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MILLENNIUM CHALLENGE CORPORATION
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# Evaluation de l'impact et des performances de l'activité de réhabilitation et d'intensification des plantations d'oliviers en zones pluviales du MCA-Maroc.

RAPPORT FINAL 2013

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# Authors and Acknowledgements

This report was produced by NORC at the University of Chicago for the Agency of Partnership for Progress (APP/MCA-Morocco) in accordance with the ME-2 contract. This report presents the results of the impact assessment and performance evaluation of the olive tree orchard rehabilitation and intensification in rain-fed areas activity of MCA-Morocco. The primary authors of the report are Benjamin Linkow, Sarah Hughes, Mawadda Damon, Yvonne Cao, Carlos Echeverria-Estrada, and Aaron Wilson. George Caldwell was the main author of the evaluation design. Other collaborators who contributed either to the content of this report or to the evaluation design include Abdou Ammor, Majid Benabdellah, Najib Benjelloun, Abderrahim Bentaibi, and Mohammed Dehhaoui.

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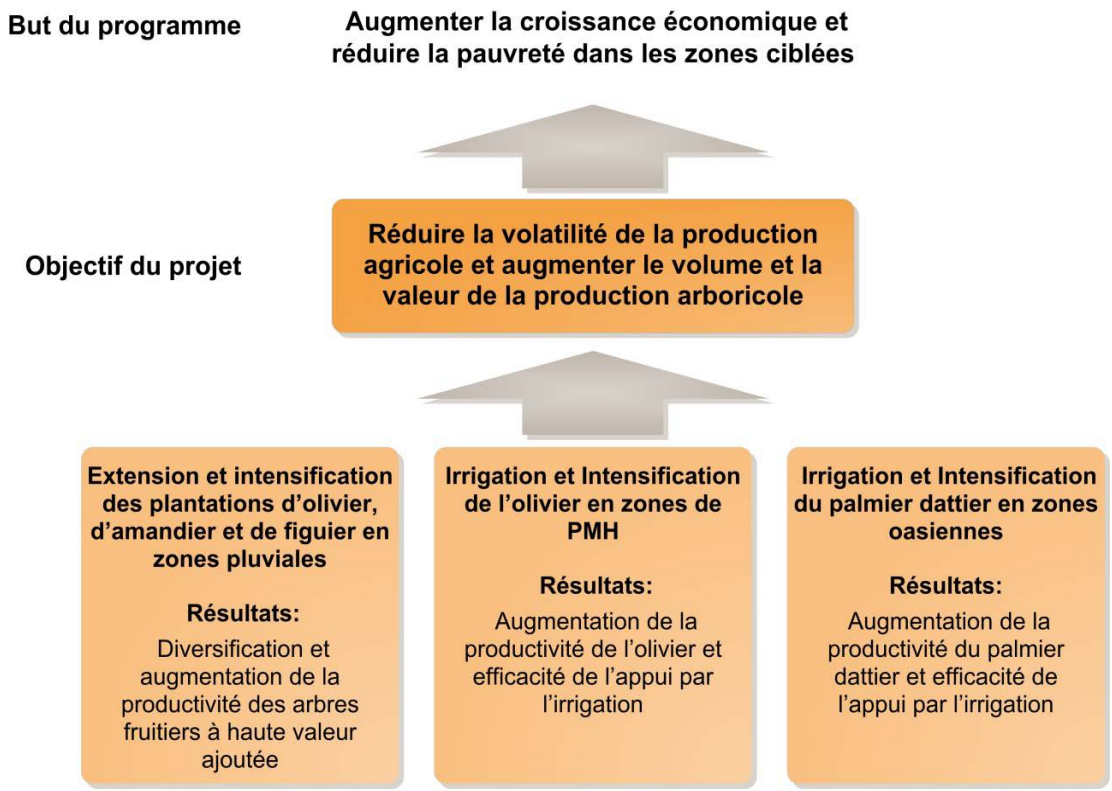
All errors are the authors' own. For any comments or questions, please contact Sarah Hughes, NORC at the University of Chicago, at the email address: hughes-sarah@norc.org.

# Summary

A primary objective of the Agency of Partnership for Progress (APP), which was in charge of managing the MCA-Morocco Compact signed in 2007 with the Millenium Challenge Corporation of the United States, is to rigorously assess the impacts of the programs and activities implemented. The Fruit Tree Productivity Project [FTPP] is one of the APP's major projects and includes (1) intensification and expansion of olive, almond, and fig tree orchards in rain-fed areas, (2) irrigation and intensification of olive trees in PMH [small- and medium-sized irrigated] areas, and (3) irrigation and intensification of date trees in oasis areas. The APP commissioned an impact assessment and performance evaluation for one of the FTPP sub-activities, the Olive, Almond, and Fig Tree Orchard Rehabilitation sub-activity, implemented under the TC-5A contract. This report presents the final results of this evaluation.

**Figure 1:** Fruit Tree Productivity Project



# I. Description of the Rehabilitation Activity

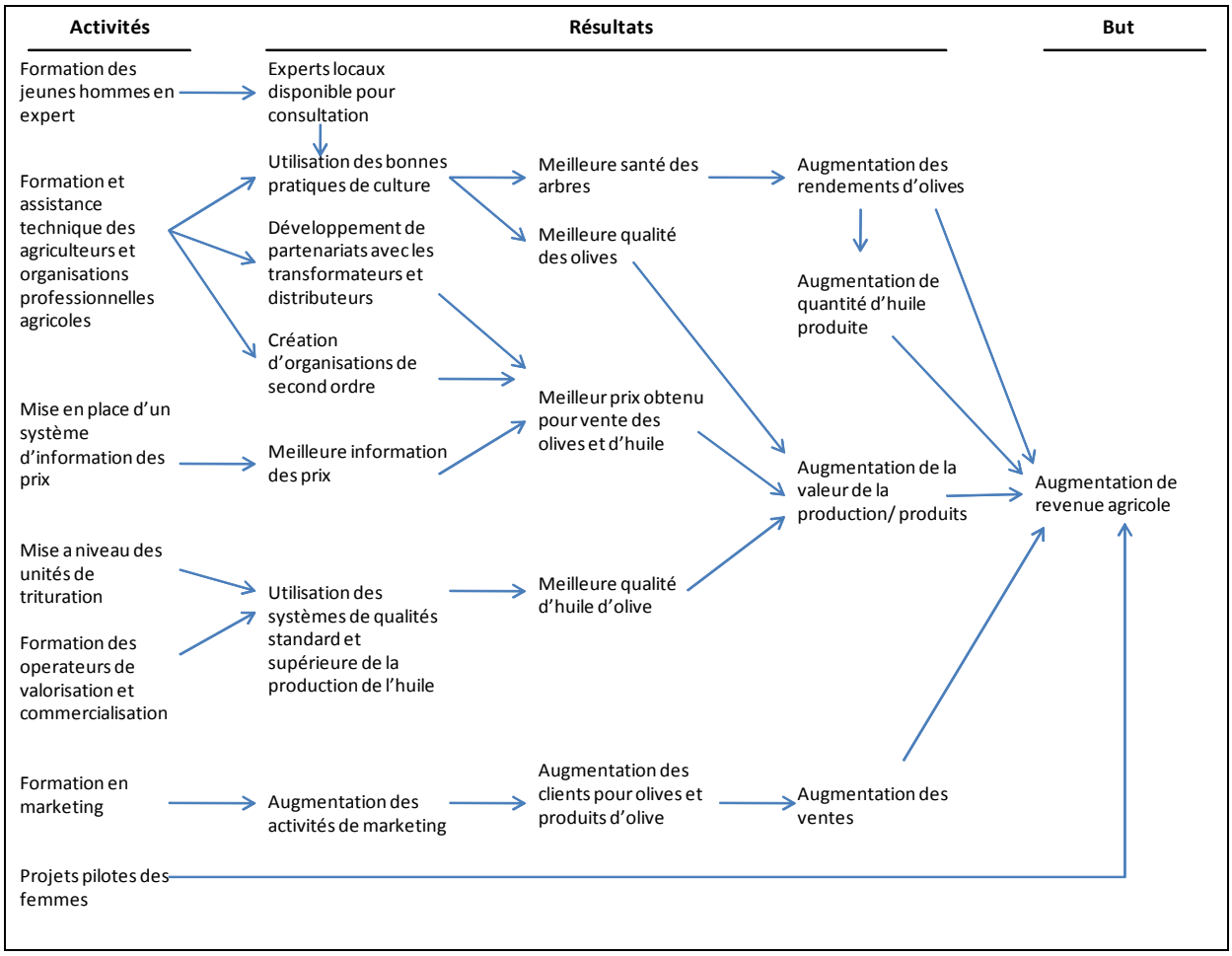
To stimulate growth in the agricultural sector, the APP implemented the Fruit Tree Productivity Project (FTPP), the interventions of which are aimed at creating the conditions necessary for increasing the productivity and competitiveness of the fruit tree sectors and thus contributing to improved [economic] growth and poverty reduction in the provinces involved. They are also aimed at inducing profound transformation in the current production systems dominated by cereal farming so as to move from a traditional agriculture, which is vulnerable to variable weather conditions, to a more productive, competitive, sustainable agriculture that is integrated into national and international markets.

The rehabilitation activity ("intervention") implemented by the TC-5A contractor targeted three major populations: farmers (olive, almond, and fig tree growers), professional agricultural organizations (PAOs), and processing units (PUs) in the Fès-Boulemane, Marrakech-Tensift-El Haouz, Meknes-Tafilalet, Tadla-Azilal, Tanger-Tetouan, and Taza-Al Hoceima-Taounate regions. The intervention consisted mainly of technical assistance activities: training and mentoring/oversight of these three populations.

Farmers were trained in the best production and harvesting techniques with a view to increasing yields and improving the quality of their production. PAOs were also an essential component of the intervention, because they were supposed to play a key role in organizing farmers for a more effective implementation of the intervention. In fact, creation of a PAO was a prerequisite for farmers operating in the perimeters to be able to benefit from the intervention. The objective of the intervention was to strengthen the capacities of the PAOs and to encourage them to develop in order to provide farmers with greater negotiating and selling power. Finally, because a better-quality olive oil is a key goal, the intervention provided for supervising the upgrading of a certain number of processing units, especially so they would comply with Law 28-07 on sanitary food safety and environmental protection, and setting up standard quality systems in some units and superior quality systems in others in order to ultimately obtain a better quality oil.

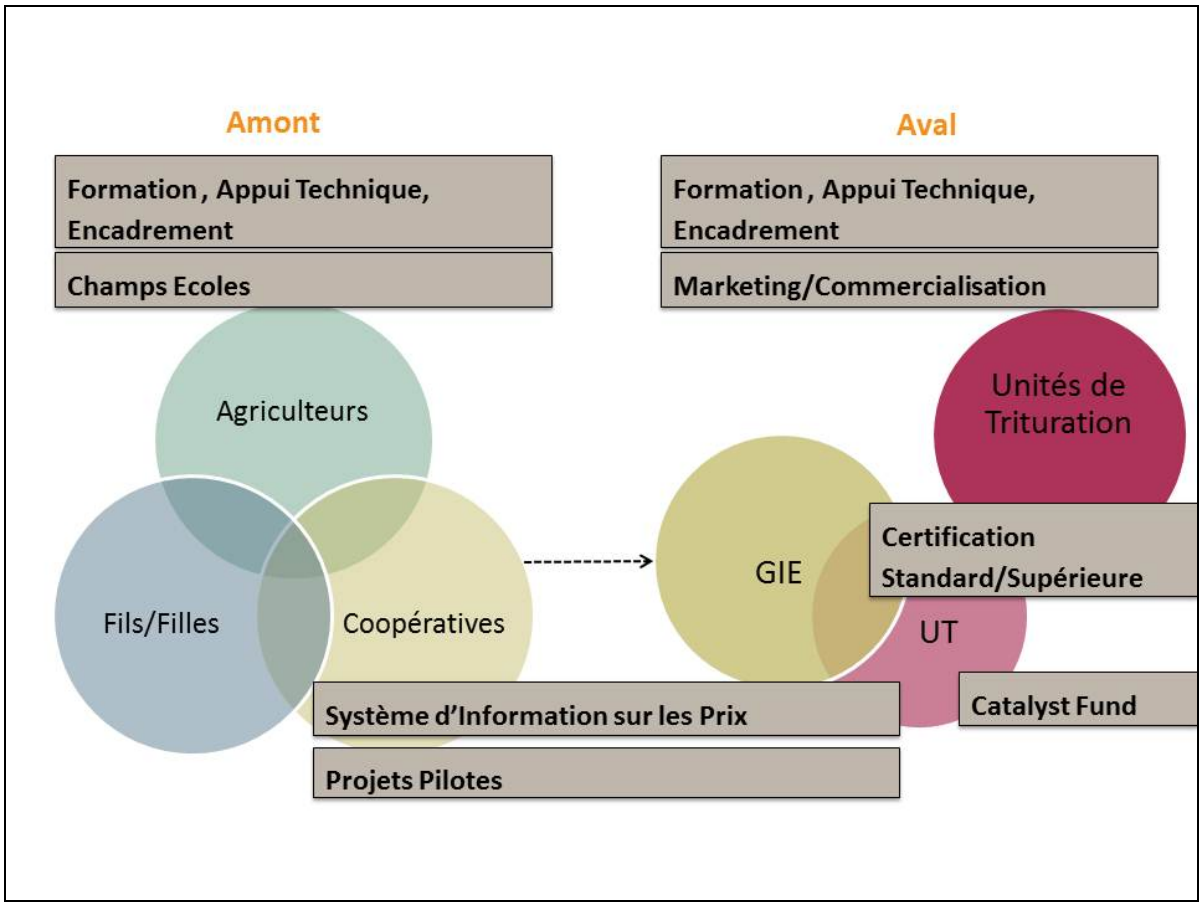
The performance evaluation covers the TC-5A contract in its entirety, whereas the impact assessment focuses specifically on the rehabilitation of olive tree orchards in rain-fed areas sub-activity, for which reason the theory of change used in this intervention model is the following: the training of farmers in improved olive production and processing techniques will lead to increased volume and value of their olive and olive oil production, the effect of which will be an increase in income from these activities and an increase all of their agricultural income. The logic of the intervention at the start of the activity is outlined in Figure 2.

