Program Evaluation of Agribusiness Support Fund

Estimating the Effects of Treatment on Farmer Groups, Agribusinesses and BDS Market in Pakistan

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Acronyms

ADB	Asian Development Bank
ADDP	Agribusiness Development and Diversification Project
AJK	Azad Jammu and Kashmir
AKRSP	Aga Khan Rural Support Programme
ASF	Agribusiness Support Fund
BDS	Business development services
BRC	British Retail Consortium
BVQI	Bureau Verities Quality International
CA	Controlled Atmosphere
CPI	Consumer Price Index
DEA	Data Envelopment Analysis
DMUs	Decision-making Units
EUREP	Euro-Retailer Produce Association
FEGs	Farmer Enterprise Groups
FY2009	Fiscal Year 2008-2009
FY2008	Fiscal Year 2007-2008
FY2007	Fiscal Year 2006-2007
GAP	Good Agricultural Practices
GoP	Government of Pakistan
HACCP	Hazard Analysis and Critical Control Points
ISO	International Standards Organization
LDDB	Livestock and Dairy Development Board
MINFAL	Ministry of Food, Agriculture and Livestock
NGOs	Non-Governmental Organizations
NRSP	National Rural Support Programme
OLS	Ordinary Least Squares
OTE	Overall Technical Efficiency
PMOs	Produce Marketing Organizations
PTE	Pure Technical Efficiency
RCDS	Rural Community Development Society
RSPs	Rural Support Programs
RSPs	Rural Support Programs

SD	Standard Deviation
SE	Scale Efficiency
SMEs	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary
TFP	Total Factor Productivity
USA	United States of America

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Executive Summary

Introduction:

Rural areas in Pakistan suffer from market failures of the sort, which prevent them to benefit from a diverse range of skills and expertise to deal with changing market environment. Agribusinesses and farms may build capacity by utilizing business development services (BDS) that could facilitate individual businesses to improve performance by using such services such as training, marketing, advisory, business linkage, brand development, and information technology, etc.

Market intervention through provision of matching grant or demand side intervention may be justified if BDS market development is constrained by lack of knowledge about perceived benefits and risks of the consulting service. Similarly, supply-side interventions may be justified when the purpose is to promote market development of BDS in some high-impact services not provided due to market failure.

Agribusiness Support Fund (ASF) was set up by Ministry of Food, Agriculture and Livestock (MINFAL) with financial support of the Asian Development Bank (ADB) in the context of Agribusiness Development and Diversification Project (ADDP) with the aim to support farmers in hiring of state-of-the-art BDS. A cornerstone of ASF matching grant program support is to enable agribusiness enterprises and farmer groups to benefit from the infrastructure of BDS, which in turn is expected to raise efficiency and productivity of the participating enterprises.

Since the start of ASF operations in FY2007, it has provided financial support to set up 927 micro agribusiness enterprises termed as farmer enterprise groups (FEGs), each consisting of around 10 farmers; more than 16000 acres of land belonging to 324 farmers was brought under Good Agricultural Practices (GAP) by linking them with 35 processors/exporters registered under ASF's GlobalGAP projects in citrus and mango; and capacity building support to many BDS providers was also provided under various training programs.

This study seeks to investigate the impact of ASF's demand-side and supply-side interventions on FEGs, agribusinesses and BDS providers. In considering the efficacy of ASF program support, a central consideration is whether the interventions have successfully corrected the market failures. This program evaluation study has three objectives: (1) to evaluate the impact of program support to FEGs; (2) to evaluate the impact of program support to agribusinesses; and (3) to evaluate the impact of support on BDS market development.

First, we examine how matching grants to FEGs in vegetable tunnel farming in Sheikhupura and Nankana Sahib Districts; FEGs in dehydration farms for apricot drying in Gilgit-Baltistan; and FEGs in horticulture farms for cut flowers in Pishin District have affected their performance.

The outcome variables considered are profitability, efficiency and productivity, employment generation, household income and expenditure, headcount poverty, and some other household level outcomes. We use a design that allows us to control for treatment and control groups and pre- and post-treatment periods. The analysis is based on 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund conducted from August 2009 to October 2009 to collect data of 396 FEGs and farms in treatment and control groups for pre-treatment (FY2007) and post-treatment (FY2009) periods.

Second, ASF has provided matching grant support to selected agribusinesses in (1) milk collection, chilling and marketing, and (2) processors/exporters under ASF's GlobalGAP project. The objective was to promote these markets by integrating agribusinesses with dairy and citrus farms. The primary objective for the citrus intervention was to assist Pakistani growers and processors to adopt internationally compliant standards. However, this study is limited to the assessment of the intervention with respect to the impact on participating citrus farmers and the potential long-term consequences thereof. Using survey data of 217 farms for pre- and post-treatment periods, we probe the implications (spill-over effects) of program support on affected and unaffected farms on real profit, productivity and efficiency, employment and income, etc. A key consideration here is whether ASF intervention has successfully corrected the market failures?

Finally, we explore how BDS market has benefited from the program support? We use data obtained from a survey of 56 BDS providers to assess market development in four selected sectors, e.g., tunnel farming, floriculture, dairy sector, and dehydration units, where ASF has partnered as a facilitator. We examine the state of market development in each of the sectors, identify specific constraints, and search for more effective ways of assisting BDS providers in these sectors.

Sample Design of FEGs and Agribusinesses:

Base-line surveys conducted before beginning of program support to target groups plays a useful role in program evaluation. But no base-line survey was conducted before ASF launched program support. Hence the task of data collection was made more challenging because the older the information more difficult it is to dig out.

To evaluate the effects of ASF program support that might have affected particular groups, we designed 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund. The sample included farms in treatment group, i.e., those who received program support, and fams in control group, i.e., those who never received program support. We collected two rounds of data where the first round was for information of pre-treatment period or before program support began (i.e., FY2007), and second round was for information of post-treatment period, or after program support was provided (i.e., FY2009).

First, the survey included FEGs and control farms in the following sectors: (a) tunnel farming of off-season vegetables; (b) dehydration tunnels for apricot drying; and (c) horticulture farms for production and marketing of cut-flowers. Second, we also took a sample of (a) smallholder dairy producers who were members of dairy apex bodies involved in milk collection, chilling and marketing of milk; and (b) citrus growing farms who were members of

Produce Marketing Organizations (PMOs) involved in GlobalGAP certification project.

The sample of treated farms was randomly drawn from the list of farms that were provided support until June 30, 2008 in respective sectors and target areas. To draw the sample of control farms we followed a purposive sampling plan. Control farms in the immediate neighborhood formed a natural basis for comparison with selected FEGs. We interviewed as many control farms as the number of FEGs in each sector and region. For the survey of dairy and citrus farms we decided to draw at least 25% sample from the control group. For data collection, two survey questionnaires were designed: one each for FEGs and farmers.

The data on FEG's questionnaire was obtained from each FEG Group Leader. Farmers' questionnaire was used to collect data from FEG/PMOs/apex body member farms and control farms. FEGs in tunnel, dehydration and horticulture sectors faced a unique situation whereby FEGs existed only in round 2 (or post-treatment period) but did not exist in round 1 (pre-treatment period). However, all member farms existed in both rounds, i.e., as individual entities in round 1 and as individual farms and FEGs in round 2. We treated FEG Members as if they were involved in joint production with FEGs. Under this approach we treated each FEG member in the survey as an independent FEG, which amounted to collecting two rounds of data at the level of farms and one round data of FEGs. Later, these data sets were merged to generate required data for our purposes.

For analytical purposes, we used two definitions for treatment and control as follows:

1. **Definition 1:** We assumed that all FEG Members were active participants of FEGs and were therefore taken as treatment group; and
2. **Definition 2:** We assume that only FEG Group Leaders were active participants of FEGs and therefore were taken as treatment group.

While adopting two different definitions for treatment and control group was an extraordinary step, but we were motivated by two considerations. One, we were informed by some FEG Members that they were not full-time active participants in all activities of FEGs and that their involvement was of a passive nature. Two, preliminary assessments on survey data further corroborated the above mentioned claim.

If definition 1 was true, then in effect, we would expect that program support to equally benefit all FEG Members in terms of technological development and marketing devices, which in turn would act as a catalyst to enhance farm productivity and profitability through demonstration effect. If definition 2 was true, then the benefits of program support would only accrue to the more active participants, which in this case was assumed to be the Group Leader of FEG.

We randomly drew a sample of 396 FEG Members and control farms: 158 farms from vegetable tunnels; 123 from apricot drying dehydration tunnels; and 115 from horticulture farms involved in cut-flowers (gladiolus). In a total of 65 FEGs in the sample, 23 were in vegetable tunnels, 25 were in dehydration tunnels, and 17 were in the horticulture sector.

The dairy and citrus sector sample consisted of 49 dairy farms (35 members of 7 apex bodies from Jhelum, Sheikhupura and Nankana Sahib Districts, and 14 from control group) and a sample of 168 farms from Sargodha District where 112 farms were drawn from PMO members linked with 13 PMOs for production, processing and marketing of citrus under ASF's GlobalGAP certification project, and 56 farms were taken from control group.

Empirical Framework and Program Evaluation:

To study the causal effects of exposure of farms and households on some outcome we compare the treatment before and after the intervention on those exposed to it to this difference with those not exposed to it. We use an empirical methodology known as difference-in-differences method, which effectively controls for other effects on these outcomes on treatment and control groups. We use the first-order and second-order interaction terms as key parameters of interest for our purposes. We also define a number of farm-level and household-level outcome variables used in program evaluation. Measurement of technical efficiency and components is premised on linear programming method known as data envelopment analysis (DEA), while total factor productivity and its components are measured by the Malmquist index. To measure headcount income and expenditure poverty, we use the official poverty line and inflate it to reflect the benchmarks for income and expenditure in pre- and post-treatment periods.

Evaluating Program Support to FEGs:

We use data of 792 FEGs and control farms drawn from tunnel, dehydration and horticulture farms to compare and evaluate the impact of program support on performance of treated and control farms. We try various empirical specifications to bring out the true effects of program support on target groups. On the basis of survey data and empirical models we find strong support to the view that after ASF intervention real profit, technical efficiency, total factor productivity and employment of treated farms remarkably increased, compared with control farms, but the true effects of program support on FEGs significantly vary depending upon how we define treatment and control groups.

The estimation results of the regression models strongly support the contention that FEG Group Leaders were the greatest beneficiaries of ASF program support as compared to other FEG Members. Based on the empirical results, it is evident that in general there was a tendency for FEG Group Leaders to be the most dynamic and active participants in the program activities and hence stood to derive proportionately more benefits than other members. The impact of program support on other outcome variables is elaborated below.

First, the results indicate that program support substantially increased real profit of treated farms in the sample, compared with control farms. But, the relative gain in real profit to FEG Group Leaders was at least 62% more than the relative gain in real profit to FEG Members.

Second, based upon the evidence gathered during the field survey, we find no indication of ASF matching grant support increasing technical efficiency on farms of FEG Members. Regardless of whether we take sector-wise or pooled data, we cannot escape the conclusion that program support did not significantly increase technical efficiency of FEG member farms compared with the control farms. By contrast, we have strong evidence suggesting that program support significantly increased technical efficiency indexes on the farms of FEG Group Leaders. An obvious explanation of this finding is that Group Leaders are cashing on innovative technologies by practicing learning-by-doing, but FEG group members appear to be risk-neutral and much less dynamic than their Group Leaders. It remains to be seen if the benefits manifested in the program activities can indeed stimulate a change in farming practices of other group members and the community at large in the long-term. Anecdotal evidence suggests that some replication of activities has already commenced in certain areas.

Third, based on the data of three sectors and taking FEG Group Leaders as treatment group, we find that TFP growth took place at 32%, compared with only 8.4% growth in control farms. Most TFP growth came about due to improvement in technology in treated and control farms. Efficiency change was positive in treated farms but negative in control farms, which explains the dispersion in productivity between the two groups. These results are further confirmed when we delete the sample of dehydration farms from the estimation. These conclusions are significantly altered when we take FEG Members as treatment where TFP growth was 18.1% in treated farms as compared with 8% growth in control farms. The growth in TFP was mostly explained (15.2%) by catching up, and much less by technical change (3.5%).

Fourth, the data shows that starting employment in treated farms was somewhat higher than control farms, but the differential significantly increased after ASF program support which was instrumental in bringing about relative gain in employment of 41 to 44 hours per week on treated farms, or an increase ranging from 123% to 139%. Without ASF program support, employment generation may have remained below 13%. Employment generation due to program support was highest in tunnel farms, followed by dehydration farms, and then horticulture farms. Without program support, employment generation in dehydration and horticulture farms may have stagnated. Consistent with the other evidence, the data reconfirms that the impact of program support was remarkably higher when we take FEG Group Leaders as treatment instead of FEG Members.

Fifth, despite increase in profit, technical efficiency and productivity of treated farms, there seems to have been no increase in household income and expenditure of treated farms in comparison with control farms, which indicates no immediate change in living standards. An explanation for this could be the relatively short duration since the beginning of the program. The incidence of poverty on treated and non-treated farms in our sample was extremely low, compared with national poverty. We find no evidence of change in income poverty or expenditure poverty after ASF program support, which is not surprising given the very low incidence in the sample.

Finally, program support was unable to make a significant difference in household asset ownership, household labor supply of men and women, child labor of boys and girls and frequency of meat consumption in treated farms, compared with control farms. Again, behavioral or cultural changes may not be expected during the short-term. Moreover, the survey did not examine related aspects such as increase in savings or reduction in liabilities.

Support to Agribusinesses and the Spill-over Effects:

Rural areas in Pakistan are known to suffer from market failures in food supply chains. ASF program support to dairy apex bodies and GlobalGAP certified citrus production was aimed at correcting market failures by integrating agribusinesses with dairy and citrus farmers. Taken as a whole, the results suggest that when an intervention to correct a market failure leads to sharing of the benefits with the concerned parties, the intervention may be successful to correct market failure. However, when the intervention leads to no-benefit sharing with affected parties, the intervention may not be successful to correct market failure. The case of dairy apex bodies may illustrate a successful correction of market failure and the GlobalGAP project may demonstrate a case of a potential unsuccessful correction of market failure.

It is well known that dairy farmers in Pakistan are exploited by traditional milk collecting agents, e.g., *dodhis*, who pay relatively lower milk prices to dairy farms due to absence of other market buyers, or the second-buyer. Introduction of dairy apex bodies was expected to increase the number of economic agents competing for rural milk supplies. We find that dairy apex bodies are an efficient mean of correcting market failure. The survey evidence on smallholder dairy producers supports the contention that upward price adjustment by dairy apex bodies acted like a subsidy by reflecting farmers' valuation of dairy milk, which produced positive spill-over effects on member-farms. Regardless of whether we compare real profit and dairy farm income of member-farms to non-member farms, or compare overall technical efficiency and total factor productivity of members with non-members, we find unequivocal support that ASF intervention remarkably increased the outcomes for treated farms, which might bring medium- and long-term sustainability of the apex bodies.

We present a variety of empirical results based upon survey data of dairy farms to probe the implications of ASF intervention on affected and unaffected farms. First, our results suggest that setting up milk collection network through dairy apex bodies relatively increased (a) real profit of member-farms by Rs.3800 per animal; (b) overall technical, pure technical and scale efficiency by 18.2%, 12.1% and 7.6%, respectively, and (c) dairy farm income by Rs.8249 per farm. Moreover, total factor productivity of member-farms increased by 20.5% compared with 4.6% decrease in productivity of non-members. Second, since employment generation and household labor supply decisions in dairy households are related to the size and scale of the farm, we do not expect program support to influence these attributes. As expected, we do not find relative increase in employment generation, and labor supply of men and women in the household. Finally, despite additional farm income after the program support there is no evidence of significant increase in real expenditure or households assets of members compared with non-members. This contention is also supported by the empirical results.

Implementation of Good Agricultural Practices in citrus production has critical significance in citrus export to European markets, but the market has failed to respond because of total disconnect between citrus growers, processors and exporters. ASF program support led to formation of PMOs while a matching grant to PMOs was used to fulfill GAP protocols mostly on PMO-member farms. Under the program the costs were shared between ASF and the lead processors with no expense being borne by the member farms. This intervention paved the way for the PMOs to obtain GlobalGAP certification, and, in turn enabled the processors to access the high-value European markets. However, the evidence in this study contemplates that PMOs may not be an efficient way of correcting market failure because until now the processors have failed to share the benefits of GloablGAP certification project with member farms. The price being offered to PMO-members on their certified citrus produce does not reflect farmers' valuation. Therefore, if the present trends continue, PMO gains may disappear next year when

ASF project would be phased-out. At that point market is likely to fail again.

To illustrate, the empirical evidence based on the survey of citrus producers shows that the spill-over effects of GlobalGAP certification project were not reaching out to member farmers. We find that the difference in per acre profit of PMO-member farmers was statistically not different from non-members' profit. Similarly, we cannot escape the conclusion that relative overall technical, pure technical and scale efficiency of PMO-members was not different from non-members. Likewise, TFP growth of PMO-member farmers was also qualitatively similar with non-members. Finally, employment generation in the two types of farms was also statistically not different from each other.

These results confirm that the medium- and long-term sustainability of the GlobalGAP project may be jeopardized unless the PMOs let prices adjust upwards to reflect farmers' valuation of GAP certified citrus fruit grown on PMO-member farms.

Program Support and Market for BDS Providers:

All else being equal, subsidies always distort market. However, the extent of market distortion is essentially determined by the structure of each market and the nature of program support. ASF program support was aimed at promoting BDS market development in some selected sectors and especially where business services were non-existent. In these sectors, research and extension services had failed to respond to the needs of private sector agribusiness enterprises.

ASF program support acted both on the demand-side by providing matching grant support to farmer groups and agribusinesses, and on the supply-side by capacity building of the BDS providers. Based on a sample survey of 56 BDS providers, drawn from different parts of Pakistan, we find that ASF intervention in tunnel farming, floriculture and dairy farming has been successful in correcting market failure. To illustrate, increase in market demand for the services has outweighed the supply thereby slightly increasing real price of BDS consulting services. Since farmers are willing to pay for the services and more BDS providers are entering into the market place, more cautious approach on the part of ASF is warranted.

There are some policy implications for ASF from the BDS provider's survey. First, in the tunnel farming cluster, ASF support must be phased-out from segments and regions where farmers are willing to pay for the services and BDS providers are catering to the increased demand. ASF may want to support those who want to extend service to underserved areas, and service segments where willingness to pay for the service is less and perceived risks are high.

Second, in the floriculture sector, subsidy needs to be targeted to specific market failures and support must be phased-out from segments where successful market development has been achieved. One weak area deserving program support is the quality of BDS being offered, which is below acceptable standard. ASF may want to arrange train-the-trainer program to upgrade the existing technical skills of BDS providers to meet international quality standards so that penetration in high-end export markets may be achieved.

Third, in the dairy segment, matching grant support to purchase chillers is far from satisfactory because most apex bodies have discontinued using chillers due to (a) high cost of electricity; and (b) prolonged periods of load shedding of electricity. But, the idea of apex bodies has a powerful appeal due to its welfare implications on small dairy farmers. It offers a welfare enhancing alternative to the prevailing milk supply chain models of milk processing industry. In comparison with the network of traditional milk collector (*dodhi*), apex bodies are indeed successful in correcting the market failure. ASF may want to continue to support dairy segment (minus chillers) by replicating dairy apex body model to other milk clusters, especially where milk processing industry is shying away. ASF may also want to scale-back support for the training business in the dairy sector because there are no signs of market failure in the BDS market for dairy development.

Finally, in the dehydration of fruits and vegetables, it is desirable that ASF extend program support to other areas where fruits and vegetables are dried so that they might also benefit from improved drying methods.

Summary of Findings:

The salient features of the impact of ASF interventions as determined by this study are summarized below:

1. ASF program support has led to a substantial increase in real profit of FEG farms as compared with control farms. However, increase in real profit of FEG Group Leaders has been 62% more than FEG Members, who appear to be risk-neutral. It remains to be seen how program activities stimulate a change in farming practices of other group members and the community at large in the long-term.

2. Program support significantly increased technical efficiency on the farms of FEG Group Leaders who promptly reacted and adopted innovative technologies by practicing learning-by-doing.

3. While total factor productivity substantially increased on treated farms, the gains in productivity were much more on the farms of Group Leaders relative to other Group Members.

4. Increase in employment generation on treated farms ranged from 123% to 139%, compared with control farms. Without program support employment generation may have remained below 13%.

5. It appears to be too early for the interventions to have had impacts on household expenditure or asset ownership of treated farms.

6. Taken as a whole the study finds that when interventions lead to sharing of the benefits with concerned parties, they succeed in correcting market failures.

7. The dairy apex body program illustrates a successful correction of market failure because upward adjustment of farm gate price of milk by apex bodies produced positive spill-over effects on member-farms.

8. The GlobalGAP project, while successful in facilitating processors and growers to achieve internationally compliant standards, may not be sustainable unless due benefits are passed on to participating farmers by the processors.

9. The program to support BDS market development has been successful in correcting market failure in the target sectors.

1 Introduction

Rural areas in Pakistan are known to suffer from market failures of the sort, which prevent them to benefit from a diverse range of skills and expertise in dealing with the changing market environment. One sure way these enterprises can build this capacity is through the utilization of business development services (BDS) that could facilitate individual businesses by improving their performance through training services, marketing services, advisory services, business linkages, brand development, and information technology, etc.

Demand-side interventions through provision of matching grants may be justified on a temporary basis if market development of BDS is constrained due to lack of knowledge of farmers/agribusinesses about the perceived benefits and risks of a consulting service. Similarly, supply-side interventions may be justified where the purpose is to promote market development of BDS in some high-impact services that are not being provided by BDS providers due to obvious market failures.

Agribusiness Support Fund (ASF) was set up by Ministry of Food, Agriculture and Livestock (MINFAL) with financial support of the Asian Development Bank (ADB) in the context of Agribusiness Development and Diversification Project (ADDP) with the aim to support farmers in hiring of state-of-the-art BDS. ASF "provides support to farmers, farmer groups, and entrepreneurs for hiring demand-driven technical and managerial services on a matching grant basis to improve their productivity, competitiveness and creditworthiness to access financing for their enterprises" [ASF (2009)]. Thus, a cornerstone of the program support by ASF is to enable agribusiness enterprises to benefit from the infrastructure of BDS, which in turn is expected to raise efficiency and productivity of the participating enterprises.

Since the start of operations in FY2007, ASF has provided financial "support in setting up 927 micro agribusiness enterprises owned and operated by FEGs consisting of 8382 male and 1556 female farmers"; "16465 acres were brought under Good Agricultural Practices (GAP) and 324 farmers and 35 processors/exporters registered under ASF's GlobalGAP projects for citrus and mango"; "support to 241 existing agribusiness enterprises, including 72 projects of acquisition of international certifications including: GlobalGAP, HACCP, British Retail Consortium (BRC), ISO 22000 and Organic"; "capacity building support to 901 agricultural professionals under various training programs" [ASF (2009, p.7)].

This study investigates the impact of demand-side and supply-side interventions of ASF on FEGs, selected clusters of agribusinesses and BDS providers in the country. In considering the efficacy of ASF program support, a central consideration is whether the interventions have successfully corrected the market failures. This program evaluation study has three objectives: (1)

to evaluate the impact of program support to FEGs; (2) to evaluate the spill-over impact of program support to agribusinesses; and (3) to evaluate market development for BDS providers.

First, we examine how matching grant support to FEGs in tunnel farms, dehydration farms and horticulture farms have impacted profitability, efficiency and productivity, employment generation, household income and expenditure, headcount poverty and some other household level outcomes. We use a design that allows us to control for treatment and control groups and pre- and post-treatment periods. We use an empirical methodology known as difference-in-differences method, which effectively controls for other effects on these outcomes on treatment and control groups [for a recent review of this literature, see Imbens and Wooldridge (2009)]. The analysis is based on 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund conducted from August 2009 to October 2009 to collect data of 396 FEGs and farms in treatment and control groups for pre-treatment (FY2007) and post-treatment (FY2009) periods.

Second, ASF has provided matching grant support to a cluster of agribusinesses in (1) milk collection, chilling and marketing, and (2) processors/exporters under ASF's GlobalGAP project. The objective was to promote these markets by integrating agribusinesses with dairy and citrus farms. The primary objective for the citrus intervention was to assist Pakistani growers and processors to adopt internationally compliant standards. However, this study is limited to assessment of the intervention with respect to the impact on participating farmers and the potential long-term consequences thereof. With data obtained from 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund of 217 farms for pre- and post-treatment period, we probe the implications (spill-over effects) of program support on affected and unaffected farms on real profit, productivity and efficiency, employment and income, etc. A key consideration is whether ASF intervention has successfully corrected the market failures?

Finally, how BDS market has benefited from ASF program support is an open question. How program support has led to capacity building and market expansion in also unclear. We use data obtained from a survey of 56 BDS providers to assess market development in four selected sectors, e.g., tunnel farming, floriculture, dairy sector, and dehydration units, where ASF has partnered as a facilitator. We identify the state of market development in each of the sectors, identify some specific constraints, and search for more effective ways of assisting BDS providers in these sectors.

The study is organized into seven chapters. Chapter 2 gives the background of ASF program support to FEGs, agribusinesses and BDS providers. Chapter 3 discusses sample design of FEGs and agribusinesses. Chapter 4 presents the method of analysis, defines outcome variables and describes technical details of measuring the outcome variables. Chapter 5 evaluates the impact of program support on FEGs. Chapter 6 provides evidence on the spill-over effects of program support to agribusinesses on farmers, and Chapter 7 discusses program support and its impact on market development of BDS providers.

2 The Agribusiness Support Fund

2.1 INTRODUCTION

The Agribusiness Support Fund came into being in July 2005 as a result of a loan agreement between Asian Development Bank and the Government of Pakistan. It is part of the Agribusiness Development Project initiative of the Government. While the project funding was released in October 2006, proper functioning of the Fund started in February 2007 after staff hiring and identification of premises. Full-scale grant funding of the project started in FY2007. Since then, the Fund has achieved significant progress and continued growth in grant funding operations. Important milestones achieved and other accomplishments of the Fund are well documented in its Annual Reports [ASF (2008, 2009)].

This chapter presents some background to the activities covered by the Fund since its inception and particularly those, which are the subject of program evaluation of the Fund.

2.2 THE AGRIBUSINESS SUPPORT FUND: KEY ACHIEVEMENTS

The mission of Agribusiness Support Fund is "to support economic growth and employment generation through agribusiness development [ASF (2009)]." The ASF aim is: (1) "to enable agribusiness enterprises to effectively utilize business development services (BDS) to enhance productivity, product and market diversity and penetration, and profitability, and (2) to enhance BDS providers' capacity to reach agribusiness enterprises through the delivery of more varied and effective services" [ASF (2009)]. The focus of ASF activities is "to strengthen and support demand-driven private sector service delivery mechanisms throughout the agribusiness value chain including supply of inputs, production, processing, and market access for domestic and export markets" [ASF (2009)]. In this regard, ASF gives a great deal of emphasis on promotion of "horticulture and horticulture business and livestock and dairy business."

A cornerstone of ASF policies is to promote BDS with the hope that it acts as a catalyst to promote efficiency, productivity and profitability in the participating businesses. In this regard, the idea is to provide limited-time finance, or time-bound support, to agribusinesses and micro enterprises to purchase eligible services of BDS providers to upgrade knowledge and skills by training or technical support. The nature, range and quality of BDS delivered by providers are also improved by capacity building programs of the Fund. The Annual Report of ASF categorizes its grants in to five types:

1. “Capacity building and related assistance to existing agribusiness enterprises and for start-up enterprises. The grants are provided to agribusiness enterprises for purchase of BDS.

2. Support to private sector BDS providers to enhance the availability and quality of services to agribusiness enterprises.

3. Support to individual farmers and farmer groups for the formation of agribusiness enterprises that can then obtain ASF support for eligible services.

4. Demand-driven research by private or public institutions leading to enhanced quality production and improved production processes, or to meet an identified market demand, and

5. Development of private sector extension services to be provided to farmers serving or proposing to serve agribusiness enterprises” [ASF (2009)].

Since its inception, ASF has provided program support to a diverse range of activities. They include acquisition of international certifications; capacity building support to agribusiness professionals in the form of training programs in certification, food safety, storage of food and vegetables, dairy farm management; extension services; research and development projects; Good Agricultural Practices (GAP); certified food production; participation in international exhibition, trade shows and promotional visits; farmer enterprise group formation through NGOs and RSPs; and registration of BDS providers to link them with farmer groups and businesses.

During FY2009, the Fund approved 763 matching grant projects in addition to 650 projects approved in FY2008. The total value of projects approved in FY2009 was Rs.185.22 million compared with Rs.184.98 million projects approved in FY2008. The average matching grant support provided by the Fund to agribusinesses was Rs.0.262 million per project. Further, the Fund also provided support to RSPs and NGOs to form 240 FEGs. As on June 30, 2009 the Fund extended program support to 2708 projects costing around Rs.500 million, which included 1528 matching grant projects for Rs.433.03 million for six categories of matching grants and Rs.67.4 million for formation of 1180 FEGs [ASF (2009)]. Program support of the Fund to FEGs, start-up support to agribusinesses and assistance to BDS providers is further elaborated below.

2.3 FARMER ENTERPRISE GROUP FORMATIONS AND BDS SUPPORT

During the first year of its operations the Fund raised awareness in rural communities about the benefits of forming farmer enterprise groups (FEGs), followed by formation of farmer groups with participatory approach. This was made possible by bringing on-board some leading NGOs and RSPs of the country, which were well-versed with community mobilization through participatory approach. The Fund successfully initiated the drive to form FEGs in diverse communities, and readied them to take-on innovative new projects in agriculture and agribusinesses. Promotion of BDS was a key component of all funded projects of the Fund.

