Study Brief 29: Impact

The Impact of Plant Clinics on the Livelihoods of Bangladeshi Farmers

Saikat Ghosh, Avinandan Taron, Frances Williams

Summary

The Plantwise programme in Bangladesh was launched in 2015 to build local capacity in plant pest and disease management to enable frontline extension workers to provide practical recommendations to farmers. We assessed the impact of plant clinics on farm productivity and profitability with a focus on cucurbits with fruit fly. A quasi-experimental approach was taken, with a matching design, based on similarity of agro-ecological zone, crops grown and pests and diseases. Results showed an increase in income for plant clinic users growing all types of cucurbits.

Key highlights

- 61% of plant clinic users reported an increase in their problem-solving ability, compared to 43% of non-users.
- Plant clinic users were 90% more likely to use pest control practices than non-users.
- Yield was significantly different for all crops apart from sponge gourd.
- Gross income is significantly different for all crops.
- Net income is significantly different for all crops apart from sponge gourd and ribbed gourd.
- Average income for clinic users was about USD 78.99 (33%) higher than for non-users.
- About 80% of plant clinics users informed other farmers about the advice received with an average of over 4 people informed by each of these households.

Context

The Plantwise programme in Bangladesh was launched in 2015. The aim of the programme is to build local capacity in plant pest and disease management to enable frontline extension workers to make accurate diagnoses and provide practical recommendations to farmers, and provide farmers greater opportunities to discuss their problems with reliable plant doctors. Within three years (from 2015-17), the programme had scaled-up to 30 plant clinics across 10 districts.

A previous study in 2017, assessed the knowledge, attitude and practices (KAP) of farmers towards solving crop related problems and determined the impact these KAP changes had on their yield and income (Rajendran and Islam, 2017). They found that users of the plant clinic are more equipped to identify crop problems quickly compared to non-users. Plant clinic users were 4.6 times more likely to indicate that their farm management knowledge had increased compared to non-users. The adoption rate of the recommendations was also found to be higher and 93% of the plant clinic users fully implemented the advice they received from plant doctors. More than 70% of the plant clinic users reported a higher profitability owing to reduced pesticide use and yield increases.

An analysis of plant clinic records in Bangladesh indicate that more than 10 percent of queries relate to *Cucurbita sp.* including pumpkin, ash gourd, bitter gourd, snake gourd, ribbed/ridged gourd and cucumber. The major pest for this family of crops is fruit fly, and that more than 50% of the queries at the clinics were related to disease management of fruit fly.

Approach

The objective of the study was to assess the impact of the plant clinics on the farm productivity and profitability. The main hypothesis underlying the relation between setting up of plant clinics and enhancement of farm productivity is through improvements in farmers' knowledge, adoption of on-farm pest management practices, and management of cucurbits with fruit fly. Therefore, to evaluate the impacts of plant clinics on farm productivity, the study answered the following questions:

- To what extent are plant clinics helping farmers to update their knowledge and to what extent is this knowledge being adopted for farm management practices?
- What are the household/farmers' characteristics that determine the adoption of the knowledge obtained from plant clinics in on-farm management practices?

Data collection

The sample size was 226 users vs. 376 non-users. During the sampling, care was taken to choose similar proportions of male and female households in the user and non-user group. Treated farmers were purposively selected from the POMS database. A larger control group was selected to ensure that a matched group could be created during the matching exercise. The set of non-users were randomly selected from the same unions [1] as the users such that agro-ecological similarity was maintained. The control group (non-users of plant clinics) was selected to be as similar as possible to the treatment group (users of plant clinics) in terms of baseline characteristics and control farmers were randomly selected from the villages in the same union. A list of farmers, growing cucurbits and affected by fruit flies, from these villages was used, with every 3rd farmer on the list being chosen for interview. The quantitative

[1] Unions are the smallest local government unit in Bangladesh. Each union consists of 9 wards and each village is denoted as a ward.

data was collected by trained enumerators through a structured questionnaire, based on Silvestri *et al* (2019), to elicit information on:

- Demographic and farm characteristics
- Farming systems: crops grown, land ownership and allocation
- Economic data: costs of input, prices of output and yield
- Interventions used by the farmers

The survey utilized computer-assisted-personal-interviewing (CAPI) and was carried out during the post-harvest season in August 2018.