## Figure 2: Intervention Logic




A few changes in the intervention were made during the initial project implementation phase. In 2011, emphasis was placed on the creation of cooperatives rather than associations. Cooperatives are more formal structures that have additional certification criteria and more opportunities for development, including carrying out for-profit activities. Additionally, some cooperatives were also grouped into second-order professional organizations (SOPOs) called Economic Interest Groups (EIGs), which can request funding from the Catalyst Fund, a component that was added to the intervention in 2011, in order to create their own processing unit. The intervention also oversaw the creation of new EIGs. Without modifying the basic logic of the intervention, an updated conceptualization of the intervention is shown in Figure 3.

**Figure 3** The intervention program for the activity (as of 2011)




# II. Research Questions

## II.1 Performance Evaluation

The purpose of the TC-5A performance evaluation is to evaluate the program along two axes: (1) the design of the program and (2) the implementation of the program. The first axis examines whether the program's design was suitable for the olive-growing sector. The second axis examines whether the consultant was able to implement the program as designed, with an analysis of the number of beneficiaries and the quality of the activities. The main research questions of the performance evaluation are the following:

- What is the validity of the intervention logic, and what are its underlying hypotheses?
- What are the success factors and the impeding factors with respect to achievement of the program objectives?
- Did the project achieve the objectives initially defined in the logical framework?
- What are the strengths and weakness of the implementation of the program?

- What are the threats and opportunities that may work for or against the sustainability of the results achieved?

The performance evaluation uses a study design centered on various methods, combining quantitative and qualitative methods.

## II.2 Impact Assessment

The impact assessment is focused only on the perimeters that are part of the rehabilitation of olive tree orchards in rain-fed areas sub-activity. The design of the impact assessment for the activity is based on measurement of the net change in the agricultural income of olive-producer households that can be attributed to the intervention. The estimated results of the project were drafted during the MCA-Morocco Compact development process. Olive tree rehabilitation and intensification were expected to enable an increase in net agricultural income of 15.6% by the end of the third year of implementation of the project, an increase in revenue from olive production of 29.8%, and also an increase in olive tree productivity under assumptions of actual price stability.[1]

The main research questions of the impact assessment are the following:

- What is the impact of the olive tree orchard rehabilitation component on farmers' incomes in the targeted rain-fed areas?
- Did olive production improve in volume and value?
- Were the popularized techniques adopted by farmers?
- Has the quality of the olive oil produced improved?
- Did the professional agricultural organizations play their role in the development of the olive-growing sector?
- Has the knowledge generated by the project spread in the vicinity of the perimeters in which the project was implemented?
- What are the differences in the impact of the project activities by gender, age, income?
- What are the unexpected impacts of rehabilitation?

The major principle of the impact assessment is the construction of a counterfactual, i.e., identifying what would have occurred if the intervention had not taken place. To create this counterfactual,

[1] These targets, calculated based on the June 2012 M&E plan, differ from the original targets. In 2010 and 2011, it was projected that net agricultural income would increase 8.4% and [both] revenue from olive production and olive tree productivity would increase 30.8%.

NORC collected data from paired perimeters[2] that were randomized either to the treatment group, which received the intervention, or to the control group, which did not receive the intervention. The evaluation is designed to capture the differences between the treatment perimeters and the control perimeters, as well as the differences over time from baseline in 2010 to the final monitoring in 2013. The evaluation plan uses the “difference-in-differences" or “double-differences” method.

The data used for the impact assessment come from surveys of farmers in the treatment and control perimeters conducted in 2011, 2012, and 2013. These data were collected from approximately 140 treatment and control perimeters from about 2,500 farmers.

An important consideration that the assessment must include is the voluntary adoption of the intervention. Any farmer wishing to benefit from the training could participate in it. But farmers who want to participate in training are slightly different from those who do not participate, which can have a marked effect on the results due to “selection bias.” Our assessment includes three modeling approaches to try to deal with this possible bias:

- **Intention-to-treat (ITT):** this approach takes into account the mean impact of the program on those to whom the program was offered and not on those who participated in it. As a result, we compare the mean outcomes for all farmers in the treatment perimeters with those in the control perimeters.

- **Treatment-on-the-treated (TOT):** in a second approach, we ignore the effects of selection bias introduced by voluntary adoption. Here we compare the mean outcomes for farmers who participated in the training with the mean outcomes for farmers who did not participate in the training. This is called “treatment-on-the-treated” insofar as we account for the impact of the treatment only on the farmers treated.

- **Treatment-on-the-treated with instrumental variable (TOT-IV):** another approach takes into account TOT but uses the technique of instrumental variables to deal with the issue of selection bias. Our TOT-IV estimation uses a randomized assignment to treatment as an instrument for participation in the program. This approach eliminates selection bias as long as certain hypotheses are met.

[2] A perimeter is a group of neighboring plots of land and represents a geographical area measuring 200-250 hectares.

# III. Results

## III.1 Performance Evaluation Results

Our performance evaluation of the project indicates that the results are mixed at the end of the MCA-Morocco Compact. In general, our analysis indicates that the program was designed to meet the most pressing needs of the Moroccan olive-growing sector. Additionally, the program works on the entire agricultural distribution chain, both upstream and downstream, and provides farmers with mentoring and assistance, which hardly existed or did not exist at all prior to its arrival. The TC-5A contract met these needs not only by organizing training for farmers, but also by putting in place mentoring processes through which field workers visit farmers to perform close supervision of the farmers on their own plots of land.

**Upstream and downstream integration.** The program that is the object of the TC-5A contract is the first program that involves the entire value chain, from upstream to downstream, and thus deals with supply and demand deficiencies. In fact, this program involves three target populations: farmers, PAOs, and PUs. The activities include training and mentoring not only for farmers, but also for PUs with respect to processing and for PAOs with respect to management, commercialization, and marketing, whereas previously these downstream activities were carried out by the private sector. Thus there is a link between olive production and the production of better quality olive oil. Although this design of integrating activities all along the value chain is a strength, marked weaknesses exist, particularly concerning actions to encourage farmers to participate in training and adopt good practices, and the lack of assistance to PAOs in the commercialization and marketing of their olive oil.

With the Catalyst Fund, the idea was to be able to provide EIGs with their own specialized PUs, since they are responsible for the valorization and commercialization of their oil, and to permit the maximum added value to be left at the farmer level. The Catalyst Fund provided for a grant so that an EIG could acquire this PU, and it represented considerable motivation for farmers to join cooperatives. However, the project ended just when the EIGs had been formed. These organizations, which are still very young, are at risk of failing if the new government agencies (ONCA [National Agricultural Advisory Office] and USGAV [EIG Oversight and Valorization Support Unit]) do not ensure the transition of the mentoring activities.

**Training targets generally achieved.** Overall, the project trained 29,481 individual farmers in at least one of the four modules in 248 perimeters, which corresponds to an 89% achievement rate. This corresponds to approximately 60% of the farmers in the target perimeters.[3] However, most farmers took part in only one training module (and not in the four modules as initially planned), and those who participated in the training did not universally adopt good practices.

**Risks to sustainability.** (1) Uncertain transition plan: In the last year of TC-5A, the project prepared applications for the transfer of the perimeters with which it worked. In addition, the Office National du Conseil Agricole [National Agency for Agricultural Advisory Services] (ONCA) was created as part of the reorganization of the MAPM [Ministry of Agriculture and Maritime Fisheries] and will be tasked with training, mentoring, supervising, and providing technical assistance to farmers. However, the ONCA was not yet operational at the end of the TC-5A program. (2) Low rate of adoption of good agricultural practices: The farmers hesitated to adopt the new techniques, among other reasons because farmers did not have the means to purchase the necessary tools and materials or because of a lack of skilled labor. In other cases, even if farmers did adopt the techniques, they did not necessarily apply them to all of their trees. (3) Non-operationality of the PAOs and EIGs. (4) Lack of a local market for better-quality oils.

## III.2 Impact Assessment Results

- ***Production Practices***

**The farmers who participated in the project training considerably increased their adoption of several of the good practice techniques explained during the training.** The farmers who participated in the training increased their probability of using manure by 23.4%, pruning by 38.8%, harvesting with vibrators by 191.9%, and digging impluviums by 166%. The application of basin and impluvium construction was also observed in the field by the NORC horticultural specialist and by the UGP. According to the UGP, the training on basin and impluviums was applied quickly because there are drought problems and farmers implement what can benefit them with the least financial expense. The results of our models, which account for selection bias, do not enable us to rule out the possibility that farmers would have been able to make these changes in their production practices even without the project. However, given that these techniques were important axes of the training, it is probable that the above estimations do reflect the project's impact on production practices.

[3] The TC-5A final report mentions the figure of 48,828 beneficiaries for 249 perimeters. The training statistics are for 248 perimeters.

Conversely, our quantitative results indicate that **the farmers did not increase their adoption of certain other good practices that were presented during the training.** These include: the use of tarpaulins during harvesting, storage of harvested olives in crates rather than in bags, the use of fertilizers or pesticides, recourse to modern processing units, and storage of oil in plastic food-grade containers. The main criticism of the project from farmers concerns the lack of financial assistance or provision of material in order to be able to apply the techniques learned during the training, which may explain the lack of change in the rates of adoption of these agricultural practices. Farmers did not have the means to procure the tools and equipment needed to put into practice the entire set of technical measures. For example, they cannot purchase the fertilizers or pesticides to perform the phytosanitary treatment. The project's hypothesis is also that these practices will be adopted gradually with market integration and startup of the Catalyst Fund PUs.

- ***Yield, Productivity, and Income***

**We do not observe any positive impact of the program on outcomes related to production, productivity, and income.** The outcomes studied by the assessment were: the quantity of olives and olive oil produced, the percentage of the harvest processed and sold as olive oil, sales and prices received for olive oil, revenue and profits obtained from olives, agricultural income and profits as a whole, olive yield per tree, and household income. The only one of these outcomes for which our analysis detected an impact was a decrease in the overall olive production as a result of the project. This may be due to short-term production declines as a result of the adoption of pruning techniques (particularly rejuvenation pruning) or incorrect application of the pruning schedule or pruning technique.

There are several possible explanations for the fact that we did not observe any improvement in terms of production and productivity. One possibility is that the **assessment period was too short to be able to detect impacts.** The project training took place in 2011 and 2012, and the last survey was conducted at the beginning of 2013. Thus, the assessment covers only one or, at most, two growing seasons since the training.

# IV. Conclusions

The TC-5A contract constituted a key first step in the development of the sector, through training, mentoring, and organization of farmers into cooperatives and EIGs capable of producing virgin and extra virgin olive oil. The addition of the Catalyst Fund in 2011 constituted a strong incentive for the grouping of cooperatives into SOPOs in the project's intervention and non-intervention areas. However, the full effect of the Catalyst Fund will not be known before at least one or two growing

seasons and will depend on the level of assistance that beneficiaries of the Catalyst Fund receive during the initial PU operationalization phase.

Similarly, the short period of time between the training and our surveys, which attempt to measure its effects, limits an assessment of the full impact of the intervention. Farmers do not necessarily adopt the learned techniques right away, and the potential impact on the volume and value of olive production may not appear until much later. Moreover, it will take time for the competencies of the PAOs with respect to services provided to their members, assistance in communicating prices, and transporting oil to develop. Ongoing mentoring and supervision is necessary to ensure their sustainability. Thus, much remains to be done to continue to develop the sector and increase agricultural income. Continued assistance and investment in the olive value chain and, in particular, in the creation of a local market for high-quality oils are necessary in order to fully realize the impact of the TC-5A project.