Farmer Enterprise Groups are micro agribusiness entities owned and operated by groups of farmers in diverse range of activities and areas. As a policy, ASF provides support to form FEGs by covering 100% of the cost of formation. The task of group formation was outsourced to NGOs and RSPs that were well entrenched in rural communities and had vast experience of these activities. Under this program selected NGOs and RSPs successfully organized farmer groups into FEGs in target areas. On average, these FEGs consisted of 10 farmers per group including women groups. By June 2009, ASF had formed 1250 FEGs in different parts of the country in collaboration with 9 NGOs and RSPs [ASF (2008)].

After the formation of FEGs, they were provided with training by RSPs/NGOs to undertake a variety of agribusiness activities on a commercial basis. After the capacity building of these FEGs, they were also assisted by RSPs/NGOs to submit grant applications as well as business plans to ASF for matching grants. By June 2008, ASF had approved 538 grants submitted by FEGs. The distribution by RSP/NGO indicates that FEGs formed by AKRSP received 150 grants; LASOONA, 60 grants; RCDS, 100 grants; NRSP, 30 grants; Taraqee Foundation, 101 grants; and SRSP, 97 grants [ASF (2008)]. Projects approved under this category of grant included milk collection, chilling and distribution; apricot dehydration tunnels, processing and marketing; tomato paste plants; tunnel farming for off-season vegetables; packaging of grapes and apples and access to new markets; pickles preparation, packaging and marketing; production, packaging and marketing of cut-flowers; onion seeds production; and potato seeds production [ASF (2008)].

2.4 START-UP SUPPORT TO AGRIBUSINESS ENTERPRISES

ASF has funded several projects aimed at promoting agribusiness enterprises in Pakistan. The Fund approved Rs.92 million in FY2008 and another Rs.55 million in FY2009 to support 294 projects in this category. An important area of support was directed towards compliance with international quality standards. To this end, 72 international compliance certificates were acquired by agribusinesses with ASF matching grant support, which include GlobalGAP, HACCP, British Retail Consortium (BRC), ISO 22000 and Organic. Because of these grants, the ability of growers and agribusinesses have been enhanced to respond to sanitary and phytosanitary (SPS) measures and other food quality standards.

ASF has also collaborated with the Livestock and Dairy Development Board (LDDB)[1] to form dairy farm clusters to promote better technology in milk collection and marketing. Estimates show that 90% of the milk in Pakistan comes from smallholder dairy producers, who are thinly spread across all over the country, which makes its collection and marketing a major challenge. The problem here is that 97% of the marketed milk is channeled through informal milk collection networks. Due to monopoly of informal buying agents in remote villages, these networks are exploitative in nature. LDDB promotes better milk marketing through cold chain

[1] LDDB was set up by the Ministry of Food, Agriculture and Livestock of the Government of Pakistan for the development of the livestock sector in the country in 2005. LDDB is a private-sector led company established under the Companies Ordinance 1984.

technology by encouraging smallholder dairy producers to form organizations to get support. Under this program, ASF has provided start-up support of Rs.0.5 to Rs.0.6 million each to several dairy apex bodies or dairy clusters to facilitate collection, chilling and marketing of milk. The dairy clusters were formed by merging five dairy FEGs with membership of ten dairy farmers each.

ASF has also upgraded the capacity of leading processors and exporters of mango and citrus value chains under its Good Agricultural Practices (GAP) initiative. GlobalGAP is a private certification system driven by large retail chains in Europe, which form the core member group of the Euro-Retailer Produce Association (EUREP). Since consumers in developed countries increasingly differentiate between the fruits produced in farms that excessively use pesticides to those who use Good Agricultural Practices, such certifications are expected to become mandatory for all fruit/vegetable exports from developing countries to the developed world in the near future. Under its matching grant program, ASF encouraged a cluster of 14 leading citrus (*kinnoo*) exporters of Bhalwal, District Sargodha to form Produce Marketing Organizations (PMOs) for acquisition of GlobalGAP certification. These certifications are mostly linked with implementation of Good Agricultural Practices in the orchards of PMO member citrus (*kinnoo*) growers.[2] ASF provided a matching-grant of around Rs.1.5 million to each participating PMO to cover various costs and consulting fee to implement the project.

2.5 ASF SUPPORT TO BDS PROVIDERS

The market for BDS providers in Pakistan fails to respond to the needs of the private sector agribusiness enterprises. On the one hand, there is non-existence of many strategic business services, and on the other, there is lack of demand of these services from agribusiness enterprises. ASF matching-grant program to agribusinesses has facilitated BDS market by providing matching-grant to purchase these services, i.e., demand-side intervention, and has supported several projects aimed at capacity building of BDS providers, i.e., supply-side intervention. While we have already discussed the demand-side interventions of ASF, next we briefly mention ASF's supply-side initiatives below.

Until June 2009, ASF has facilitated BDS market development in the country by supporting 283 capacity building projects amounting Rs.19.34 million. This support includes collaborative training programs for capacity building of the agribusiness sector, viz., GlobalGAP Train-the-Trainer program; training on Controlled-Atmosphere (CA) technology; British Retail Consortium 3rd Party Auditor (Food Safety Issue-5); dairy farm management and mushroom cultivation; tunnel farming; course on Ornamental Plants Production; Certified Gardner Course; Tissue Culture Lab Technician course; Home Gardening course; Nursery Management; and Agribusiness Entrepreneurship program [ASF (2009)].

[2] ASF has supported 241 existing agribusiness enterprises to acquire international certifications including GlobalGAP [ASF (2009)]. As part of this initiative ASF has also assisted in capacity building of agricultural professionals by arranging training programs including GlobalGAP Train-the-Trainer Program in collaboration with Ms. FoodPlus GMBH, Germany [ASF (2009)].

2.6 CONCLUSIONS

In summary, the Agribusiness Support Fund has come a long way in its drive to support agribusiness development in the country by promoting demand and supply of BDS in the country through matching-grants and other components of grant funding. While the Fund has provided support to a diverse range of activities, the most significant interventions were FEG formation and BDS support, start-up support to agribusinesses, and assistance to BDS providers to facilitate BDS market. It is clear that development of agribusiness enterprises cannot succeed in Pakistan by neglecting BDS market failures. Therefore, a key motivation for ASF interventions was to use matching-grants as a public-policy tool to correct market failures of the sort elaborated above. The analysis here reveals that a process of changed management of agribusiness enterprises may have begun whereby the economic agents participating in the programs may have realized that better use of BDS consulting services ensures better returns to their investments. There remains, however, the need to probe the interrelationships between program support and its impact on selected outcomes so that the true impact of these interventions could be assessed on the treatment groups. However, program evaluation of these interventions largely hinges on the availability of reliable data, which is discussed in Chapter 3.

3 Sample Design of FEGs and Agribusinesses

3.1 INTRODUCTION

Base-line surveys are often conducted before program support to target groups begins. But, no base-line survey was conducted before launching of ASF program support to farmer enterprise groups and agribusinesses that are being evaluated in this study. Consequently, the task of data collection for program evaluation of ASF was made more challenging because the older the information more difficult it was to dig out. This Chapter presents information on survey design and data collection of FEGs and agribusinesses and their members. While describing the survey of FEGs, we also elaborate on the definitions used for treatment and control farms.

3.2 SURVEY DESIGN AND DATA

The objective of the survey was to evaluate and identify the effect of ASF program support to FEGs and agribusinesses, which might have affected particular groups of farmers in the treatment group. To be able to identify the effects, we needed detailed information about the attributes of farms including information about farm owners, nature of support received from ASF, production and cost structure of farms and household attributes of the farms. Therefore, we designed 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund.

Our sample design included farms in treatment group, i.e., those who received ASF program support, and control group, i.e., those who never received ASF program support. The survey was designed to collect data for two rounds. The first round was meant to get information of pre-treatment period (base-line) or before program support began, and the second round was for information of post-treatment period, or after program support. Based on these considerations, we decided to evaluate program support by surveying farmers of five selected activities on the basis of a sample frame of FEGs and agribusinesses. The sample of FEGs consisted of (1) tunnel farming of off-season vegetables; (2) dehydration tunnels for apricot drying; and (3) horticulture farms for production and marketing of cut-flowers.

ASF program support was also extended to agribusinesses including those who were involved in (a) milk collection, chilling and marketing, and (b) certified production, processing and export of citrus (*kinnoo*) under the GlobalGAP project. In these cases, ASF grant was extended directly to agribusinesses for promotion of BDS and only spill-over benefits were envisaged for dairy farmers and citrus growers. To evaluate the spill-over effects of program support we obtained a sample of (1) smallholder dairy producers who were members of dairy apex bodies involved in milk collection, chilling and marketing of milk; and (2) citrus growing farms who were members of Produce Marketing Organizations (PMOs) involved in GlobalGAP certification project. The area-wise distribution of selected activities along with the names of RSPs/NGOs who helped form these FEGs and agribusiness networks is listed in Table 3.1.

Table 3.1. Selected sectors and target areas for the sample design

Activity	Target area (district/region)	Name of RSP/NGO	Scale of production
1. Tunnel farming of off-season vegetables	Sheikhupura, Nankana Sahib	RCDS	Small-scale
2. Dehydration tunnels for apricots drying	Gilgit and Baltistan	AKRSP	Small-scale
3. Horticulture farms for production, packaging and marketing of cut flowers	Pishin	Taraqee Foundation	Small-scale
4. Dairy sector initiative for milk-collection, chilling and marketing	Sheikhupura, Nankana Sahib, Jhelum	RCDS, NRSP	Small-scale
5. Citrus (*kinnoo*) production under GlobalGap certification	Sargodha	GlobalGap Certification Project	Medium- and large-scale

3.3 SURVEY OF FEGS

Our choice of FEG sample and sectors was driven by several factors. First, the selected sectors represent about 71% of total grants approved by ASF until June 30, 2008. Second, tunnel farming, dehydration, horticulture and dairy farm activities involved small-scale farmers, including women where ASF program support would be expected to produce pro-poor growth, especially leading to increased farm-level productivity, efficiency, employment as well increased farm incomes. Third, due to narrow specialization in similar activities by the small-scale farmers, the inputs used and outputs produced were relatively homogenous, which made it convenient to obtain reliable valuation of costs of production and gross output. Fourth, the selected activities were based in districts where average landholding is relatively small due to dominance of peasant farmers. It made easier for us to select farms in the control group that were operating at a small-scale and were involved in similar activities under homogenous conditions. Finally, our past experience suggested that SMEs in Pakistan do not cooperate with the enumerators and often show reluctance in sharing information on sales, cost of production, and employment.[3] However, it was much easier to get this information from farmers, who are the main focus of this survey.

[3] Burki (2009) has noted that "SMEs often suspect enumerators as government agents/functionaries posing as researchers in an attempt to extract information on violation of labor laws or income tax laws."

ASF engaged NGOs/RSPs for formation of FEGs in FY2007 while the first set of grants was approved in FY2008. Therefore, we fix pre-treatment period as FY2007 or just before ASF grants were approved. Post-treatment period was taken two-years after the beginning of ASF grants to FEGs, i.e., FY2009. Those FEGs who were disbursed ASF grant after June 30, 2008 were not selected for data collection for the survey. Data of each farm was collected for two full fiscal years, i.e., FY2007 or July 1, 2006 to June 30, 2007 (pre-treatment or round 1) and FY2009 or July 1, 2008 to June 30, 2009 (post-treatment or round 2).

The sample of treated FEGs and member farms was randomly drawn from those who were provided support until June 30, 2008 in respective sectors and target areas. However, we followed a purposive sampling plan to draw the sample of farms in control group. A control group of farms in the immediate neighborhood of sampled FEGs and farms formed a natural basis for comparison with selected FEGs. Therefore, utmost care was exercised in selecting farms in the control group. Under this approach those farms were included in control group that were first encountered by the enumerator after conducting interviews with FEGs or member farms during field trips to pre-identified areas in selected sectors. We decided to interview as many control farms as the number of FEGs in each sector and region.

For data collection, two survey questionnaires were designed: (a) FEG questionnaire; and (b) Farmer's questionnaire. Altogether there were four sections in the survey questionnaire. Section 1 dealt with information about the farm/FEG; section 2 asked information about ASF grants; section 3 was about earnings and cost of production of farms/FEGs, while section 4 pertained to information about members of the farm household. Section 1 and Section 3 were common to both FEG's and Farmer's questionnaires; section 2 was deleted from Farmer's questionnaire, and Section 4 was deleted from FEG's questionnaire. While Farmer's questionnaire asked information for both periods, FEG's questionnaire only asked information for post-treatment period.

The data on FEG's questionnaire was obtained from each FEG Group Leader who was responsible for maintaining accounts and for taking all administrative and managerial decisions. Farmers' questionnaire was used to collect data from FEG member farms and from farms in control group. In the case of FEGs in tunnel, dehydration and horticulture farms, we faced a unique situation whereby FEGs existed only in round 2 (or post-treatment period) while they were non-existent in round 1 (pre-treatment period). However, all member farms existed in both rounds, i.e., as individual entities in round 1 (i.e., FY2007), and as individual farms and FEGs in round 2 (i.e., FY2009). In other words, after the formation of FEGs, Members continued their normal operations individually in round 2, independent of FEG operations. For example, let there be a vegetable growing farm called A, who owns 5 acres of land in round 1. Farmer A becomes member of an FEG that produces vegetable on a medium-tunnel set up on one-acre of rented land, which is a joint-venture of 10-FEG Members including farmer A.

To address this situation, we treated each FEG member as if they were involved in joint production with FEGs. Under this approach we treated each FEG member in the survey as an independent FEG, which amounted to collecting two rounds of data at the level of farms and one round data (round 2) at the level of FEGs. Later, these data sets were merged to generate required data for our purposes. To illustrate, farmer A provided information about his 5-acre vegetable farm for round 1 and round 2 while information gathered from FEG Group Leader about this FEG was supplemented to round 2 data provided by farmer A to complete the required information. Farms in control group remained individual entities both in round 1 and round 2, therefore, they were only administered the Farmer's Questionnaire.

We used two definitions for treatment and control as follows:

- **Definition 1:** We assumed that all FEG Members were active participants of FEGs and were therefore taken as treatment group; and

- **Definition 2:** We assumed that only FEG Group Leaders were active participants and therefore were taken as treatment group.

Adopting two different definitions for treatment and control group may appear an extraordinary step, but we were motivated by two considerations to adopt this line of action for this impact assessment. One, we were informed by several FEG Members during the survey in Sharaqpur region that they were not full-time active participants in all activities of FEGs and that their involvement was of a more passive nature. Two, preliminary assessments on survey data further corroborated the above mentioned claim.

By implication, if definition 1 was true, then in effect, we presuppose that the BDS program support provided by ASF to FEGs would equally benefit all FEG Members in terms of technological development and marketing devices, which in turn would act as a catalyst to enhance their farm productivity and profitability through demonstration effect. This would serve the original purpose well of providing matching grant to farmer groups. However, if definition 2 was true then the greatest benefits of program support would accrue to the more active and dynamic member, which in this case is the Group Leader of FEG. The absence of equality of stakes by all members of FEGs greatly simplifies the analysis where we treat FEG Group Leaders as the principal stakeholder of FEG while all FEG Members are treated as control group. This characterization is depicted in Table 3.2 which shows that when FEG Group Leaders alone are taken as treatment group in the right-hand panel, then the composition of the sample in col.(4) – col.(6) in each group significantly changes as compared to the sample in col.(1) – col.(3).

A sample of 396 FEG Members and control farms was drawn from tunnel farms, dehydration farms, and horticulture farms. Table 3.2 shows that the FEG sample consists of 65 FEGs, 327 FEG Members and 69 control farms. Sector-wise distribution indicates that 158 farms were taken from tunnel farm cluster in Sheikhupura and Nankana Sahib Districts of Punjab; 123 were from apricot drying dehydration tunnels in Gilgit-Baltistan region; and 115 were from horticulture farms involved in cut-flowers (gladiolus) in the Pishin District of Balochistan. In a total of 65 FEGs in the sample, 23 were in tunnel farming, 25 were in dehydration tunnels, and 17 were in horticulture sector.

The left-hand panel of Table 3.2 shows sample distribution for definition 1 and the right-hand panel indicates sample distribution for definition 2.

Table 3.2. Sample design and distribution of FEGs by sector

	Definition 1: FEG Members taken as treatment			**Definition 2:** FEG Group Leaders taken as treatment		
	Round 1	Round 2	All	Round 1	Round 2	All
	(1)	(2)	(3)	(4)	(5)	(6)
1) Distribution of FEGs by treatment and control:						
a) Number of FEG Members in the sample: (number of FEGs in the sample = 65)	327	327	654	65	65	130
b) Number of control farms in the sample:	69	69	138	331	331	662
Total FEG sample:	**396**	**396**	**792**	**396**	**396**	**792**
2) Distribution of FEGs by sector:						
a) Number of FEG Members in tunnel farming (number of FEGs in the sample = 23)	133	133	266	23	23	46
b) Number of control farms in tunnel farming	25	25	50	135	135	270
c) Number of FEG Members in dehydration tunnels (number of FEGs in the sample = 25)	100	100	200	25	25	50
d) Number control farms in dehydration tunnels	23	23	46	98	98	196
e) Number of FEG Members in horticulture farms (number of FEGs in the sample = 17)	94	94	188	17	17	34
f) Number of control farms in horticulture farms	21	21	42	98	98	196
Total FEG sample::	**396**	**396**	**792**	**396**	**396**	**792**

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

3.4 DAIRY APEX BODIES AND PMOs: SURVEY OF MEMBER FARMS

The second set of sample was drawn from dairy and citrus clusters where ASF formed dairy apex bodies by merging 5 dairy FEGs (consisting of 10-members each) and by setting-up PMOs in the citrus cluster. For the survey of dairy and citrus farms we decided to draw at least 25% sample from control group. A sample of 49 dairy farms (35 members of 7 apex bodies, and 14 from control group) was drawn from Sheikhupura, Nankana and Jhelum Districts (see Table 3.3). Moreover, a sample of 168 farms was taken from Sargodha district where 112 farms were drawn from PMO members linked with 13 PMOs for production, processing and marketing of citrus under ASF's GlobalGAP certification project, and 56 farms were taken from control group. Since most GlobalGAP certification protocols are applied to citrus producing farms, it would be expected that ASF matching grant to GlobalGAP certification would contribute to higher levels of productivity, efficiency and employment in member farms, vis-à-vis control farms from the same region.

Table 3.3. Sample design and distribution of farms in dairy and citrus clusters

	Round 1	Round 2	Total
1. Sample of farms in dairy cluster:			
a) Number of dairy apex body members in the sample: (number of dairy apex bodies in the sample = 7)	35	35	70
b) Number of control farms in dairy cluster:	14	14	28
II. Sub-total:	**49**	**49**	**98**
2. Sample of farms in citrus cluster:			
a) Number of PMO member farms in citrus cluster in the sample: (number of PMOs in the sample = 13)	112	112	224
b) Number of control farms in citrus farm cluster:	56	56	112
III. Sub-total:	**168**	**168**	**336**
Total sample (I + II):	**217**	**217**	**434**

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

3.5 SURVEY ADMINISTRATION

The questionnaires were administered by a trained enumerator who had MSc Economics degree from Quaid-i-Azam University and who had over 20 years of field experience of conducting rural surveys. The survey was conducted from August 20, 2009 to October 25, 2009 in face-to-face interviews with most knowledgeable and responsible owners of the farms. For this purpose, the enumerator traveled to each of the respondents to fill-out the questionnaires. Field interviews with FEGs and their members were coordinated with active support of RCDS in Sheikhupura and Nankana Sahib; RSP in Jhelum; AKRSP in Gilgit-Baltistan; Taraqee Foundation in Pishin; and program staff of ASF GlobalGAP project of Bhalwal in Sargodha District.

3.6 CONCLUSIONS

Summing up we conducted 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund to evaluate the affect of program support to FEGs and agribusinesses by drawing representative samples of 396 FEGs from vegetable tunnel farms, dehydration farms and horticulture farms, and 217 farms from dairy and citrus clusters. The sample included farms in treatment and control. The data was collected for pre- and post-treatment periods. We adopted two definitions for treatment and control where definition 1 assumed that all FEG Members were in treatment group while definition 2 assumed that only FEG Group Leaders were in treatment group. The survey was conducted from August 2009 to October 2009 in personal interviews with most knowledgeable individuals of the farms with active support of NGOs/RSPs that had helped form FEGs, apex bodies and PMOs. The description in Chapter 4 identifies the estimation strategy used in this study to evaluate selected program outcomes.

4 Empirical Framework for Program Evaluation

4.1 INTRODUCTION

While many policy decisions in economics depend on causal effects of programs, the econometric and statistical analysis of such causal effects is still in its infancy in developing countries such as Pakistan. A central question studied in program evaluation is that of evaluating the effect of exposure of a set of individuals, households, farms/firms, markets or countries to a program, or treatment on some outcomes. The objective here is to obtain the causal effects of programs or policies by comparing the observed outcomes of a treatment before and after the intervention for groups exposed to it to this difference for groups not exposed to it [Meyer (1995); Gruber (1994)].

Various methods have been proposed for program evaluation under specific circumstances and the data availability.[4] The simplest method is often termed as the one-group-before-and-after-design where the researcher simply computes the difference in average outcomes of only treated groups in the pre- and post-treatment period. However, this simple difference may be misleading as it includes the effect of other influences on the outcome variable occurring in the pre- and post-treatment period, and not just the targeted intervention. In terms of regression framework, following Cameron and Trivedi (2005), this is illustrated by taking a case where we compare the outcome of an intervention on the treatment group before and after intervention as follows:

$$Y_{it} = \alpha + \gamma \tau_t + \varepsilon_{it},$$

where Y_{it} measures the outcome of interest, i indexes unit/household ($i = 1,\dots,N$), t indexes years (=1 if post-treatment period, =0 if pre-treatment period), τ is a dummy variable indicating if enterprise/household is in the treatment group, i.e., $\tau_t = 1$ if t refers to post-intervention period, $\tau_t = 0$ otherwise. In this case, the estimate of the program impact (or the causal effect of treatment on outcome) is given by γ, which is equal to the average difference in the pre- and post-treatment outcome, or

$$\begin{aligned}\hat{\gamma} &= \frac{1}{N}\sum_i \left(Y_1 - Y_0\right) \\ &= \bar{Y}_1 - \bar{Y}_0\end{aligned}$$

[4] For a review of theoretical and empirical issues in the econometrics of program evaluation, see among others, Imbens and Wooldridge (2009); Heckman and Vytlacil (2007); Cobb-Clark and Crossley (2003); Heckman, LaLonde, Smith (1999)].

where the bar depicts average and subscripts 1 and 2 depict the time periods. This one group comparison in a pre- and post-treatment framework is premised on the assumption that the treatment group remains comparable overtime. This is a strong assumption, which may be violated in practice because there might be several other influences on the outcome that one might not be able to rule out as explanations. However, if we allow α to vary between the two periods, the problem arises that γ would not be identified any more. One-group before-and-after design also suffers from the problem that the causal effect (i.e., estimate of the $\hat{\gamma}$ parameter) coming from such models may be called into question for failing to identify appropriate control groups.

In cases where the treatment and control groups can be effectively defined, the difference-in-differences method is a widely used tool for the impact assessment [Imbens and Wooldridge (2009)]. In this study, we also use difference-in-differences method as performance measurement framework where outcomes are observed for units in one of two groups, in one of two time periods [for other influential applications, see for instance, Banerjee et al. (2007); Angrist et al. (2006); Abadie et al. (2003); Jin et al. (2003); Blundell et al. (1998); Card and Krueger (1993, 1994)].

4.2 THE DIFFERENCE-IN-DIFFERENCES ESTIMATOR

We use a design where we include both treatment and control groups. The treatment group consists of those enterprises or FEGs that have received program support that could affect post-treatment outcomes. The control group consists of enterprises that have not been directly affected by the program support.[5] This approach is commonly referred to as the difference-in-differences estimator, which has become the most popular way to investigate outcomes of interventions on treatment and control groups.

Under this approach, we compare the difference in outcomes of intervention in a before and after scenario for treatment and this difference for the control groups. Thus the regression equation for the difference-in-differences model is specified as

$$Y_{ijt} = \alpha + \phi\tau_t + \delta\,\mathrm{TR}_j + \beta\left(\tau_t \times \mathrm{TR}_j\right) + \gamma X_{ijt} + \lambda\ \mathrm{SECTOR} + \eta\,\mathrm{DISTRICT} + \varepsilon_{ijt} \qquad (4.1)$$

where Y_{ijt} being outcome variable (performance indicator) for the ith enterprise in pre- and post-treatment periods is indexed by group subscript j, where $j=1$ for treated group and 0 for control group; τ_t equals 1 for post-treatment period and 0 otherwise; TR_j is a dummy variable for treatment group that equals 1 if treatment, and 0 otherwise; and $\left(\tau_t \times TR_j\right)$ is a dummy variable for whether the intervention has affected treatment group in post-treatment period (1 if

[5] For other recent literature where appropriate control groups are chosen see, for example, Meyer (1995), Angrist and Krueger (1999), Bertrand et al. (2002), Kubic and Moran (2003), Abadie et al. (2007), Belasen and Polachek (2009).

post-intervention period and treatment group, and 0 otherwise). Assuming that $E\left[\varepsilon_{ijt} \mid \tau_t \times TR_i\right]=0$, we can obtain unbiased estimates of β by the sample average given by

$$\hat{\beta}=\left(\bar{Y}_1^1-\bar{Y}_0^1\right)-\left(\bar{Y}_1^0-\bar{Y}_0^0\right)$$

where bars depict average over i, subscripts 0 and 1 indicate before and after time periods, and superscripts 0 and 1 are for treated and untreated groups, respectively. To reduce the sampling variance of the difference-in-differences model, we control for other observables that may affect the outcome variables. Therefore, we include a vector of farm/enterprise level observable characteristics, X_{ijt}, which are termed as farm fixed-effects and FEG fixed-effects. We also include sector fixed-effects and district fixed-effects to control for differences in outcomes due to heterogeneity and diversity due to sectors and regions.

In addition to the first-order interaction terms, we also define treatment by interacting more than two variables termed as second-order interaction terms or triple interaction terms. In this case, the coefficients of the second-order interaction terms become the key parameters of interest. The empirical model in Eq.(4.1) is estimated by the ordinary least squares (OLS), and linear probability model routines.

It is also common to present the difference-in-differences estimator in the form of a table as presented in Table 4.1.[6] This table presents before and after outcome of intervention on treatment and control groups. The estimate for $\hat{\beta}$ is given in the lower right hand corner.

Table 4.1. Difference-in-differences

	Treatment group	Control group	Treatment-control difference
Pre-treatment period	$\bar{Y}_0^T$	$\bar{Y}_0^C$	$\bar{Y}_0^T-\bar{Y}_0^C$
Post-treatment period	$\bar{Y}_1^T$	$\bar{Y}_1^C$	$\bar{Y}_1^T-\bar{Y}_1^C$
Post-pre difference	$\bar{Y}_1^T-\bar{Y}_0^T$	$\bar{Y}_1^C-\bar{Y}_0^C$	$\bar{Y}_1^T-\bar{Y}_1^C-\left(\bar{Y}_0^T-\bar{Y}_0^C\right)$

4.3 DEFINING OUTCOME VARIABLES

We use a number of outcome variables to evaluate the impact of program support. The outcome variables are defined separately for enterprises and households. To find out the causal effects of program support on these outcomes, we elicit the regression framework given in Eq.(4.1) and use

[6] See also Card and Krueger (1994).

the outcomes as dependent variable. The enterprise and household level outcomes variables are discussed in more detail below.

A. Measuring Farm/Enterprise Level Outcomes

Profitability of the Enterprise

The profitability of each enterprise is measured by subtracting annual total cost from annual total revenue in constant 2000-01 prices. Estimates of the impact of program support on yearly profit are obtained by using two rounds of the survey data while the regression framework used resembles Eq.(4.1) where the dependent variable Y_{ijt} is defined as the logarithm of total yearly profit.

Measuring Technical Efficiency and its Components[7]

Overall technical efficiency (OTE) refers to efficient utilization of enterprise resources relative to the best practice within the sample and in comparison with the reference firm. Overall technical efficiency is further decomposed into pure technical efficiency (PTE) and scale efficiency (SE). These concepts are illustrated below.

We focus on the issue of measuring efficiency for an enterprise/farm producing one output by using several inputs or factors of production. In this context, production frontier is simply the maximum possible output for a given set of inputs. Farms producing on the frontier are efficient while those inside frontier are inefficient. In this case, a farm using one unit of the input to produce one unit of output would get TE score of 1 (1/1) or 100% efficiency. A second firm using six units of input and producing three units of output would get TE score of 0.5 (3/6) or 50% efficiency. A score of 0.5 for a firm indicates that the firm could raise output by 50% by becoming efficient and moving to the frontier [Burki and Terrell (1998)].

Farms may be inefficient simply by making inefficient use of inputs or by failing to operate at the optimal scale. To determine the source of inefficiency, pure technical efficiency and scale efficiency are calculated as two other measures of efficiency. Scale efficiency measures the output loss due to operating at an inefficient scale, while pure technical efficiency measures efficiency at the firm's current scale. These measures are easily explained in the context of the method of measuring efficiency known as data envelopment analysis (DEA). DEA method constructs a linear or piece-wise linear frontier using input/output combinations of farms in the sample and calculates efficiency measures based on deviations from that frontier.

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[7] This sub-section draws heavily from Burki and Terrell (1998) and Burki and Dashti (2003).

