This unfavorable impact related to variety adoption by the minority of the farmer participants in La Union leading to low seed production was mainly due to the failure of the participants to implement the recommended cultural management practices for the different crops grown plus the sudden infestation of the crops by rodents which was possibly triggered by climate change.

In addition, the farmer participants were also surveyed on the other prospects of IPB-bred vegetable and legume varieties and their residues as component of their farming system. (**Table 5**). All 18 (100 %) farmers indicated that they will use the peanut and vegetable residues for composting purposes. Farmers further indicated that the compost, a form of organic fertilizer, will be used for fertilization of the succeeding crops in their farm. The use of organic fertilizers like compost can reduce carbon footprint that reduces greenhouse gases emissions (*Lansigan 2008*), that could in

Table 4. Results of the Chi-square tests between selected demographic profiles and the amount of seeds produced.

Demographic profile	df	Computed Chi-square	Tabular Chi-square	Significance	Interpretation
Age	2	53.33	5.99	significant	Highly associated
Literacy	2	49.33	5.99	significant	Highly associated
Farming Experience	3	47.73	7.81	significant	Highly associated
Land Ownership	1	52.12	3.84	significant	Highly associated
Household Goals	2	49.00	5.99	significant	Highly associated
Off- & non-farm Income	2	50.22	5.99	significant	Highly associated

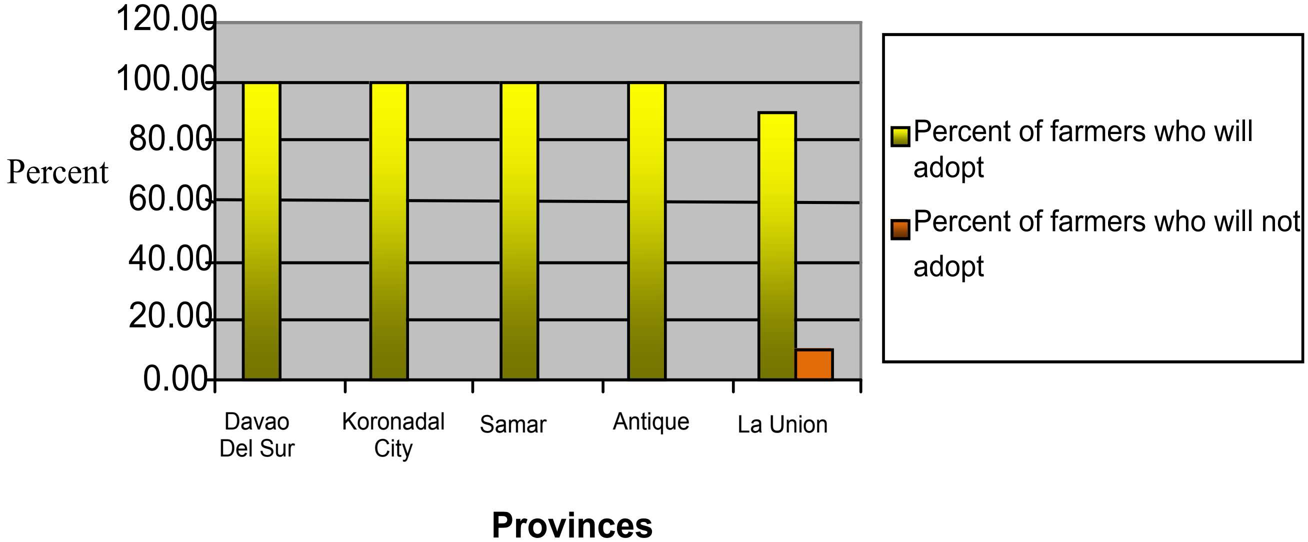

Figure 2. Percent of farmer participants who will adopt the IPB-bred varieties in future cropping system.

Table 5. Prospective uses of IPB-bred vegetable and legume varieties and their residues as component of their farming systems.

Prospective Uses for Farming System	Number of Farmers who will adopt	Percent
Composting	18	100.00
Green manuring	2	11.11
Crop rotation	15	83.33
Intercropping	10	55.55

turn minimize the ill effects of climate change. While these farmers still use inorganic fertilizers, they mixed it with organic compost to augment soil fertility and improve soil texture. Many of the farmer participants (83.33 %) will also use the IPB-bred peanut and vegetable varieties for crop rotation in their farms. They recognize the benefits of crop rotation especially using the peanut and pole sitao that could bring back soil fertility through nitrogen fixation from the atmosphere. Generally, the farmer participants after planting rice which is a heavy nitrogen feeder, will plant peanut or pole sitao that develop nodules containing nitrogen that is beneficial to the soil. More than half of the farmer participants (55.55 %) will use the peanut and vegetable varieties for intercropping with either rice or corn. This cropping system will maximize the use of the land and other farm resources to improve farm productivity and income. Likewise, half (50.0 %) of the farmer participants will utilize the IPB-bred peanut and vegetable varieties for sequential cropping especially after rice. Accordingly, the vegetable and peanut varieties could take advantage of the remaining soil moisture and nutrients after the rice crop, thus reducing the need for inorganic fertilizers. This cropping strategy will minimize soil acidity and reduce fertilizer requirement. Reduction in the use of inorganic fertilizers will mean a reduced fossil fuel use and less carbon dioxide emission, that could lessen climate change variability (*Noordwijk 2010*). Furthermore, all farmer participants (100.0 %) indicated that they will use "saved seeds" they stored from the previous crop in establishing the succeeding crop on the following season.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The participation of farmer beneficiaries of DAR in the utilization of IPB-bred vegetable and peanut varieties was explored. The questionnaire method was used in gathering the data. Eighteen purposively pre-selected farmer beneficiaries were provided with training on seed production and cultural management practices for vegetable and peanut production by IPB researchers. The farmer beneficiaries were predominantly mature adults, male, married, and college graduate.