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# List of Abbreviations

| | |
|---|---|
| AAPOR | American Association for Public Opinion Research |
| APP | Agency of Partnership for Progress |
| DPA | Direction Provinciale de l'Agriculture [Provincial Directorate of Agriculture] |
| DRA | Direction Régionale de l'Agriculture [Regional Directorate of Agriculture] |
| EIG | Economic Interest Group |
| FTPP | Fruit Tree Productivity Project |
| GHP | Good Hygiene Practices |
| GIS | Geographic Information System |
| HACCP | Hazard Analysis and Critical Control Points |
| INDH | Initiative Nationale pour le Développement Humain [National Initiative for Human Development] |
| ITT | Intention-to-Treat |
| MAPM | Ministère de l'Agriculture et de la Pêche Maritime [Ministry of Agriculture and Maritime Fisheries] |
| MCA-Morocco | Millennium Challenge Account – Morocco |
| MCC | Millennium Challenge Corporation |
| NORC | National Opinion Research Center at the University of Chicago |
| PAO | Professional Agricultural Organization |
| PU | Processing Unit |
| SOPO | Second-Order Professional Organization |
| TOT | Treatment-on-the-Treated |
| TOT-IV | Treatment-on-the-Treated with Instrumental Variable |
| UGP | Unité de Gestion du Projet [Project Management Unit of the Moroccan Ministry of Agriculture and Maritime Fisheries] |
| UNOPS | United Nations Office for Project Services |
| WC | Work Center |

# 1. Study Description

## 1.1 Introduction

The goal of the MCA-Morocco Compact is to reduce poverty through economic growth by increasing productivity and employment in sectors with high potential (MCC-Morocco Compact, 2007). The Compact is managed by the Agency of Partnership for Progress (APP), which is tasked with implementing and executing the program. To stimulate growth in the agricultural sector, the APP implemented the Fruit Tree Productivity Project (FTPP), the goal of which is to encourage the transition of farmers from annual cereal crops, which are vulnerable to climate conditions, toward perennial fruit tree cultivation, which is more productive and better adapted to local conditions, such as olive tree cultivation. By investing in an intensive training and technical assistance project in the olive-growing sector, it was projected that olive tree rehabilitation and intensification would increase net agricultural income by 15.6% by the end of the third year of implementation of the project, revenue from olive production by 29.8%, and also olive tree productivity, assuming actual price stability.[4] As production and product prices increase, the project anticipated providing indirect benefits to the key players through the olive production value chain (MCC-Morocco Compact, 2007).

One of the major focuses of the FTTP is improving the production and quality of olives and olive oil. Olive growing is a vital sector for Morocco. The national olive-growing holdings occupy a surface area on the order of 735,400 ha with a production of 1,483,510 tons of olives in 2010, thus ranking Morocco in fourth place on the global scale after Spain, Italy, and Greece (FAO, 2012). The FTPP was designed to rehabilitate 55,000 hectares of existing olive orchards (including 45,000 hectares in rain-fed areas) and expand olive orchards with new trees over an additional surface area of 80,000 hectares (62,000 hectares funded by the MCC and 18,000 ha funded by the Moroccan government). After issuing a request for proposals, the APP selected UNOPS (United Nationals Office for Project Services) to implement the intervention activities under the TC-5A contract.

The APP also hired NORC to conduct an evaluation of the project. This evaluation includes an evaluation of the implementation of the intervention ("performance evaluation") as well as an evaluation of the effects of the intervention ("impact assessment"). The performance evaluation is

[4] These targets, calculated based on the June 2012 M&E plan, differ from the original targets. In 2010 and 2011, it was projected that net agricultural income would increase 8.4% and [both] revenue from olive production and olive tree productivity would increase 30.8%.

based primarily on the analysis of monitoring data provided by the TC-5A consultant and the results from focus groups and interviews with resource persons, while the impact assessment is based primarily on the results of surveys conducted with farmers in the areas involved in the rehabilitation intervention (Treatment) and in similar areas not involved in the intervention (Control). A more detailed description of the evaluation methodology is included below.

This report presents the final results of both evaluations, the performance evaluation and the impact assessment. The performance evaluation concerns the implementation of the intervention according to four main criteria: relevance, coherence, efficacy, and sustainability. As such, the evaluation therefore focuses on the quality of the activities implemented and the immediate outcomes of the intervention (e.g., number of beneficiaries trained and mentored). The impact assessment concerns the ultimate medium-term and long-term objectives of the project (including adoption of techniques and increase in agricultural income). Although each evaluation is given its own section in this report, both evaluations complement one another inasmuch as the results of the impact assessment may be better understood and enhanced by the results of the performance evaluation.

The rest of this report is structured as follows: Sections 1.2 and 1.3 describe the interventions, the intervention logic, and a review of the literature. Section 2 presents the performance evaluation, and Section 3 presents the impact assessment. Section 4 summarizes the main results in light of the qualitative results and issues recommendations based on these results.

## 1.2 The Intervention

The fruit tree orchard rehabilitation activity ("intervention"), the Terms of Reference of which were developed by the APP, targeted three major populations: farmers (olive producers), professional agricultural organizations (PAOs), and processing units (PUs) in the Fès-Boulemane, Marrakech-Tensift-El Haouz, Meknes-Tafilalet, Tadla-Azilal, Tanger-Tetouan, and Taza-Al Hoceima-Taounate regions. The intervention consisted mainly of technical assistance activities: training and mentoring/supervision of these three populations. Of these three target populations, the farmer population was the most important, since farmers' net agricultural income is the key indicator of the impact assessment. Farmers were trained in the best olive production and harvesting techniques with a view to increasing yields and improving the quality of their production.

PAOs were also an essential component of the intervention, since they were supposed to play a key role in organizing farmers in order to more effectively implement the intervention. In fact, creation of a PAO was a prerequisite for farmers operating in the perimeters to be able to benefit from the intervention. The objective of the intervention was to strengthen the capacities of the PAOs and to encourage them to develop in order to provide farmers with greater negotiating and selling power.

The intervention conducted work to raise the awareness of farmers and to mobilize them to join PAOs, to organize joint commercialization through connections with superstores, buying syndicates, cooperatives, and public and semi-public institutions to sell oil at favorable prices. In 2011, emphasis was placed on the creation of cooperatives rather than associations. Cooperatives are more formal structures that have additional certification criteria and more opportunities for development, including carrying out for-profit activities. Additionally, some cooperatives were also grouped into second-order professional organizations (SOPOs) called Economic Interest Groups (EIGs), which can request funding from the Catalyst Fund, a component that was added to the intervention in 2011, in order to create their own processing unit. The intervention also oversaw the creation of new EIGs.

An important component of the olive value chain is olive oil production. Better-quality olive oil can potentially be sold at a higher price. Therefore, the intervention provided for supervising the upgrading of a certain number of processing units, especially so they would comply with Law 28-07 on sanitary food safety and environmental protection, and setting up standard quality systems in some units and superior quality systems in others in order to ultimately obtain a better quality oil. The goal was to encourage the PAOs to sign contracts with the processing units in a win-win partnership inasmuch as the PAOs would have a guaranteed buyer or a [service] provider able to produce quality oil while the processing units would have a supplier of reliable-quality olives. This intervention thus anticipated that marketing and promotion of commercialization would be ensured by the PAOs, EIGs, and processing units. Finally, a price information system would be set up to ensure commercialization of the production at encouraging prices, enabling olive growers to invest in the upkeep of their olive tree orchards.

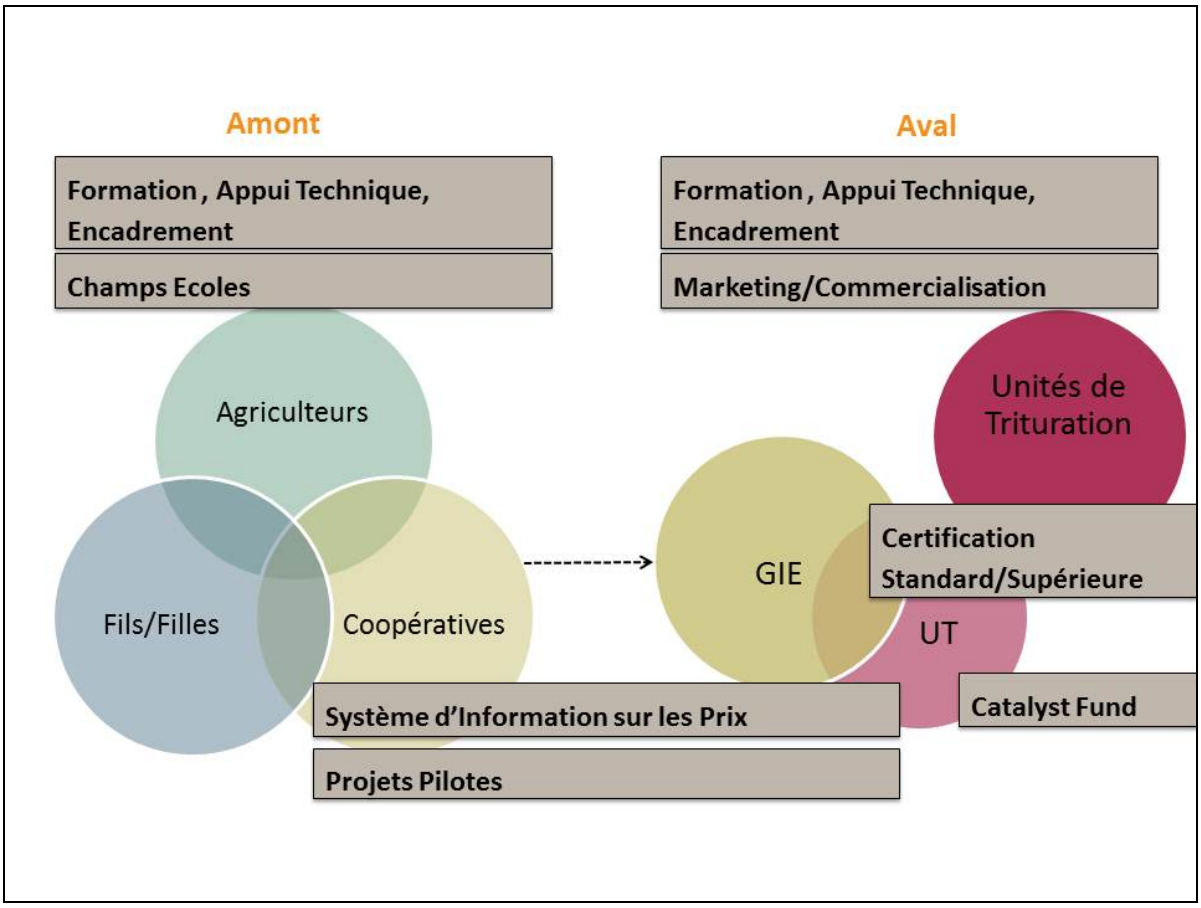
Among the farmer population, there are two subpopulations targeted by the intervention. The first is young people, who receive training to acquire knowledge on the various aspects of olive production, such as pruning or phytosanitary control, in order to encourage them to become service providers in their region. The second is rural women, who have the opportunity to receive funding for small "pilot" projects related to olive production.

The activities and objectives of olive tree orchard rehabilitation and intensification in rain-fed areas can be summarized upstream and downstream as follows:

- Mentoring, training, and technical assistance for producers and their professional organizations with respect to orchard management and planning and management of cultivation operations.
- Training and technical assistance for managers of olive production processing units on improving production processes with a view to upgrading the quality of the oil produced, while promoting hygiene and environmental protection in these units.

Figure 1.1 below summarizes the different activities planned as part of the TC-5A program.

**Figure 1.1** The TC-5A contract intervention program




The theory of change used in this intervention model is the following: the training of farmers in improved olive production and processing techniques will lead to increased volume and value of their olive and olive oil production, the effect of which will be an increase in income from these activities and an increase in all of their agricultural income.

# 2. Performance Evaluation

## 2.1 Objectives

The objective of the TC-5A performance evaluation (the rehabilitation of olive tree orchards in rain-fed areas sub-activity) is to evaluate the program along two axes: (1) the design of the program and (2) the implementation of the program. The first axis examines whether the program design was suitable for the olive-growing sector. The second axis examines whether the consultant was able to

implement the program as designed, with an analysis of the number of beneficiaries and the quality of the activities. The main research questions of the performance evaluation are the following:

- What is the validity of the intervention logic, and what are its underlying hypotheses?
- What are the success factors and the impeding factors with respect to achievement of the program objectives?
- Did the project achieve the objectives initially defined in the logical framework?
- What are the strengths and weakness of the implementation of the program?
- What are the threats and opportunities that may work for or against the sustainability of the results achieved?

To answer these questions, the NORC team examines the relevance, coherence (internal and external), efficacy, and sustainability of the program. Table 2.1 summarizes the criteria used to evaluate the program for each of these categories. Relevance concerns how the program corresponds to the needs of the olive-growing sector and its operators and its compliance with the strategic directions of the Ministry of Agriculture and Maritime Fisheries (MAPM). With respect to coherence, NORC examines whether the TC-5A consultant's human and financial resources are adequate to achieve the program objectives, whether the program was implemented in a harmonized manner in all the geographical areas, and whether the program activities were well integrated with one another.