Consider again the case of the farm sector where farms use a single input to produce one output. Fig. 4.1 illustrates the DEA method of calculating production frontiers and efficiency measures for a sample of four firms with input-output combinations at points *B, C, D* and *F*. The constant return to scale frontier is simply a ray through the origin *OC* that envelops the data, which represents the ratio of the quantity an efficient farm would have used to produce a unit of output to the quantity used by the farm being evaluated. The fully efficient farm at point *C* lies on the frontier and thus overall technical efficiency of this farm equals one. The other three farms represented by points *B, D* and *F* operate inside the frontier and are thus inefficient. Farms may be inefficient simply by making poor use of inputs or by failing to operate at the optimal scale. Thus, a measure for overall technical efficiency is given by *TE = GH/GF*.

To divide *TE* into pure technical efficiency (*PTE*) and scale efficiency (*SE*), a variable return to scale frontier is constructed, which is the piecewise linear frontier *ABCD* in Fig. 4.1. Clearly, this more general form of technology envelops the data most closely. Because farms *B*, *C*, and *D* lie on this frontier, they receive a pure technical efficiency score of one or 100% while *F* is inefficient by this criterion as well. *PTE* is measured by the ratio of the inputs required on the variable returns to scale frontier to those used by the farm, or *PTE=GJ/GF* [Burki and Terrell (1998)]

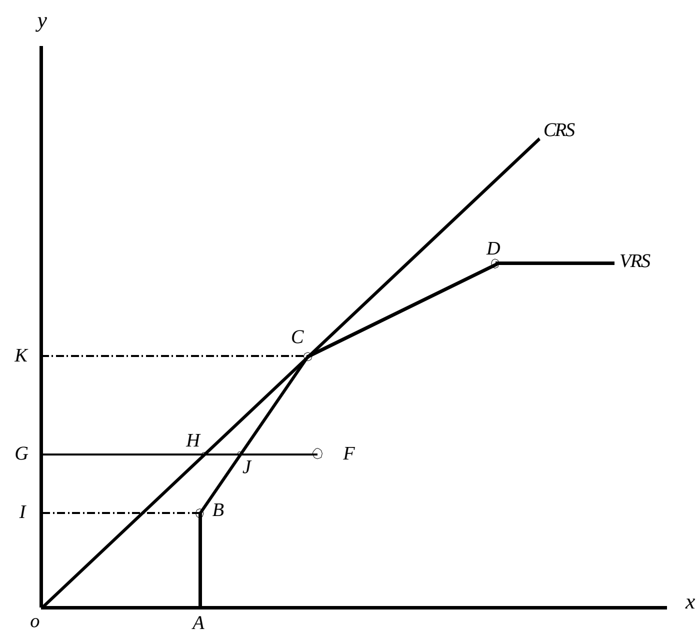


Fig. 4.1:
Overall technical, pure technical and scale Efficiencies

Source: Burki and Terrell (1998)

Although farms *B* and *D* are efficient in terms of pure technical efficiency, neither is considered technically efficient because they operate on an inefficient scale. Both farms could produce more output per unit of input by adopting the scale employed by farm *C*. Using this logic, a measure of scale efficiency can be obtained by taking the ratio of scores for *TE* and *PTE*. Pure scale efficiency for farm *F* in Fig. 4.1 is *GH/GJ*. In other words, to measure the most productive scale size, technical efficiency is first eliminated by moving from point *F* to point *J* on production frontier and then measuring the divergence in the input from the constant returns to scale frontier. This implies that $1 - GH / GJ$ measures the percent of input reduction that could occur if this farm was producing at the most efficient scale. Thus point *C* is the only scale efficient point in Fig. 1.

We measure overall technical efficiency of the operating units as an indicator of performance by data envelopment analysis (DEA), which was originally developed by Charnes *et al.* (1978) and has been used by many recent studies in estimating efficiency of decision making units.[8] Because the objective of this impact assessment is to examine efficiency of each yearly cross-section of enterprises, we prefer DEA approach over other alternatives. Since we also want to evaluate how these enterprises were able to reduce costs after program support, input use efficiency measurement is our preferred choice.

Following Fare et al. (1994a) and Coelli et al. (1998) we use an input output vector to estimate overall technical efficiency by using DEA method to frontier estimation. It involves construction of non-parametric best-practice frontier or a piecewise linear surface obtained from observed data, which serves as benchmark for comparison. The resultant efficiency measure, ranging between zero (least efficient) and one (most efficient), depicts the distance from each unit to frontier. The linear programming minimization problem solved to obtain input oriented overall technical efficiency is given by

$$\begin{aligned} &\min_{\theta,\lambda} \ \theta \\ &\text{subject to} \\ &-y_i + Y\lambda \geq 0, \\ &\theta x_i - X\lambda \geq 0, \\ &\lambda \geq 0 \end{aligned} \tag{4.2}$$

In this problem, θ is a scalar; λ is a $n \times 1$ vector of constants; X is the ($k \times n$) matrix of inputs where n represents the number of decision making units (DMUs); Y is the ($m \times n$) matrix of outputs. For the *i*th DMU, the vectors x_i and y_i represent the inputs and outputs, respectively. The value of θ represents TE score for the *i*th DMU, where the condition $\theta \leq 1$ holds. To obtain the value of θ for each DMU, we solve LP problem *n* times.

Due to constant returns to scale, LP problem in Eq.(4.2) does not fully envelop the data set and thus enlarges the feasible region. Therefore, in the second step, to measure pure technical

[8] Major benefits associated with DEA method are (i) its parsimonious nature toward the data, and (ii) its property of not imposing a functional form on the data due to which it operates well with mixed sizes of firms.

efficiency (PTE) scores we relax the assumption of CRS by introducing the convexity constraint $NI'\lambda = 1$ in to Eq.(4.2). A measure of scale efficiency (SE) is obtained by taking the ratio of scores for TE and PTE.

The evaluation of the impact of program support on technical efficiency (OTE) entails a two-step procedure. In the first-step, we measure TE, PTE and SE of each enterprise relative to the best practice within the sample for each of the years.[9] In the second-step, we use these indexes (i.e., bounded between 0 and 1) as dependent variable and regress Eq.(4.1) with Ordinary Least Squares to obtain the parameters of interest.[10] This will allow us to comment on the role of program support on increasing/decreasing technical efficiency of treated enterprises vis-à-vis control group.

Measuring Total Factor Productivity Growth:

The most comprehensive indicator of performance of an enterprise is its total factor productivity (TFP) growth in the two time periods. The outcome variable in this case is TFP growth, which is obtained from a non-parametric linear programming framework.

To measure TFP growth we use Malmquist total factor productivity index due to Caves et al. (1982) and its extensions [Fare et al. (1994b)]. This is a non-parametric measure of productivity change, which has been widely used in various applications including performance in the farm sector. Unlike parametric approach (regression framework), this approach is not sensitive to the degrees of freedom due to which it is attractive in our kind of application where some program clusters may yield very small samples.

Under this approach, productivity growth is calculated as a geometric mean of two Malmquist productivity indexes. The distance functions are functional representations of multiple-output, multiple-input technology, which require data only on input and output quantities. To define the output-based Malmquist productivity change index, we begin by assuming that we have *M* outputs and *N* inputs. We also assume that for each time period $t = 1, \ldots, T$, the production technology $G^t(y^t)$ describes possibilities for transforming inputs x^t into outputs y^t. For the production technology in period t and with $y = y_1, y_2, \ldots, y_M \in \Re_+^M$ outputs and $x = x_1, x_2, \ldots, x_N \in \Re_+^N$ inputs, we can write this technology as

[9] DEA method to frontier estimation involves construction of non-parametric best-practice frontier or a piecewise linear surface obtained from observed data, which serves as benchmark for comparison. The resultant efficiency measure, ranging between zero (least efficient) and one (most efficient), depicts the distance from each unit to frontier. Technical efficiency is the outcome measure that simply means the maximum possible output for each combination of inputs. Firms producing on the frontier are efficient, while those inside the frontier are inefficient.

[10] Since efficiency indexes are bounded between zero and one, the Tobit maximum likelihood regression is more appropriate to evaluate the sources of measured efficiency. However, our results show that the bias that may have occurred due to the OLS model was virtually non existent in our data. Therefore, we stick to the OLS model.

$$G^t(y^t) = \left\{ \left(x^t, y^t \right) : x^t \text{can produce } y^t \right\}.$$

Caves et al. (1982) define the output distance function at time t as the reciprocal of the 'maximum' proportional expansion of output vector y^t given input vector x^t

$$D_0^t\left(x^t, y^t\right) = \inf\left\{ \pi : \left(x^t, \frac{y^t}{\pi} \right) \in G^t\left(y^t\right) \right\}$$

where π indicates the coefficient dividing output vector y^t to obtain frontier production vector at time t given input vector x^t. Similarly, the distance function for production points at $t+1$ for reference production technology at time t is defined by

$$D_0^t\left(x^{t+1}, y^{t+1}\right) = \inf\left\{ \pi : \left(x^{t+1}, \frac{y^{t+1}}{\pi} \right) \in G^t\left(y^t\right) \right\}$$

Caves et al. (1982) define the Malmquist productivity indexes for reference technologies at t and $t+1$ by

$$M_0^t = \frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}$$

$$M_0^{t+1} = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^t, y^t)}$$

Following Fare et al. (1994b), we define an output based Malmquist productivity change index without choosing arbitrary benchmark as the geometric mean of two Caves et al. (1982) type Malmquist indexes

$$M_0\left[M_0^t + M_0^{t+1}\right]^{\frac{1}{2}} = \left[\frac{D_0^t\left(x^{t+1}, y^{t+1}\right)}{D_0^t\left(x^t, y^t\right)} \times \frac{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_0^{t+1}\left(x^t, y^t\right)} \right]^{\frac{1}{2}}$$

Equivalently, this index can be further written in terms of efficiency change and technical change indexes as

$$M_0\left[M_0^t + M_0^{t+1}\right]^{\frac{1}{2}} = \frac{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_0^t\left(x^t, y^t\right)} \times \left[\left(\frac{D_0^t\left(x^{t+1}, y^{t+1}\right)}{D_0^{t+1}\left(x^{t+1}, y^{t+1}\right)} \right) \times \left(\frac{D_0^t\left(x^t, y^t\right)}{D_0^{t+1}\left(x^t, y^t\right)} \right) \right]^{\frac{1}{2}}$$

The term outside the bracket $[.]$ indicates efficiency change or deviation of actual production from the maximum potential production, while the term inside square brackets is the geometric mean of the two ratios that capture technical change or shift in production technology between the two time periods such as t and $t+1$.

While in practice the distance functions $D_0^t(x^t, y^t)$, $D_0^{t+1}(x^{t+1}, y^{t+1})$, $D_0^t(x^{t+1}, y^{t+1})$, and $D_0^{t+1}(x^t, y^t)$ can be measured either with DEA type linear programming methods suggested by Fare et al. (1994) or the stochastic frontier approach [for further details, see Coelli et al. (1998)]. We measure TFP growth by solving linear programming problems (not specified here for brevity) with inequality constraints and assuming constant returns to scale technology [see Coelli et al. (1998)].

Employment Generation

Employment is measured by the total number of weekly hours work by hired labour, family labour and hours worked by the owners of these farms/enterprises. We expect that program support would increase employment in treated enterprises as compared with those that are untreated. The dependent variable is weekly hours worked and the model is run by the OLS. The parameter estimates of the determinants of employment would demonstrate the causal effect of program support on employment generation.

B. Household Level Outcomes

Household Income and Expenditure:

The survey questionnaire asks questions on household income from the enterprise/farm, total household income from all sources, and household expenditure from each surveyed household for pre- and post-treatment periods. We convert them into constant 2000-01 prices and use them in their nominal and real magnitudes. Total expenditure of each surveyed household is also converted into per capita terms by dividing with total household members. To obtain estimates of the impact of program support on these income and expenditure attributes, we take assistance of the regression framework defined in Eq.(4.1) and use data for both the years.

Asset Ownership:

Household non-land assets are calculated by taking the value of all non-land assets of households in the sample survey for both the time periods. The impact of program participation on change in asset holding is obtained by regressing assets variable on its determinants.

Household Supply of Labor

We calculate market labor supply of sampled households by taking total hours worked in the past week of all adult men and women of the household including self-employment of men and women. To evaluate the impact of program intervention on market labor supply of men and women, we run regressions separately for men and women by employing the model specified in Eq.(4.1).

Calculating Headcount Poverty of Sampled Households

To compare household level poverty of the participating groups in pre- and post-treatment periods, we use the head count ratio of poverty, which gives us the relative incidence of the poor, or the number of people below the poverty line. For our purposes, we calculate both income and expenditure based poverty.

To illustrate, if we denote expenditure (income) by y and subscripts i refers to households, and p refers to the poverty line, then head count poverty denoted by H is given by the number of households so that $y_i < p$. The head count ratio (p_0) is given by

$$p_0 = \frac{H}{n} \times 100$$

where n is the total population in the reference group. Distributional sensitivities in poverty measures are addressed in the class of poverty measures proposed by Foster, Greer and Thorbecke (1984). To illustrate, for any power α, the Foster-Greer-Thorbecke measure is defined

$$p_\alpha = \frac{1}{n} \sum_{y_i < p} \left(\frac{p - y_i}{p} \right)^\alpha$$

where the measure is just the head count ratio when $\alpha = 0$; the measure is the poverty gap ratio when $\alpha = 1$; and the measure takes into account the degree of inequality and severity of poverty among the poor households when $\alpha = 2$. For the present application, we only use headcount income and expenditure based poverty.

As before, we evaluate the impact of program support on poverty by running separate regressions for income and expenditure based poverty.

4.4 CONCLUSIONS

In this chapter we present the econometric and statistical tools employed to study the effect of exposure of farms and households on some outcomes to obtain the causal effect by comparing the outcomes of treatment before and after the intervention on those exposed to it to this difference with those not exposed to it. The approach used in this study is referred to difference-in-differences. We explain the first-order and second-order interaction terms as key parameters of interest for our purposes. We also define a number of farm-level and household-level outcome variables used in program evaluation. We also elaborate on the measurement of technical efficiency, total factor productivity and headcount income and expenditure poverty, among others. This obviously takes us to the empirical investigation of the program support to FEGs, to which we turn in Chapter 5.

5 Evaluating Program Support to FEGs

5.1 INTRODUCTION

This chapter presents impact assessment of ASF program support to farmer groups by using graphical, statistical and econometric procedures. We use data of 792 program and non-program farms from 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund. As discussed above, the sample of FEGs comes from tunnel farms growing off-season vegetables, dehydration farms drying apricots, and horticulture farms producing cut-flowers.

For analytical purposes, we apply two definitions for treatment and control groups: (a) definition 1 allows us to take FEG Members as program farms; and (b) definition 2 lets us to take FEG Group Leader as program farms (also see text in chapter 3). We try a number of model specifications to discover the true effects of ASF program support to farmer groups and present, discuss and interpret the effects on several outcomes.

The outcome variables defined in chapter 4 include: (1) farm profitability; (2) productive efficiency; (3) total factor productivity; (4) employment generation; (5) income and expenditure of farm households; (6) headcount poverty; (7) asset holding; (8) labor supply of men and women; (9) child labor; and (10) frequency of mean consumption.

5.2 IDENTFICATION TECHNIQUES

The empirical specifications tried in this chapter to identify the true effects of program support require controlling for a number of systematic differences across program and non-program farms, and accommodating other shocks that affect the outcomes of program farms after program support or that are correlated with the outcomes, but are not due to program support.

Table 5.1 presents descriptive statistics of the independent variables used in these specifications. First, we include dummy for post-intervention or year effects, which captures systematic national differences in outcomes across two time-periods. Second, we include dummy variable for treatment group to capture any systematic differences in outcomes across program and non-program farms. Third, we include interaction term (post × treatment) to evaluate if program support has affected program farms after program support. Fourth, we include controls for farm to capture differences in outcomes due to owners' education, owners' experience, farms' age, number of owners, and share of boys and girls in farm households. Fifth, we control for FEG

Table 5.1. Summary statistics of independent variables used in regression analysis

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	Mean	Std. Dev	Mean	Std. Dev
Post-intervention (yes=1, no=0)	0.50	0.50	0.50	0.50
Treatment group (yes=1, no=0)	0.826	0.38	0.164	0.37
Post × treatment	0.413	0.49	0.082	0.27
Post × treat × tunnel farms	0.168	0.37	0.029	0.17
Post × treat × dehydration farms	0.126	0.33	0.031	0.17
Post × treat × horticulture farms	0.119	0.32	0.021	0.14
Owner's education	7.26	4.83	7.26	4.83
Owner's experience	12.46	8.98	12.46	8.98
Age of the firm	10.91	8.14	10.91	8.14
Number of farm owners	1.51	1.06	1.51	1.06
Education of FEG group leader	10.93	3.88	11.01	3.68
Share of boys in the household	0.199	0.14	0.199	0.14
Share of girls in the household	0.173	0.15	0.173	0.15
Sheikhupura (yes=1, no=0)	0.182	0.38	0.182	0.38
Nankana Sahib (yes=1, no=0)	0.217	0.41	0.217	0.41
Gilgit-Baltistan (yes=1, no=0)	0.311	0.46	0.311	0.46
Pishin (yes=1, no=0)	0.290	0.45	0.290	0.45
Tunnel farm (yes=1, no=0)	0.399	0.49	0.399	0.49
Dehydration farm (yes=1, no=0)	0.311	0.46	0.311	0.46
Horticulture farm (yes=1, no=0)	0.290	0.45	0.290	0.45
Sample size	792	--	792	--

characteristics by including education of FEG Group Leader. Sixth, we include dummy variables to control for differences across sectors where required. Finally, we include dummy variables to control for any systematic differences across districts where required. In definition 1, treated or program farms consist of 82.6% of the total sample, compared with only 16.4% program farms in definition 2. Likewise the statistics for first-order and second-order interactions also change across the two definitions.

5.3 PROGRAM SUPPORT AND PROFITABILITY OF FEGs

We begin by evaluating the impact of program support on farm profitability. We calculate profit of each farm in our sample for two rounds of the survey by subtracting real total cost in the reference period from real total revenue. The nominal values in both rounds are normalized with CPI with the base-year of 2000-01 to arrive at real numbers. The means of the data on real cost, real revenue and real profit are presented in the left-hand panel of Table 5.2 for definition 1 and in the right-hand panel for definition 2 both for pre-treatment and post-treatment periods.

Table 5.2. Difference-in-differences of real profits of FEGs

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):								
Real total cost (Rs.)	120391	120422	89067	7878	105620	136952	107924	97180
Real total revenue (Rs.)	171142	168872	120216	105370	151211	156152	164440	161710
Real profits (Rs.)	50751	74916	31149	51180	45591	62161	56516	80680
Sample size	327	--	69	--	65	--	331	--
Post-treatment (FY2009):								
Real total cost (Rs.)	235693	161814	87494	80182	218571	180186	107275	99609
Real total revenue (Rs.)	359263	254369	126228	134970	366711	323676	161412	155938
Real profits (Rs.)	123570	116879	38734	98557	148141	166038	54138	79018
Sample size						--	--	--
Difference-in-differences:								
Real total cost (Rs.)	116875	--	--	--	113600	--	--	--
Real total revenue (Rs.)	182109	--	--	--	218528	--	--	--
Real profits (Rs.)	65234	--	--	--	104928	--	--	--

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

The numbers on the left-hand panel of Table 5.2 show that average cost, revenue and profit before the program support was Rs.120391, Rs.171142 and Rs.50751, respectively in treatment farms, compared with Rs.89067, Rs.120216 and Rs.31149 in control farms. The average starting real profit of treated farms increased by 143% while the relative gain in real profit (or difference-in-differences) in treatment farms was 28.5%.

By contrast, the numbers on the right-hand panel of Table 5.2 indicate that there are no striking differences in starting cost and revenue across treatment and control farms while the difference in real profit is also less striking than the left-hand panel. Following the program support, average starting real profit of treated farms increased by 165%, compared with 4.2% decrease in real profit of control farms. Taking the difference between the real profit of before and after program support, there is a 130% increase in real profit of treated farms, compared to the increase in real profit of control farms. When we compare the relative gain in real profit of treatment farms in the right-hand panel with the left-hand panel we note that increase in real profit of FEG Group Leaders was substantially more than FEG Members. These results give further credence to the need to maintain the two definitions for treatment group in the subsequent analysis.

The regression estimates in Table 5.3 take into account systematic differences in real profit due to several factors. A statistically positive estimated coefficient of post-intervention dummy variable indicates increase in profit; a statistically negative coefficient suggests decrease in profit; and a statistically insignificant coefficient shows no change in profit across two time-periods. Similarly, statistically positive, negative and insignificant coefficients on treatment group dummy indicate positive effect, negative effect, and no-change, respectively in profit of treated farms as compared with control farms. The interaction term (post × treatment) is the variable of key interest in this empirical exercise where likewise statistically positive, statistically negative, and statistically insignificant effects would determine the direction and magnitude of the true effect of program support.

In Table 5.3 the estimated coefficients for post-intervention and treatment group dummies are in each case statistically equal to zero, which indicate that on average there was no difference in real profit after program support, compared with before program support. Real profit of treated farms was also not different from control group. However, the estimated coefficients for (post × treatment) in col.(1) and col.(3) are very close to the simple difference-in-differences reported in the left-hand and the right-hand panels of Table 5.2. These results suggest that holding all else as constant, treated farms in our sample earned Rs.64733 more profit under definition 1 and Rs.104975 more profit under definition 2, compared with control group. These results are statistically significant at the 99% confidence level.

We use second-order interaction term (post × treat × sector) to disaggregate the true effect of program support by sectors. The results suggest that program support significantly increased real profit of treated farms in all the sectors. The profits accruing to tunnel farms were relatively highest regardless of which definition was used to define treatment group (see col. (2) and col. (4) of Table 5.3). In both cases, average profits of treated tunnel farms were more than the average for the entire sample. The evidence further suggests that program support led to additional profit to treated farms in dehydration and horticulture sectors compared with control farms, however, the magnitude of differential in profits in the left-hand and the right-hand panel present conflicting results. For instance, the results in left-hand panel (col.(2)) suggest that the differential

Table 5.3. Regression on the impact of program support on real profit of FEGs

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	19382.0	12709.0	31341.8**	30104.7**
	(1.34)	(0.84)	(2.09)	(2.04)
Post-intervention (yes=1, no=0)	4770.4	4807.3	-5440.1	-5315.7
	(0.35)	(0.36)	(-0.96)	(-0.93)
Treatment group (yes=1, no=0)	9315.9	9170.3	-10458.6	-10678.3
	(0.88)	(0.87)	(-1.12)	(-1.15)
Post × treatment	64733.5***	--	104975.0***	--
	(4.29)		(4.76)	
Post × treat × tunnel farms	--	80765.6***	--	140779.0***
		(4.09)		(3.09)
Post × treat × dehydration farms	--	39236.3**	--	90602.5***
		(2.48)		(3.29)
Post × treat × horticulture farms	--	69163.4***	--	77664.4***
		(4.36)		(3.58)
Controls for farm	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for districts	Yes	Yes	Yes	Yes
R^2	0.210	0.218	0.168	0.174
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

in profit of treated farms was highest in tunnel farms (i.e., Rs.80765), followed by horticulture farms (Rs.69163), and then dehydration farms (Rs.39236). By contrast, the results in right-hand panel (col.(4)) show that in each case the relative profits were more under definition 2 as compared with profit under definition 1; the differential profit to treated farms than control farms was highest in tunnel farms (Rs.140779), next highest in dehydration farms (Rs.90602) and then horticulture farms (Rs.77664).

In sum these results provide strong support to the view that after program support real profits of treated farms substantially increased under both the definitions. The relative gain in real profit to FEG Group Leaders was at least 62% more than the real profit to FEG Members, compared with control farms. While we find convincing evidence from the survey data that program support has indeed led to increased profitability of treated farms, the two definitions adopted for treatment and control produce remarkably different results. It suggests that FEG Group Leaders are proportionately greater beneficiaries of ASF program support as compared to other members of the group. This implies that individuals within the group who assumed leadership role were more active and dynamic in the program activities. In most cases these individuals were prepared to take a greater risk by experimenting with new and innovative activities on their own farm land and thus ended-up deriving greater benefits than other members. On the other hand, those FEG Members who were more risk-averse, and assumed a relatively passive support role in FEG activities, also gained benefits as compared with the control farmers, but their benefits were proportionately much less than the Group Leaders.

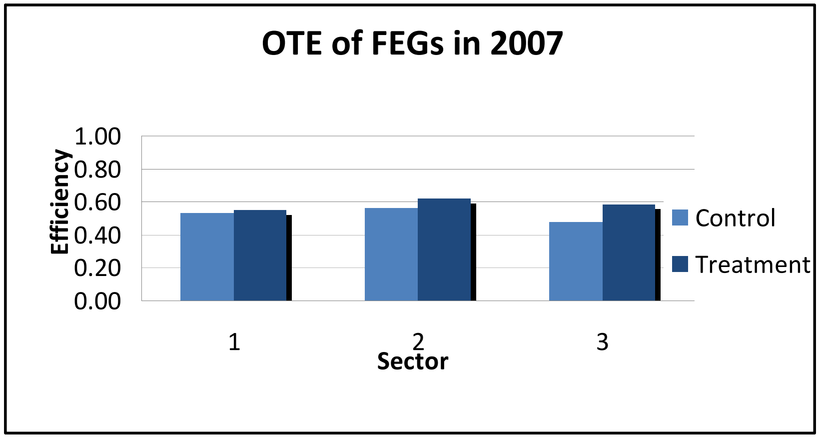
5.4 IMPACT OF PROGRAM SUPPORT ON PRODUCTIVE EFFICIENCY

We also evaluate the impact of program support to FEGs on technical efficiency in comparison with farmers in control group. To solve the linear programming DEA model specified in Eq.(4.2), we use farm specific data of tunnel farms, dehydration farms and horticulture farms for the period FY2007 and FY2009. We construct separate efficiency frontiers for each yearly cross-section of farms. This approach differs from constructing one multi-year frontier (or common frontier) for each cross-section.

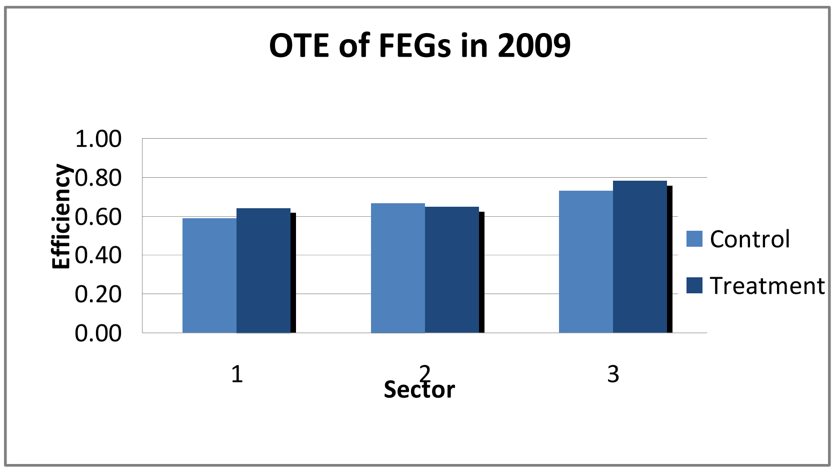
The data used in this analysis consists of one output (*Y*), and four inputs namely, cost of capital (*K*), cost of labor (*L*), cost of raw material (*M*) and cost of energy (*E*). Output is measured by the gross value of sales and earnings of the farm. Capital cost (*K*) includes rental value of land owned or rented-in, rental value of equipment owned or rented-in; rental value of transport equipment owned or rented-in, and financial charges or interest payments on loans. Labor cost (*L*) takes into account the opportunity cost of all working owners, unpaid family workers, hired, part-time and contract workers used by the farm. Reported hours worked per week in respective categories were multiplied by the education-specific hourly wage rates adjusted for inflation for the agriculture and livestock sector, obtained from the *Labour Force Survey 2006-07*. Raw material (*M*) cost includes expenditure on all agricultural inputs or materials consumed including cost of seeds, fertilizer, pesticides, irrigation cost and packaging cost, etc. Cost of energy (*E*) takes into account cost of diesel, electricity and other fuels used by the farm for agricultural production or marketing. All values are adjusted for inflation by converting them into 2000-01 constant prices.

We solve DEA models separately for each yearly cross-section of the survey data, which allows us to vary efficiency measures over time. To avoid heterogeneity, we convert the data of tunnel and horticulture farms into per acre terms; we divide farm output/inputs with land area-operated of each farm. Land area-operated, in most cases, was not relevant in dehydration farms. Therefore, we use their farm-level data to measure efficiency models. Reported energy use was zero in many dehydration and horticulture farms, which forced us to use three inputs to estimate DEA efficiency of these sectors.

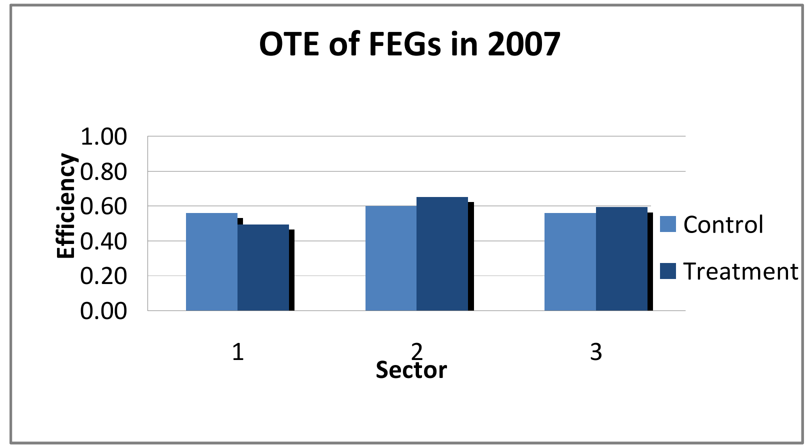
We calculate three efficiency measures for each farm in the sample by assuming that efficient production technology is same within a sector, but may be different across sectors. Fig.5.1 to Fig.5.3 show mean efficiency scores of all three components of technical efficiency in treatment and control groups by sector for definition 1 and definition 2. Overall technical efficiency (OTE) indicates performance by imposing constant returns to scale technology, while pure technical efficiency (PTE) depicts variable returns to scale technology. Scale efficiency (SE) index indicates relative inefficiency of farms due to application of incorrect or inefficient scale.