The selected farmer beneficiaries of DAR were made technically competent on seed production by providing them with technical assistance through the trainings and provision of high-quality planting materials. Knowledge of proper seed production techniques helped them solve the problem on seed sourcing and they were also able to beat the high prices of seeds. Their ability to produce and store the seed planting materials for the next season planting make the farmer beneficiaries confident in their farm planning for the succeeding cropping.

The amount of vegetable and peanut seeds produced by farmer participants in Samar, Koronadal City and Antique increased dramatically. The increase in seed production could be due mainly to the use of improved vegetable and peanut varieties used by the farmer participants and the application of the production skills acquired during their training. In addition, a highly significant association of the farmer participants' selected demographic variables with the amount of seeds produced was detected.

The farmer participants from Samar, Antique, Davao del Sur, Koronadal City and La Union also indicated that they will utilize the IPB-bred legume and vegetable varieties in their farms. For instance, this kind of activity will have implication to climate change adaptation in the sense that adjustments will be made in the planting calendar of these varieties by all the farmers due to heavy rains that occur starting September that causes crop damage and delayed field operations. Also, utilization of the legume residues for composting to produce organic fertilizers was considered by all (100.0 %) farmers. Another is that, the peanut producing nodules that can fix nitrogen from the air were also considered for crop rotation by majority (83.33%) of the farmers in order to lessen the use of inorganic fertilizers causing soil acidity. Further, the peanut will be utilized by many of the farmers (50.0 %) for sequential cropping after rice to bring back soil fertility.

On the overall, the participatory extension approach is a practical approach in the dissemination and adoption of IPB-bred varieties since the farmer participants became equipped with the technical knowledge on appropriate seed production and cultural management practices. They were also able to produce good quality seeds for livelihood and also "saved seeds" for planting in the succeeding cropping seasons.

The following are recommended in order to attain a successful and sustainable seed production system in relation to climate change adaptation: the varieties given by the IPB breeders to the farmer participants should be the ones that are acceptable to the particular area or community; farmers training enhancement on hybrid seed production should be provided to ensure the adoption of technology; the planting calendar of the vegetable and peanut varieties in times of heavy rains or drought should be adjusted to avoid crop damage; peanuts for intercropping and rotation cropping should be used in order to enrich the soil via the root nodules that fix nitrogen from the air and; finally, peanut and vegetable residues for composting should be utilized to produce organic fertilizers that will prevent soil acidity.

REFERENCES

[CSC] Crop Science Cluster. 2008. CSC Annual Report 2007. College of Agriculture, University of the Philippines Los Baños, College, Laguna, Philippines. 310 p.

[CSC] Crop Science Cluster. 2010. CSC Annual Report 2009. College of Agriculture, University of the Philippines Los Baños, College, Laguna, Philippines. 213 p.

Dumayaca, C.A., T. Sandoval, T. Corales, A. Matir, J.B. Salvani and J.B. Araos. "Enhancing Food Security Through Improved Rice Productivity and Increased Farmers' Income in the Rainfed Lowlands of Nortrhern Mindanao. (Abstract)". Paper presented at the 23rd National Research Symposium, Department of Agriculture-Bureau of Agricultural Research (DA-BAR). Manila, Philippines, October 10, 2011. 29 p.

Fulgueras, L.P., L.P. Palada and C.A. Arroyo. 2011. "Development and Participatory Evaluation of Site Specific Nutrient Management for Hybrid Maize in Region 6. Paper presented at the 23rd National Research Symposium, Department of Agriculture-Bureau of Agricultural Research (DA-BAR). Manila, Philippines, October 10, 2011 (Abstract P 23).

Hagmann, J., E. Chuma, K. Murwira, M. Connolly. 1999. Putting Process Into Practice: Operationalising Participatory Extension. Agricultural Research and Extension Network (AGREN) Network paper No. 94. http://www.odi.org.uk/work/projects/agren/papers/agrenpaper_94.pdf (28 June 2010).

Hess, C. 2007. Reader: Extension and Research Approaches for Rural Development. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn, Germany. http://www.gtz.de/de/dokumente/en-Extensions-Reader-2007.pdf (28 June 2010).

[IPB] Institute of Plant Breeding. 2006. IPB Annual Report 2005. College of Agriculture, University of the Philippines Los Baños, College, Laguna, Philippines. 249 p.