NORC evaluates the efficacy of the consultant's implementation of the activities based on the number of beneficiaries trained, the quality of the training, and the technical support and mentoring provided. Finally, NORC evaluates the sustainability of the program, particularly the level of operationality of the professional agricultural organizations (PAOs) and their competence in the production of olives and quality olive oil and the commercialization of the oil at a favorable price.

The TC-5A contract performance evaluation focuses on the activities of training, technical support, and mentoring of farmers, their professional agricultural organizations, and the processing units, including the Catalyst Fund component that was added to the program in 2011 in the rain-fed area. The cross axis of the environment was not part of this evaluation. The cross axis of gender will be examined, but in less detail since the APP has sponsored another gender evaluation covering the TC-5A contract.

**Table 2.1** Evaluation criteria

| |
|---|
| **Program design** |
| **Relevance** |
| Correspondence with the needs and requests of the beneficiaries |
| Compliance with the strategic directions of the MAPM at the policy and national level |
| **Program implementation** |
| **Relevance** |
| Concordance of the various means (human and financial resources) and instruments mobilized to contribute to achievement of the objectives. |
| Integration of the program activities |
| Concordance with the other actions of the State and other local development players |
| **Efficacy** |
| Quality and timing of the action plans received from the TC-1A consultant |
| Quality and timing of the activities of the TC-5A consultant |
| Management of unforeseen events and adaptation to changes in circumstances |
| **Sustainability** |
| Level of operationality of the professional agricultural organizations |
| Possibility of reproducing or generalizing the activity |

## 2.2 Methodology

The performance evaluation uses a study design centered on various methods, combining quantitative and qualitative methods. The qualitative data include focus groups with program beneficiaries, interviews with resource persons, field observations, and a review of key documents. The quantitative data include the TC-5A monitoring data, quantitative surveys with beneficiaries in the perimeters of the impact assessment, and quantitative evaluation based on scores collected during field observations.

It is important to remember that the focus groups, interviews, and beneficiary observations are not representative of these populations because the objective of the qualitative data was to obtain a rich and detailed perspective in order to support the results of the quantitative data and to enhance these data with concrete examples from the experience of the beneficiaries and the program. As for the quantitative data from the PAOs and PUs, they concern only a small sample and are not part of a rigorous methodology including a control group. Thus these data are used for information purposes only and cannot be used to demonstrate the causal impact of the intervention.

The NORC team collected qualitative data for the performance evaluation on two occasions: the first after about one year of implementation of the intervention and the second after about two years of implementation. In 2011 to the beginning of 2012, NORC conducted five focus groups, 28 interviews

with resource persons, and 12 training observations. At the end of 2012, NORC conducted five focus groups, 38 interviews with resource persons, 24 observations of farmers' plots, and 12 observations of processing units (PUs). In 2013, NORC conducted two focus groups. The NORC quantitative surveys took place once a year between 2010 and 2013 (PAO survey in 2010, 2012, and 2013, and PU survey in 2011, 2012, and 2013). NORC also used a set of monitoring data and periodic reports from the TC-5A consultant covering the period from the start of the program to June 2013. Further details regarding the data collected for the performance evaluation are included in Appendix B.

## 2.3 Results

The results given below are presented for each of the performance evaluation criteria: relevance, internal coherence and external coherence, efficacy, and sustainability. The analysis covers both the strengths and the areas for improvement for each criterion.

### 2.3.1 Relevance

This section examines the relevance of the intervention program, namely the correspondence between the program design and the needs and requests of the beneficiaries, as well as compliance with the strategic directions of the MAPM at the policy and national level.

The strengths and criticisms of the program design are summarized below and discussed in greater detail in the following sections.

***Strengths:***

- Focusing the assistance on training and mentoring
- Improved farmer organization
- Upstream and downstream integration
- Addition of the Catalyst Fund

***A few criticisms of the program design:***

- Lack of concrete motivation to prompt farmers to participate
- Lack of financial aid to processing units
- Request for a training participation certificate
- Initial absence of the Catalyst Fund

#### Correspondence with the Needs and Requests of the Beneficiaries

In general, our analysis indicates that the program was designed to meet the most pressing needs of the Moroccan olive-growing sector, particularly in rain-fed areas where few assistance projects were operating compared with other fruit tree cultivation areas or compared with irrigated areas.

Additionally, the program works on the entire agricultural sector, both upstream and downstream, and provides farmers with mentoring and assistance, which hardly existed or did not exist at all prior to its arrival. However, the program design changed over the period of the program's implementation, which indicates, on the one hand, that the initial design was not completely satisfactory, but, on the other hand, that there was adaptation work to better meet the beneficiaries' need, which, all in all, is a positive aspect.

***Strengths:***

- **Focusing the assistance on training and mentoring.** The Ministry of Agriculture and Maritime Fisheries (MAPM) and the MCC promoted the idea of providing "soft" assistance, i.e., farmer training and mentoring, to set it apart from earlier programs. The APP would thus improve the capacities and organization of farmers via the TC-5A program, while the MAPM would provide grants through programs that were already in existence. Also, the MAPM and the Green Morocco Plan already had programs that provided equipment kits to farmers (although these programs are not extensive). Farmers were not using good agricultural practices to reduce the natural fluctuation of olive production and increase yields with, for example, good harvesting practices to avoid damaging trees, use of pruning, and construction of basins and impluviums to catch rainwater. In fact, TC-1A feasibility studies "underscored an inadequacy or sometimes even absence of upkeep of olive tree orchards [...], as well as poor management of existing professional organizations" (UNOPS 1st Quarterly Training Report). Thus there was a logical gap to make up for, namely the need to increase farmers' level of knowledge, since the MAPM was organizing very little training. The TC-5A contract met these needs not only by organizing training for farmers, but also by putting in place a mentoring process through which UNOPS field workers visit farmers to closely supervise the farmers on their own plots of land. The idea was to focus on the quality, and not just the quantity, of olive production and to encourage farmers to invest in their farms. By means of this training and close mentoring, the TC-5A contract plays a role, in a way, as an extension of the MAPM in the field with farmers.

> *"This is a relevant program that has come just in time to fill the void in the region. As you know, the Ministry suffers from a lack of human resources and logistics for executing this program, namely in terms of close mentoring." – DPA member*

- **Improved farmer organization.** Most farmers own small plots of land and individually do not produce sufficient amounts of olive oil for sale to big customers such as superstores. Other programs had attempted to reach all farmers, but the MAPM does not have the resources to provide assistance to all individuals. As with other agricultural programs, it was therefore important to work with professional agricultural organizations (PAOs) in order to (1) implement activities more effectively with a group of farmers at the perimeter level than with individual farmers, and (2) help farmers better organize to enable them to negotiate better with customers

and sell larger quantities at better prices. In particular, the goal was to increase farmers' negotiating and marketing power so that they could sell without going through middemen, because it is the middlemen who currently obtain the most profit from the sale of olives and olive oil. Few PAOs with olive production activities existed prior to the program. Thus the program met the need of assisting in the creation and management of PAOs. Furthermore, the TC-5A contract encouraged the creation of second-order professional organizations, EIGs. For their part, EIGs can sell to big customers, such as superstores, because they have a commercial registry, whereas cooperatives do not.[5] It was therefore important to also place emphasis on these EIGs in order to be able to market to big customers (exporters, buying syndicates, and superstores).

- **Upstream and downstream integration.** The program that is the object of the TC-5A contract is the first program that involves the entire value chain, upstream to downstream, and thus deals with supply and demand deficiencies. In fact, this program involves three target populations: farmers, PAOs, and PUs. The activities include training and mentoring not only for farmers, but also for PUs with respect to processing and for PAOs with respect to management, commercialization, and marketing, whereas previously these downstream activities were carried out by the private sector. Thus there is a link between olive production and the production of better quality olive oil. It is not enough for olives to be good quality in order to get quality oil. The processing process has an impact via technology and environmental conditions (hygienic and sanitary). Likewise, it is not enough to produce high-quality oil; having customers and being able to market this oil at prices that are favorable to the producer are also required. For their part, PAOs and, in particular, EIGs, which group together several cooperatives, play a role in the marketing and commercialization of olive oil. By aggregating productions, they enable the volumes required by structured markets to be achieved and, in this way, permit a marketable supply to be developed. They have the power to negotiate with buyers and are in the position to be able to participate in marketing activities such as national or international fairs in order to stimulate the demand for Moroccan olive oil.

- **The Catalyst Fund.** The Catalyst Fund is an initiative that was added to the project in July 2011 in order to strengthen the sustainability of the FTPP's achievements. The Catalyst Fund plays an important role in improving the olive processing capacity in Morocco. Previously, the

> *"The Catalyst Fund also played an important role because the farmer sees that the goal of all this upstream training is to produce well and better. He now knows that he is acting in a well-organized structure and that he is a member in that unit. It [the CF] played an important role."– UGP member*

[5] An overhaul of the law on cooperatives is under way. A novelty of this project is registration in the cooperative registry, i.e., the equivalent of the commercial registry for companies.

approach was to plant more trees, but the processing capacity was not sufficient to handle the increased production. Thus there was a bottleneck, which the government tried to solve by installing small-size processing units. Today farmers have to be better prepared for the national and international market, so their needs have evolved and they must be able to process and store oil on a larger scale. With the Catalyst Fund, the idea is to be able to provide EIGs with their own specialized PUs, since they are responsible for the valorization and commercialization of their oil, and to permit the maximum added value to be left at the farmer level. The Catalyst Fund provides for a grant so that an EIG can acquire this PU, and it represents considerable motivation for farmers to join cooperatives. All the EIGs surveyed were satisfied with the PU funding and 35% of these EIGs thought that having to pay five percent of the cost of the PU was a positive aspect, since this causes "the members to be involved and makes them work." Thus the Catalyst Fund played a very important role in organizing farmers. Another benefit of the creation of large-capacity PUs is environmental protection. At present, there are many small-size PUs scattered across the country that are not large enough to justify the creation of a water-treatment structure. Hence, they are very polluting. With larger PUs, it will be easier to identify the problem and process waste from olive processing, especially since there has been an environmental law in Morocco since 2011 that permits authorities to shut down PUs that do not protect the environment.

***A few criticisms of the program design:***

- **Lack of concrete motivation to prompt farmers to participate.** The project essentially provided "soft" assistance, i.e., training, mentoring, and awareness-raising, which was viewed as a positive aspect because it made up for a shortcoming of the MAPM. The program wanted to set itself apart from previous programs that offered farmers material or funding, since these programs can create a dependence on the part of farmers, as often happens in development projects. However, without any material or financial assistance, there was no concrete motivation for farmers to take part in the training. Furthermore, even if farmers did participate in the training, they did not have the necessary equipment or material to apply what they had learned. In fact, according to our farmer survey, more than 70% of farmers who had not applied the technique did not do so because of a lack of resources and material. Thus, in almost all of our focus groups with farmers, we collected comments concerning the lack of financial aid and the lack of provision of farm implements to farmers. It is true that offering material free of charge can create dependency, but the project could have found other ways of motivating farmers and supporting them in procuring the material they need. For example, the project could have increased support for obtaining credit or a grant to acquire the farm implements.

- **Lack of financial aid to PUs.** In addition to training for PU mangers and technicians, the assistance they were given consisted primarily of support for the development of business plans for the purpose of upgrading the PU (standard level or superior level). No other assistance was provided beyond this business plan, so the PUs did not have any aid for implementing it. For example, one cooperative surveyed by NORC that had a PU was not able to implement the business plan because of a "lack of resources, especially since the cooperative had just paid its share [for membership in the EIG]." As a result, most PUs were not able to follow their business plan (according to UNOPS, 110 PUs created business plans but only 43 PUs signed a commitment letter) and upgrade even when the upgrading of existing PUs is very important because the new PUs created through the EIGs are not deemed sufficient to meet processing needs.

> *"But the obstacle I am faced with today is the PUs' lack of financial means. In fact, for each of the 30 PUs I deal with, I diagnose insufficiencies, I make a business plan, I present it to the PU with a commitment letter to be signed. But no one has signed yet: they find that the amount to be invested for the upgrade is greater than their income. They ask us to fund this upgrade for them, but we cannot. Our action is limited to technical and theoretical assistance." – PU expert, UNOPS*

- **Request for a training participation certificate.** Another component that was intentionally not included in the project but which was cited multiple times by young farmers during our focus groups is the issuance of a certificate that the young farmers could use to prove they had participated in the training and that they could present in order to be hired as specialized technicians by other farmers. A certificate signed by the APP/UNOPS could also have been a motivation for participating in the training, however one member of the UNOPS team indicated that the APP was not able to give UNOPS authorization to offer certificates because UNOPS is not an institution with the authority to issue official diplomas.[6] Because the young farmers did not necessarily take part in all the training modules, it might actually be difficult to certify their competence and there might be a risk of falsification of certificates. One idea cited by a member of UNOPS would have been to work with a qualified training center to organize a competitive examination for the most motivated young farmers in order to issue them a professional certificate.