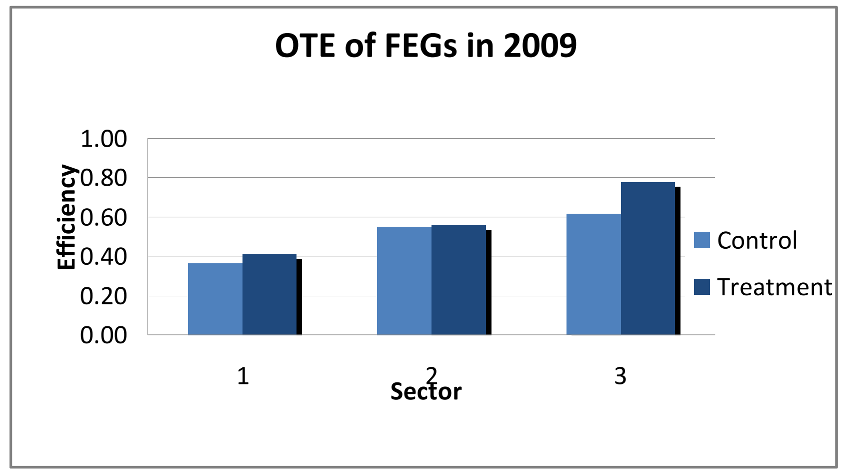
(a) OTE by taking FEG Members as treatment in pre-treatment period



(b) OTE by taking FEG Members as treatment in post-treatment period



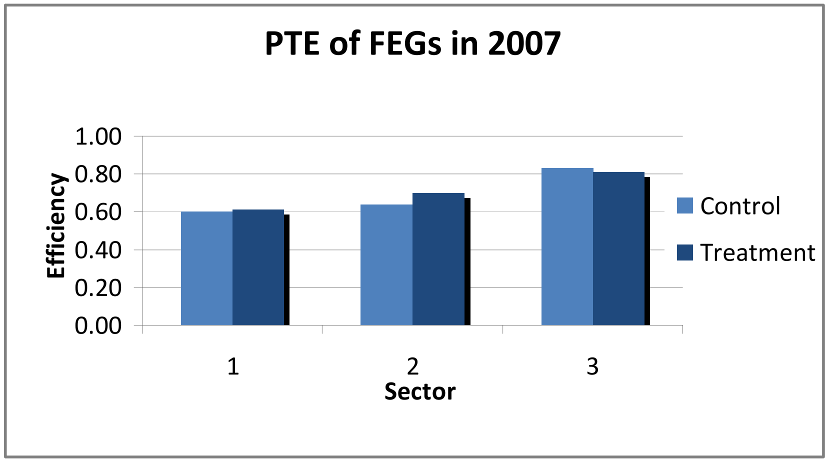
(c) OTE by taking FEG Group Leaders as treatment in pre-treatment period



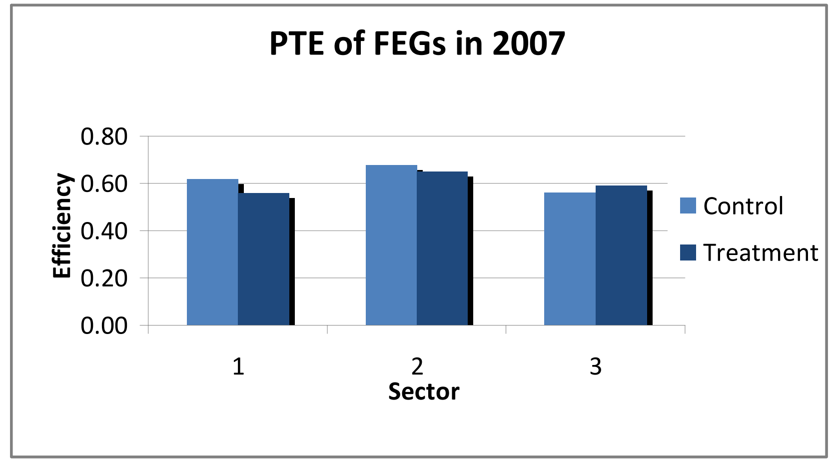
(d) OTE by taking FEG Group Leaders as treatment in post-treatment period

Fig. 5.1:
Mean overall technical efficiency of FEGs by sector

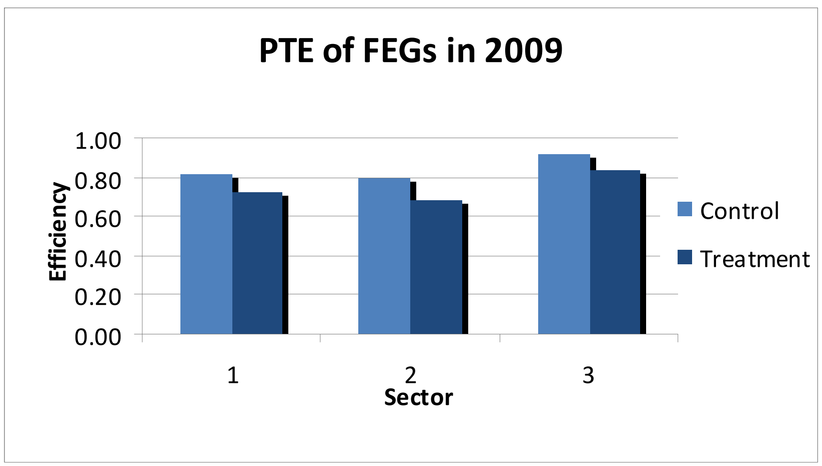
1= tunnel farming; 2 = dehydration farms; 3 = horticulture farms



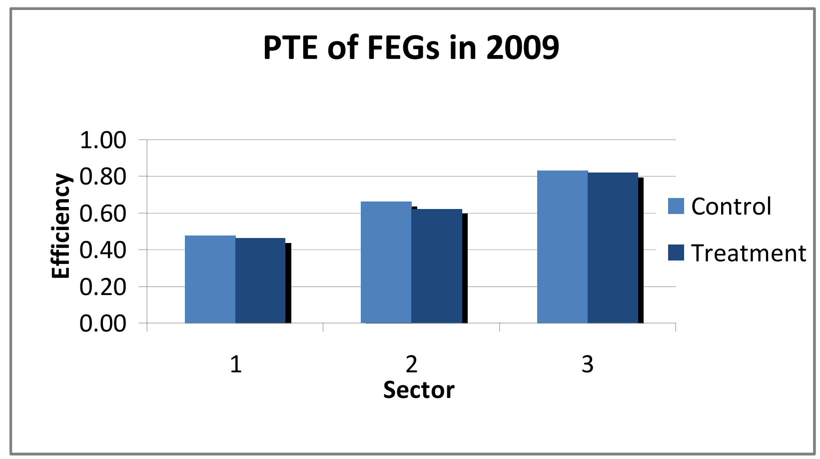
(a) PTE by taking FEG Members as treatment in pre-treatment period



(c) PTE by taking FEG Group Leaders as treatment in pre-treatment period

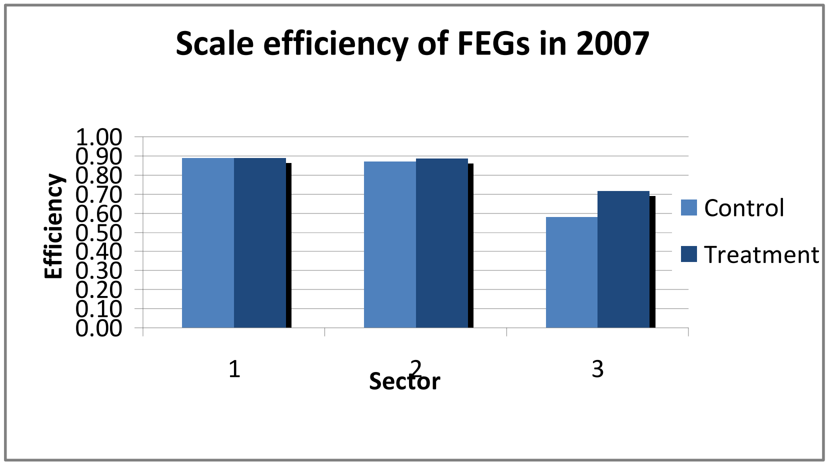


(b) PTE by taking FEG Members as treatment in post-treatment period

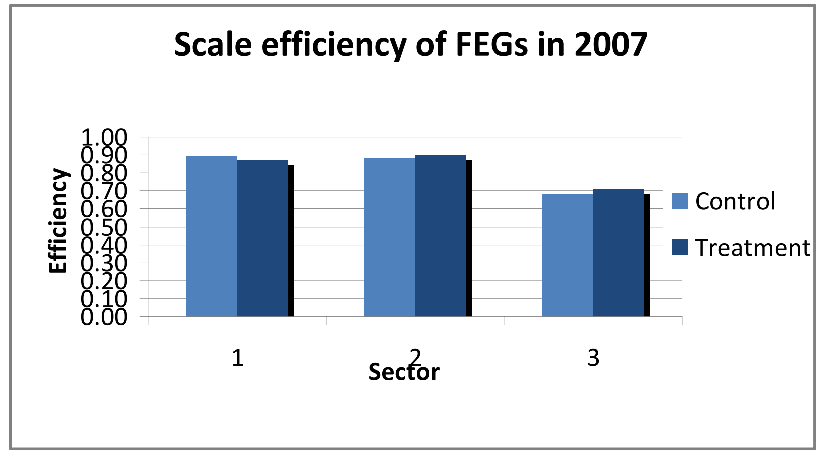


(d) PTE by taking FEG Group Leaders as treatment in post-treatment period

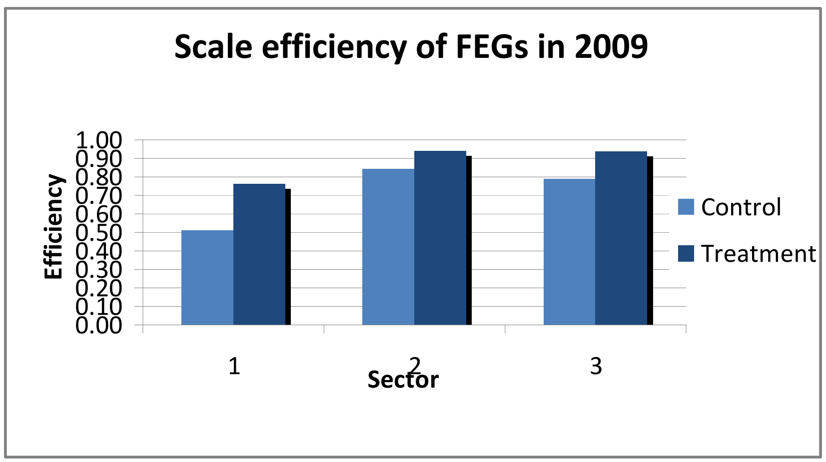
Fig. 5.2:
Mean pure technical efficiency of FEGs by sector
1= tunnel farming; 2 = dehydration farms; 3 = horticulture farms



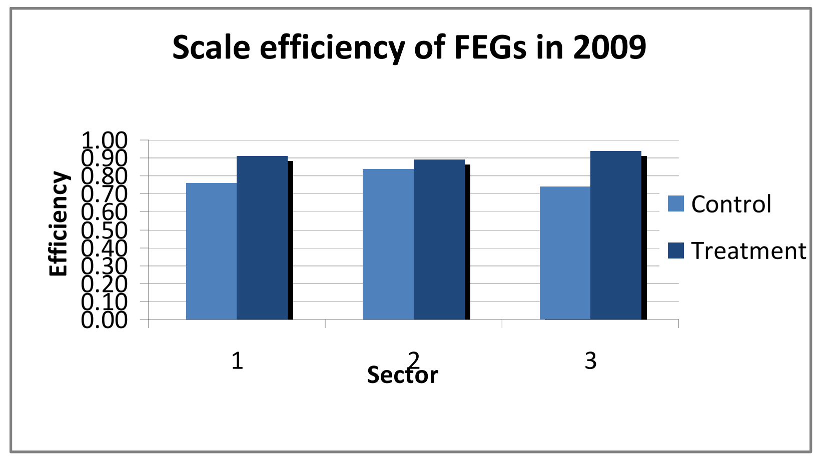
(a) SE by taking FEG Members as treatment in pre-treatment period



(c) SE by taking FEG Group Leaders as treatment in pre-treatment period



(b) SE by taking FEG Members as treatment in post-treatment period



(d) SE by taking FEG Group Leaders as treatment in post-treatment period

Fig. 5.3:
Mean scale efficiency of FEGs by sector
1= tunnel farming; 2 = dehydration farms; 3 = horticulture farms

Table 5.4 to Table 5.6 (bottom-row) show that the lowest overall technical efficiency occurs in tunnel farms where mean efficiency score varies between 0.59 (col.1) and 0.46 (col.4), indicating that contingent upon the definition of treatment group, the potential for reduction of input use varies from 41% to 54%. Highest mean technical efficiency occurs in horticulture farms (Table 5.6) indicating they were operating much closer to the most efficient frontier. We notice a significant advantage in starting technical efficiency to dehydration farms, which turns into disadvantage in post-treatment period (Table 5.5). It is pertinent to note that dehydration farms generally complained about bad weather leading to poor apricot harvest in FY2009, but treated farms appear to have suffered much more than the farms in control group. Fig.5.1 further shows that the performance of tunnel and horticulture farms is much less clear in pre- and post-treatment periods. In both cases, the causal effect of program support varies depending upon how treatment group is defined. When FEG Members are defined as treatment group the distribution of technical efficiency of tunnel and horticulture farms looks very similar in the two periods (see Fig.5.1, panel (a) & (b)), indicating no significant difference in relative efficiency of treatment and control. However, the picture is reversed when we define FEG Group Leaders as treatment group; we detect significant efficiency gains attributable to treated farms in tunnel and horticulture sectors while the relative disadvantage to treated farms also disappears in dehydration sector (see Fig.5.1 (c) & (d)).

Just like OTE, the lowest PTE also occurs in tunnel farms where mean score is 0.673 and 0.543 (Table 5.4). The highest PTE score is found in horticulture farms where mean efficiency is around 82%, indicating that farms in this sector lie much closer to the best practice frontier. Starting PTE of treated dehydration farms is higher than control group in Fig.5.2 (a) & (b); however, this pattern is reversed in post-treatment period. This pattern significantly differs when we observe treatment and control groups over the two time-periods in Fig.5.2 (c) & (d). Likewise, the causal effects of program support significantly differ across the two definitions for PTE and SE depicted in Fig.5.2 & Fig.5.3.

Next we turn to a more rigorous difference-in-differences regression framework, defined in Eq.(4.1), to evaluate the impact of program support on productive efficiency of treated farms vis-à-vis control farms. The regression framework allows us to control for other observable sources of variation in outcome variables of interest. We regress farm-specific estimates of OTE, PTE and SE obtained from non-parametric DEA method on a vector of explanatory variables by OLS framework. We begin by regressing efficiency indexes on separate samples of tunnel farms, dehydration farms and horticulture farms, which allow us to evaluate program effect on these sectors relative to each other. Table 5.4 to Table 5.6 present some very interesting sector specific results of the impact of program support on efficiency indicators of farms.

In general, these results strongly suggest that the performance effect of program support significantly differs across the two definitions. First, following definition 1, we conclude that post-intervention efficiency indicators mostly improved in tunnel, dehydration and horticulture farms, but the results of definition 2 suggest that mean efficiency significantly fell in tunnel and dehydration farms and somewhat improved in horticulture farms (see Table 5.4 to Table 5.6). Similarly, definition 1 suggests that relative efficiency of treated farms was less than control in tunnel farms and more than control in dehydration and horticulture farms. The results of definition 2 indicate that efficiency of treated farms in tunnel and horticulture sector marginally increased relative to control and remained unchanged in dehydration farms. However, no statistical significance could be attached to most of these results. These results corroborate the conclusions drawn from the graphical analysis that the performance effect of program support significantly differs across the two definitions of treatment group.

Second, following definition 1, we cannot escape the general conclusion that ASF program support did not result in a rise in efficiency of treated enterprises in any of the selected sectors as compared with control. To illustrate, OTE of FEGs in tunnel, dehydration and horticulture farms was statistically no different from control farms in post-treatment period. Moreover, program support decreased PTE of FEGs; treated farms were 11% less efficient than control in tunnel farms, 17% less efficient in dehydration farms and 6.5% less efficient in horticulture farms. These results were robust to alternative empirical specifications tried but not reported for brevity. The results also show that program support made tunnel and dehydration farms more scale efficient relative to control. The finding that program support would not influence OTE of treated farms and rather lower their PTE is surprising.

Table 5.4. Regression on efficiency effects of program support on tunnel farm FEGs

	Definition 1: FEG Members taken as treatment			**Definition 2:** FEG Group Leaders taken as treatment		
	Overall technical efficiency	Pure technical efficiency	Scale efficiency	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.484***	0.551***	0.877***	0.478***	0.556***	0.850***
	(13.69)	(16.23)	(30.03)	(16.06)	(21.45)	(35.38)
Post-intervention (yes=1, no=0)	0.05	0.209***	-0.168***	-0.205***	-0.152***	-0.142***
	(1.10)	(6.32)	(-3.89)	(11.4310)	(-8.88)	(-8.82)
Treatment group (yes=1, no=0)	-0.025	-.008	-0.040	0.050	0.083	-0.009
	(-0.56)	(-0.21)	(1.13)	(0.56)	(0.48)	(-0.25)
Post × treatment	0.025	-.109***	0.158***	0.112**	0.047	0.172***
	(0.52)	(2.98)	(3.50)	(2.23)	(0.87)	(5.01)
Controls for farm	Yes	Yes	Yes	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.109	0.224	0.156	0.283	0.214	0.225
Sample size	316	316	316	316	316	316
Mean efficiency	0.590	0.673	0.875	0.462	0.543	0.537
SD	(0.16)	(0.16)	(0.12)	(0.18)	(0.17)	(0.15)

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. One FEG-level control variable includes completed years of education of FEG group leader or key decision-making owner. Controls for districts refer to dummy variables for Sheikhupura and Nankana Sahib distircts.

Table 5.5. Regression on efficiency effects of program support on dehydration farm FEGs

	Definition 1: FEG Members taken as treatment			**Definition 2:** FEG Group Leaders taken as treatment		
	Overall technical efficiency	Pure technical efficiency	Scale efficiency	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.471***	0.593***	0.830***	0.483***	0.609***	0.833***
	(9.36)	(11.46)	(25.04)	(12.83)	(14.06)	(25.38)
Post-intervention (yes=1, no=0)	.099*	0.153***	-.034***	-0.061**	-0.025	-0.045***
	(1.69)	(2.63)	(-0.87)	(-2.46)	(-1.01)	(-2.44)
Treatment group (yes=1, no=0)	0.082	0.071	0.022	-0.006	-0.009	0.006
	(1.53)	(1.28)	(0.58)	(-0.06)	(-0.09)	(0.11)
Post × treatment	-0.081	-.169***	0.085*	-0.044	-0.077	0.036
	(-1.21)	(2.59)	(1.95)	(-0.66)	(-1.21)	(0.94)
Controls for farm	Yes	Yes	Yes	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.094	0.088	0.111	0.152	0.099	0.059
Sample size	246	246	246	246	246	246
Mean efficiency	0.631	0.697	0.905	0.582	0.670	0.868
SD	(0.19)	(0.19)	(0.11)	(0.20)	(0.19)	(0.14)

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. One FEG-level control variable includes completed years of education of FEG group leader or key decision-making owner.

On the contrary, it is quite remarkable that definition 2 paints a different picture leading us to conclude that ASF program support indeed acted as a catalyst to enhance enterprise efficiency of FEGs at least in tunnel farming and dehydration sectors. We find that, on average, FEGs in these sectors were respectively 11.2% and 13.3% more technically efficient (i.e., OTE) than control farms. While program support could not succeed in making a difference in PTE of treated and control farms in any of the sectors, the dynamics of change occurred through scale effects. Our results strongly suggest that ASF program support effectively acted through improvement in scale efficiency of treated farms than control since the positive impact of program support on scale efficiency was most pronounced in all the sectors. The average scale efficiency score in tunnel farming sample was only 53.7% indicating that these farms as a group were losing about 46% of their output due to adopting incorrect scale. Horticulture farms as a group were losing about 27% of potential output due to incorrect scale. Most technical inefficiency in this sample stems from the fact that farms produce much lower than their true production potential. On average, these farms could have saved from 18% to 46% of currently used inputs by being purely technically efficient in horticulture and tunnel farms, respectively.

Table 5.6. Regression on efficiency effects of program support on horticulture farm FEGs

	Definition 1: FEG Members taken as treatment			**Definition 2:** FEG Group Leaders taken as treatment		
	Overall technical efficiency	Pure technical efficiency	Scale efficiency	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	.461***	0.817***	0.571***	0.495***	0.792***	0.629***
	(10.84)	(26.27)	(15.07)	(10.87)	(28.87)	(15.78)
Post-intervention (yes=1, no=0)	.238***	0.087***	0.207***	0.043*	0.016	0.047**
	(4.87)	(3.06)	(3.98)	(1.88)	(1.21)	(2.06)
Treatment group (yes=1, no=0)	.142***	-0.010	0.169***	0.003	-0.013	0.024
	(3.58)	(-0.39)	(4.23)	(0.04)	(-0.32)	(0.51)
Post × treatment	-0.049	-0.065**	0.009	0.133**	-0.013	0.171***
	(-0.86)	(-2.15)	(0.16)	(2.08)	(-0.32)	(3.59)
Controls for farm	Yes	Yes	Yes	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.367	0.123	0.501	0.157	0.030	0.200
Sample size	230	230	230	230	230	230
Mean efficiency	0.670	0.832	0.800	0.603	0.822	0.731
SD	(0.19)	(0.11)	(0.18)	(0.17)	(0.10)	(0.17)

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. One FEG-level control variable includes completed years of education of FEG group leader or key decision-making owner.

Dehydration sector as a whole performed poorly for the simple reason that bad weather led to poor harvest of apricots in FY2009 due to which mean overall technical efficiency significantly fell from 61.1% in FY2007 to only 55.3% in FY2009 (see also, Fig.5.1). Under these conditions, as one would have expected, program support could not make a significant difference in enhancing efficiency of FEGs. This is also confirmed by our results for definition 2 in Table 5.5 where we note that the impact of program support on OTE, PTE and SE of FEGs relative to control was statistically equal to zero. It is interesting to note that the estimated coefficients of (post × treatment) dummy variable under definition 1 and definition 2 fall in a narrow range, suggesting that the impact of program support under the two definitions was almost the same. It should, however, be pointed out that unlike horticulture and tunnel farms, dehydration activities did not entail changes in on-farm production practices.

Third, the broad conclusions drawn so far about performance effects of program support are found to be robust to an empirical specification for pooled data. We have estimated the models in Table 5.7 using pooled data of the three yearly cross-sections (tunnel farms, dehydration farms and horticulture farms) and our results suggest strong similarities between the impacts of program support on efficiency in pooled data to that found for the data of individual sectors in Tables 5.4 to 5.6. The estimated coefficients of the (post × treatment) dummy present average effect of

Table 5.7. Regression on efficiency effects of program support on tunnel, dehydration and horticulture FEGs: pooled cross-section data

	Definition 1: FEG Members taken as treatment			**Definition 2:** FEG Group Leaders taken as treatment		
	Overall technical efficiency	Pure technical efficiency	Scale efficiency	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.474***	0.621***	0.803***	0.411***	0.515***	0.811***
	(16.61)	(22.46)	(33.32)	(17.30)	(25.42)	(40.30)
Post-intervention (yes=1, no=0)	0.125***	0.152***	-0.005	-0.090***	-0.065***	-0.057
	(4.07)	(6.16)	(-0.18)	(-6.67)	(-5.62)	-4.95)
Treatment group (yes=1, no=0)	0.077***	0.018	0.062**	0.008	-0.007	0.012
	(2.89)	(0.80)	(2.53)	(0.16)	(-0.16)	(0.41)
Post × treatment	-0.035	-0.110***	0.079**	0.065*	-0.009	0.124***
	(1.04)	(-4.02)	(2.47)	(1.73)	(-0.27)	(5.01)
Controls for farm	Yes	Yes	Yes	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.167	0.261	0.213	0.192	0.394	0.195
Sample size	792	792	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. One FEG-level control variable includes completed years of education of FEG group leader or key decision-making owner. Controls for sectors include dummy variables for included sectors namely tunnel farms; dehydration and horticulture farms, while controls for districts refer to dummy variables for each included district in the survey.

program support. We find that the results are qualitatively similar for all three measures of efficiency under the two definitions.

Finally, excluding dehydration sector from our analysis and using the same empirical specification on restricted pooled data of the two yearly-cross sections (i.e., tunnel farms and horticulture farms) further reinforces the conclusion that the impact of program support is accurately predicted only under definition 2. In Table 5.8, a simple difference-in-differences of treated and control farms in pre- and post-treatment periods shows that following ASF program support mean OTE, PTE and SE of FEGs under definition 2 increased by 12.8%, 2.4% and 17%, respectively. Consistent with earlier results, the impact of program support on FEGs under definition 1 was negative on mean OTE and PTE and positive on SE. These results, however, make no allowance for other sources of variation in efficiency, such as differences on account of farm-, FEG-, sector- and region-specific factors. These sources of variation are incorporated in the estimates presented in Table 5.9.

Table 5.8: Difference-in-differences of efficiency in tunnel and horticulture FEGs

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Full sample:								
Overall technical efficiency in FEGs	0.632	0.18	0.584	0.19	0.556	0.22	0.515	0.19
Pure technical efficiency in FEGs	0.730	0.16	0.790	0.16	0.647	0.22	0.663	0.19
Scale efficiency in FEGs	0.863	0.13	0.749	0.20	0.863	0.14	0.780	0.17
Sample size	452	--	94	--	82	--	464	--
Pre-treatment period (FY2007):								
Overall technical efficiency in FEGs	0.566	0.18	0.510	0.15	0.537	0.19	0.561	0.17
Pure technical efficiency in FEGs	0.692	0.17	0.711	0.16	0.673	0.19	0.700	0.17
Scale efficiency in FEGs	0.820	0.16	0.743	0.21	0.802	0.15	0.801	0.17
Sample size	226	--	47	--	41	--	232	--
Post-treatment period (FY2009):								
Overall technical efficiency in FEGs	0.698	0.15	0.658	0.20	0.574	0.24	0.470	0.19
Pure technical efficiency in FEGs	0.767	0.13	0.869	0.13	0.622	0.25	0.625	0.21
Scale efficiency in FEGs	0.907	0.09	0.756	0.21	0.923	0.09	0.752	0.16
Sample size	226	--	47	--	41	--	232	--
Difference-in-Differences:								
Overall technical efficiency in FEGs	-0.016	--	--	--	0.128	--	--	--
Pure technical efficiency in FEGs	-0.083	--	--	--	0.024	--	--	--
Scale efficiency in FEGs	0.073	--	--	--	0.170	--	--	--

Indeed, the results are comparable to the simple difference-in-differences of efficiency change in the restricted sample for both definition 1 and definition 2. The results of the restricted sample under definition 1 suggest that there was no-change in OTE of FEGs between period 1 and period 2 ($\hat{\beta}$ = –0.016, *t* = –0.4), PTE fell by 8.4% (*t* =–3.25) between the two periods, while scale efficiency increased by 7.5% (*t* = 1.77). However, the results of definition 2 suggest that OTE of FEGs increased by 12.7% (*t* =2.89), PTE remained unchanged (*t* = 0.66) and scale efficiency increased by 17.6% (*t* = 5.78). Hence the discrepancy between the two estimates persists even in the restricted sample.

In summary, we find no indication from the results that ASF matching grant support increased technical efficiency on the farms of FEG Members. However, we find unequivocal support to the view that ASF program support significantly increased efficiency indexes on the farms of FEG

Table 5.9. Regression on efficiency effects of program support on pooled data of tunnel and horticulture FEGs

	Definition 1: FEG Members taken as treatment			**Definition 2:** FEG Group Leaders taken as treatment		
	Overall technical efficiency	Pure technical efficiency	Scale efficiency	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.422***	0.590***	0.764***	0.601***	0.841***	0.714***
	(14.40)	(22.96)	(25.21)	(23.55)	(41.53)	(34.46)
Post-intervention (yes=1, no=0)	0.138***	0.152***	0.008	-.100***	-0.081***	-0.063***
	(3.86)	(6.54)	(0.19)	(-6.29)	(-6.50)	(-4.30)
Treatment group (yes=1, no=0)	0.074**	-0.004**	0.080**	0.005	-0.004	-0.010
	(2.45)	(-0.17)	(2.53)	(0.08)	(-0.08)	(-0.03)
Post × treatment	-0.016	-0.084***	0.075*	0.127**	0.024**	0.176***
	(-0.40)	(-3.25)	(1.77)	(2.89)	(0.66)	(5.78)
Controls for farm	Yes	Yes	Yes	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.233	0.371	0.211	0.211	0.533	0.197
Sample size	546	546	546	546	546	546

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. One FEG-level control variable includes completed years of education of FEG group leader or key decision-making owner. Controls for districts refer to dummy variables for Sheikhupura, Nankana Sahib and Pishin districts.