Analysis

Impact evaluation studies generally follow statistical approaches such as Neyman-Rubin Counterfactual Framework[2] (as elicited in Guo and Fraser, 2010). They use counterfactuals that refer to potential outcomes that would have happened in absence of the cause (Shadish et al., 2002). In these studies, a quasi-experimental approach can be used, with a matching design based on (i) similarity of agro-ecological zone, ii) similarity of crops grown; iii) similarity of pests and diseases; iv) no spill-over effect into the non-clinic user area. However, as farmers choose to come to plant clinics, selection bias is a major challenge: propensity score matching techniques may help to address this.

In this study, the data analysis was conducted using both descriptive and inferential statistics using STATA-15. The impact of the use of plant clinics on the adoption of farming technologies and net farm income was estimated by two different matching methods: Nearest Neighbourhood Matching (NNM) and Propensity Score Matching (PSM). This approach allowed us to control for selection bias and to reduce the possibility that the observed differences in the outcomes between the two groups may be due to an imperfect match rather than caused by the intervention. The estimation of the impact of the plant clinic use on farm income was conducted in two stages: firstly, analysis for each of the nine crops was conducted using PSM and NNM to see if there was any significant variation with respect to the total yield [3], cost of production [4], and crop-wise farm income [5]. Then differences in net farm income [6] were tested separately using the same techniques.

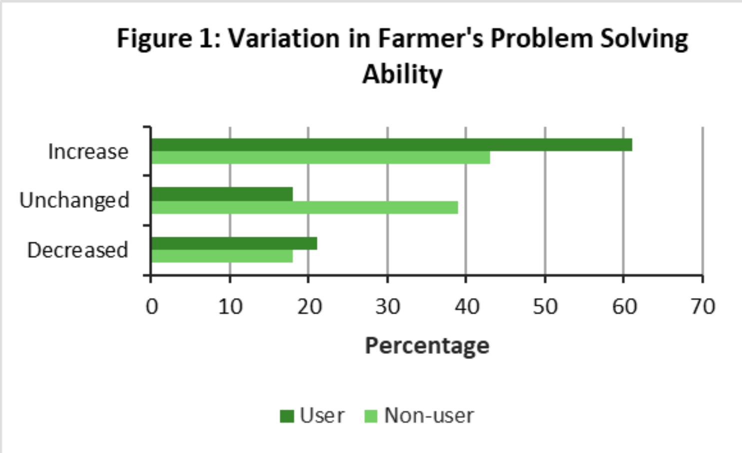
The independent variables used for analysis included: i) age of the head of the household, ii) educational level of the head, iii) highest education level achieved by any member, iv) household size, v) young dependent ratio (the ratio between number up to age 14 years and total household size), vi) total farm size (total area used to cultivate Cucurbita last season), vii) total value of assets owned by the household, viii) whether the household experienced any crop failure in the last season, ix) whether the household received any free inputs, x) whether they experienced any health hazards, and xi) whether they received any credit. In terms of matching the independent variable, the estimation showed a good match between 224 treated and 376 untreated observations, where only 2 treated observations were dropped.

[2] Initiated by Neyman in 1923 and extended by Rubin in 1974, 1978, 1980 and 1986.
[3] Total yield is defined as production for both household consumption and sale.
[4] Cost of production refers to the total cost incurred for inputs, pesticides etc.
[5] Crop-wise farm income = [(yield x price) – cost of production] per individual crop
[6] Net Farm Income= Aggregated revenue from all nine crops – total cost of production

Findings

Farming Practices

Figure 1 shows a statistically significant variation in self-assessed problem-solving ability between plant clinic users and non-users. 61 percent of plant clinic users reported an increase in their problem-solving ability, compared to 43 percent for non-users. A relatively higher percentage of non-users, compared to users, reported no change in their ability.



Plant clinic users, in general, used a significantly higher number of pest control practices compared to plant clinic non-users, when tested through both matching methods. Overall clinic users were 90% more likely to use pest control practices than non-users (significant at 1% level). Table 1 shows the likelihood of plant clinic users using each pest control method as compared to clinic users. For example, those farmers who used plant clinics were 20 percent more likely to use pheromone traps compared to non-users and this difference is statistically significant at 1% level.