Lantican, R.M. 2001. The Science and Practice of Crop Production. SEAMO Regional Center for Graduate Study and Research in Agriculture (SEAMO SEARCA) and University of the Philippines Los Baños (UPLB), College, Laguna. 330 pp.

Lansigan, F.P. (2008). "Climate Change and its Effects on Agriculture and Fruit Production". Paper presented at the 16th National Fruit Symposium of the Philippine Fruit Association. Los Baños, Laguna, Philippines. November 5-7, 2008. 7 p.

Lasco, R.D. 2010. "Issues on Climate Change and Biodiversity in Southeast Asia". In: Moving Forward Southeast Asian Perspectives on Climate Change and Biodiversity (eds. P.E. Sajise, M.V. Ticsay and G.C. Saguiguit Jr.). Institute of Southeast Asian Studies, Singapore and Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Los Baños, Laguna, Philippines. pp. 11-29.

Magdalita, P.M., V.N. Villegas and A.L. Aquino. 2001a. Fruit characteristics of 'Mapino', a newly released chico (*Manilkara zapota* L.) variety. The Philippine Agricultural

Scientist 84(2): 221-223.

Magdalita, P.M., V.N. Villegas and A.L. Aquino. 2001b. Fruit characteristics of 'Aguinaldo', the first processing type of guayabano (*Annona muricata*) variety. The Philippine Agricultural Scientist 84(4): 432-434.

Magdalita, P.M. and L.D. Valencia. 2009a. 'Roja' a red and sweet rambután (*Nephelium lappaceum* L.) cultivar. Philippine Journal of Crop Science 34(1): 119-123.

Magdalita PM and Valencia LD. 2009b. 'Amarillo' the first Philippine yellow variety of rambután (*Nephelium lappaceum* L.). Philippine Journal of Crop Science 34(2): 117-121.

Magdalita, P.M., F.T. Dayap and L.D. Valencia. 2011. "Farmer Participatory Breeding and Selection". In: The Jackfruit (eds. Thottappily, G., K.V. Peter and S.G. Valavi). Stadium Press LLC, Texas, USA, pp. 89-113.

Narciso, J.O. and C.H. Balatero. 2010. 'Assunta' and 'Ara': UPLB's first fresh market tomato F1 hybrid varieties for off-season production (*Lycopersicon esculentum* Linn.). Philippine Journal of Crop Science 35(2): 69-73.

Noordwijk, M.V. 2010. "Climate change, biodiversity, livelihoods, and sustainability in Southeast Asia". In: Moving Forward Southeast Asian Perspectives on Climate Change and Biodiversity (eds. Sajise, P.E., M.V. Ticsay and G.C. Saguiguit Jr.). Institute of Southeast Asian Studies, Singapore and Southeast Asian Regional Center for Graduate Study and Research in Agriculture, Los Baños, Laguna, Philippines. pp. 55-62.

[PAGASA] Philippine Atmospheric Geophysical and Astronomical Services Administration. 2009. PAGASA Weather. http://www.pagasa.dost.gov.ph (10 January 2013).

Pokorny, B., C. Guilhermina and N. Westphalen. 2005. Participatory Extension as Basis for the Work of Rural Extension Services in the Amazon. Agriculture and Human Values. http://www.springerlink.com/content/y7213551n1673611/ (29 June 2010).

Razik, T.A. and A.D. Swanson. 2001. Fundamental Concepts and Educational Leadership: Upper Saddle River, Prentice Hall, Ithaca, New York, USA, pp. 1-210.

Raymundo AD. 2011. Impact of climate change on epidemics of abaca bunchy top and banana black sigatoka. University of the Philippines Los Baños Journal 9: 93-99.

Torres, C.S., M.T.H. Velasco, M.C.H. Cadiz, and R.R.M. de Villa. 2006. Public Understanding and Perception of Attitude Towards Agricultural Biotechnology in Indonesia. SEAMO Regional Center for Graduate Study and Research in Agriculture (SEARCA), International Service for the Acquisition of Agri-biotech Applications (ISAAA) and College of Development Communication, University of the Philippines Los Baños, College, Laguna, Philippines.

Valencia L.D.,and P.M. Magdalita. 2010. Development of 'Mabini'jackfruit (*Artocarpus heterophyllus* Lamk.), a dual purpose variety. Philippine Journal of Crop Science 33(3): 90-93.

Woodward, B., J. Brink, and D. Berger. 1999. Can Agricultural Biotechnology Make a Difference in Africa? AgBioForum. 2(3 and 4): 175-181. http://www.agbioforum.org. (2 July 2010).

ACKNOWLEDGMENT

The authors acknowledged the following: Department of Agrarian Reform (DAR)-Asian Development Bank (ADB)-Agrarian Reform Communities Project (ARCP) for the financial support; the Crop Science Cluster-Institute of Plant Breeding for the facilities; Mr. Conrado M. Cervantes and Ms. Ma. Fe H. Cayaban, Agricultural and Laboratory Technicians, respectively, for the support in the conduct of different field operations, and Ms. Erlinda G. Bugawan, Administrative Aide for the preparation and processing of relevant documents used in this study.