Group Leaders. These findings are robust to different specifications, regardless of whether we take sector-wise or pooled data to compare FEG efficiency with control farms. The results are particularly relevant on horticulture farms in Pishin and vegetable farms in Sheikhupura and Nankana of of FEG Group Leaders. By contrast, relative efficiency on dehydration units of FEG Group Leaders in Gilgit-Baltistan remained almost the same as control farms. This may be explained by the fact that in FY2009, bad weather led to poor harvest and a general decline in productive efficiency, due to which the performance of FEGs was as good as control farms. These results suggest that short-term on-farm efficiency improvement is mostly restricted to FEG Group Leaders who are cashing on innovative technologies by practicing learning-by-doing. However, FEG group members appear to be risk-neutral and much less dynamic than their Group Leaders. It remains to be seen if the benefits manifested in the program activities can indeed stimulate a change in farming practices of other group members and the community at large in the long-term. Anecdotal evidence suggests that some replication of activities has already commenced in certain communities.

5.5 PROGRAM SUPPORT AND TOTAL FACTOR PRODUCTIVITY GROWTH

We account for total factor productivity (TFP) growth in treatment and control farms by estimating the Malmquist productivity index and isolate the contribution of technical change and efficiency change (see Chapter 4). We report and discuss only average performance of farms.

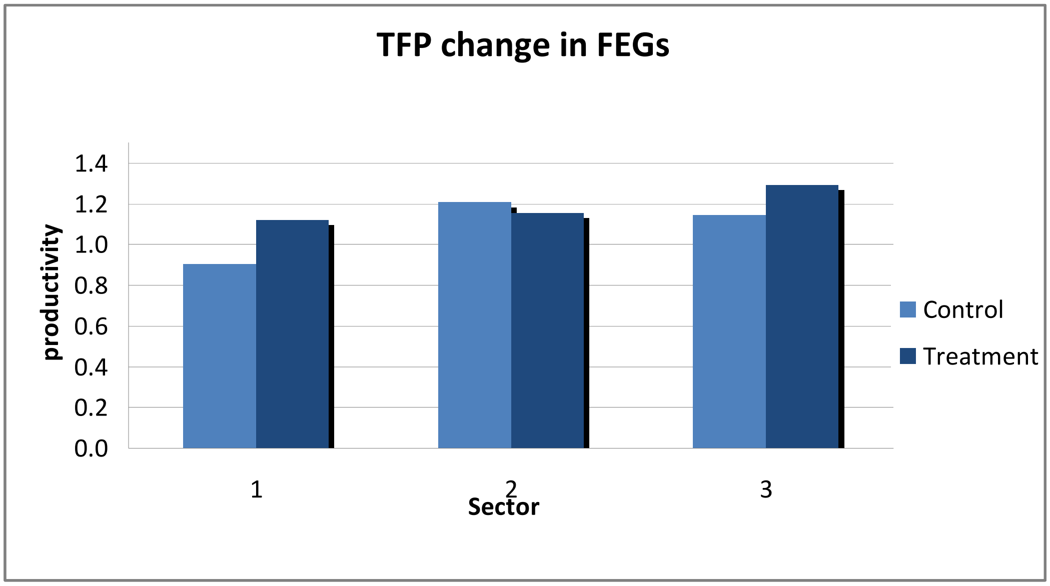
We begin by noting that if there is no change in ratio of inputs and outputs of farms in a period then the Malmquist index would equal unity, which signals no productivity change. If the value of the index is more than 1, it indicates improvement in productivity; and a value of less than one depicts productivity regress. By definition, the product of technical change and efficiency change indexes equals Malmquist productivity change index. Let technical change index be 0.7 (less than 1) and efficiency change index be 1.8 (greater than 1), then the Malmquist productivity change index would be the product of the two, or 1.26 which is greater than 1 and suggests improvement in productivity at the rate of 26%. Improvements in technical change are considered evidence of innovation while improvements in efficiency change are considered evidence of catching-up.

Fig.5.4 to 5.6 presents the distribution of mean TFP, technical change and efficiency change by sector and by the two definitions. We note that treatment farms experienced significant productivity growth in all the sectors. But productivity growth of treatment farms under definition 2 was in each case higher than treatment farms under definition 1. Control farms also posted positive productivity growth in dehydration and horticulture farms, except tunnel farms where they experienced productivity regress at the rate of 10%. Most productivity growth in tunnel farms was triggered by technological innovations since both the definitions confirm that production frontier shifted outward from FY2007 to FY2009. Technical change was also high in dehydration farms under both definitions but more so under definition 2. Most of the growth in productivity in horticulture sector was, however, explained by significant catching up or efficiency change.

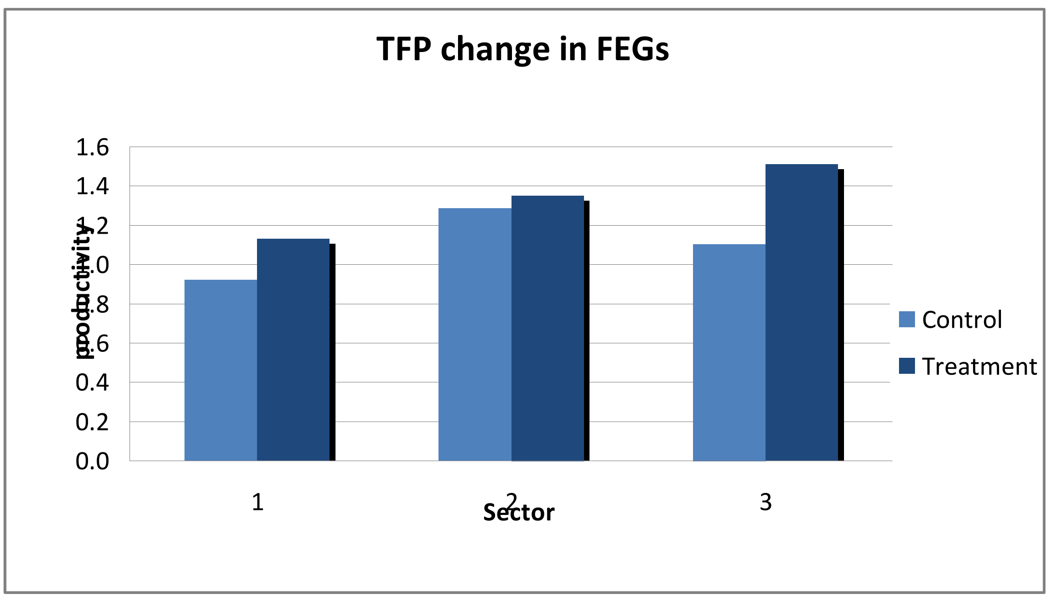
Table 5.10 presents mean TFP change index and its components for treatment and control under definition 1 and definition 2 with and without dehydration farms in the sample. Based on the data of all the three sectors, the results suggest that under definition 1 TFP growth was 18.1% in treated farms as compared with only 8% growth in control farms. The growth in TFP was mostly explained (15.2%) by catching-up, and much less by technical change (3.5%). Deleting dehydration farms from the overall sample does not produce any qualitative change in these results.

However, we get a different message from the results when we apply definition 2. Table 5.10 further shows that TFP growth in treatment farms took place at 32% as compared with only 8.4% growth in control farms. Moreover, our findings are that most TFP growth came about due to improvement in technology both by treated and control farms. Efficiency change was positive in treated farms but negative in control farms, which explains the dispersion in productivity between the two groups. These results are further confirmed when we delete the sample of dehydration farms from our estimation.

From the data, we conclude that the results from alternative combinations meant to probe the robustness of the conclusions confirm that treatment farms performed much better than control farms. We also compare productivity growth under definition 1 and definition 2. Again these results point toward higher productivity growth of FEGs under definition 2.



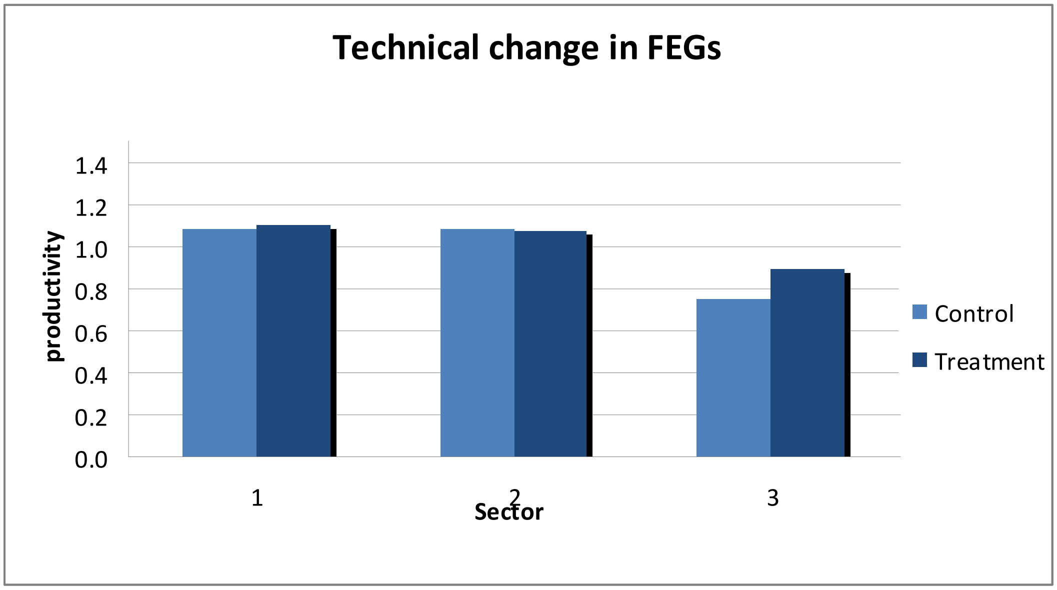
(a) TFP growth when FEG Members taken as treatment group



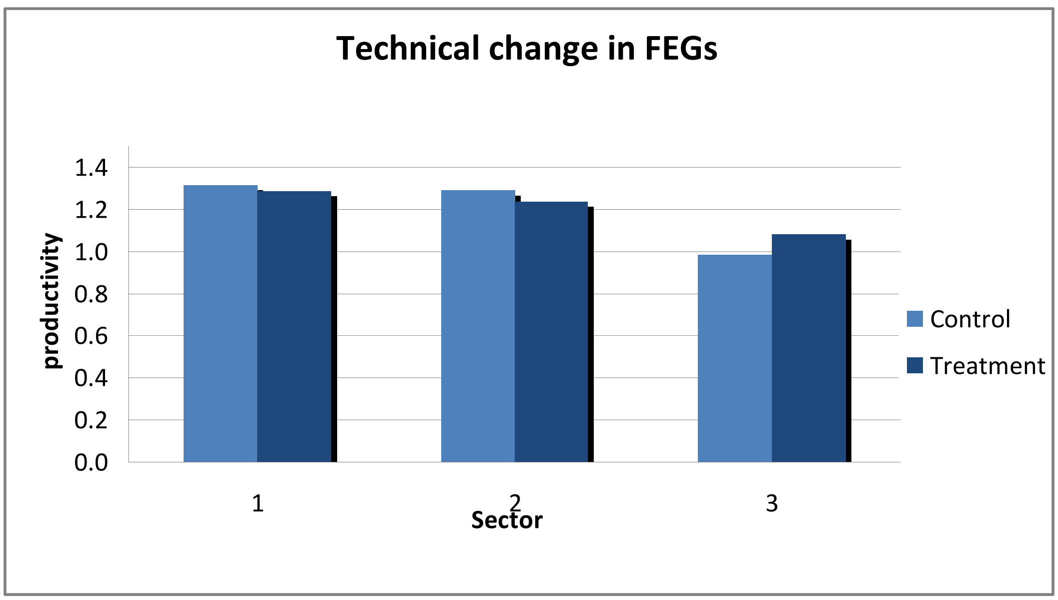
(b) TFP growth when FEG Group Leaders are taken as treatment group

Fig. 5.4:
Malmquist TFP growth by sector

1= tunnel farming; 2 = dehydration farms; 3 = horticulture farms



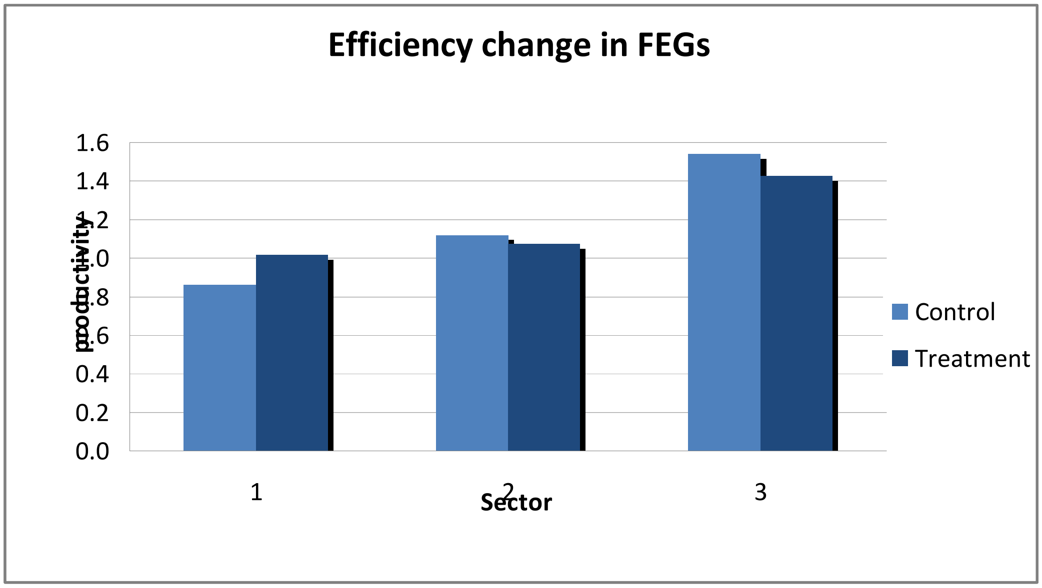
(a) Technical change when FEG Members taken as treatment group



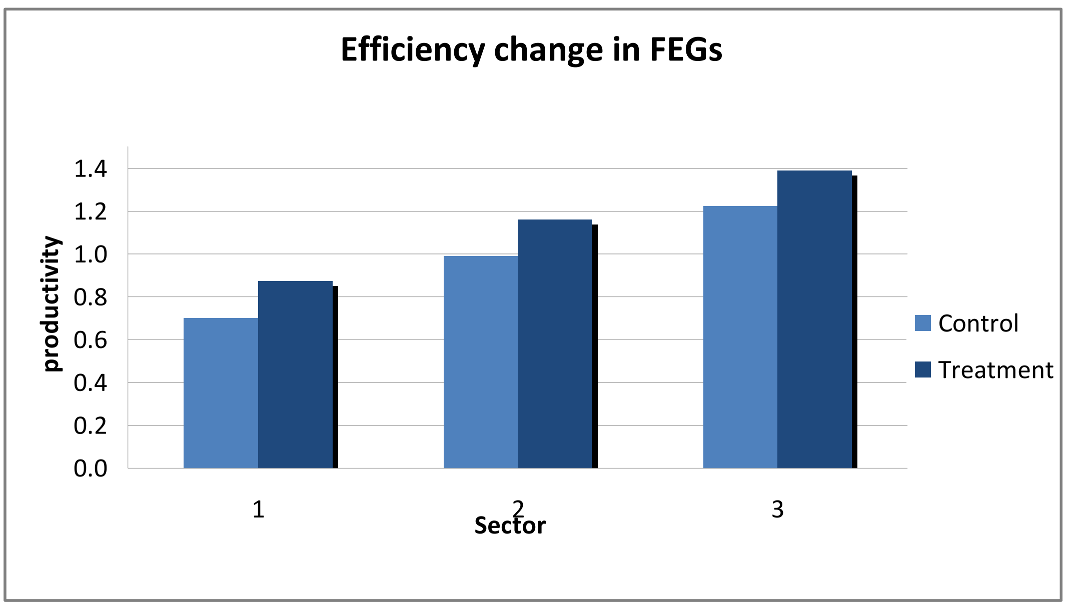
(b) Technical change when FEG Group Leaders are taken as treatment

Fig. 5.5:
Technical change by sector

1= tunnel farming; 2 = dehydration farms; 3 = horticulture farms



(a) Efficiency change when FEG Members taken as treatment group



(b) Efficiency change when FEG Group Leaders are taken as treatment

Fig. 5.6:
Efficiency change by sector

1= tunnel farming; 2 = dehydration farms; 3 = horticulture farms

Table 5.10. Comparison of total factor productivity growth of FEGs in treatment and control

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Productivity growth in FEGs: (tunnel, dehydration & horticulture sectors)								
Total factor productivity change	1.181	0.67	1.080	0.37	1.319	0.91	1.084	0.81
Technical efficiency change	1.035	0.14	0.976	0.20	1.212	0.18	1.211	0.22
Efficiency change	1.152	0.62	1.160	0.45	1.122	0.84	0.911	0.52
Sample size	327	--	69	--	66	--	330	--
Productivity growth in FEGs: (tunnel & horticulture sector)								
Total factor productivity change	1.192	0.40	1.016	0.19	1.299	0.44	0.998	0.22
Technical efficiency change	1.018	0.17	0.926	0.22	1.198	0.12	1.177	0.18
Efficiency change	1.187	0.39	1.179	0.41	1.010	0.40	0.877	0.26
Sample size	226	--	47		41	--	232	--

5.6 EMPLOYMENT EFFECTS OF PROGRAM SUPPORT

Table 5.11 summarizes average employment levels (hours worked per week) for treatment and control in pre- and post-treatment periods and the numbers for the difference-in-differences. Fig.5.5 (a) suggests that initially treatment farms were slightly bigger in size than control farms under definition 1 and due to program support, employment in treated farms increased by 130.5% compared with 8.4% increase in employment in control farms. The difference-in-differences or the relative gain in employment in treated farms is 42.02 hours per week or 123.3%. Without program support, relative change in employment in program farms was only 3.11 hours per week or 8.5% increase. Definition 2 also suggests that initially treated farms were mostly bigger in size than control farms (Fig.5.5 (c)), but relative gain in employment due to program support was 43.5 hours per week or 139%. Without program support, relative gain in employment in program farms was 3.92 hours per week, or 12.6%. These results provide strong support that ASF program support substantially increased employment in FEGs.

This evidence is further corroborated by Fig. 5.5, which shows the distribution of employment in treatment and control farms in pre- and post-treatment periods under definition 1 and definition 2. As noted above, treated farms in each case were slightly bigger in size than control farms. Employment generation took place in both treated and non-treated farms in round 1, but growth

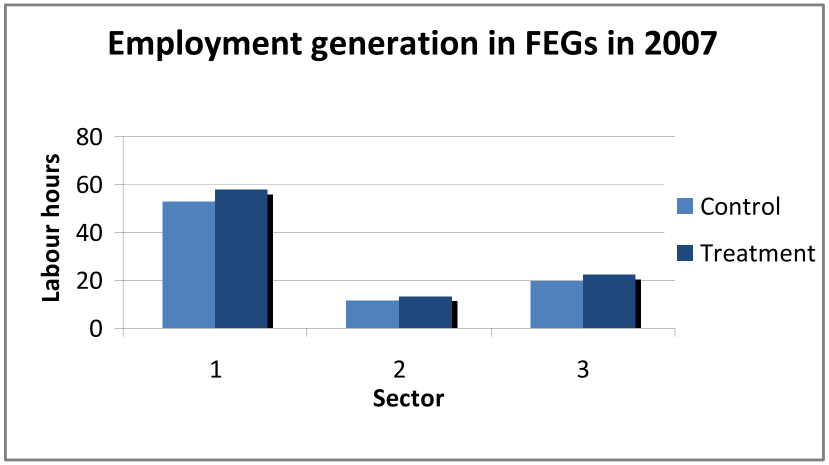
Table 5.11. Difference-in-differences of average employment in FEGs and farms

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (2007):								
Employment generation in FEGs (hours per week)	34.07	27.01	28.41	22.83	31.22	27.26	33.43	26.23
Farm employment without ASF support (hours per week)	34.07	27.01	28.41	22.83	31.22	27.26	33.43	26.23
Sample size	327	--	69	--	66	--	330	--
Post-treatment (FY2009):								
Employment generation in FEGs (hours per week)	78.53	56.63	30.81	24.73	78.84	62.49	37.59	30.02
Farm employment without ASF support (hours per week)	39.36	32.98	30.81	24.73	39.30	39.95	37.59	30.02
Sample size	327	--	69	--	66	--	330	--
Difference-in-differences:								
Employment generation in FEGs (hours per week)	42.02	--	--	--	43.46	--	--	--
Farm employment without ASF support (hours per week)	2.89	--	--	--	3.92	--	--	--

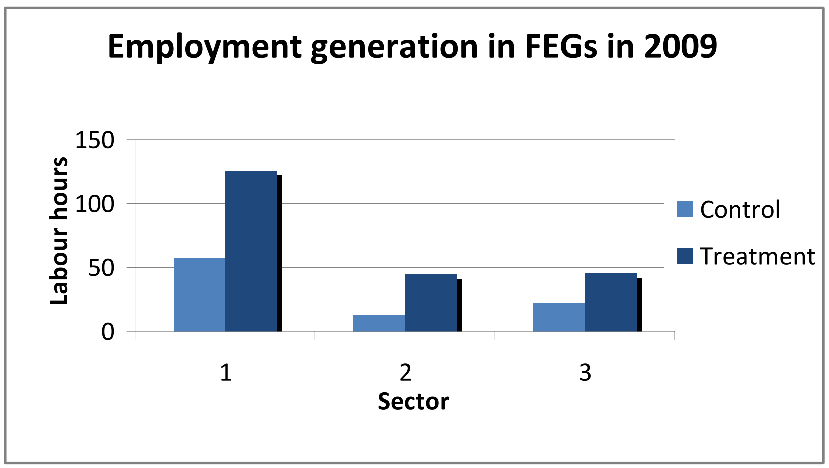
in employment in treated farms was much faster than control farms under either definition. It is also clear from Fig.5.5 that growth in employment was fastest in tunnel farming and slowest in horticulture farms.

Table 5.12 presents the results for the regression analysis where, as before, we allow other sources of variation in growth in farm-level employment. The estimated coefficient for (post × treatment) is directly comparable with the simple difference-in-differences for both definition 1 and definition 2. Moreover, the results of second-order interaction term in col.(3) – col.(4) and col.(7) – col.(8) further show that due to program support, increase in employment was highest in tunnel farming (i.e., 64 hours to 68 hours per week) followed by dehydration farms (i.e., 28 to 38 hours per week) and lowest in horticulture farms (i.e., 20 to 22 hours per week).

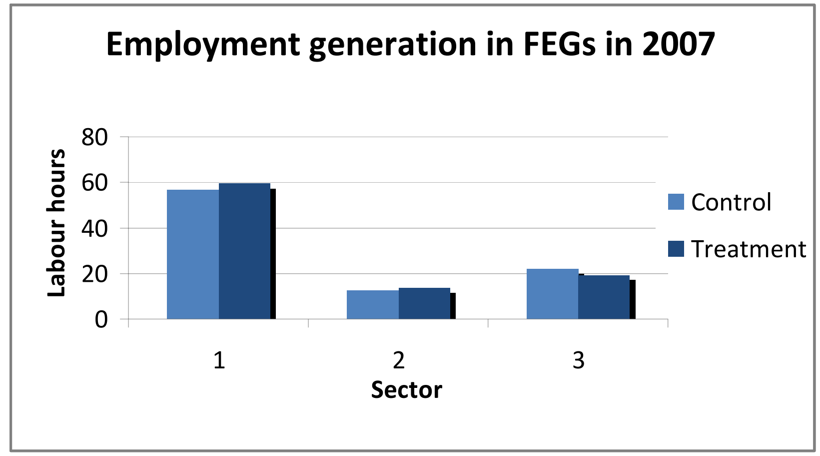
In Table 5.13, we predict employment generation without ASF program support. To do so, we restrict our analysis to the employment data of individual farms by deleting employment creation due to formation of farmer groups in round 2. Like simple difference-in-differences of employment changes, this restriction leads to substantially smaller estimate of relative increase in employment under definition 1 ($\hat{\beta}$ = 2.8, t = 0.26) and definition 2 ($\hat{\beta}$ = 3.97, t = 0.97), which is statistically not different from zero. The results in Table 5.10 further suggest that without ASF support employment increased by 8 to 15 hours per week in tunnel farms, while there was no change in employment generation in dehydration and horticulture farms.



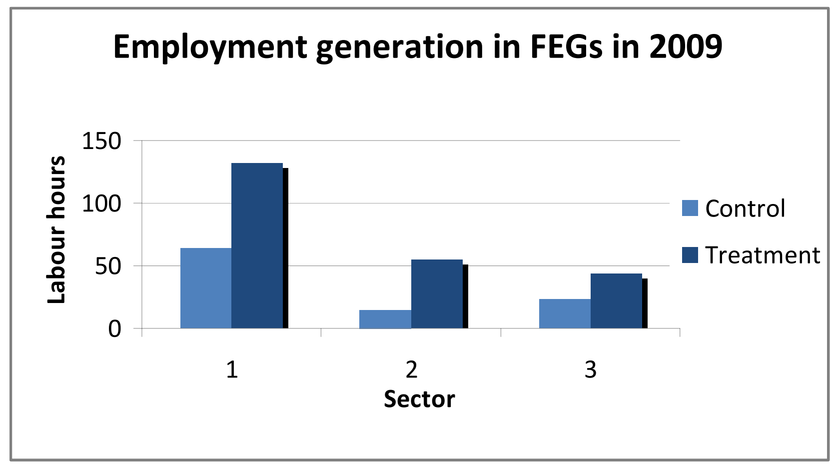
(a) Employment of labor in round 1 when FEG Members are taken as treatment



(b) Employment of labor in round 2 when FEG Members are taken as treatment



(c) Employment of labor in round 1 when FEG Group Leaders are taken as treatment



(d) Employment of labor in round 2 when FEG Group Leaders are taken as treatment

Fig. 5.7:
Impact of program support on employment generation (weekly hours) in FEGs
1= tunnel farming; 2= dehydration farms; 3=horticulture farms

Table 5.12. Regression on the impact of program support on employment generation

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	57.34***	57.48***	47.19***	47.19***	49.9***	50.2***	49.2***	49.4***
	(12.74)	(12.71)	(12.26)	(12.25)	(14.59)	(14.81)	(15.08)	(15.19)
Post-intervention	3.19	3.19	3.21	3.21	3.91***	3.91***	3.97***	3.98***
(yes=1, no=0)	(1.33)	(1.34)	(1.45)	(1.45)	(2.81)	(2.81)	(2.86)	(2.86)
Treatment group	2.57	-0.28	0.932	0.93	-0.186	-5.66	-0.240	-4.62
(yes=1, no=0)	(1.18)	(-0.08)	(0.30)	(0.39)	(-0.08)	(-0.83)	(-0.10)	(-0.79)
Post × treatment	41.98***	41.98***	--	--	43.53**	43.5***	--	--
	(11.86)	(11.88)			(6.51)	(6.52)		
Post × treat × tunnel	--	--	64.85**	64.85***	--	--	68.0***	68.1***
farms			(13.89)	(13.89)			(7.07)	(7.05)
Post × treat ×	--	--	27.7***	27.7***	--	--	38.3***	37.9***
dehydration farms			(5.20)	(5.21)			(3.07)	(3.04)
Post × treat ×	--	--	22.0***	22.0***	--	--	19.5***	19.9***
horticulture farms			(8.14)	(8.13)			(5.28)	(5.49)
Controls for farm	Yes	Yes	Yes	Yes	--	Yes	Yes	Yes
Controls for FEGs	No	Yes	No	Yes	No	Yes	No	No
Controls for sectors	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.589	0.589	0.631	0.631	0.570	0.570	0.594	0.594
Sample size	792	792	792	792	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. One FEG-level control variable includes completed years of education of FEG group leader or key decision-making owner. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

In sum, our results show that starting employment in treated farms was slightly more than control farms but the differential significantly increased after ASF program support to farmer groups. Our estimates show that program support to farmer groups was instrumental in bringing about relative gain in employment of 41 to 44 hours per week on treated farms, or an increase ranging from 123% to 139%. We also find that without ASF program support, employment generation may have remained below 13%. Our evidence further shows that employment generation due to program support was highest in tunnel farms followed by dehydration farms and then horticulture farms. Our results predict that without program support, employment generation in dehydration and horticulture farms my have stagnated. Consistent with the other evidence, the data reconfirms that the impact of program support was remarkably higher on the farms of FEG Group Leaders than farms of other FEG Members.

Table 5.13. Regressions predicting employment generation without program support

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(4)	(5)	(8)
Intercept	45.82***	43.69**	48.76***	48.44***
	(13.48)	(12.83)	(15.01)	(15.14)
Post-intervention (yes=1, no=0)	1.95	1.96	3.76***	3.80***
	(0.89)	(0.89)	(2.73)	(2.76)
Treatment group (yes=1, no=0)	3.43*	3.60*	0.199	0.151
	(1.82)	(1.95)	(0.09)	(0.06)
Post × treatment	2.80	--	3.97	--
	(0.26)		(0.97)	
Post × treat × tunnel farms	--	7.95**	--	14.99*
		(2.05)		(1.65)
Post × treat × dehydration farms	--	-0.63	--	-0.398
		(-0.25)		(-0.13)
Post × treat × horticulture farms	--	-0.12	--	-4.03
		(-0.05)		(1.37)
Controls for farm	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.587	0.591	0.584	0.590
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

5.7 PROGRAM SUPPORT AND INCOME AND EXPENDITURE OF HOUSEHOLDS

Despite remarkable increase in efficiency and productivity of treated farms, there seems to have been no increase in household income and expenditure of treated farms in comparison with control farms, which indicates no immediate change in living standards. We present detailed evidence from the survey to address this question. We use a number of income and expenditure related outcome variables from the survey to evaluate the impact on (1) household income from the enterprise, (2) real household income from the enterprise, (3) total household income, (4) real total household income, (5) household per capita expenditure, and (6) real household per capita expenditure. For analytical purposes, we take monthly values of these outcome variables.