Table 1: Plant clinic use and probability of using pest control practices

Propensity Score Matching (ATE) n=602	Coefficient (User vs. Non-user)
Pest and disease resistant/tolerance varieties	0.08*
Crop rotation	0.06
Cover crops	-0.01
Conservation tillage	0.02
Removal of alternative host plants for disease management	0.03
Pheromone traps	0.20***
Attractant/repellent plants	0.05
Improving habitats for neutral enemies	0.001
Botanical pesticides	0.19***
Early Planting	0.11**
Uproot and burning of infected plants	-0.01
Record keeping for monitoring	0.05**

*p<0.10, **p<0.05, ***p<0.01

Therefore, it can be inferred that plant clinic users not only tend to use greater number of pest control practices, but also, they are more likely to use each of the practices compared to non-users. These findings allow it to be inferred that use of plant clinic has a positive impact on the use of pest control practices by households. It may also improve their ability to deal with pest challenges and problems.

Farm Productivity

Table 2 shows crop-wise differences between users and non-users for all nine varieties of crops considered in the study. The increased cost of pesticide use in four out of the nine crops is due to the use of different, more expensive pesticides, or increased dosage of similar pesticides, in line with plant doctor recommendations. For all crops apart from sponge gourd, the yield is significantly different, while the gross income is significantly different for all crops. The net income is significantly different for all crops apart from sponge gourd and ribbed gourd. In these two cases users are getting a slightly better price for their produce but the price increase is insufficient to compensate entirely for the increase in production costs.

Table 2: Difference in yield, production costs and income for plant clinic users and non-users

			Ash gourd (46, 88)	Bitter gourd (34, 50)	Bottle gourd (75, 152)	Cucumber (47, 42)	Pointed gourd (34, 50)	Pumpkin (74, 51)	Ribbed gourd (20, 22)	Snake gourd (16, 18)	Sponge gourd (46, 88)
Labour cost	(USD/ ha)	User	1112.9	806.7	1000.2	1364.8**	806.7	1006.0*	1061.1	991.8	1103.2
		Non-user	1118.6	829	1065.5	1522.9**	829	1090.5*	1021.6	1000.8	1046.0
Seed cost	(USD/ ha)	User	79.7	48.0	41.0	178.1*	48.0	51.0	71.0	41.13	68.1
		Non-user	82.4	47.0	43.4	136.7*	47.0	50.8	56.4	38.0	66.1
Fertilizer cost	(USD/ ha)	User	227.2	146.0	161.7*	305.3	146.0	238.5	96.9	154.6	185.8*
		Non-user	209.8	153.8	151.1*	342.6	153.8	253.6	91.9	143.8	174.5*
Pesticide cost	(USD/ ha)	User	98.3	139.2***	74.6	404.7	139.2***	89.7	106.3**	111.7***	126.4
		Non-user	96.7	131.0***	74.5	407.0	131.0***	88.9	90.1**	103.2***	126.3
Total cost	**(USD/ ha)**	**User**	1518.1	1139.9	1277.5	2252.8*	1139.9	1385.2*	1335.9	1299.1	1483.5*
		Non-user	1507.5	1160.8	1334.5	2409.1*	1160.8	1483.9*	1259.9	1285.8	1412.9*
Yield #	**(t/ha)**	**User**	118*	134***	140**	204*	134***	133**	121***	211**	222
		Non-user	112*	125***	132**	199*	125***	117**	113***	201**	222
Gross income	**(USD/ ha)**	**User**	3030.1**	3069.2***	4133.1***	3812.0**	3069.2***	2706.7**	2764.8***	4944.3***	3536.6***
		Non-user	2748.7**	2825.5***	3611.6***	3657.2**	2825.5***	2580.8**	2528.4***	4601.6***	3360.9***
Net income	**(USD/ ha)**	**User**	1512.0*	1929.3***	2855.6***	1559.3***	1929.2***	1321.5***	1428.9	3645.2**	2053.1
		Non-user	1241.2*	1664.7***	2277.1***	1248.1***	1664.6***	1096.9***	1268.4	3315.8**	1948.0

1. # Yield of Ash Gourd and Bottle Gourd was measured in pieces and all others crops in tonnes.
2. Numbers in parenthesis represent the number of farmers sampled in user and non-user group respectively.
3. *p<0.10, **p<0.05, ***p<0.01 for independent sample t-test between users and non-users

However, the sample size on an individual crop basis is small and the significance tests are therefore not very robust. Therefore, NNM and PSM were used to test whether use of plant clinics led the farmers to have greater net farm income from the production of all cucurbit crops. [7]

[7] Note that these methods were not used to test differences in production costs or gross income due to differences in production methods and therefore costs. Therefore, using average production costs across all crops would not compare like

All the estimates provide statistically significant positive coefficients for clinic use, which means those plant clinic users had, on average, higher net farm income compared to plant clinic non-users. Considering the average treatment effect on treated for the PSM estimations, the average income for clinic users was about 6631 BDT (USD 78.99) (33%) higher than the non-users and the difference was significant at 1% level.