- **Initial absence of the Catalyst Fund.** The Catalyst Fund is viewed as a strength of the project by all of the stakeholders. However, this component was not part of the initial program design; it was not added until July 2011. One respondent from the UGP remarked that if the Catalyst Fund had

[6] The MCA-Morocco closure plan dated June 2013 indicates, however, that training certificates will be issued to young people.

been created right from the outset, the cooperatives could have been formed more quickly and many of them would already be registered (whereas some are still awaiting registration at the end of the TC-5A program) and the EIGs would already be operational. Although the program is integrated upstream and downstream, its actions were not as well defined downstream as upstream. The marketing plan initially projected was expanded further with the advent of the Catalyst Fund.

### Compliance With the Strategic Directions of the MAPM at the Policy and National Level and the External Coherence of the Program

The activities carried out by TC-5A, particularly the activities intended for disadvantaged populations and regions like small farmers and mountain areas, reinforce the national agricultural policy of the Moroccan government, the Green Morocco Plan, and, more specifically, the third foundation of Pillar II, which provides for solidarity-based support for small farming with a view to modernization and which consists of training and mentoring to improve productivity and support for reconversion to growth sectors. Additionally, the TC-5A activities upstream and downstream are in keeping with the Green Morocco Plan's emphasis on aggregation as a means of improving market access.

***Strengths:***

- **Complementarity of the TC-5A program with the Green Morocco Plan and other MAPM programs.** The general view of respondents is that the program is relevant and it converges with the objectives of the MAPM. According to our interviews with UGP staff, the MAPM programs did not place emphasis on the "training" component due to a lack of financial and human resources, and the TC-5A contract (and the FTPP in general) thus fills this gap. Moreover, the EIG and Catalyst fund component falls within the vision of the Green Morocco Plan of encouraging self-aggregation in rural areas.

- **Complementarity of the TC-5A program with the other FTPP activities.** The FTPP targets the entire olive-growing sector with irrigation infrastructure works in PMH areas, orchard works in expansion perimeters in rain-fed areas, and training, technical support, and mentoring for farmers, PUs, and PAOs, and applied research services and scientific support. Thus TC-5A is an important FTPP activity since it provides training, technical support, and mentoring services to beneficiaries, professional agricultural organizations, and value-chain operators in all olive intervention areas.

### 2.3.2 Coherence

Internal coherence involves coherence among the different components of the TC-5A program, in other words, the complementarity of the various activities for achieving the objectives. This also involves matching of the various means (human and financial resources) and instruments mobilized to contribute to the achievement of the objectives. External coherence concerns concordance of the program with the other players in the government, local development, and investors. Our results can be summarized as follows:

***Strengths:***

- Internal complementarity of the program components
- Implementation of a harmonized program in the areas

***Mixed results and areas for improvement:***

- Insufficient number of field workers
- Varied assessments of the qualifications of the trainers and field workers
- Cumbersome financial system
- UNOPS internal communication

#### Internal Coherence

***Strengths:***

- **Internal complementarity of the program components.** As mentioned in the Relevance section, the program works on the entire olive-growing sector and thus deals with supply needs (by working upstream) and the demand for olives and olive oil (by working downstream).

  In addition, the project also involved the sons and daughters of farmers and rural youth (SDFRY) and, on a different level, input suppliers and transporters. All of these players are connected with one another. Each of them was intentionally targeted to meet the primary objective, which is downstream quality. Downstream drives the rest of the program, since the farmer cannot be motivated to improve his production if he isn't better paid and because this better pay can only be achieved with better farmer organization and elimination of middlemen. Thus there is a complementarity between all of the training modules and the mentoring activities involving all the links in the chain. The project was designed with a view to integration of the chain, which is new for these small farmers.

  The coherence of upstream and downstream activities was strengthened with the introduction of the Catalyst Fund component, which places emphasis on valorization. The Catalyst Fund

constituted a significant source of motivation for farmers. The objective of TC-5A was to organize farmers, but it was difficult for farmers to understand what the benefit of joining a cooperative was. The Catalyst Fund contributed to funding for the creation of large-capacity PUs for the benefit of EIGs, which enabled the project to better structure the actions and have a connecting thread for working in an integrated manner within the chain. By giving farmers their own processing tool rather than working only with private PUs, the project's message became more credible because there was a clear vision of the flow of all the activities along the olive production chain. These EIGs will thus be able to establish direct partnership ties with merchants and superstores and will perhaps even be able to consider exporting internationally.

An integrated system enables farmers to harvest only the amount needed for processing, and this also improves quality since the olives are processed immediately after harvesting. Additionally, larger-capacity PUs enable farmers to store their olive oil under better conditions. The harvest period lasts only a few months, while the selling period can extend over the course of the year. Previously, the farmer had to process and sell off his production right away, but with a PU with a large storage capacity he can regulate his supply over time and sell when the price is the most favorable for him.

- **Harmonized implementation in the areas.** According to the UNOPS core team, the quality level of the training was not harmonized during the first year of the intervention, even though this harmonization was stipulated in the Terms of Reference. This was mainly due to a lack of trainers and to efforts put into awareness-raising campaigns that were carried out at the same time as the training. However, at the beginning of 2011, in order to harmonize implementation of the intervention, i.e., harmonization of the activities in each program area and coherence among the various intervention components, the project drew up a uniform training program and standardized training manuals in accordance with the Terms of Reference that had been drafted by the UGP and APP, the project manager. In addition, each area team was made up of staff with similar experiences, including specialists, a team of field workers, and a team of trainers. The quality of the program's implementation and its messages were thus standardized across the different areas. There is homogeneity in the technical messages communicated to the beneficiaries via standardized training and materials, which were designed at the head office in Rabat.

> *"Thus they have the text in French and the text, the slide show in Arabic and then the brochures, so everything is there. You just have to stress the messages that need to be given. I think this worked, this method. This is why there is a certain homogeneity in the training at the farmer and SDFRY level"– UNOPS member, Core team*

Although it is important to standardize the approach in order to maintain the quality of the training for all beneficiaries, it is also necessary to be watchful not to become rigid in the

implementation of these standards. Some perimeters are historically more reticent than others and as one member of an area team says, it is necessary "to stick to the basic principles in the approach, but to have a certain degree of flexibility in movement and action…; the specificity of each perimeter must be taken into consideration and, in order to do this, a certain amount of freedom must be given to those in charge."

***Mixed results and areas for improvement:***

- **Insufficient number of field workers.** The Terms of Reference specified a fixed number of trainers and field workers. In terms of human resources deployed to contribute toward achievement of the project objectives, our interviews reveal that, in general, the number of trainers was sufficient but the number of field workers was not. While the trainers had a well-defined number of trainings to give and used aids that had already been developed by the core team, the field workers had a much heavier workload. The field workers were, in effect, responsible for the support and close mentoring of the beneficiaries in their perimeter. They were also responsible for filling out individual forms for monitoring farmers and recruiting farmers for training. On average, one field worker was responsible for a territory 1,500-2,000 ha in size and therefore had to travel throughout the perimeter, sometimes in very difficult conditions and over very difficult roads. If the number of field workers had been increased, it would have been possible to have more mentoring (although this was not necessarily possible due to budget constraints). Moreover, the uncertainty of the length of the contracts was a disincentive to some field workers, who were working under 6-month contracts.

> *"There was a problem with staff numbers from the start. There was not enough staff. The field worker's intervention area was extensive. Moreover, sometimes the core team asks for information about an area that requires traveling 20 km. The workload exceeds the field worker's ability" – WC member*

- **Mixed assessments of the qualifications of the trainers and field workers.** At the start of the project, the APP deemed that some trainers and field workers did not meet the required standards. In 2011, UNOPS responded to these observations by replacing most of the trainers, even though it was difficult to find candidates who met the APP's requirements and met the needs of the intervention. For the PAOs in particular, the trainers were judged to be high quality especially because most came from the development office and so these were people who had in-depth knowledge of organizations. NORC's training observations also underscored the abilities of some trainers to clearly convey concepts and examples to farmers using their language and adapting to their needs, while others did not promote a participative approach during training sessions and did not always use audiovisual resources well. One positive aspect stems from the fact that UNOPS made sure to recruit trainers from the same regions as the participants, which facilitated contact and contributed to the quality of the training.

Some, like on of our UGP respondents, consider that the quality of the field workers is heterogeneous. Some field workers are technicians while others are engineers, and the level of knowledge is not the same for all field workers. Additionally, even though they had satisfactory knowledge regarding upstream in the olive value chain, their knowledge with respect to downstream was generally limited. In fact, field workers did not always have the required food-processing industry qualification to supervise the PUs, and so UNOPS decided to organize training specifically for field workers to train them in topics such as HACCP principles and hygiene measures so as to better supervise the PUs. Despite the differences among field workers in terms of skills and knowledge, certain regions were more high performing than others because of the area team they were covered by. So even if the field worker has an average level of knowledge, he can have good results if he is mentored by a good area team.

> *"They would work in a team, but each field worker has his/her area of specialization, because the APP presumed trainers/field workers with the five years of training required in the ToR. It was not the case to find experienced trainers/field workers with good skills right from the start." – UNOPS member, Rabat*

Two TC-5A areas in particular were higher performing, Taza and Beni-Mellal, especially with respect to the PAO aspect (the Beni-Mellal team leader was a specialist in PAOs). In fact, the Beni-Mellal area witnessed the formation of the largest number of EIGs, seven in all, whereas the other areas formed four or five EIGs. In contrast, the Taounate area experienced many more difficulties. These differences among areas are not necessarily due to the performances of the teams but may also be attributed to the different sociocultural characteristics of each area. Even if the team is very competent, the messages may not get through due to this human factor, which is not easy to manage.

- **Cumbersome financial system.** In general, our interviews indicate that financial resources were more than sufficient. However, the UNOPS financial system experienced difficulties. As an organization in the United Nations system, in order to release funds UNOPS had to go through the head office in Tunisia and then in Italy. This process proved to be very cumbersome and caused numerous delays in paying staff.

> *"From a financial standpoint, the financial system is a bit cumbersome. It is somewhat lacking. Normally, if it were another entity, private entities that do not have other rigid requirements and regulations like the UN, this could alleviate things." – UNOPS, Rabat*

This slowness in releasing funds also affected implementation of the program because the acquisition of vehicles for the area teams had to be delayed. UNOPS then proposed that field workers use their own vehicles to get around. The UGP qualified this as a "mistake." Field workers who were not satisfied with this situation quit after three or four months, considering the compensation proposed for the use of their own vehicles inadequate.

The rigidity of the financial system does not allow UNOPS to be reactive to certain needs and requires advanced planning of activities. The purchase of some equipment, for example, could take up to six months. We note, however, that this cumbersome nature of the financial system is independent of the willingness of the UNOPS team in Morocco, since they have to follow the procedures put in place by UNOPS headquarters.

- **UNOPS internal communication.** Regular communication between the head office and the area teams is crucial for ensuring harmonious and effective implementation of activities. At the start of the project, meetings between the core team and the area teams were not frequent enough. There was a feeling that communication was one-sided, from the area teams to the core team, but that the core team did not communicate enough with the area teams in return. A UNOPS specialist commented that when the core team needed something it called the area teams, but that feedback was lacking. Exchanges were often carried out informally, especially among people who had known one another personally before the UNOPS TC-5A team. In contrast, when this was the case, communications were very effective and fluid. Team members were able to call one another easily by mobile phone since communications were free. The few division meetings that were organized were also viewed positively. At the end of the project, these comments regarding communication between the core team and the area teams were generally absent, except for one UNOPS specialist who noted that communication between areas, within areas, and with the central team remain poor, even at the end of the project.

> *"It has been almost six months since the project ended and a tremendous number of activities still remain to be implemented. If there is an extension of the project, then the mechanisms and channels of communication will be well regulated, well oiled. Currently, I would say that the communication system is weak, whether it is within our team, with the central team, or between our team and other partners, the DPAs, WCs. If I had to grade it on a scale of 1 to 10, I would say it was a 4."*
> *– UNOPS member, Area team*

  Thus the program would have benefited from more frequent meetings, especially between the core team experts and the area teams. As one UNOPS expert said, "an action plan explained in person in the field with live interactions is better than an attachment in an email."

## External Coherence

- **Relations between MAPM department staff and the TC-5A consultant (UNOPS).** Initially, there was a rivalry between the UNOPS staff, on the one hand, and the staff of the Work Centers (WCs) and Provincial Directorates of Agriculture (DPAs), on the other hand. Several WC

> *"There was a lack of coordination with the Ministry departments. It was difficult to follow their program. The problem that arose was that we were not informed until the day before. We needed to be given more time to allow us to arrange our schedules." – DPA member*

members complained that the UNOPS teams did not alert them of their activities and their arrival in their areas of action. Similarly, some DPA members did not feel that they were consulted. They were invited to some training sessions but there was not always any follow-through, and they were not notified of activities far enough in advance to coordinate their schedules with those of the TC-5A consultant. However, after the UGP's intervention, relations between WC/DPA staff and UNOPS staff improved and, according to UNOPS, the WCs/DPAs now view it as an ally that enhances their own actions with farmers. Conversely, the TC-5A contractor also appreciates the recommendations of the WCs and DPAs and sometimes needs their intervention in special cases, for example, when there are conflicts between farmers that UNOPS cannot settle. The WCs and DPAs are familiar with the farmers whom they have seen regularly for many years and thus have an advantage over the UNOPS teams, who do not know the populations in these perimeters as well.