In Table 5.14 we present simple difference-in-differences of these outcome variables. It is interesting to note that there was significant difference in starting income and expenditure attributes of treated and control farms. The evidence suggests that under definition 1, starting income and expenditure of treated households was higher than households in control group, but under definition 2, in most cases starting income and expenditure of control farms was higher than treatment.

Treated and control farms experienced significant increase in nominal income and expenditure in post-treatment period, but this increase was diluted by an episode of very high inflation in the same period. For example, CPI inflation registered 36% increase between FY2007 and FY2009, i.e., the CPI index increased from 141.87 in FY2007 to 191.9 in FY2009. To illustrate, under definition 1, nominal increase in enterprise income of treated farms was 44%, but real increase was only 6.5%. For control farms, real increase was only 3.8%. However, under definition 2, real increase in enterprise income was 26.3% for treated farms, compared with only 2.5% for control farms. It is significant to note that the difference-in-differences of six income and expenditure outcomes were in each case bigger for definition 2 compared with definition 1, which reinforces our earlier contention that FEG Group Leaders were the greatest beneficiaries of the program support. The relative gain to treated farms in household income from enterprise was Rs.5189 and real household income from enterprise increased by Rs.2977. Similarly, total household income and real total household income also increased under definition 2, but they decreased under definition 1.

Table 5.15 presents regression coefficients for income and expenditure outcomes where the dependent variables are six monthly income and expenditure outcomes defined above. The empirical specifications used here are very similar to those used for efficiency and employment effects of program support.

The estimated coefficients for post-intervention dummy are positive and statistically significant for all the nominal values, but insignificant for all real values. These results suggest that income and expenditure increased in nominal terms in FY2009 compared with FY2007, but in real terms this increase was statistically not different from zero. Similarly, the estimated coefficients for treatment group are positive and statistically significant for definition 1 indicating that, in general, income and expenditure of treated farms were more than control in this category, but for definition 2 the differential between the two groups was statistically equal to zero. For our purposes, the variable of

Table 5.14. Difference-in-differences of farm household income and expenditure

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):								
Mean household income from enterprise per month (Rs.)	20203	19900	13731	12336	17837	18344	19322	19086
Real household income from enterprise per month (Rs.)	14240	14027	9678	8695	12573	12930	13620	13453
Total household income per month (Rs.)	30466	27095	20908	14190	30513	29388	28459	24770
Real total household income per month (Rs.)	21488	19126	14738	10002	21508	20714	20060	17460
Household per capita expenditure per month (Rs.)	1890	2080	1444	720	1768	1022	1821	2052
Real household per capita expenditure per month (Rs.)	1333	1466	1017	507	1246	721	1283	1447
Sample size	327	--	69	--	66	--	330	--
Post-treatment (FY2009):								
Mean household income from enterprise per month (Rs.)	29084	36456	19421	21179	30487	41302	26783	32962
Real household income from enterprise per month (Rs.)	15156	18997	10120	11036	15887	21523	13957	17176
Total household income per month (Rs.)	40833	36859	32184	37514	43740	43868	38444	35569
Real total household income per month (Rs.)	21279	19207	16771	19449	22793	22860	20033	18535
Household per capita expenditure per month (Rs.)	2551	2274	1972	1017	2368	1453	2467	2229
Real household per capita expenditure per month (Rs.)	1330	1185	1028	530	1234	757	1285	1162
Sample size	327	--	69	--	66	--	330	--
Difference-in-differences:								
Mean household income from enterprise per month (Rs.)	3191	--	--	--	5189	--	--	--
Real household income from enterprise per month (Rs.)	474	--	--	--	2977	--	--	--
Total household income per month (Rs.)	-909	--	--	--	3242	--	--	--
Real total household income per month (Rs.)	-2242	--	--	--	1312	--	--	--
Household per capita expenditure per month (Rs.)	133	--	--	--	-46	--	--	--
Real household per capita expenditure per month (Rs.)	-14	--	--	--	-14	--	--	--

Table 5.15. Regression on the effects of program support on income and expenditure

	Definition 1: FEG Members taken as treatment						**Definition 2:** FEG Group Leaders taken as treatment					
	HH income from enterprise	Real HH income from enterprise	Total HH income	Real total HH income	HH per capita expenditure	Real HH per capita expenditure	HH income from enterprise	Real HH income from enterprise	Total HH income	Real total HH income	HH per capita expenditure	Real HH per capita expenditure
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	12617***	9310***	18036***	13086***	1902.2***	1291***	16427***	12200***	24300***	17635***	2171.3***	1492.9***
	(2.54)	(3.38)	(3.44)	(4.24)	(5.94)	(6.53)	(3.15)	(4.19)	(4.55)	(5.59)	(7.32)	(8.53)
Post-intervention (yes=1, no=0)	4752**	-94	10664**	1670	556.6***	27.71	6329***	-309	9154***	-519	659.38***	10.77
	(2.06)	(-0.07)	(2.36)	(0.69)	(4.45)	(0.37)	(3.88)	(-0.33)	(4.31)	(-0.42)	(4.23)	(0.11)
Treatment group (yes=1, no=0)	5136***	3776***	8639***	6190***	352.4***	258.0***	290	22	2608	1796	-17.93	-15.74
	(3.47)	(3.85)	(4.21)	(4.43)	(2.82)	(3.06)	(0.14)	(0.01)	(0.75)	(0.74)	(-0.12)	(-0.15)
Post × treatment	3008	369	-1116	-2352	118.04	-21.71	5205	2986	3226	1303	-40.78	-11.11
	(1.01)	(0.22)	(-0.22)	(-0.83)	(0.59)	(-0.18)	(1.04)	(1.08)	(0.56)	(0.38)	(-0.17)	(-0.07)
Controls for farm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.267	0.274	0.221	0.207	0.182	0.155	0.262	0.268	0.214	0.199	0.176	0.150
Sample size	792	792	792	792	792	792	792	792	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

key significance is (post × treatment), which indicates the true effect of program support on treated farms. The estimated coefficients in Table 5.15 are directly comparable with the simple difference-in-differences reported in Table 5.14. The results suggest that the differential effect of program support on treatment group relative to control is mostly positive, but this effect is statistically not different from zero. In other words, there is evidence of economic significance of ASF program support on income and expenditure of target groups. The statistical insignificance of these results does not imply that there was no effect of program support on income and expenditures of treated households, but that there was no statistical difference between income and expenditures of treated and control farms in the sample. To conclude, the true effect of ASF program support on real income was uniformly positive, but statistically it was not different from zero.

5.8 IMPACT OF PROGRAM SUPPORT ON HEADCOUNT POVERTY

Survey data is also used to calculate headcount income and expenditure poverty for each farm household in the sample. In this regard, we employ the cutoff of Rs.723.4 for basic needs poverty in 2001-02,[11] worked out by the Government of Pakistan [GoP (2007)]. We inflate the official poverty line to reach at the cutoffs for basic needs poverty for FY2007 and FY2009. No cutoffs for basic needs poverty have been established yet for Gilgit-Baltistan region in our knowledge. Therefore, we restrict this analysis to the sample of tunnel and horticulture farms.

In Table 5.16 we report headcount income and expenditure poverty on the basis of household data of tunnel and horticulture farms. The table summarizes average poverty in treatment and control in pre- and post-treatment periods. In sharp contrast to the incidence of rural poverty of about 30% in the national sample, poverty incidence in our sample was almost none. For example, our definition 1 suggests that starting income and expenditure poverty in treatment farms was very low and after program support income poverty remained unchanged while expenditure poverty marginally increased. Similarly, income poverty in control farms was 8.5% and expenditure poverty was 4.2%, which registered marginal change in post-treatment period.

The simple difference-in-differences shows that income poverty decreased by 2.1% and expenditure poverty increased by 2.6%. By any standards, the incidence of income and expenditure poverty in the surveyed households was almost non-existent. The picture does not change much when we use definition 2. Tables 5.17 and 5.18 present regression results for income poverty and expenditure poverty where we examine whether program support is associated with change in poverty status of treated farms. The results show that none of the poverty variables shows a statistically significant change in treatment relative to control farms. In sum, while income poverty and expenditure poverty in our sample was very low, there is no evidence of change in income poverty or expenditure poverty after ASF program support.

[11] It indicates the income/expenditure required to achieve the minimum calories of 2350 per adult equivalent per month.

Table 5.16. Difference-in-differences of income poverty and expenditure poverty: tunnel and horticulture farms

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):								
Income poverty	0.0177	0.13	0.0851	0.28	0.000	0.000	0.0345	0.18
Expenditure poverty	0.0265	0.16	0.0425	0.20	0.024	0.16	0.0302	0.17
Sample size	226	--	47	--	41	--	232	--
Post-treatment (FY2009):								
Income poverty	0.0177	0.13	0.1064	0.31	0.000	0.000	0.0388	0.19
Expenditure poverty	0.0309	0.17	0.0213	0.15	0.0488	0.22	0.0259	0.16
Sample size	226	--	47	--	41	--	232	--
Difference-in-differences:								
Income poverty	-0.021	--	--	--	-0.0043	--	--	--
Expenditure poverty	0.026	--	--	--	0.0291	--	--	--

Table 5.17. Regressions on the impact of program support on income poverty: tunnel and horticulture farms

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	0.063	0.063	0.020	0.020
	(1.39)	(1.38)	(0.96)	(0.97)
Post-intervention (yes=1, no=0)	0.019	0.019	0.003	0.003
	(0.31)	(0.32)	(0.15)	(0.15)
Treatment group (yes=1, no=0)	-0.068	-0.068	-0.020	-0.020
	(-1.62)	(-1.62)	(-1.50)	(-1.50)
Post × treatment	-0.021	--	-0.004	--
	(-0.34)		(-0.24)	
Post × treat × tunnel farms	--	-0.011	--	-0.002
		(-0.18)		(0.10)
Post × treat × horticulture farms	--	-0.035	--	-0.008
		(-0.57)		(-0.40)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	No	No	Yes	Yes
Controls for district	No	No	Yes	Yes
R^2	0.059	0.061	0.032	0.032
Sample size	546	546	546	546

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. For explanation of other variables, see footnote Table 5.15.

Table 5.18. Regressions on the impact of program support on expenditure poverty: tunnel and horticulture farms

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	0.036	0.034	0.027	0.031
	(0.90)	(0.88)	(1.22)	(1.35)
Post-intervention (yes=1, no=0)	-0.022	-0.021	-0.006	-0.006
	(-0.56)	(-0.55)	(-0.38)	(-0.36)
Treatment group (yes=1, no=0)	-0.014	-0.014	-0.014	-0.014
	(-0.43)	(-0.45)	(-0.55)	(-0.54)
Post × treatment	0.024	--	0.030	--
	(0.58)		(0.67)	
Post × treat × tunnel farms	--	0.045	--	0.069
		(0.99)		(1.04)
Post × treat × horticulture farms	--	-0.005	--	-0.020
		(-0.11)		(-0.70)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	No	No	Yes	Yes
Controls for district	No	No	Yes	Yes
R^2	0.023	0.030	0.023	0.028
Sample size	546	546	546	546

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. For explanation of other variables, see footnote Table 5.15.

5.9 IMPACT OF PROGRAM SUPPORT ON OTHER OUTCOME MEASURES

We further extend this analysis and consider other outcome measures we expect to be related to program support to small farmer groups. In this category, we consider the impact on household attributes consisting of: (1) non-land asset holding; (2) labor supply of men and women; (3) child labor of boys and girls; and (4) frequency of meat consumption. The results are presented in Appendix Tables A1 to A7.

First, Table A1 illustrates simple difference-in-differences estimation of the effect of program support on household non-land assets. Top rows compare starting average real ownership of assets in 2000-01 constant rupees. The starting asset level of treated and control farms is respectively Rs.122570 and Rs.91560 for definition 1 and Rs.155240 and Rs.109460 for definition 2. Taking the difference-in-differences we find that there was Rs.8860 increase (7.3%) in real assets of program farms compared with control farms under definition 1, and a fall in real assets of Rs.1290 in program farms, relative to control farms under definition 2. Consistent with these results, regression results in Table A2 indicate that none of the variables shows a statistically significant increase or decrease in real assets. In other words, regardless of which definition is used, the results provide no evidence that program support increased real household non-land assets of treated farms. A disaggregated analysis in Table A2 also presents the results of second-order interaction.

Second, we evaluate the impact on household labor supply of men and women by taking weekly hours worked as indicator of labor supply. In Table A3, the upper rows show that the starting labor supply of men and women was remarkably similar in treatment and control. Taking the difference-in-differences, there is almost no change in hours worked by men and women irrespective of which definition is used. The results reported in Tables A4 and A5 indicate that treatment dummy across time is statistically insignificant in all regressions meaning that program support was unable to change household labor supply of men and women coming from treated households. Disaggregated regression results in Table A4 (col.2), however, provide some evidence that labor supply of men in horticulture sector increased from 5 to 7 hours per week for definition 1 and definition 2, respectively.

Third, we consider the impact of ASF program support on child labor (weekly hours worked) of boys and girls. The dependent variable is child labor defined as weekly hours worked of boys and girls as paid or unpaid help at home, own-farm or business, or for wage and non-wage benefits at other places. Our regression results in Tables A6 and A7 do not identify any change in hours worked of boys and girls coming from program households than this impact on boys and girls of non-program households. Moreover, none of the estimated coefficients in col.(2) and col.(4) of treatment dummy across sectors show a statistically significant change in child labor.

Finally, we consider the impact of program support on the frequency of meat consumption. Our dependent variable is the average number of times per month meat was consumed by the household. Consistent with other results in this section, Table A8 shows that none of the variables turned out to be statistically different from zero including disaggregated results for the treatment dummy across sectors in col.(2) and col.(4).

5.10 CONCLUSIONS

The basic point of this chapter has been to evaluate the impact of ASF matching-grant support to FEGs. We used two rounds of survey data of 396 farms in treatment and control groups to examine the impact of program support on tunnel farms, dehydration farms, and horticulture farms. The data provides strong support to the view that after ASF intervention, real profit, technical efficiency, total factor productivity and employment of treated farms significantly increased, compared with control farms. To investigate the true effects of program support on FEG Members and FEG Group Leaders, we adopted two definitions for treatment and control. However, the estimation results of the regression models strongly support the contention that FEG Group Leaders were greater beneficiaries of ASF program support as compared to other FEG Members.

While the program support had differential effect on increased profitability of FEG Group Leaders and FEG Members, in each case the profitability of the Group Leaders was relatively much higher. The results suggest that, in general, there was a tendency for FEG Group Leaders to be the most dynamic and active participants in the program activities and hence stood to derive proportionately greater benefits than other members. We also have robust conclusions suggesting that productivity growth of FEG Group Leaders and employment generation on their farms was also much higher compared with FEG Members, all compared with control farms. Furthermore, we cannot escape the general conclusion that the program support did not raise the efficiency indexes of FEG Members in any of the specification tried for this purpose. This is explained by virtue of the fact that all production based activity (such as tunnel farming) was being conducted on the Group Leaders farms. The results suggest that short-term on-farm efficiency improvement is restricted to those farms where actual activity takes place. It remains to be seen if the benefits manifested in the program activities can stimulate a change in farming practices by other members of the group and the community at large in the long-term. Anecdotal evidence suggests that some replication of activities has already commenced in certain communities.

The empirical evidence also suggests that despite increase in profit, efficiency and productivity of treated farms in our sample, the income and expenditure of treated farm households have not made an immediate real difference in their living standards in comparison with control farms. The incidence of poverty on treated and non-treated farms in our sample was already very low by the national standards. We, therefore, find no evidence of change in income poverty or expenditure poverty after ASF program support.

Finally, as compared with control farms, program support did not make a significant difference in household asset ownership, household labor supply of men and women, child labor of boys and girls and frequency of meat consumption in treated farms. The absence of impact on household income and expenditure, on asset holdings and on consumption may be explained by the relatively short duration since start of the program, whereby immediate behavioral or cultural changes may not be expected. Moreover, the survey did not examine related aspects such as increase in savings or reduction in liabilities.

6 Support to Agribusinesses and the Spill-over Effects

6.1 INTRODUCTION

Market failures in food supply chains are a common site in Pakistan. ASF has provided startup support to a diverse range of agribusiness enterprises to correct market failures. Two such initiatives are (1) milk collection, chilling and marketing, and (2) citrus (*kinnoo*) production, processing and export under GlobalGAP certification. The aim of program support directed to these agribusinesses was to promote market linkages and to penetrate into unconventional export markets.

Small dairy farmers are often exploited by village milk collecting agents due to their monopsony power leading to lower prices of farmer milk [Burki and Khan (2008)]. Creation of second-buyer in rural milk markets may be an efficient way of correcting market failure. ASF set up several dairy apex bodies for collection, chilling and marketing of milk, and linked them with a cluster of 50 smallholder dairy producers by giving them membership of the apex bodies. Similarly, implementations of Good Agricultural Practices (GAP) are needed to promote export of citrus to developed countries. But, the market fails to respond on its own due to disconnect between growers, processors and exporters. In an attempt to correct market failures, ASF helped form Produce Marketing Organizations (PMOs), linking processors/exporters with citrus growing farms, to implement GAP protocols on the orchards and the processing units. However, the success or failure of these attempts to correct market failure may largely depend on the outcome of the spill-over effects on dairy farmers and citrus growers.

While program support to FEGs in tunnel, dehydration and horticulture sectors was aimed at directly benefiting groups of small farmers, the nature of program support to the agribusinesses in dairy and citrus value chains differed in a few respects. First, the prime focus of program support to dairy and citrus value chains was on the promotion of agribusinesses by providing them business development services through consultants with the aim to promote best practices in marketing and certified production. Second, the grant component was signed between ASF and the owners of agribusinesses rather than dairy and citrus (*kinnoo*) farmers. Third, unlike other FEGs, the intent of promoting the interests of farmers was not direct. It was envisaged that the spill-over effects of the program support would also benefit dairy and citrus producers in the target regions. Finally, the end producers had no direct stakes in the ownership of dairy marketing companies, and citrus processing units.

It was assumed that promotion of dairy apex bodies for collection, chilling and marketing of milk, and citrus processing units under GlobalGAP certification would also benefit smallholder dairy producers and citrus growing farmers as other key players in the value chains. While the medium-and long-term sustainability of the dairy apex bodies and certified processing and export of citrus hinges on the supply response of the dairy and citrus clusters, no attempt has been made to assess the true benefits accruing to farmers of these value chains. In this chapter, we envisage to evaluate the spill-over effects of ASF program support to dairy apex bodies, and certified processing and export of citrus on smallholder dairy producers in the dairy cluster and citrus growing farms in the citrus value chain.

6.2 HAS ASF SUPPORT TO DAIRY APEX BODIES BENEFITTED DAIRY FARMS

ASF has helped set up several dairy apex bodies for collection, chilling and marketing of milk by merging five dairy farmer groups each with membership of 10 dairy farms. Merging five dairy FEGs constituted a cluster of about 50 dairy farms under each apex body. ASF provided matching grant to dairy apex bodies to the tune of Rs.500000 to Rs.600000 to purchase business development services to upgrade capacity to collect and procure milk from dairy farmers by installing small chilling units. As part of overall program, the apex bodies were required to purchase, transport and install chillers at collection sites.[12] Farm gate price of milk by the apex bodies was set at Rs.1 to Rs.2 more than the price in the village. The price differential offered by dairy apex bodies to member farms is expected to have produced spill-over effects on member dairy farms. Is impact assessment of dairy apex bodies possible? Have member dairy farms benefited from this change? We address these and other questions below.

A. Survey of Dairy Apex Bodies and Dairy Farms

Eight apex bodies that received matching grant support from ASF were identified in Sheikhupura, Nankana and Jhelum (Pind Dadan Khan Tehsil) districts for data collection. One apex body had suspended operations by the time survey was conducted, i.e., August 27, 2009 to September 3, 2009. The remaining seven apex bodies, three from Jhelum, and two-each from Sheikhupura and Nankana Sahib Districts, were included in survey design. Given that apex bodies were non-existent in the pre-treatment period, impact assessment of ASF program support to apex bodies was virtually impossible. A cross-sectional comparison of the outcomes of apex bodies with control in the post-treatment period alone was indeed possible, but due to serious methodological issues in this approach, this analysis was not attempted. However, two comments are in order on the basis of the field survey.

First, only four of the seven apex bodies interviewed had chillers at the site. Three apex bodies (one in Sheikhupura and two in Nankana) were functioning without a chiller, despite a requirement for installation under the overall program design. Further enquiries suggested that these apex bodies had in the beginning rented-in chillers to conform to ASF requirements, but had returned them a few weeks after grant disbursement. Second, the apex bodies were paying somewhere between

[12] No grant was provided for purchase of chillers. The service element was calculated at 10% of the equipment cost for which ASF paid 50%, which translates to around 5% of the chiller cost.

Rs.21 to Rs.30 as purchase price of milk to dairy farmers who were part of their network; they were also paying Re.0.5 to Re.1 as collection cost of milk to third parties. The apex bodies were charging Rs.5 to Rs.6 per liter as the difference between purchase and sale price of milk. Finally, in the case of activities of the apex bodies such as milk collection network there is likely to be scope for spill-over effects on the well being of smallholder dairy producers in respective areas.

It is well known that most dairy farmers in remote areas face imperfect markets due to absence of effective competition. The milk collection network of the apex bodies is an innovative way to address the issue of building supply chains. We seek to estimate the impact of milk collection network of apex bodies on the efficiency and welfare of smallholder dairy producers in comparison with dairy farms in control group. The survey of dairy producers was aimed at drawing a representative sample in the treatment and control groups. Dairy farmers selling milk to the apex bodies, as part of the arrangement, were taken as treatment while all others were taken as control. It is significant to note that the sample areas were not covered by milk collection network of milk processing industry. Therefore, we believe that a control group of dairy farms in these villages forms a natural basis for comparison with the experiences of dairy farms associated with the apex bodies. In other words, we have a homogenous group of dairy farmers who were selling milk to traditional milk collecting agents such as *dhodhis* before program support to the apex bodies began.

The survey design includes a sample of 49 dairy producers of which 35 are members of FEGs, or treatment farms, and 14 are in control farms. We collect two rounds of data for the period before and after program support and evaluate the spill-over effects of program support on the following: (1) profitability of dairy farms; (2) dairy farmer efficiency and productivity; (3) employment generation; (4) household supply of labor; and (5) change in income and assets.

B. Effects of Program Support on Profitability of Dairy Farms

We calculate per animal cost, revenue and profit and convert them into real terms by using the CPI with base-year 2000-01. Table 6.1 presents the means of real cost per animal, real revenue per animal and real profit per animal for the period before and after treatment for both treatment and control groups. The starting real cost in treatment farms was higher and real profit was lower, compared with control farms. However, the difference in starting revenue per animal was much less striking. Following program support to apex bodies, average real profit of treated dairy farms increased by 95%, compared with 18% fall in real profit of control farms. After program support, the relative gain in real profit of treatment farms was Rs.3761 per animal, compared with control farms.

Table 6.2 presents the results of the regression model. The estimated coefficients indicate that in general there was statistically no change in real profit in pre-treatment and post-treatment periods. Moreover, the difference in real profit of treatment and control groups was also equal to zero. However, consistent with simple difference-in-differences of Table 6.1, we find that creating milk collection networks through dairy apex bodies has increased real profits of participating farms on average by Rs.3800 per animal, compared with control group. Thus we have unequivocal evidence to show that there were positive spill-over effects of program support to the apex bodies on real profit of dairy farms.

Table 6.1. Difference-in-differences of profit, revenue and total cost in dairy farms

	Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):				
Real total cost per animal (Rs.)	20680	8712	19062	5239
Real total revenue per animal (Rs.)	23868	10454	23241	8233
Real profits per animal (Rs.)	3188	4617	4169	4113
Sample size	35	--	14	--
Post-treatment (FY2009):				
Real total cost per animal (Rs.)	18120	4323	19155	4261
Real total revenue per animal (Rs.)	24330	6006	22585	6233
Real profits per animal (Rs.)	6210	3167	3430	2849
Sample size	35	--	--	--
Difference-in-differences:				
Real total cost per animal (Rs.)	-2653	--	--	--
Real total revenue per animal (Rs.)	1118	--	--	--
Real profits per animal (Rs.)	3761	--	--	--

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

Table 6.2. Regression on the impact of program support on real profit per animal in dairy farms

Variable	Coefficient
Intercept	5402.9***
	(3.65)
Post-intervention (yes=1, no=0)	-874.3
	(-0.74)
Treatment group (yes=1, no=0)	-836.3
	(-0.88)
Post × treatment	3800.2***
	(2.77)
Controls for farm	Yes
Controls for sectors	Yes
Controls for districts	Yes
R^2	0.440
Sample size	98
Mean profit	4442
SD	4024

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The model is estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. Controls for districts refer to dummy variables for Sheikhupura, Nankana Sahib and Jhelum districts.

C. Effects of Program Support on Dairy Efficiency and Total Factor Productivity

As before, we estimate overall technical, pure technical and scale efficiency of each farm by assuming that production technology is same for each year, but may be different across years. Therefore, we obtain efficiency index for each farm by maximizing linear programming problem given in Eq.(4.2). We take these efficiency indexes and use them as dependent variable in the regression framework defined in Eq.(4.1).

Table 6.3. Spill-over effects of program support on efficiency of dairy farms

	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)
Intercept	0.834***	0.870***	0.958***
	(18.52)	(23.90)	(31.47)
Post-intervention (yes=1, no=0)	-0.119***	-0.116***	-0.011
	(-3.07)	(-3.51)	(-0.44)
Treatment group (yes=1, no=0)	-0.103	-.038	-0.074
	(-0.88)	(-0.50)	(-0.66)
Post × treatment	0.182***	0.121***	0.076**
	(4.16)	(3.27)	(2.54)
Controls for farm	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes
R^2	0.334	0.380	0.358
Sample size	98	98	98
Mean efficiency	0.809	0.874	0.925
SD	(0.12)	(0.10)	(0.09)

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. Controls for districts refer to dummy variables for Sheikhupura, Nankana Sahib and Jhelum districts.

Table 6.3 presents the estimated coefficients of the effect of program support on overall technical efficiency, pure technical efficiency and scale efficiency. The results in col.(1) show that mean overall technical efficiency of dairy farms in the sample was about 81%. The results in col.(2) and col.(3) show that the mean pure technical efficiency index was 87.4% while mean scale efficiency index was 92.5%. In other words, most overall technical inefficiency of dairy farms stems from the fact that dairy farms produce much lower than their full potential.

The regression coefficients show that while overall technical efficiency of dairy farms fell by 11.9% in post-treatment period, most of the decline in efficiency index may be attributed to poor performance of non-program dairy producers. For example, the difference-in-differences coefficient (post × treatment) shows that after program support relative efficiency of program farms increased by 18.2%, compared with dairy farms in control group. These estimates are statistically significant at the 99% confidence level. These results suggest strong similarities between the impact of program support on overall technical efficiency of dairy farms to that found for tunnel, dehydration and horticulture farms in Table 5.4 under definition 2. Similarly, the results also indicate that program support was instrumental in raising pure technical and scale efficiency of program farms than control group. Program farms were 12% more purely technically efficient and 7.6% more scale efficient than control farms. These results take on greater importance in light of the results for the impact of program support on pure technical efficiency of treated farms in tunnel, dehydration and horticulture sectors (see Table 5.4).

We can safely conclude that program support to the apex bodies had strong spill-over effects on the participating smallholder dairy producers who appear to more efficiently convert dairy inputs into output and have more incentives to operate at better scale than those who are not part of the apex body network and thus have fewer such opportunities. Most of these results appear similar to those of Burki and Khan (2008) in a study of the impact of food supply chain on smallholder efficiency in Pakistan's Punjab. Their study also finds that milk collection network of milk processing industry significantly increases technical efficiency of treated farms because increase in the number of economic agents competing for rural milk supplies leads to development of an efficient private milk market because traditional milk collecting agents are marginalized.

Table 6.4 presents estimation of the effects of program support on total factor productivity and its components. As before, growth in total factor productivity is measured by the Malmquist total factor productivity index and the contribution in productivity of technical change and efficiency change. Our results suggest that between FY2007 and FY2009 total factor productivity increased by 20.5% in treatment group, compared with 4.6% decrease in productivity in control farms. Productivity increase in treatment farms was equally explained by innovations and catching-up to the best-practice frontier. For example, these farms were introducing technical change due to which production frontier shifted outward at the rate of 7% between FY2007 and FY2009. Improvement in TFP due to efficiency change at 7.9% was also impressive indicating that these farms were catching-up to the best practice frontier. However, the same was not true in control farms, which were faced with productivity regress in the same period. Technological change in control farms was also impressive at 9.5%, but these farms were lagging behind in their attempt to improve efficiency change. In other words, these farms could have significantly saved their dairy inputs to produce same output, which they have been unable to do.

Thus, we find significant spill-over effects of program support to dairy apex bodies on smallholder dairy producers, which triggered productivity growth in treated farms. At the same time, productivity of dairy farms in control group declined mostly due to their failure to catch up with the best practice technology. The finding of positive productivity growth for dairy farms in treatment group also runs parallel and corroborates the other two findings that program support increased relative profitability and technical efficiency of treated farms, compared with dairy farms in control group.