Sharing of advice

There was a snowball effect of plant clinics in terms of users spreading the knowledge among others. About 80 per cent of farmers, who used plant clinics, informed other farmers about the advice received from plant clinic with an average of over 4 people informed by each of these households. The total number of persons informed was 907, implying that information and knowledge was shared among users and non-users. This may help farmers who have not visited plant clinics, and therefore, the non-users may also indirectly benefit from plant clinics.

Conclusions

Plant clinics seems to be a crucial intervention which may improve the livelihood of farmers. For example, visiting plant clinics may improve the knowledge of the farmer regarding good agricultural practices. This may in turn improve farm productivity and farm income. The study presented empirical evidence inferring that using of plant clinics was associated with improved farming practices and knowledge gain by farmers. Use of the practices prescribed by the plant clinics may help reduce the damages from pests and thus increase production per unit of land. Given that the market price of the crop was not very variable, increased production may increase farmer income and their economic well-being. This could be the reason for the clinic users having significantly higher income compared to the non-users. In addition, the sharing of information to other may spread good agricultural practices among other farmers who had not visited plant clinics. Therefore, both users and non-users may benefit at the same time.

The opinions and experience of farmers using the plant clinics show that plant clinics were mostly able to satisfy farmers' need and, therefore, had positive impact on farm productivity in one way or another. Problems were identified efficiently, and advice was effective, which may not only increase the productivity but also raise farmers' confidence. This is crucial for sustainability of such interventions as well as farm productivity. Therefore, interventions such as plant clinics may guide farmers towards more sustainable farming.

---

with like. This also means that gross income cannot be compared as production costs have not been excluded. Yield per hectare cannot be tested through matching techniques because yield measurements varied. Net income is the only comparable measurement across all nine cucurbit crops.

References

Guo, S., and Fraser, W. M. 2010. Propensity Score Analysis: Statistical Methods and Applications. Sage Publications Inc

Neyman, J.S., 1923. Statistical problems in agricultural experiments. Journal of Royal Statistical Society, Series B, 2 107-180

Rajendran, G. and Islam, R. 2017. Plant clinics in Bangladesh: are farmers losing less and feeding more? CABI case study 19. DOI: https://dx.doi.org/10.1079/CABICOMM-25-8072

Rubin, D. B., 1974. Estimating causal effects of treatments in randomized and non-randomized studies. Journal of Educational Psychology, 66, 688-701

Rubin, D. B., 1978. Bayesian inference for causal effects: The role of randomization. Annals of Statistics, 6, 34-58

Rubin, D. B., 1980. Percent bias reduction using Mahalanobis metric matching, Biometrics, 36, 293-298

Rubin, D. B., 1986. What ifs have causal answers? Journal of American Statistical Association, 75, 961-962

Shadish, W. R., Cook, T. D., & Campbell, D. T. 2002. Experimental and quasi-experimental designs for generalized causal inference. Boston: Houghton Mifflin

Silvestri, S., Macharia, M., & Uzayisengai, B. 2019. Analysing the potential of plant clinics to boost crop protection in Rwanda through adoption of IPM: the case of maize and maize stem borers. Food Security. https://doi.org/10.1007/s12571-019-00910-5

Acknowledgements

CABI is an international intergovernmental organisation, and we gratefully acknowledge the core financial support from our member countries (and lead agencies) including the United Kingdom (Department for International Development), China (Chinese Ministry of Agriculture), Australia (Australian Centre for International Agricultural Research), Canada (Agriculture and Agri-Food Canada), Netherlands (Directorate-General for International Cooperation), and Switzerland (Swiss Agency for Development and Cooperation).

Project donors

Plantwise is supported by:

Project partners

Department of Agricultural Extension, Bangladesh

Authors

Saikat Ghosh, Project Coordinator at LifBi, Germany.

Avinandan Taron, Researcher, International Water Management Institute

Frances Williams, Global Monitoring and Evaluation Manager, CABI

Editorial team

Frances Williams, CABI

How to cite this paper

Ghosh, S., Taron, A., & Williams, F. (2019). The impact of plant clinics on the livelihoods of Bangladeshi farmers. CABI study brief 29: Impact. DOI number: https://dx.doi.org/10.1079/CABICOMM-62-8107