### 2.3.3 Efficacy

Efficacy mainly concerns the quality of the activities carried out, i.e., the timing and outputs of the activities compared with the program objectives and the quality of the activity content. In this section we examine the timing and length of the training, the number of beneficiaries trained in relation to the initial targets, and the quality of implementation of the training, mentoring, and marketing-related activities.

#### Timing and Length of Training

An important element of the program's efficacy involves the appropriate timing of the intervention to ensure that those who are eligible to benefit from it have the opportunity to take part and that the training is held at the right time of the year. In order to achieve these objectives, the project planned the training sessions so that they would coincide with the olive tree growing calendar. So, for example, pruning training was scheduled between the harvesting and flowering periods. PAO and PU training was scheduled when the participants did not have any other obligations. For example, PU managers were not available during the olive harvesting period because that is the height of the processing campaign.

The initial TC-5A Terms of Reference [ToR] planned for the training of farmers, PAOs, and PUs to begin one year earlier than it actually did. The delivery of the TC-1A contract feasibility studies delayed the start of the UNOPS activities. Changes within the UNOPS core team in 2010 also delayed the activities. Aside from this delay, the training activities generally took place close to the time they had been planned for, and farmer training coincided with the olive tree growing cycle.

***Strengths:***

- Timing of farmer and SDFRY training

***Mixed results and areas for improvement:***

- Timing of PAO training
- Length of training

***Strengths:***

- **Timing of farmer and SDFRY training.** With the exception of the first year of the TC-5A contract, in which there were delays and turbulence due to staff changes, the actual dates of farmer training sessions were very close to the dates they had been planned for in 2011 and subsequent years. However, some modules were postponed, like Module 3 in 2012, which was delayed for three months. According to UNOPS quarterly reports, these delays were generally due to "circumstantial disruptions of the staff of trainers mobilized as a result of departures for various personal reasons," inclement weather, or the inaccessibility of some perimeters. UNOPS scheduled make-up training to alleviate these problems and, by the end of the program, had succeeded in holding the number of sessions initially planned.

  Regarding the appropriate timing of training to coincide with the olive tree growing cycle and the availability of farmers, some respondents reported a few cases in which UNOPS agents imposed the training date and location and this conflicted with farm work. One respondent in a focus group with young people also commented that "the demonstration of the harvesting technique needed to be done exactly at the time of the harvest. But this was not done." Nevertheless, one UNOPS respondent indicated that the schedule was imposed in the beginning by the TC-1A feasibility studies, but that UNOPS changed it based on the concerns of the beneficiaries and the specificities of the area. For example, soil work for olive trees had been planned for June, but because rainfall in Morocco is neither regular nor homogeneous and the soil in the area in question is very hard, the month of November was considered to be the best time for this work. UNOPS also made an effort to schedule the training at times when farmers were free; for example, when farmers were busy during the day, training could take place in the evening.

***Areas for improvement:***

- **Timing of PAO training.** The PAO training should have started at the beginning of 2011 but was delayed, partly due to the number of PAOs that had to be created before being able to

> *"The period proposed for the training was rejected because not all the farmers can participate due to the harvest. Dialogue stopped at this level. No, there was not enough consultation." – EIG president*

receive training. Modules 1 and 2, which were initially planned for between February and July, finally took place in September 2011. In 2012, the training was also rescheduled in order to achieve training objectives before the end of 2012. The presidents of the EIGs also commented that the PAO training schedule conflicted with other obligations the farmers already had, such as harvesting. They also stressed the lack of agreement between farmers and UNOPS regarding training dates. However, by the end of the program, UNOPS was able to schedule all PAO training and achieve the number of sessions initially planned.

- **Length of training.** Apart from the timing of the training, a certain number of respondents think that the length of the training and the number of training sessions were not sufficient to achieve the project objectives, although a greater number of training sessions was not necessarily possible given the project's budget. This was especially the case for youth. A respondent from the DPA stated that “young people need more training sessions combining both learning and practice.” Similarly, sessions for farmers lasted only half a day, which was not sufficient for them to properly assimilate all the techniques.

### Numbers Trained[7]

TC-5A had specific objectives in terms of the number of farmers, SDFRY, PAOs, and PUs to be trained. These objectives are shown in Table 2.2 below. The TC-5A contract provided for the management of 328 perimeters, but by the end of the program UNOPS had only received 247 feasibility studies from the TC-1A and TC-1B contracts (the UNOPS program received 32 additional non-TC-5A contract perimeters in which it was prompted to intervene upon the formation of the EIGs that were to benefit from the Catalyst Fund initiative).[8]

**Table 2.2** Objectives: numbers to be trained

| Entity | Training objectives (numbers) | Number trained | Achievement rate |
|---|---|---|---|
| Farmers | 33,000 | 29,481 | 89% |
| Sons and daughters of farmers and rural youth (SDFRY) | 6,600 | 14,902 | 226% |
| PAO members not including AWUAs[*] | 1,620 | 1,369[a] | 85% |
| PAO members including AWUAs[*] | 1,980 | 1,376[b] | 70% |
| Members **per** PAO (average) | 6 | | |
| PU managers | 100 | 105 | 105% |
| PU technicians | 200 | 192 | 96% |

a: The objective was to train 1,620 each for modules 1 and 2. UNOPS trained 1,423 in module 1 and 1,315 in module 2. This number is the mean of the two figures.
b: The objective was to train 1,980 each for modules 3 and 4. UNOPS trained 1,423 in module 3 and 1,329 in module 4. This number is the mean of the two figures.
[* Agricultural Water Users Associations]

It is important to note that the definition of a "trained farmer" has changed since the start of the project. Initially, a farmer was considered to be trained when he had participated in the four training modules intended for farmers. This definition was changed and the definition of a "trained farmer" is a farmer who participated in at least one training module.

We first describe the strengths and areas for improvement with respect to the numbers trained before giving the detailed figures for each target population.

[7] In this section, the analysis covers the TC-5A contract in its entirety and not just the activities in rain-fed areas.
[8] The TC-5A consultant had to receive a feasibility study for each perimeter in the intervention.

***Strengths:***

- Strong participation of PUs in the training
- Strong participation of young farmers in the training

***Areas for improvement:***

- Low farmer participation rates

***Strengths:***

- **Strong participation of PUs.** The interest of PUs in the training has been strong since the start, so that the project was able to achieve the objectives set in terms of numbers trained as of 2011. This high level of interest is due to the fact that the training content was particularly relevant to ensuring the operation of PUs. The training enabled PU managers to acquire the knowledge necessary to comply with the new environmental law. No make-up sessions had to be scheduled for the PU training.

- **Participation of young people.** Overall, even though the final objective was not achieved in full, the numbers trained with respect to the training of sons and daughters of farmers and rural youth are high. Young farmers displayed a certain degree of motivation for learning new production techniques and creating their own service-provider cooperatives.

***Areas for improvement:***

- **Farmer participation rates.** The UNOPS program was able to complete all the training days planned (1,320) but was not able to achieve the 50 participants per training session, which points to a problem with recruiting participants. The number of farmers to be trained was ambitious (33,000 farmers and 50 farmers per session), especially since the project experienced a delay in its first year of implementation. All the stakeholders were aware of the problem with the farmer participation rate, but, in general, the UGP considered that the TC-5A consultant had made considerable efforts to make up for this deficiency by adjusting the times for providing the training and by evaluating the trainers and replacing them when necessary. The consultant used field workers to advantage to encourage farmers to participate. They tried to choose close training locations and avoided *souk* days. Recruiting and training organization methods improved over time.

> *"I was not informed all the time, especially during outings for practice sessions. I don't know why. I had asked them to let me know. Even if the site of the demonstration is far away, I am prepared to travel, no problem. But they don't tell me." – Female farmer, Focus Group*

Despite these efforts, participant recruitment could have been done better. The program elected to go through the PAO presidents for recruiting participants and not all farmers in a perimeter were necessarily informed of the training. Some farmers in our focus groups indicated that they were interested in the training but were not always notified. Several respondents noted that field workers should have gone door to door and encouraged farmers to take part by recruiting them directly. Thus, another method for increasing the participation rate would have been to improve recruitment efforts so that the message offered regarding training reached all the beneficiaries in the perimeter.

Distribution of supplies (crates for harvesting or tools for pruning, for example) would have further motivated farmers to participate, but this did not pertain to UNOPS because the initial program design did not include material assistance. Similarly, if the Catalyst Fund had been included in the program design from the outset, the program implementation team (UGP and UNOPS) believes that this would have highly motivated farmers to participate in the training.

***Numbers Trained***

**Farmers.** Overall, the UNOPS program trained 29,481 individual farmers in at least one of the four modules on olive tree cultivation techniques in 248 perimeters, which corresponds to an 89% achievement rate. This corresponds to approximately 60% of the farmers in the target perimeters.[9] This rate is higher than what was projected by the TC-5A contract, in which 100 farmers were to be trained for each perimeter (i.e., 24,800 farmers or 51% of farmers). Although this achievement rate seems high, Table 2.3, which gives the number of farmers who participated in one, two, three, and four modules, shows that over 60% of the farmers trained took part in only one training module. According to the UNOPS final report, this is explained by "the impossibility of maintaining the stability of the groups served" because farmers only come to modules that interest them in view of their availability. As indicated above, some farmers had mentioned that the training sessions conflicted with other farming activities. Furthermore, Table 2.4 shows that only a quarter of the farmers in the target perimeters participated in any training.

[9] The TC-5A final report cites the figure of 48,828 beneficiaries for 249 perimeters. The training statistics are for 248 perimeters.

**Table 2.3** Number of farmers who took part in 1, 2, 3, and 4 modules

| Number of modules | Number of farmers | % |
|---|---|---|
| 1 module | 18,637 | 63.2 |
| 2 modules | 6,253 | 21.2 |
| 3 modules | 2,730 | 9.3 |
| 4 modules | 1,861 | 6.3 |
| **Total** | **29,481** | **100** |

Table 2.4 gives the number of individual farmers trained per module and per area (the number in parentheses indicates the percentage of the total farmer population per area that participated in that module). It can be seen that the number of farmers trained is approximately the same for each module, with the Soil Work and Fertilization module having the largest number of participants. It should be noted that the figures in Table 2.4 differ from those in the TC-5A final report. The UNOPS program offered training modules more than one time in the perimeters and a farmer may have participated in several training sessions, which could explain the differences between the figures below and those in the UNOPS report. Area 2 is the one that trained the lowest percentage of participants.

**Table 2.4** Farmer participation per module

| | Area 1 | Area 2 | Area 3 | Area 4 | Total |
|---|---|---|---|---|---|
| **Module 1: Pruning** | 3,783 (24%) | 1,330 (14%) | 3,930 (32%) | 3,121 (28%) | 12,164 (25%) |
| **Module 2: Soil Work and Fertilization** | 5,045 (32%) | 1,303 (13%) | 3,574 (29%) | 2,597 (24%) | 12,519 (26%) |
| **Module 3: Phytosanitary Work** | 4,062 (26%) | 1,170 (12%) | 3,603 (29%) | 2,432 (22%) | 11,267 (23%) |
| **Module 4: Harvesting** | 4,148 (26%) | 1,162 (12%) | 3,325 (27%) | 2,936 (27%) | 11,571 (24%) |

Source: UNOPS, "BDD globale de formation technique consolidée.xlsx" [Global Database on Consolidated Technical Training]

- **SDFRY.** The achievement rates for this training are among the program's highest. In all, UNOPS trained 14,902 SDFRY (226% achievement rate) in olive tree cultivation techniques. Table 2.5 shows the number of SDFRY who participated in one, two, three, and four modules. As with adult farmers, over 60% of the SDFRY took part in only one training module.

## Table 2.5 Number of SDFRY who took part in 1, 2, 3, and 4 modules

| Number of modules | Number of SDFRY | % |
|---|---|---|
| 1 module | 9,540 | 64.0 |
| 2 modules | 2,932 | 19.7 |
| 3 modules | 1,446 | 9.7 |
| 4 modules | 984 | 6.6 |
| **Total** | **14,902** | **100** |

Table 2.6 gives the number of SDFRY trained per module and per area. As with adult farmers, the number of SDFRY participants does not differ markedly between each module. It is noted, however, that the module with the greatest number of participants is the pruning module, which might be explained by the fact that SDFRY were interested in the creation of service-provider cooperatives and that pruning is precisely one of the services to be offered to other farmers.