Table 6.4. Impact of program support on total factor productivity in dairy farms

	Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev
Total factor productivity change	1.205	0.23	0.954	0.13
Technical efficiency change	1.070	0.07	1.095	0.09
Efficiency change	1.079	0.16	0.966	0.12
Sample size	35	--	14	--

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

D. Effects of Program Support on Dairy Farm Income

The increase in technical efficiency of program farms is likely to have increased relative farm income of program farms compared with farms in control group. To investigate this hypothesis, we use the regression framework to evaluate the effects on farm income.

Table 6.5 presents the estimated coefficients of the program effect on farm income. The dependent variable is real farm income. The results in col.(1) of Table 6.5 suggest that in general, average farm income in post-treatment period was Rs.2892 more than the same income in pre-treatment period. Moreover, farm income of treatment and control groups was statistically not different from zero. The true spill-over effects of program support on farm income suggest that program farms earned Rs.8249 more than control farms due to program support to apex bodies; the results are statistically significant at the 90% confidence level.

We also explored the impact of program support on total income of farm households, per capita household expenditures and non-land assets, but unfortunately none of the effects turned out to be statistically different from zero (see col.(2) to col.(4)). In other words, program support was not long enough to produce true differentials in income and expenditures of farm households relative to control group.

E. Effects of Program Support on Dairy Sector Employment and Household Labor Supply

Given that smallholder dairy producers mostly employ household labor for dairy production, we do not expect program support to have increased employment generation by dairy farms in the sample. Nor do we expect that labor supply of the households would significantly increase in the short period of time since these outcomes are related to the size and scale of the farms. Table 6.6 illustrates the estimation results.

Table 6.5. Spill-over effects of program support on farm income in dairy sector

Variable	Income from enterprise	Total income of the HH	Real per capita HH expenditure	Real non-land asset holding
	(1)	(2)	(3)	(4)
Intercept	11664.8***	1638.5***	1473.3***	160787***
	(3.00)	(5.61)	(7.04)	(5.15)
Post-intervention (yes=1, no=0)	2891.9***	763.9**	17.84	37410.5
	(0.78)	(2.41)	(0.11)	(1.08)
Treatment group (yes=1, no=0)	-8180.6	-478.5	36.80	-62840.7
	(-1.20)	(-0.93)	(0.09)	(-0.76)
Post × treatment	8249.4**	-11.24	109.86	-17635
	(2.09)	(-0.03)	(0.60)	(-0.46)
Controls for farm	Yes	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.629	0.314	0.415	0.191
Sample size	98	98	98	98

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. Controls for districts refer to dummy variables for Sheikhupura, Nankana Sahib and Jhelum districts.

Table 6.6. Spill-over effects of program support on employment generation and labor supply in dairy sector

Variable	Employment generation	HH labor supply of men	HH labor supply of women
	(1)	(2)	(3)
Intercept	14.59***	16.37***	11.83.8***
	(4.36)	(5.44)	(4.51)
Post-intervention (yes=1, no=0)	-1.275	0.554	0.093
	(-0.36)	(0.24)	(0.05)
Treatment group (yes=1, no=0)	7.758	8.57*	-4.05
	(1.06)	(1.72)	(-1.24)
Post × treatment	3.575	0.117	0.623
	(1.02)	(0.04)	(0.28)
Controls for farm	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes
R^2	0.703	0.196	0.216
Sample size	98	98	98

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners. Controls for districts refer to dummy variables for Sheikhupura, Nankana Sahib and Jhelum districts.

As expected, none of the difference-in-differences coefficients in col.(1) to col.(3) turn out to be statistically different from zero. In other words, we have convincing evidence to show that due to the small size and scale of dairy farms, program support was not effective in making a dent on the relative employment and household labor supply. However, we hope that if the current trends continue, program farms are likely to increase their scale, which in turn might make a major impact on employment generation and household labor supply of men and women.

6.3 IMPACT ASSESSMENT OF CITRUS VALUE CHAIN: GLOBAL-GAP PROJECT

ASF facilitated a cluster of 14 leading citrus exporters in Bhalwal to acquire GlobalGAP certification. ASF facilitated these exporters to form Produce Marketing Organizations (PMOs) for acquisition of GlobalGAP certification by implementation of Good Agricultural Practices in the orchards of PMO member citrus (*kinnoo*) growers. The primary objective of the ASF initiative was to assist Pakistani growers and processors to adopt internationally compliant standards. While ASF's goal was successfully achieved within a year of program start, this study is limited to assessment of the intervention with respect to the impact on participating farmers and the potential long-term consequences thereof.

The project was launched in 2007 for a period of three years. In this regard, 324 citrus (*kinnoo*) farmers holding 15116 acres of land in Bhalwal region were registered under the GAP program. ASF provided matching grant of around Rs.1.5 million to each of the 14 processors/exporters spread into three years. The grant money was used to cover certification cost[13]; consulting fee to GAP protocol adoption consultants and facilitators; training of facilitators and orchard owners; analysis cost for testing of water and pesticide residue and other related tests, among others.

The audit process was initiated after about seven to eight months from the date of registration and GlobalGAP certifications were issued only after it was established that all the GlobalGAP requirements had been met. In its first year, the objective of the project was to introduce and implement GAP protocols on the orchards as well as the processing units to acquire certification. The second and third year objectives of the project were to maintain GAP protocols and to get renewal of GlobalGAP certifications. It was hoped that after three-years of its implementation, farmers would be trained enough to independently maintain GAP protocols on their farms for future certifications.

The GlobalGAP project envisaged a number of socioeconomic and environmental benefits including benefits to citrus growers and traders/exporters. However, it remains to be seen how GlobalGAP certification project has impacted the performance of citrus growers. In this regard, a survey was designed to collect relevant data from Bhalwal, Sargodha District for impact assessment from: (1) 14 PMOs and control group; and (2) PMO member citrus growers and control farms.

Unfortunately, the survey planned for PMOs had to be abandoned after a few days due to non-cooperation and unwillingness of respondents to share relevant information. Before the survey, an

[13] Ms. Bureau Verities Quality International (BVQI), Pakistan is authorized to provide these certifications in Pakistan.

official letter was written to the heads of PMOs by Principal Investigator seeking cooperation in the survey. Moreover, the head of ASF's field office in Bhalwal also approached PMOs to ask for their cooperation and informed them about the significance of the survey and the impact assessment. Despite these confidence-building measures, the PMOs did not cooperate with the survey team. The survey team made numerous phone calls and paid repeated visits to the PMOs, but the respondents or their representatives expressed their inability to meet with them for the survey. Even those who met with the survey team either refused to divulge any information or tried to provide fictitious information. At this point, it was mutually agreed between ASF and the Principal Investigator to abandon the survey of PMOs.

For the survey of PMO member citrus growers, a sample was randomly drawn from the list of 324 PMO members growing citrus in Sargodha district. A sample of non-PMO farms, or control farms, growing citrus in the same region was also drawn by using purposive random sampling plan for data collection. We collect data from 168 citrus farms consisting of 112 PMO member farms and 56 citrus growing farms in the control group. The control group here comprises those citrus farms who were unaffected by the GlobalGAP certification project. We collect data for two rounds to cover periods before and after program support.

The survey collects information from the respondents only about citrus (*kinnoo*) farm and its production activity. Agricultural and livestock activities of the farms, if present, were ignored for the purposes of the field survey. Therefore, the data strictly pertains to citrus (*kinnoo*) production. The average size of citrus farms in our sample was 42 acres (SD=52); the average size of treated farms was 46 acres (SD=48), compared with average farm size of 34 acres (SD=57) of control farms. Thus unlike the very small size of farms in tunnel, dehydration and horticulture sectors, citrus farms represent medium and large-size farms. We can note that the dispersion in control farms was much bigger than the treated farms.

We evaluate the spill-over effects of program support to PMOs on the following outcome variables of PMO member farmers versus non-member farmers: (1) profitability of citrus growing farms; (2) efficiency and productivity of citrus growing farms; and (3) employment generation in citrus growing farms.

A. Have Program Support Impacted Profitability of PMO Member Farms?

We address this question by presenting two sets of information. First, we study simple difference-in-differences of profit, revenue and cost data of treatment farms, comparing them to citrus farms that were unaffected by GlobalGAP certification project. Second, we run difference-in-differences model in a regression framework on the data of each farm to allow for all other sources of variation in profits across citrus farms.

Table 6.7 presents mean total cost, total revenue and total profit for the period before and after program support. As before the nominal values are converted into real by normalizing them with CPI 2000-01. In other words, the numbers in the table represent cost, revenue and profit in constant 2000-01 prices. As noted in Table 6.7, the starting per acre profit was high in PMO member farms than non-PMO members but this differential in profit grew further after the launch of GlobalGAP certification project. Our calculations show that starting profit of PMO farms increased by 17%, i.e., from Rs.13860 to Rs.16257. However, the relative gain in real profit of PMO members was Rs.3285 or 24% increase in per acre profit.

Table 6.7. Difference-in-differences of profit, revenue and total cost in citrus farms

	Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):				
Real total cost per acre (Rs.)	18942	6640	21151	3619
Real total revenue per acre (Rs.)	32803	9950	29556	11084
Real profits per acre (Rs.)	13860	11439	8405	10211
Sample size	112	--	56	--
Post-treatment (FY2009):				
Real total cost per acre (Rs.)	16160	2502	18072	3060
Real total revenue per acre (Rs.)	32417	10672	25589	9259
Real profits per acre (Rs.)	16257	10106	7517	8973
Sample size	112	--	56	--
Difference-in-differences:				
Real total cost per acre (Rs.)	297	--	--	--
Real total revenue per acre (Rs.)	3578	--	--	--
Real profits per acre (Rs.)	3285	--	--	--

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

Table 6.8 presents the results for a more rigorous analysis where the dependent variable is per acre real profit. The results suggest that real per acre profit of PMO members was Rs.4952 more than non-PMO members. But the estimated coefficients show that holding all else as constant GlobalGAP certification was unable to create a true differential in the relative profit of treatment and control farms. We find that even though real per acre profit of PMO member farms was more than non-PMO members, but the difference in PMO members' profit was statistically not different from non-PMO members' profit (t=1.59). That there was no statistical difference between real profit of member and non-member farms suggests that the spill-over effects of GobalGAP certification project were not reaching out to the growers. If true, this should be a matter of great concern to both ASF and citrus processing PMOs because without sharing the benefits with citrus growers, the Good Agricultural Practices project may not be sustainable beyond the three-year life span of the project.

Table 6.8. Impact of program support on real profits per acre of citrus farms

Variable	Coefficient
Intercept	5893.6** (2.17)
Post-intervention (yes=1, no=0)	-903.6 (-0.54)
Treatment group (yes=1, no=0)	4951.9*** (2.85)
Post × treatment	3303.9 (1.59)
Controls for farm	Yes
R^2	0.119
Sample size	336
Mean real profit per acre (Rs.)	12693
SD	10945

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The model is estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners.

B. Have GlobalGAP Project Impacted Relative Efficiency and Productivity of PMO-Member Farms?

We take farm-level data and calculate overall technical efficiency, pure technical efficiency and scale efficiency of each farm by maximizing separate frontiers for each cross-section, i.e., pre-treatment and post-treatment periods, by using DEA model specified in chapter 4. The mean efficiency score of citrus farms is summarized in the bottom row of Table 6.9. The results show that due to presence of some very efficient farms, mean relative overall technical efficiency of the rest of the group is quite low. The results suggest that in general citrus farms were technically inefficient because they were operating at much less than their overall potential relative to the best practice in the same region. They have the potential to save 51% of their currently used inputs by following on the footsteps of most efficient farms in the region who are overall technically efficient or whose efficiency index score is 1 or close to 1. In other words, most farms suffered from inappropriate combination of farm inputs to produce same output levels. This is hardly surprising in a country like Pakistan where majority of the farmers lack necessary information and skills to optimally utilize their scarce farm inputs.

Turning to evaluate the sources of overall technical efficiency of the farms, we notice that pure technical efficiency score in the bottom row of Table 6.9 is 0.811 (or 81.1% efficiency), and scale efficiency score is 0.599 (or about 60% efficiency). These results indicate that most technical inefficiency occurs due to scale inefficiency since, on average, citrus farms in our sample lose about 40% of their produce due to adopting incorrect scale of production.

Table 6.9. Spill-over effects of program support on efficiency of citrus farms

	Overall technical efficiency	Pure technical efficiency	Scale efficiency
	(1)	(2)	(3)
Intercept	0.374***	0.745***	0.521****
	(8.37)	(24.59)	(10.89)
Post-intervention (yes=1, no=0)	-0.052*	0.017	-0.084
	(-1.94)	(0.80)	(-2.63)
Treatment group (yes=1, no=0)	0.085***	0.101***	0.032
	(3.10)	(5.14)	(1.03)
Post × treatment	0.030	-0.016	0.058
	(0.90)	(-0.64)	(1.59)
Controls for farm	Yes	Yes	Yes
Controls for FEG	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes
R^2	0.130	0.144	0.095
Sample size	336	336	336
Mean efficiency	0.488	0.811	0.599
SD	(0.17)	(0.12)	(0.18)

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners.

The observed overall technical, pure technical and scale efficiency might be related to program support along with a number of farm and owner attributes. Table 6.9 evaluates the spill-over effects of the GlobalGAP certification project on efficiency of member and non-member farms. While we find that overall technical efficiency and pure technical efficiency of PMO member farms is significantly more than the same efficiency for non-member farms, the relative change in overall technical, pure technical and scale efficiency of member farms was no different from non-member farms. Very low *t*-values for the estimated coefficient (post × treat) seem to suggest that GlobalGAP certification initiative did not improve relative efficiency of member farms in post-treatment period, compared with non-members. Thus, we cannot escape the conclusion that program support to PMOs was ineffective in increasing relative efficiency of PMO member citrus farms.

Table 6.10 summarizes evidence on total factor productivity growth and its components between FY2007 and FY2009 in treatment and control farms. Consistent with evidence on relative efficiency of treated and control farms, mean TFP index of PMO member and non-member farms shows that productivity of members increased by 9%, compared with 7% productivity growth of non-member farms, which translates to per annum increase of 4.5% in member farms and 3.5% in non-member farms. The components of productivity growth suggest that member and non-member farms shifted production frontier outward by adopting technical change at roughly the

Table 6.10. Impact of program support on total factor productivity of citrus farms

	Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev
Total factor productivity change	1.091	0.25	1.067	0.41
Technical efficiency change	1.132	0.08	1.130	0.07
Efficiency change	0.960	0.17	0.950	0.23
Sample size	112	--	56	--

Source: 2009 Farmer Enterprise Survey for Program Evaluation of Agribusiness Support Fund

same rate, i.e., 13%. However, productivity regress due to failure to catch up with the best practice technology remains a major problem for both types of farms explaining slow productivity growth. Just like the impact of treatment on relative efficiency, we have strong evidence to show that GlobalGAP certification also did not make a mark in increasing relative total factor productivity of PMO member farms, compared with non-members.

C. Have GlobalGAP Project Increased Employment on PMO Members Farms?

Since citrus farms are regarded as medium and large-farms, they employ on average 117 hours of labor per week or 3 full-time workers (see Table 6.12, bottom row). It is unclear if GlobalGAP certification project produced any spill-over effects on relative employment generation in PMO member and non-member farms. To investigate this possibility, we produce regression results in Table 6.12, which show that the difference-in-differences coefficient turns out to be statistically equal to zero (t=0.10). Thus, we confirm that program support to PMOs did not produce employment generation effects on PMO member farms that were different from employment generation by non-members.

6.4 CONCLUSIONS

Rural areas in Pakistan are known to suffer from market failures in food supply chains. ASF program support to dairy apex bodies and GlobalGAP certified citrus production had the objective to correct market failures by integrating agribusinesses with dairy and citrus farmers. Taken as a whole, the results suggest that when an intervention to correct a market failure leads to sharing of the benefits with the affected parties, the intervention may be successful to correct market failure. But, when the intervention leads to no-benefit sharing with affected parties, the intervention may not be successful to correct market failure. The case of dairy apex bodies may illustrate a successful correction of market failure while the GlobalGAP project may demonstrate a case of a potentially unsuccessful correction of market failure.

Table 6.11. Impact of program support on employment generation in citrus farms

Variable	Coefficient
Intercept	41.12*
	(1.67)
Post-intervention (yes=1, no=0)	4.12
	(0.22)
Treatment group (yes=1, no=0)	29.17*
	(1.67)
Post × treatment	2.10
	(0.10)
Controls for farm	Yes
R^2	0.094
Sample size	336
Mean employment (hours per week)	117
SD	94

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. The model is estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; years since farm production started by present owner(s); and number of farm owners.

Dairy farmers are exploited by traditional milk collecting agents, known as *dodhis*, who pay relatively lower prices of milk to dairy farmers due to absence of other buyers. Increase in the number of economic agents, in the form of dairy apex bodies, competing for rural milk supplies may be an efficient way of correcting the failure. However, the success of this argument crucially depends on the ability of apex bodies to let prices adjust upwards to reflect farmers' valuation of dairy milk. If farmers value the benefits they receive (like a subsidy), dairy apex bodies can be an efficient way of correcting market failure. This could bring medium- and long-term sustainability of the dairy apex bodies.

The survey evidence on smallholder dairy producers supports the contention that upward price adjustment by dairy apex bodies acted like a subsidy by reflecting farmers' valuation of dairy milk, which produced positive spill-over effects on member-farms. Regardless of whether we compare real profit and dairy farm income of member-farms to non-member farms, or overall technical efficiency and total factor productivity of members with non-members, we find unequivocal support that ASF intervention remarkably increased the outcomes for treated farms.

We present a variety of empirical results on the basis of survey data of dairy farms to probe the implications of ASF intervention on affected and unaffected farms. First, our results suggest that setting up milk collection network through dairy apex bodies relatively increased (a) real profit of member-farms by Rs.3800 per animal; (b) overall technical, pure technical and scale efficiency by 18.2%, 12.1% and 7.6%, respectively, and (c) dairy farm income by Rs.8249 per farm. Moreover, total factor productivity of member-farms increased by 20.5% compared with 4.6% decrease in productivity of non-members. Second, since employment generation and household labor supply decisions in dairy households are related to the size and scale of the farm, we do not expect program support to influence these attributes. As expected, we do not find relative increase in employment generation, and labor supply of men and women in the household. Finally, it appears too soon for the additional farm income after program support to have made significant difference in real expenditure or households assets of members compared with non-members. This contention is also supported by the empirical results.

Implementation of Good Agricultural Practices (GAP) in citrus production has critical significance in citrus export to European markets, but the market has failed to respond because of total disconnect between citrus growers, processors and exporters. ASF program support led to formation of PMOs while a matching grant to PMOs was used to fulfill GAP protocols mostly on PMO-member farms, which paved the way for the PMOs to attain GlobalGAP certification and, in turn, enabled the processors to access the high-value European markets. However, the evidence in this Chapter contemplates that PMOs may not be an efficient way of correcting market failure because they have failed to share the benefits of GlobalGAP certification project with PMO-farmer-members. The price being offered to PMO-farmer-members on their certified citrus produce does not reflect the farmers' valuation. Therefore, if the present trends continue, PMO gains may disappear next year when ASF project would be phased-out. At that point, there is a danger that the market is likely to fail again.

The empirical evidence based on the survey of citrus producers shows that the spill-over effects of GlobalGAP certification project were not reaching out to PMO-farmer-members. We find that the difference in per acre profit of PMO-farmer-members was statistically not different from non-members' profit. Similarly, we cannot escape the conclusion that relative overall technical, pure technical and scale efficiency of PMO-farmer-members was also not different from non-members. Likewise, TFP growth of PMO-farmer-members was also qualitatively similar with non-members. Finally, employment generation in the two types of farms was also statistically not different from each other.

7 Program Support and Market for BDS Providers

7.1 INTRODUCTION

Business development services (BDS) are a diverse range of activities that can help firms/farms improve performance by providing them training, marketing services, advisory services, technology development, business linkages, and information and communication services, among others. These services are designed to facilitate individual businesses rather than larger groups or sectors and may relate to (a) operational business services, which are often needed by the enterprises to run their day-to-day operations, or (b) strategic business services that are often needed to address medium- and long-term issues, especially those relating to performance enhancement, market access and the ability to effectively compete. These services may include designing of new products, help in setting-up new technologies and facilities, identification of service markets, etc. By their very nature, operational services may already exist because of the willingness of enterprises to pay for these services. However, market for strategic business services are the ones that have failed to develop obviously due to market failures.

BDS providers may be individuals, private sector consulting firms, NGOs, RSPs, industry associations, academic institutions, government agencies, small enterprises, and farmers, etc. In market economies such as Pakistan, most BDS services act like private goods where the rules of the market would normally apply.

ASF has acted as BDS facilitator in which capacity it has tried to promote BDS market development in the context of agribusinesses where strategic business services are almost non-existent. Due to obvious market failures, research and extension services have failed to respond to the needs of private sector agribusiness enterprises. ASF (2009) notes that "[t]hese supply-side constraints are exacerbated by a lack of demand on the part of agribusiness entperprises, which have yet to understand the benefits of BDS and have limited choice of competitively priced services geared to meeting their business development needs." ASF has facilitated BDS development by providing matching grant for purchase of "eligible services including technical, managerial, financial and marketing capacity building and related assistance" [ASF (2009)]. ASF has provided grant support to agribusiness enterprises and farmer groups to purchase BDS and to private sector BDS providers for capacity building and availability of BDS.

ASF attempts to facilitate BDS were geared toward both demand-side and supply-side interventions. Under demand-side intervention, ASF provided incentives through matching grant to agribusiness enterprises to provide awareness to farming communities (who lack knowledge and have perceived high risks) of the potential benefits so that they try these services to assess their benefits. The supply-side intervention involved technical training and capacity building of BDS providers.

In this chapter, we assess the performance of BDS providers in selected sectors where ASF has partnered with BDS providers as a facilitator. We focus on the institutional performance of the providers and evaluate market development of BDS in these sectors. Some important indicators of market development of BDS include real price and quality of the service offered, satisfaction level of the customers, repeat usage of the service and the extent to which BDS providers are reaching out to underserved areas. To this end, we conduct interviews with randomly selected BDS providers operating in selected cities to make judgment about the nature of the impact. Before we dwell on the survey evidence, we present theoretical underpinnings from economic theory on the likely impact of matching grant subsidies in the light of the prevailing market structure.

7.2 DO SUBSIDIES DISTORT OR CREATE MARKET FOR BDS?[14]

Economic theory tells us that, all else being constant, subsidies always distort markets. However, the extent of market distortion of subsidies depends upon some factors. For instance, matching-grant subsidies to enterprises often target market development of BDS. However, the impact of such interventions critically hinges on the prevailing market structure in respective BDS markets. Since cost sharing grants represent demand-side interventions, they are sometimes justified in market structures where target enterprises are constrained by lack of knowledge about potential gains associated with use of such services [see, for example, Hallberg (1999)]. But such interventions do not always produce desirable results. Whether these cost-sharing subsidies lead to market development of BDS or promote market distortion may critically depend on relative slopes of market demand and market supply curves. This is illustrated below by taking demand and supply of a hypothetical BDS.

Fig.7.1 and Fig.7.2 present two extreme cases of market development, and market distortion. Fig.7.1 suggests that when market supply of a service is perfectly elastic (i.e., horizontal supply curve), then cost-sharing grants may lead to market development by increasing the volume of BDS purchased, without increasing the price of service offered.

But, Fig.7.2 presents another extreme case where supply of BDS consultants is perfectly inelastic. In this market, cost-sharing grant raises the price charged by BDS Providers with no change in market penetration. Fig.2.3 illustrates a more moderate picture where supply curve is moderately elastic. In such cases, the impact of subsidy would be to increase the volume of service with some increase in consultants' fees.

One implication of this analysis is that if the supply of BDS providers is relatively inelastic in a BDS segment, the benefits of subsidy would mostly accrue to the consultants and only a small share of the subsidy would be transferred to the enterprise [see also Hallberg (1999)]. Such a market would be the one where BDS providers are not very well developed, and where service

[14] This section draws from Burki (2009).

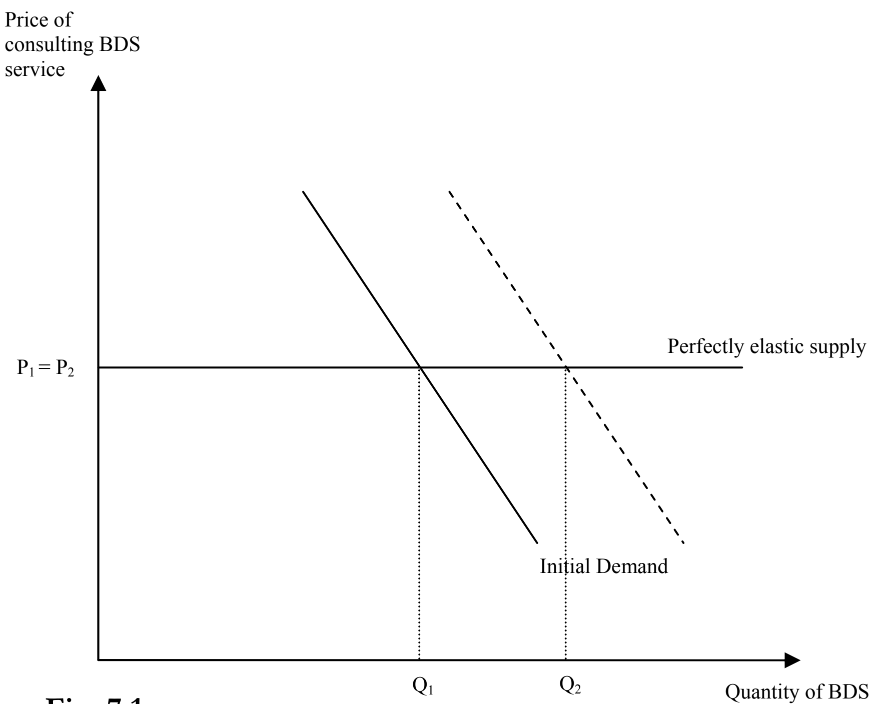


Fig. 7.1:
Maximum Market Penetration

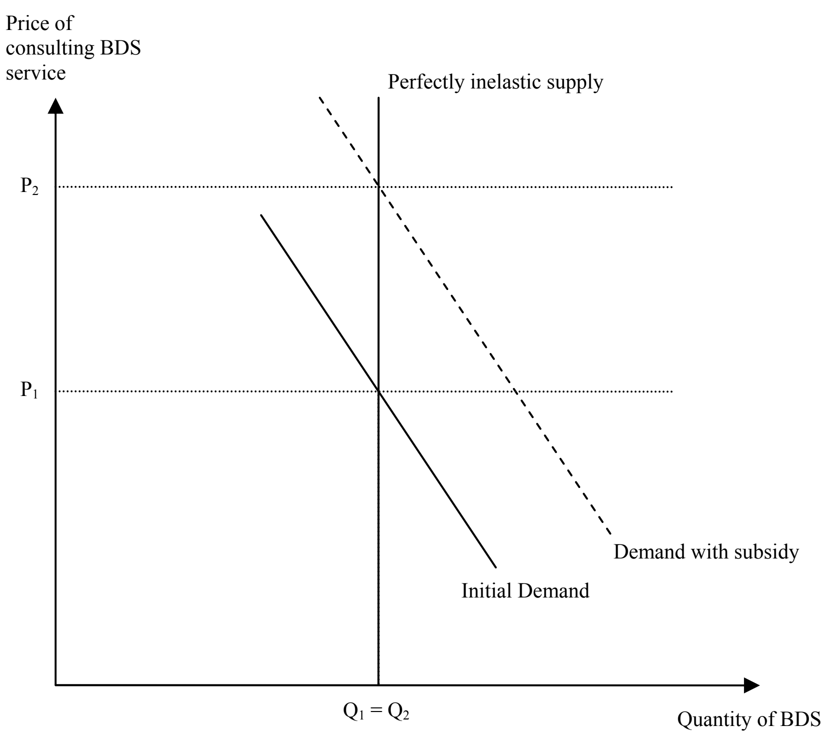


Fig. 7.2:
No Market Penetration

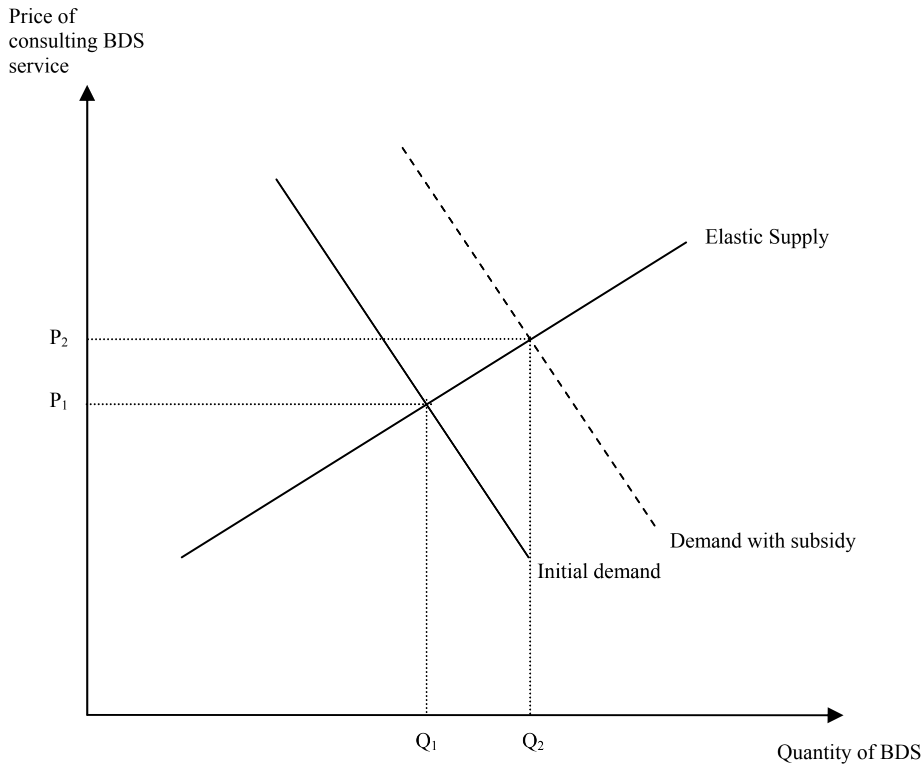


Fig. 7.3:
Moderate Level of Market Penetration

providers are limited in number. Such a market resembles an inelastic supply curve. Therefore, a justification for demand-side subsidy in the form of cost-sharing grant can only be made if such interventions indeed encourage market development. However, it goes without saying that such interventions are also justified in environments where market development is seriously constrained due to lack of knowledge or awareness about BDS, or where enterprise perceive high risk in using these services [Hallberg (1999)].