## Table 2.6 SDFRY participation per module

| | Area 1 | Area 2 | Area 3 | Area 4 | Total |
|---|---|---|---|---|---|
| **Module 1: Pruning** | 1,322 | 1,039 | 2,376 | 2,252 | 6,989 |
| **Module 2: Soil Work and Fertilization** | 1,645 | 1,007 | 1,906 | 1,740 | 6,298 |
| **Module 3: Phytosanitary Work** | 1,442 | 985 | 1,472 | 1,551 | 5,450 |
| **Module 4: Harvesting** | 1,192 | 961 | 1,597 | 1,763 | 5,513 |

Source: UNOPS, "BDD globale de formation technique consolidée.xlsx"

- **PAOs.** The objective to be achieved for PAOs was 1,620 beneficiaries per module for Modules 1 and 2, and 1,980 beneficiaries for Modules 3 and 4.[10] On average, UNOPS achieved 77% of this objective with the highest rate for Module 1 (88%) (last column of the table below). UNOPS trained a total of 2,533 members of the Boards of Directors of 331 PAOs in 225 perimeters (81% of targeted perimeters).

[10] The objective with respect to numbers to be trained was 1,620 for modules 1 and 2, and 1,980 for modules 3 and 4. There were 60 PAOs (agricultural water users association/AWUA), with 6 members per PAO, that received training in the first two modules under another contract (TC-1B) and were excluded from training in these two modules under the TC-5A contract.

**Table 2.7** PAO member participation per module

| | Area 1 | Area 2 | Area 3 | Area 4 | Total | Achievement rate |
|---|---|---|---|---|---|---|
| **Module 1: Formation and Operation of PAOs** | 458 | 255 | 368 | 342 | 1,423 | 87.8% |
| **Module 2: Management and Administration of PAOs** | 392 | 234 | 328 | 361 | 1,315 | 81.2% |
| **Module 3: Introduction to the Entrepreneurial Spirit** | 386 | 312 | 340 | 385 | 1,423 | 71.9% |
| **Module 4: Types of SOPOs** | 368 | 300 | 306 | 355 | 1,329 | 67.1% |

Source: UNOPS, "BD OPA_SUIVI EAT & FORMATION_FINALE_sept2013.xlsx" [PAO DATABASE_FIELD WORKER TEAM MONITORING & TRAINING_FINAL]

In addition, UNOPS data indicate that three quarters of the PAOs targeted took part in three or four training modules, which represents a considerable advantage for these PAOs. The achievement rates are higher than for farmers and SDFRY. UNOPS explains this by the fact that the training participants are members of the boards of directors and so the target population is therefore more stable.

- **PUs.** The achievement rates for PU training are the highest in the program. Most of the PU training was completed in 2011. The training achievement rate for technicians is 96% (target of 200 technicians) and for PU managers is 105% (target of 100 managers).[11] These high participation rates can be explained by the fact that the new Law 28-07 on sanitary food safety and environmental protection motivated PU managers to participate, since the training provided the information required to comply with this law.

***The project's "spread" effect on other perimeters***

The TC-5A contract had stipulated a certain number of perimeters to be trained. The TC-5A contractor did not specify any training participation criteria – all those who were interested were able to take part in the training. Consequently, some farmers outside the intervention perimeters also participated in the training. The NORC survey data indicate that approximately 15% of those who stated that they had participated in the UNOPS training came from perimeters not targeted by the intervention. The module that generated the most interest was the pruning module (90% of farmers who participated in a training session and who were not from the treatment perimeters attended this

[11] TC-5A Final Report.

module), followed by the harvesting techniques and soil work modules (40% of these farmers participated).

### Feasibility Studies

The APP had split up the activities concerning the olive tree rehabilitation perimeters in rain-fed areas between two consultants. The first, the TC-1A consultant, had to complete feasibility studies and design action plans for each perimeter, while the TC-5A consultant had to implement these action plans.

In general, the TC-1A feasibility studies were very important for the TC-5A program to determine the needs of the beneficiaries and provide TC-5A with specific data on the characteristics of the perimeters. The studies concerned the size and location of the perimeter, slope, tree density, yield, rainfall, characteristics of the *douars* connected with the perimeter, and advantages and limitations for production, among other data. However, they posed several problems:

- First, these feasibility studies took time to be prepared and were delivered late to the TC-5A consultant. The TC-5A consultant received the perimeters in several waves. This staggered takeover of responsibility for the perimeters made organization of some logistics difficult. For example, it was difficult for the TC-5A consultant to know at any given moment exactly how many trainers and field workers to recruit without knowing when the perimeters were going to be handed over and without knowing the number of beneficiaries in each perimeter. On the other hand, the delay in handing over the perimeters had an impact on training scheduling as well, since some training had to be postponed. This also meant that some perimeters received training much earlier than others and thus that they benefitted from mentoring for a longer period. It was therefore difficult to implement the program in a homogeneous manner, and the program's impact on beneficiaries suffered.

> *"[...] receipt of the perimeters sporadically. There was the first series of 97 perimeters, then we had to wait 8 months to get the second series. That is to say the pace, that is the speed, we operated with 2 or 3 speeds. There were perimeters at the end in which we had completed 2 years, and others not even one year, and others not even 6 months. So, in other words, taken all together, we have about 240 perimeters, but when all is said and done, we have only 100-120 perimeters that were monitored for 2 full years, others 1.5 years, and others 6 months, and this heterogeneity bothered us." - UNOPS member, Rabat*

- Secondly, the content of the feasibility studies was not always accurate or useful. According to the TC-5A consultant, they worked "on the basis of figures provided by TC-1A, whereas they do not correspond to reality." For example, for one perimeter, the number of beneficiaries was calculated by multiplying the number of households by a certain number of members per household. But not all residents are beneficiaries, since a beneficiary is a person who has a plot with olive trees. Thus this led to an overestimation of the number of beneficiaries in this

perimeter. In general, the TC-5A consultant felt that the feasibility studies were not adequate. They were merely reference documents that then had to be developed further with the people in the field in order to truly understand the risks and the social context in each perimeter.

### Training Quality

Training constitutes the heart of the assistance provided by the project to farmers, PAOs, and PUs. It was therefore essential that the training be high quality to achieve the project's ultimate objective, namely better yields and higher production quality in order to reduce the poverty level of farmers.

***Strengths:***

- Training content
- Demonstration platforms/field schools

***Mixed results and areas for improvement:***

- Some subjects were too advanced for the training participants
- Lack of emphasis on the practical aspect
- Target population of the PAO training

***Strengths:***

- **Training content.** Most of the beneficiaries in the focus groups expressed their satisfaction with the content of the training and what they had learned. In general, the learning objectives of the training were achieved. Through their observations, the NORC experts gave the training very good scores in terms of quality and content, especially for the farmer and SDFRY training. Trainers communicated with farmers using the language of the area, which made taking and assimilating the module easier. And trainers gave clear answers, enabling farmers to understand problems, although the NORC experts commented that not all trainers used a participative approach. The NORC horticultural expert also made observations of 24 farmers' plots. Among those who participated in the training and applied the technique, the NORC expert reported that performance of the technique was generally good. Table 2.8 below gives the average performance quality score for some of these practices (scale from 1 "very poor" to 5 "very good"). (It should be noted that the sample for each technique was less than 24 because not all the farmers took part in the training or applied the technique.)

> *"Thanks to the training, we now know the steps that have to be followed to have quality olive oil, as well as how to do pruning, how to fertilize our orchards, how to do phytosanitary treatments." – Female farmer, Focus Group*

**Table 2.8** Quality of the agricultural techniques observed by the NORC horticultural expert

| Technique | Performance quality |
|---|---|
| Pruning | 3.1 |
| Impluvium | 3.6 |
| Basin | 3.7 |
| Phytosanitary treatment | 3.2 |

- **Demonstration platforms/field schools.** On average, a field school is at least 20 trees large, half of which are tended according to the farmer's method and the other half of which is tended according to the good practices introduced through the support of the TC-5A teams. The aim of this approach is to demonstrate to the farmer that practicing the entire technological package on the same trees will contribute effectively to improving productivity.

  The field schools were appreciated by the beneficiaries; they enabled beneficiaries to personally observe the effect of the agricultural techniques on olive trees.

***Areas for improvement:***

- **Some subjects were too advanced for the training participants.** The PAO training received the most mixed assessments. Some training sessions, like the Administration and Management module for PAOs, were too packed with information to be properly assimilated by the participants, especially for members of new, recently created PAOs. Finally, it appears that the training for women was not adequate; some women did not even seem to be able to distinguish between associations and cooperatives.

  *"For the modules aimed at PAO members, in my opinion, they are adapted to experienced members, whereas the PAOs have just been created. The content was not adapted to the managerial skills and abilities of the PAO members. There was a gap between the training content and the ability of the members to understand it." – WC member*

  *"Most women are illiterate [and] the training sessions are largely in the classroom, so for this reason we are excluded or we don't profit much, and since we also want to learn many things, we wish there was more practical training in the field." – Female farmer, Focus Group*

  The observations of PU training by the NORC expert in 2011 indicated that interactivity was the strength of field workers, who called on and involved all the participants throughout the day. This was particularly true of the "financial management and accounting, marketing techniques, and quality protocol application" component, whereas for the "labeling, bio certification, and traceability" components, not all of the participants participated because of concepts that were too abstract in relation to their abilities (techniques, culture, experience). As a result, some participants did not complete all of the training.

- **Emphasis placed on the practical aspect.** Although the training was much appreciated by the beneficiaries, they would have liked the emphasis to have been placed on the practical aspect. The theoretical aspect is of more benefit to better educated participants, whereas most male farmers have not completed enough schooling (less than 4% of the farmers in our survey had completed formal agricultural training, for example) and most female farmers are illiterate. The SDFRY would have liked more demonstrations on pruning techniques, in particular, shape pruning and not just rejuvenation pruning. These techniques are particularly important for this population, because the training is intended to encourage them to become service providers for farmers in their region.

- **Target population of the PAO training.** Training was also provided mainly to new cooperatives created as part of the program. Some EIG presidents would have liked the training to be provided to all cooperatives at the same time, since some PAOs that were EIG members had already been in existence for several years. In addition, the training included registered cooperatives as well as cooperatives in the process of becoming registered and AWUAs. Finally, for those AWUAs that received training before converting into cooperatives, some of the people involved had already taken Modules 1 and 2. Thus these people were trained twice in the same topics.

### Mentoring Quality

This section discusses the quality of the mentoring and technical assistance activities that the UNOPS field workers and technical experts provided to farmers and SDFRY, PAOs, and processing units to supervise them in the application of the techniques they learned during the training and in the marketing of their agricultural products.

***Strengths:***

- Mentoring of farmers
- Mentoring for the creation of cooperatives and EIGs
- Operation Harvest
- Field schools

***Mixed results and areas for improvement:***

- Intensity of the mentoring
- Mentoring of PUs for their upgrading

***Strengths:***

- **Mentoring of farmers.** The close mentoring of farmers on their own plots of land over a continuous period was a strength, since the Ministry's departments do not have the human or financial resources to perform this type of long-term supervision. One respondent from the UGP noted that over a period of two to three years, "the field workers succeeded in building extraordinary bonds of trust with farmers" and they play a key role in the project because they have direct and ongoing contact with beneficiaries. However, it is also noted that the level of mentoring is not the same in all the areas. Some youth in areas 1 and 4, for example, expressed that the level of mentoring that they received was inadequate or even nonexistent.

> *"At the level of the Ministry of Agriculture, whether for the DPA or the WCs, we don't have the necessary technical staff to mentor the farmers; this program has helped us a lot." – DPA member*

- **Mentoring for the creation of cooperatives and EIGs.** A major result of the project was being able to mobilize farmers to create cooperatives and EIGs despite some initial reluctance. Very few olive-growing cooperatives existed at the start of the program, so it was necessary for the project to decide in June 2011 to support farmers in the creation of new cooperatives, a necessary step for self-organization. As a result, 88 AWUAs and associations were mentored and supervised for the creation of cooperatives, 120 cooperatives were created and registered as part of the program (including 12 in perimeters that were not among the TC-5A perimeters), and 39 letters of intent to create cooperatives were filed.[12] At the end of the program, the UNOPS program counted 465 PAOs in 268 perimeters, except 11 program perimeters did not have any PAOs. Of these 465 PAOs, there was a total of 374 cooperatives, 217 (69%) of which were registered and 69 (18%) of which were in the process of becoming registered.[13] With the support of the DPAs/ORMVAs [Regional Offices for Agricultural Development] and the UGP, the project was able to facilitate the registration process for cooperatives by reducing the length of the procedure, which normally takes 10-14 months, to only 5-6 months. The creation of an EIG requires a certain number of registered cooperatives, funding, and formal documentation. It is a complex and new process for Morocco. Some EIGs, moreover, experienced administrative problems because most administrative officials did not know what an EIG was. For example, one EIG president told us that he had to wait four months to obtain their commercial registry [number] and that the bank did not want to open a bank account for them in the EIG's name. The project provided considerable

[12] TC-5A Final Report.