7.3 BDS PROVIDERS' SURVEY

We conducted a survey of BDS providers to get first-hand information on the state of BDS market in respective categories. While a wide range of activities are being offered by BDS providers, we select four broad categories of BDS in which ASF was actively involved as a facilitator. For the sake of data collection, we randomly selected 56 BDS providers from the list of service providers obtained from ASF. They were contacted for telephonic interviews in the month of August and September 2009. The interviews were conducted on the basis of structured questions. The coverage of the survey of BDS providers was restricted to only those clusters that were included in the survey of BDS customers, namely FEGs and Agribusinesses. Four broad clusters included for the survey are: (1) tunnel farming of off-season vegetables; (2) floriculture farms; (3) dairy farming; and (4) dehydration units. The survey covered major cities Karachi, Lahore, Faisalabad, Multan, Rawalpindi/Islamabad, Sialkot, Sheikhupura, Sahiwal, Sargodha, Peshawar, Quetta, Hyderabad and smaller cities/towns of Rawalakot, Pishin, Ziarat, Sanghar, Narowal, Bajour Agency, Kurram Agency, Gilgit and Lower Dir. The random selection of the providers ensures elimination of selection or attrition bias due to regional fixed factors. Sample distribution by BDS providers is presented in Table 7.1.

Table 7.1. Sample distribution of BDS providers

Sector	Full sample
Tunnel farming	24
Dehydration units for fruits and vegetables	9
Floriculture	12
Dairy farming	11
Total	56

7.4 EVIDENCE FROM THE SURVEY OF BDS PROVIDERS

It is important to note that we are reviewing BDS market as a whole because it is not possible to separate the effect of ASF intervention from other developments taking place.

A. Market for BDS Providers in Tunnel Farming[15]

We interviewed individuals, private for-profit firms, NGOs, academia and farmers to gather information about capacity building by ASF, the nature and extent of BDS provided and real price and quality of service in the tunnel farming sector. Apart from several other organizations, ASF also provided capacity building support to agricultural professionals, individual farmers, and BDS providers by arranging training programs on tunnel farming in collaboration with the University of Agriculture, Faisalabad and University of Arid Agriculture, Rawalpindi.

[15] Tunnel farming projects are mainly concentrated in Chitral, Baltistan, Gilgit, Swat, Upper Dir, Pind Dadan Khan, AJK, Sheikhupura, Nankana Sahib, Faisalabad, Kasur, Umer Kot, Nawab Shah, Larkana, Charsadda, Nowshehra, Haripur, Mansehra, Pishin and Ziarat. These projects were undertaken in collaboration with Sarhad Rural Support Program, Sindh Rural Support Program, Agha Khan Rural Support Program (AKRSP), LASOONA, National Rural Support Program (NRSP), Rural Community Development Society (RCDS), and Taraqee Foundation. Popular vegetables grown in tunnels are cucumbers, chilies, tomatoes, sweet pepper, and squash. The advantage of tunnel farming is not just that off-season vegetables can be grown, but also that productivity is also higher when crops are grown in tunnels.

Most people interviewed during the survey had seen the advertisements of ASF training on tunnel farming. Those who received training had mixed background including potential tunnel farmers, trainers, BDS providers and academics interested in offering courses and providing consulting services. Among those interviewed, Sitara Chemicals, AgriCon and Greenhouse Technologies had the objective to increase capacity by enhancing knowledge on modern farming practices and to offer high quality services to clients. Agricon had also developed a training module for farmers. Sitara Chemical provides technical support to farmers all over the country. It arranges full day information sessions for farmers to attract clients. Consulting services are also being offered by rural NGOs to farmers on commercial basis. Some faculty members and graduates of leading agricultural universities are also providing training and consulting services to farmers while some government institutions also organize training programs on tunnel farming, e.g., Ayub Agricultural Research Station.

These trends suggest that BDS providers consisting of agricultural professionals, NGOs, farmers, and private for-profit firms have already made significant inroads in BDS market for tunnel farming by developing relationships with farmers willing to pay for the services of the providers. The survey evidence suggests that the providers are not driven by subsidies, but they appear more business-like by being competitive.

Thus tunnel farming cluster faces a fairly competitive supply of consultants to cater to the mainstream activities in most parts of Pakistan. The developments in this segment have increased the volume of consulting services. Fig.7.4 depicts an overall picture in this market segment showing that market development has outweighed market distortion effects. Increase in market demand for the services has outweighed the supply thereby increasing real price of BDS consulting. Since farmers are willing to pay for the service and more BDS providers are entering into the market place, this leads us to conclude that ASF intervention in this sector is largely successful to correct market failure.

The evidence further suggests that as demand for these services increased, the service providers in this segment experienced marked periods of diversification in other related activities by providing a mix of consulting services. In the process, some professionals and farmers have also extended these services to many underserved areas thereby increasing market penetration. However, it goes without saying that farmers in southern Punjab and some parts of interior Sindh and NWFP are still unaware of the potentials of tunnel farming. Extension of BDS in these underserved areas is an obstacle that is hampering complete diffusion of this technology.

There are some policy implications for ASF from the survey evidence. First, ASF may want to support BDS providers who want to extend their services to underserved areas of all the four provinces, AJK and FATA regions. Second, ASF may want to extend its support to those segments where due to lack of awareness, farmers' willingness to pay for the service is less, or where farmers' perceived risks are still high. Extension of program support to these activities would encourage farmers to try these services and raise demand through demonstration effect. Finally, ASF program support must be phased-out from services and regions where farmers are willing to pay for the services and BDS providers are catering to the increased demand. In well-functioning demand and supply sides, market forces would catalyze future growth in this segment.

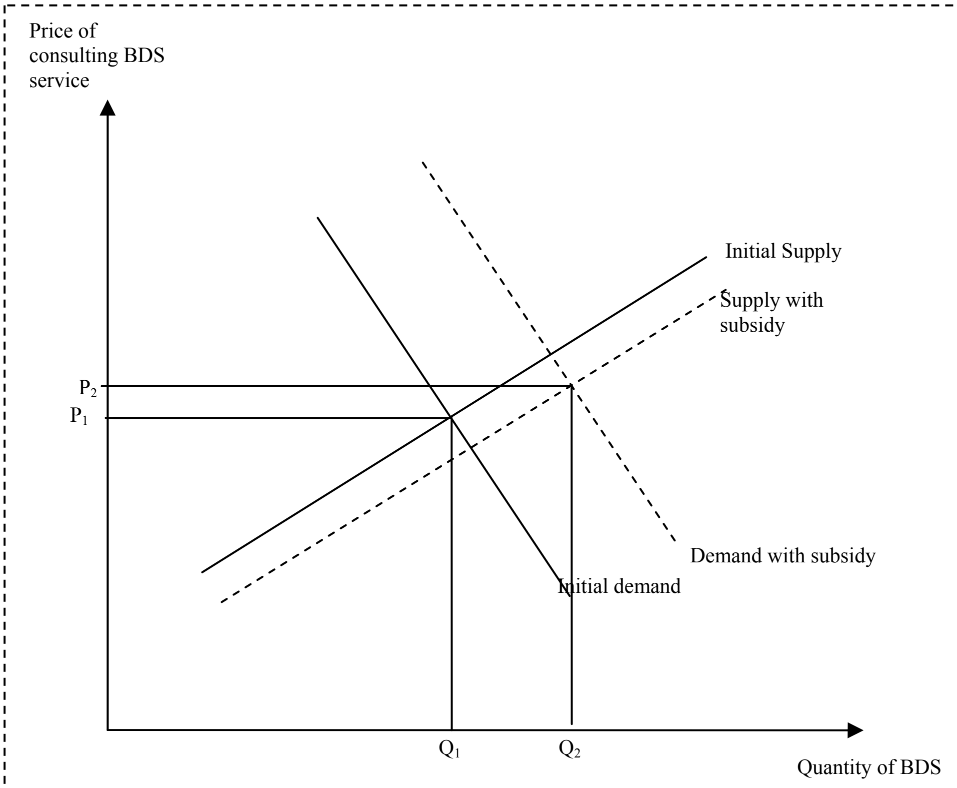


Fig. 7.4:
Market penetration in tunnel farming, dairy and floriculture sectors

B. Market for BDS in Floriculture Farming

Recently, Quetta, Kalat and Pishin Districts of the Balochistan province have made major inroads in capturing market for off-season flowers. In parts of Punjab and Sindh, flowers are usually planted in September for domestic sale in November and December. However, floriculture business is prospering in Balochistan and AJK due to suitable climate for off-season flowers planted in March for sale in June to October. Flowers grown in Balochistan and AJK are marketed in big cities like Karachi, Lahore, Islamabad and Quetta. Some large companies are also fetching high prices by exporting flowers to Dubai.

Due to capacity building of farmers and exporters by ASF and others, farmers have diversified from traditional focus on production of grapes, apples and stone fruits, among others, to growing flowers like gladiolus, Mary gold and roses. There are about 30 cut flower farms in Quetta, and about 45 farms in surrounding districts of Kalat and Pishin. With remarkable success in a short time, some of the farmers in Balochistan are contemplating setting up farms near Lahore and Karachi for easier access to market.

ASF has provided matching grant support to FEGs, especially to farmers in Pishin District along with BDS support provided by Taraqee Foundation, Quetta. Balochistan Horticulture Society is playing a significant role in promotion of horticulture activities by providing technical support and information. One BDS consulting firm known as AgroShell Pvt. Ltd is actively providing technical support to local farmers. Large farmers in floriculture business are also helping about three to four farmers per month to start floriculture farms. They are also helping them with marketing of flowers in other cities.

The survey evidence shows that a broad range of service providers are involved in training and in providing consulting services to local farmers. This is not just driven by the matching grant subsidy of ASF to FEGs, but also by the additional demand autonomously created due to high returns. To fetch high returns, farmers are willing to pay for technical support to service providers. Even though the number of BDS firms possessing requisite skills is limited, trained workers of NGOs as well as a large number of experienced farmers are helping out local farmers to adopt new technology. Hence the evidence from the survey is that supply and demand are moderately elastic. As shown in Fig.7.4, shift in demand for BDS was accompanied by a moderate shift in supply. Real price of BDS in floriculture has slightly increased in FY2009, compared with FY2007, but there has been remarkable increase in market development. Just like tunnel farming, the evidence that farmers are willing to pay for BDS and the providers are also there strongly suggests that interventions in this sector has also succeeded in correcting the problem of market failure. However, the quality of BDS being offered in floriculture sector is below acceptable standards. If agribusinesses in this sector are eying competitive export to developed countries, then they must possess state-of-the-art technology for production, processing and export, which remains a far cry.

ASF may want to continue its program support to this sector by focusing on quality aspects alone. First, ASF support must be phased-out from those segments where there is successful market development without much price distortion. Second, subsidies need to be targeted to specific market failures. ASF must begin with a good understanding of the structure and performance of BDS market in floriculture sector. A lack of reliable data on the nature of demand and supply in this sector may be a constraint to make more informed policy. Published statistics in this and other services sectors is non-existent, which may warrant internal data gathering to find out the size and quality of the service being provided. Finally, ASF may want to arrange train-the-trainer program to upgrade the existing technical skills of the BDS providers to meet international quality standards so that high-value export markets may be tapped.

C. BDS Market in the Dairy Sector

Dairy sub-sector is one of the most important sectors of Pakistan's economy. In terms of market value, the contribution of milk to GDP is more than any single major crop. While Pakistan is the fourth largest producer of milk in the world, dairy production in Pakistan is marred by low productivity. Therefore, diffusion of BDS has key significance in the dairy sector.

Dairy Development Company, which is a public-private partnership company set up by the Government of Pakistan, is an important BDS provider of dairy sector extension services. It provides technical support to farmers all over the country. It is maintaining a work fore of more than 100 farm production advisors who are spread all over Pakistan to provide technical services to dairy farmers and also arrange monthly discussion sessions, field days and training workshops for farmers. In 2005, Dairy Development Company initiated model farm program and has the target to set-up 1000 model farms in different parts of Pakistan. The hallmark of the model farms concept is that it promotes modern dairy practices.

A number of other initiatives at the level of the government and private sector level are also actively pursuing modernization of the dairy sector by extending extension services to end producers. In this regard, Altaf and Co. is also actively providing training and support services to dairy farmers including help in cattle breeding, calf raising and increasing milk yield. It also provides consulting services to dairy farms to improve their dairy management skills. It has opened 10 branches all over Pakistan, which are providing services to more than 200 farmers every month.

Few private for-profit companies are also active in the field of genetics, but they are struggling due to low clientele. Livestock and Dairy Sialkot has established a state of the art buffalo farm to promote local buffalo breeds, which are believed to be as productive as imported buffalos. Their aim is to assist farmers by training them in better dairy practices.

Milk processing companies are also playing an important role in providing extension services to the farmers. In this regard, Nestle Pakistan and Halla Cooperatives are two leading examples, which provide a variety of extension services to dairy farms including assistance to improve animal productivity, herd management, breeding, vaccination, silage making, shed development, etc. In September 2006, Nestle and Engro Foods in collaboration with UNDP, implemented a development project meant to benefit Lady Livestock Workers in Punjab. Since livestock management is mostly in the hands of women, this work force visits dairy farms and meets dairy women to empower them by providing training in raising milk yields, animal husbandry, better hygiene and understanding of the milk collection networks of the processing industry. Nestle Pakistan has also made arrangements with Agricultural Development Bank of Pakistan to provide farmers easy access to loans. Likewise, Halla Milk also provides a wise variety of services to its 26000 strong members based in Punjab. In addition, few multinational companies, e.g., Kargil and Pioneer, whose main business is to market maize, are actively involved in training the farmers in silage making.[16]

The above evidence suggests that due to interventions of industry players, dairy sector BDS market is quite well developed. The services being offered to dairy producers are more business-like. Due to commercialization of rural milk market, farmers realize the need to be competitive. For the same reason they are willing to pay for the BDS services. Due to abundance of BDS service providers, this sector faces a fairly competitive supply and demand. Therefore, we have enough evidence to suggest that this sector has also faced market development for BDS over the last more than 5-years. If at all there is a role for ASF as BDS facilitator, it is just marginal in nature. The training programs offered by ASF in dairy management made positive impact, but ASF cannot hope to claim to have made a major contribution in the development of BDS in this sector. Fig.7.4 illustrates the interaction of demand and supply for BDS in the dairy sector. Indeed market development in this sector outweighed market distortion, but the contributions made by other major players carry major weight.

[16] Silage is animal feed made by storing green plant material in a silo where it is preserved by partial fermentation. This is a highly nutritious and cheap alternative to green fodder in lean months, especially in summer when green fodder is in short supply in the market.

ASF model of creating apex bodies for collection, chilling and marketing of milk appears to be a roaring success due to its spill-over effects on smallholder dairy producers. However, there are important implications for ASF to consider. First, matching grant support to encourage purchase of chillers is far from satisfactory because most apex bodies are not using chillers due to (a) high cost of electricity; and (b) prolonged periods of load shedding. But, the idea of apex bodies has a powerful appeal due to its welfare implications on small dairy farmers. It offers a welfare enhancing alternative to the prevailing milk supply chain models of milk processing industry. In comparison with the network of traditional milk collector (*dodhi*), apex bodies are indeed successful in correcting the market failure. Second, ASF may want to continue to support dairy segment (minus chillers) by replicating dairy apex body model to other milk clusters where milk processing industry is shying away. Finally, ASF may want to phase-out of the training business in the dairy sector because there are no signs of market failure in the BDS market for dairy development.

D. BDS Market for Dehydration of Fruits and Vegetables

Dry fruits like apricot are abundantly produced in the Northern Areas, e.g., Gilgit-Baltistan region. Apricots dried with traditional methods have very little shelf life. In the traditional method, apricots were dried in the open air under the sunlight, which not only distorted the appearance but also resulted in highly contaminated produce of dried apricots. ASF provided matching grant support to FEGs to correct the obvious market failure that was resulting from the absence of modern technology.

The new technology for dehydration was introduced to dry apricots in Apricot Drying Tunnels. Adoption of the new technology was expected to increase value of the produce due to better drying techniques, reduce wastage, better appearance and reduction in the chances of contamination. Implementation of new drying methods resulted in more value addition and increased demand for export where it fetched 150% more price than the traditional method.

A similar initiative was to set up glass house solar dehydration units with ASF matching grant support in Sindh, e.g., Nawab Shah, Umerkot , Larkana, Sangher, Matyari and Kunri. These dehydration units were set up to dry chilies abundantly grown there. Traditional drying methods and poor harvesting practices were leading to contamination, loss in appearance of the product, and low price in the international market. Chilies dried in solar dehydration units result in value added product that fetches a good price in the international market. Technical support and training for drying of vegetables and chilies in these dehydration units is being provided by faculty members of some universities of Sindh.

In Gilgit-Baltistan, competition is limited due to very small size of the market. There are only two companies operating on a large scale. However, small local farmers are plentiful and are providing sufficient competition. The survey of BDS providers suggests that increased awareness about the advantages of using tunnels for drying fruits and vegetables has increased demand for consultancy and technical support in this sector of the economy. Demand for BDS has also increased because

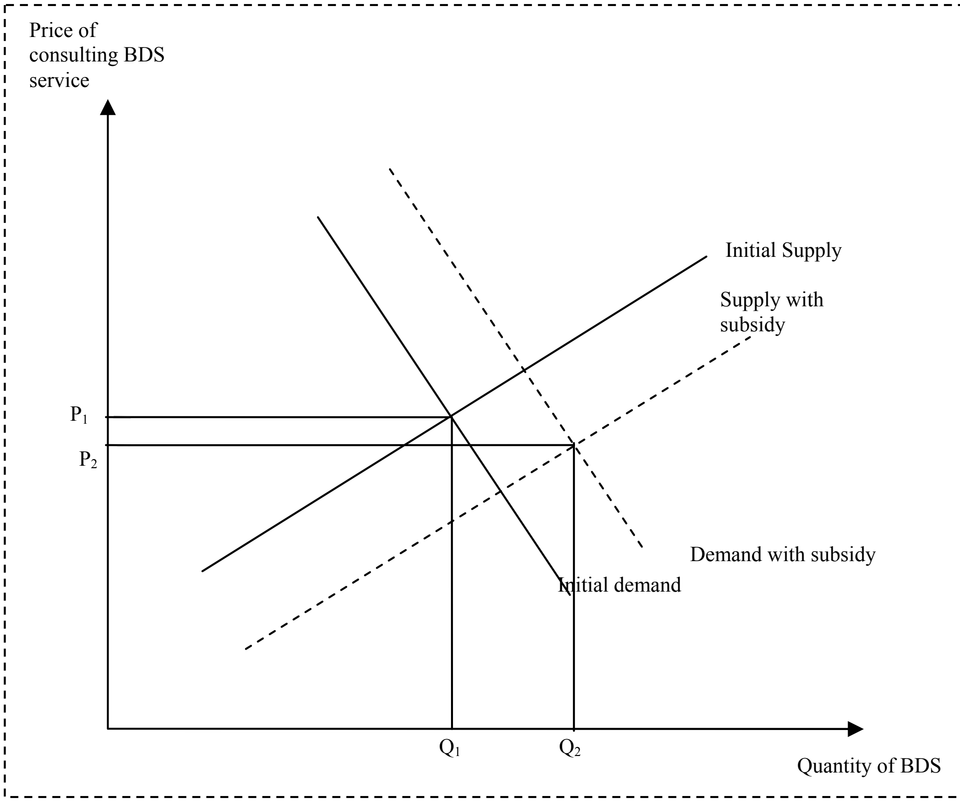


Fig. 7.5:
Market penetration in dehydration sector

of increasing export standards; farmers now want to produce a better quality product that fetches a good price in the international market. Fig.7.5 shows that these factors along with ASF matching grant support that subsidizes consultancy costs, led to shift of the demand curve for BDS to the right.

The evidence also shows that real price of consultancy in the dehydrating sector have decreased in the last two years. Unlike other sectors, supply curve in this case has shifted more than the demand curve. Seeing the increase in the demand for consultancy for dehydrating units, many small players have entered the market resulting in increased competition and reduced prices for BDS services. The motivation to large farmers to train small farmers in apricot drying techniques is to buy dried apricots from them for export to developed countries, especially USA.

ASF subsidy may have proved beneficial for farmers involved in the dehydration of fruits and vegetables. But, this support is limited to apricot drying in northern areas and drying of chilies in some areas of Sindh. It is important that ASF extends this service to other parts of the country where fruits and vegetables are dried so that they also benefit by improved drying methods.

7.5 CONCLUSIONS

All else being equal, subsidies always distort market. However, the extent of market distortion is essentially determined by the structure of each market and the nature of program support. ASF program support was aimed at promoting BDS market development in some selected sectors and especially those where business services were non-existent. In these sectors, research and extension services had failed to respond to the needs of private sector agribusiness enterprises. ASF program support acted both on the demand-side by providing matching grant support to farmer groups and agribusinesses, and on the supply-side by capacity building of BDS providers. Based on the survey of BDS providers, we find that ASF intervention in tunnel farming, floriculture and dairy farming has been successful. Increase in market demand for the services has outweighed the supply thereby slightly increasing real price of BDS consulting. Since farmers are willing to pay for the services and more BDS providers are entering into the market place, this leads us to conclude that ASF interventions in these sectors has been successful in correcting market failure.

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Appendix Tables

Table A1. Difference-in-differences of non-land asset holding

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):								
Household ownership of real non-land assets (Rs.in '000)	122.57	149.83	91.56	88.50	155.24	218.86	109.46	119.05
Sample size	327	--	69	--	66	--	330	--
Post-treatment (FY2009):								
Household ownership of real non-land assets (Rs.in '000)	133.89	160.02	94.02	74.92	163.92	239.51	119.43	122.83
Sample size	327	--	69	--	66	--	330	--
Difference-in-differences:								
Household ownership of real non-land assets (Rs.)	8860	--	--	--	-1290	--	--	--

Table A2. Regressions of the effects of program support on non-land asset holding

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(4)	(5)	(8)
Intercept	112864***	67763***	125844***	76303***
	(4.55)	(2.56)	(5.12)	(2.99)
Post-intervention (yes=1, no=0)	-848	-968	5527	5559
	(-0.06)	(-0.07)	(0.65)	(0.66)
Treatment group (yes=1, no=0)	27566**	26851**	47758**	48605**
	(2.22)	(2.15)	(1.98)	(1.98)
Post × treatment	7779	--	-1663	--
	(0.45)		(-0.04)	
Post × treat × tunnel farms	--	6404	--	65235
		(0.28)		(0.83)
Post × treat × dehydration farms	--	-1131	--	-56630**
		(-0.05)		(-2.16)
Post × treat × horticulture farms	--	19347	--	-10804
		(1.15)		(-0.28)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.134	0.144	0.141	0.161
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

Table A3. Difference-in-differences of household labor supply

	Definition 1: FEG Members taken as treatment				**Definition 2:** FEG Group Leaders taken as treatment			
	Treatment		Control		Treatment		Control	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Pre-treatment period (FY2007):								
Labor supply of men	23.67	12.61	22.37	11.87	23.04	12.99	23.53	12.40
Labor supply of women	12.43	6.33	11.04	5.90	11.97	9.94	12.23	6.14
Sample size	327	--	69	--	65	--	331	--
Post-treatment (FY2009):								
Labor supply of men	27.33	16.18	25.64	14.66	26.61	16.40	27.12	15.85
Labor supply of women	14.82	7.67	13.22	6.89	14.43	8.63	14.56	7.35
Sample size	327	--	69	--	65	--	331	--
Difference-in-differences:								
Labor supply of men	0.39	--	--	--	1.78	--	--	--
Labor supply of women	0.21	--	--	--	0.13	--	--	--

Table A4. Regressions on the effects of program support on labor supply of men

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	14.00***	15.156***	14.87***	14.72***
	(7.21)	(7.71)	(9.40)	(9.34)
Post-intervention (yes=1, no=0)	3.31*	3.31*	3.59***	3.57***
	(1.79)	(1.81)	(4.22)	(4.22)
Treatment group (yes=1, no=0)	1.14	1.08	0.004	0.017
	(0.79)	(0.76)	(0.003)	(0.01)
Post × treatment	0.339	--	1.71	--
	(0.17)		(0.07)	
Post × treat × tunnel farms	--	-2.11	--	-2.08
		(-0.95)		(-0.74)
Post × treat × dehydration farms	--	-1.27	--	-2.92
		(-0.55)		(-1.06)
Post × treat × horticulture farms	--	5.53**	--	7.11**
		(2.51)		(2.27)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.444	0.457	0.443	0.449
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

Table A5. Regressions on the effects of program support on labor supply of women

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	11.66***	12.33***	12.40***	12.41***
	(11.50)	(11.97)	(15.00)	(15.04)
Post-intervention (yes=1, no=0)	2.27**	2.27**	2.42***	2.41***
	(2.35)	(2.37)	(5.46)	(5.46)
Treatment group (yes=1, no=0)	1.10	1.15	0.573	0.580
	(1.46)	(1.42)	(0.74)	(0.75)
Post × treatment	0.224	--	0.125	--
	(0.21)		(0.11)	
Post × treat × tunnel farms	--	-1.25	--	-2.17
		(-1.07)		(-1.48)
Post × treat × dehydration farms	--	0.326	--	0.252
		(0.27)		(0.17)
Post × treat × horticulture farms	--	2.20*	--	3.05*
		(1.79)		(1.86)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.365	0.375	0.362	0.368
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

Table A6. Regressions on the effects of program support on child labor of boys

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	-1.15**	-1.08**	-1.09**	1.03**
	(-2.27)	(-2.02)	(2.45)	(2.33)
Post-intervention (yes=1, no=0)	0.326	0.326	0.438**	0.437**
	(0.77)	(0.77)	(2.29)	(2.29)
Treatment group (yes=1, no=0)	0.269	0.263	0.846	0.844
	(1.03)	(1.01)	(1.28)	(1.29)
Post × treatment	0.149	--	0.037	--
	(0.31)		(0.04)	
Post × treat × tunnel farms	--	-0.020	--	0.844
		(-0.03)		(1.28)
Post × treat × dehydration farms	--	0.375	--	1.22
		(0.56)		(0.69)
Post × treat × horticulture farms	--	0.147	--	-0.163
		(0.33)		(-0.27)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.163	0.164	0.170	0.177
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

Table A7. Regressions on the effects of program support on child labor of girls

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	0.043	0.06	-0.20	-0.18
	(0.08)	(0.11)	(-0.49)	(-0.44)
Post-intervention (yes=1, no=0)	0.430	0.440	0.411**	0.409**
	(0.88)	(0.88)	(2.00)	(1.99)
Treatment group (yes=1, no=0)	-0.155	-0.156	0.731	0.733
	(0.43)	(-0.43)	(1.12)	(1.13)
Post × treatment	-0.045	--	-0.118	--
	(-0.08)		(-0.13)	
Post × treat × tunnel farms	--	-0.088	--	-0.933
		(-0.14)		(-1.06)
Post × treat × dehydration farms	--	0.115	--	0.40
		(0.16)		(0.620
Post × treat × horticulture farms	--	-0.154	--	0.482
		(-0.29)		(0.85)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.264	0.265	0.268	0.269
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.

Table A8. Regressions on the effects of program support on frequency of meat consumption

	Definition 1: FEG Members taken as treatment		**Definition 2:** FEG Group Leaders taken as treatment	
	(1)	(2)	(3)	(4)
Intercept	2.27***	2.22***	2.27***	2.22***
	(5.12)	(5.00)	(6.87)	(6.63)
Post-intervention (yes=1, no=0)	0.54	0.54	0.745***	0.740***
	(1.01)	(1.00)	(3.26)	(3.25)
Treatment group (yes=1, no=0)	0.309	0.313	1.41***	1.42***
	(0.71)	(0.72)	(3.02)	(3.02)
Post × treatment	0.196	--	-0.296	--
	(0.33)		(-0.43)	
Post × treat × tunnel farms	--	0.347	--	-1.07
		(0.59)		(-1.49)
Post × treat × dehydration farms	--	-0.349	--	-1.23
		(-0.54)		(-1.51)
Post × treat × horticulture farms	--	0.566	--	2.00
		(0.79)		(1.62)
Controls for farm	Yes	Yes	Yes	Yes
Controls for household	Yes	Yes	Yes	Yes
Controls for sectors	Yes	Yes	Yes	Yes
Controls for district	Yes	Yes	Yes	Yes
R^2	0.540	0.542	0.549	0.556
Sample size	792	792	792	792

Notes: *, ** and *** indicate statistically significant at the 90%, 95% and 99% confidence level, respectively. All models are estimated with Ordinary Least Squares. The robust *t*-values in parentheses are corrected for both heteroskedasticity and autocorrelation within pooled cross-section units. Four farm-level control variables are farm owner's completed years of schooling; farm owner's years of management experience; and number of farm owners. Household controls are share of boys in the household and share of girls in the household. Controls for sectors include dummy variables for three sectors, viz., tunnel farms; dehydration farms; and horticulture farms while controls for districts refer to dummy variables for each district included in the survey.