[13] TC-5A Final Report.

assistance in these administrative procedures, and the EIGs seem grateful for the support they received. The project made a lot of efforts to assist EIGs in preparing construction project studies and in identifying land for building their processing unit. In all, the project oversaw the creation of 22 EIGs (4 in area 1, 5 in area 2, 7 in area 3, and 6 in area 4), all of which held their statutory meeting between August 2011 and May 2013, covering a total of 113 perimeters, 156 PAOs, 5,976 members, and a surface area of 55,931 ha.[14] By the end of the UNOPS program, 42% of the cooperatives were part of an EIG. In addition, the EIGs created an EIG association, Al Alfiya, which was able to file specifications for a label. This is a huge success, especially for EIGs, which are a new entity in the olive-growing sector.

- **Operation Harvest**. Operation Harvest (or Action Harvest) consisted of close supervision of a small number of farmers so they would harvest at the proper time using the best harvesting techniques, i.e., manually or mechanically, and assistance for contact between cooperatives and high-performing PUs, thus ensuring fast delivery of olives for processing. The operation also helped farmers take part in fairs and facilitate contact between cooperatives and commercial olive and olive oil businesses. This Operation Harvest was viewed very positively, and the focus group respondents who said they were able to sell more oil or received better prices per liter of oil sold are, for the most part, the PAO members who were invited to participate in Operation Harvest 2011/2012. However, even though Operation Harvest is a positive element of the program, this component was only able to reach a small percentage of all the beneficiaries targeted by the program.

> *"Yes, the UNOPS agents are always with us at our meetings, but the decision-making is ours alone. They mentor us and help us. The helped us especially at the level of the local administrations and authorities. When we run up against a problem, we call them to help us. They are the ones who contacted the heads of the different administrations." – EIG president*

- **Field schools.** In 2010, the TC-5A contractor began developing its farmer-to-farmer approach, by means of which farmers perform demonstrations of good agricultural practices on their own olive tree plots. Thus the area teams identified farmers who would allow them to implement these practices (pruning, soil work, harvesting, etc.). These demonstration platforms thus enabled the entire set of technical measures to be demonstrated on a single plot of land so that farmers could observe the effects on olive production of applying the whole set of agricultural

> *"I discovered field schools thanks to this program. Previously, there was one outreach approach. Now we talk about field schools. It is a new, practical, and effective tool." – WC member*

[14] TC-5A Final Report.

techniques recommended by the technical assistance. At the beginning of 2011, the area teams set up these demonstration plots, called "field schools," and increased the number of these field schools annually. The field schools were a new thing for olive tree farmers. This initiative was viewed very positively by farmers and by the departments of the MAPM.

However, the choice of locations for the field schools was not always optimal. The sites for these field schools depended to a large extent on the farmer who agreed to give his plot of land for the field school and so the TC-5A team had limited control of the choice of location. Sometimes the farmer who was receptive to the field school idea was not located on a roadside where there was a lot of visibility by other farmers. There was also the situation in which the farmer who agreed was not very popular in the area, which thus prevented other farmers from coming to see the field school. By the end of March 2013, the project had set up 147 field schools, including 130 for olive trees, spread throughout the 4 areas (11th Mentoring Report, UNOPS). Despite this quite high number of field schools, our quantitative surveys show that only 11% of farmers in the treatment perimeters covered in our impact assessment visited a field school.

***Areas for improvement:***

- **Intensity of the mentoring.** The biggest criticism of the mentoring activities is that they are not sufficient. The activities were not able to reach all the beneficiaries and were not intensive enough for the beneficiaries reached. Our quantitative survey of farmers shows that only 15% of farmers in the perimeters covered in the impact study were mentored. The number of field workers was limited and they had numerous tasks, which limited their availability in the field. Some WCs also remarked that the supervision was not yet sufficient to help beneficiaries truly strengthen their skills. The focus groups with young farmers revealed that they were not always satisfied with the mentoring they received, and in some cases they indicated that they had not received any mentoring. The surveys of PAO presidents indicated that monitoring is viewed as a prerequisite for achieving the objectives assigned to the TC-5A contract: "if the program is to succeed, the organizations must be properly mentored and, above all, supervised" (PAO respondent).

> *"This activity (supervision) is not yet where it should be and was not implemented in full this year. The first year was for raising the awareness of the people and mobilizing them (they focused on the recruitment of farmers), so the field workers did not perform supervision everywhere and mentoring suffered." – UNOPS member, Rabat*

> *"Young people need multiple training sessions combining both learning and practice. For this reason, they need supervision and monitoring for 2 or more years." – DPA member*

Additionally, the members of the Ministry departments questioned, such as the DPAs and the UGP, also thought that the mentoring was insufficient to help young people create service-provider cooperatives and to train them in order for them to help their parents on the farm and to

ensure they eventually take over the farm. They need closer mentoring over a longer period of time.

- **Mentoring of PUs for their upgrading** A goal of the TC-5A contract was to mentor 100 PUs for their upgrade to standard level, including 25 to be upgraded to superior level. This upgrade would have enabled the PUs to comply with the new Law 28-07 on sanitary food safety and Law 10-95 on environmental protection (pretreatment or fees on spillage of liquid waste). This task's design had provided for assistance only in terms of developing business plans and not financial assistance for this upgrade. It seems that given the extent of the efforts to be made for the upgrade, the lack of financial motivation, and the fact that the new law is not yet enforced by the government, the project had a great deal of trouble motivating PUs to participate in this upgrade. By the end of the TC-5A program, only 43 PUs had signed a commitment letter (12th Mentoring Report, UNOPS). These difficulties, among others, led to the decision to abandon the standard and superior certification options (11th Mentoring Report, UNOPS), since it was not possible to achieve in time the minimum number of upgraded PUs for issuing the request for proposals to identify a certifying body, although 78% of PUs surveyed by NORC had made site improvements after the start of the mentoring, which may be a sign that there could have been a preliminary effect of the project's efforts.

  In fact, the PU observations by the NORC expert show that the deficiencies of the PUs are so numerous (location, design, fixtures, being under-equipped, hygienic and sanitary practices) that a large budget is needed for the upgrade. Most PUs cannot mobilize the funds to carry out the required operations. Moreover, in the short term, these investments would not translate into additional profits. Thus this constitutes a challenge for these PUs, because they would no longer be competitive or economically profitable.

### Quality of Marketing Activities

The downstream work with respect to marketing and commercialization is an important element of the TC-5A contract. In fact, in order for farmers' incomes to improve, downstream demand must increase so that they can sell their production at favorable prices. The program initiated several activities relating to the marketing and commercialization of olive oil. The UNOPS core team created a website that provides information to EIGs on olive oil prices. The TC-5A commercialization and marketing activities do not involve farmers directly, but focus rather on training and technical assistance for PAOs that carry out these commercialization and marketing activities for their members. This training and technical assistance consists of three main activities: (i) aggregation and development of connections between groups of producers, particularly Second-Order Professional Organizations and specifically EIGs, and large-capacity PUs to ensure the existence of adequate PUs

that will be able to process production in less than 48 hours in order to convert farmers' production into virgin and extra virgin olive oil; (ii) valorization of products and development of a local label; and (iii) development of a marketing plan and technical support for carrying out these activities. For a limited number of cooperatives and EIGs that are particularly promising, UNOPS also provided special assistance under the "Operation/Action Harvest" program.

***Strengths:***

- Training and support for PAOs for the production and commercialization of quality oil
- Organized visits to fairs
- Creation of the Al Alfiya label
- Price information system

***Mixed results and areas for improvement:***

- UNOPS communication regarding commercialization
- Harvest planning and storage of olive oil
- Inadequate support to EIGs for commercialization

***Strengths:***

- **Training and support for PAOs for the production and commercialization of quality oil.** The problem of valorization and commercialization of olives and olive oil was mentioned many times during our interviews and focus groups. The Moroccan olive production sector suffers from too many middlemen who obtain profits from sales without giving a portion back to farmers. Furthermore, a lack of modern PUs close to beneficiaries remains an obstacle to larger-capacity processing and storage of olive oil. The training plans drawn up by the TC-5A team took these needs into account, and the training modules for PAOs included information on marketing and commercialization, as well as on entrepreneurial spirit. For some PAOs, the project conducted Operation Harvest, which included assistance in determining the optimal period for harvesting, improved harvesting techniques, and coordination between cooperatives and PUs so that olives could be processed within 48 hours after harvesting.

  The focus group respondents and resource persons surveyed among the cooperatives reported a better knowledge of quality oil; for example, now they knew that a low acidity level was

> *"Last year, UNOPS agents supervised us during the harvest period. This is why we succeeded in having quality oil on a national scale with an acidity level of 0.2 and a peroxide level of 4.4 and 4.2. I can say that our knowledge was not all correct prior to the arrival of UNOPS. They are the ones who enabled us to improve this knowledge regarding quality, techniques, and valorization." – Farmer, Focus Group*

associated with high-quality oil. This knowledge was attributed specifically to Operation Harvest, organized by the TC-5A team.

- **Organized visits to fairs.** A prerequisite for better commercialization of olives and olive oil also lies in better knowledge of the market, particularly the demand for high-quality oil. Some respondents noted that the project helped to provide them with new commercialization opportunities outside their *douar*. The TC-5A consultant, with the assistance of the APP (which was in charge of financing and organizing the logistics of the visits), took them to national and international fairs (for example, the Salon International de l'Agriculture de Meknès [Global Food Marketplace], SIAL), and one participant even remarked that a project field worker was able to give him a potential customer. Participation in regional and international fairs in Morocco and France made a big impression on cooperative members. In fact, Moroccan farmers are not used to selling in an organized market. The olive oil market in Morocco is a bulk market. Thus it is important awareness-raising for farmers to see in person an organized market where the olive oil is high quality and sold at a better price. For some PAOs, the project also organized visits to high-performing PUs and other commercial sites (olive oil markets, superstores), and it organized factory visits and scientific workshops to which EIGs and cooperatives were invited. These are meeting points for manufacturers, producers, and scientists.

> *"Thanks to [name], our field worker, we were able to take a lot of trips and do a lot of training, and we visited different fairs in the country. It isn't like before, when we didn't know anything about what was going on outside our* douar*." – Female farmer, Focus Group*

- **Creation of the Al Alfiya label.** Although some farmers now better understand what characterizes a high-quality oil, some respondents indicated that there is still a penchant in the national market for oil that is considered poor quality. To increase market opportunities for an improved oil, some respondents believe that local tastes have to change or else that local markets should be taken into consideration when cooperatives draft their marketing plans. To these ends, UNOPS initiated a label that will provide cooperatives with quality standards and will indicate to consumers which oil is quality oil. The label concept contributes toward changing the image of Moroccan olive oil by informing consumers that there are different categories of oils and that some are more "prestigious" than others. This label, the Al Alfiya label, includes strict specifications drawn up by the project. A request for proposals was issued to identify the certifying agency, and the agency NORMACERT won this tender. The application was filed with the Direction du Développement des Filières de Production [Directorate of Production-Chain Development] (DDFP) on March 6, 2013, and the TC-5A team assisted the EIG association with submitting the label specifications to the Commission Nationale des Signes Distinctifs d'Origine

et de Qualité [National Commission for Distinctive Signs of Origin and Quality] on May 16, 2013 (12th Monitoring Report, UNOPS).

We note, however, that the applicants for the Al Alfiya label face two difficulties. One concerns the establishment and management of the documentation system, which requires technical skills primarily on the part of the manager but also on the part of the staff. The other challenge lies in the cost of certification, which can only be borne for a production volume large enough that the additional certification cost does not heavily impact the oil's cost structure. Otherwise, the sales price would exceed the acceptable psychological price even for the most loyal consumers.

- **Price information system.** The TC-5A contractor created a website that includes a page intended only for EIGs for accessing information on olive oil prices in Morocco. Each EIG and its member cooperatives have access to a password-protected private space where they can enter oil prices for all points of sale in their area. This website, www.al-alfiya.ma, also serves as a portal for Al Alfiya label olive oil orders from the general public. Our surveys indicate that at the beginning of 2013, 63% of EIGs collected data on olive and olive oil prices and reported them to the member cooperatives. However. none of them entered this information on the website.

***Areas for improvement:***

- **Communication problem regarding commercialization.** On several occasions, farmers' complaints revealed that the mentoring teams had promised to help them market their oil or had guaranteed them a certain price per liter of oil and these sales and prices never materialized (in area 3, for example). Thus it seems that there were misunderstandings between some field workers and farmers or that, out of a desire to motivate beneficiaries, field workers made promises they could not keep.

  Focus group participants in different areas stated that UNOPS had told them that better quality oil could be sold at better prices, but even at higher prices some were disappointed.

  One focus group respondent, for example, mentioned that the farmers in his PAO had hired staff and taken out a loan in order to apply the cultivation techniques, but that they were then unsuccessful in selling their oil at better prices. This led to disappointment with the project and, in one case, the *douar* refused to participate in other UNOPS training and activities. Other focus group participants complained that they did not receive any revenue from the sale of their oil at fairs, that they did not sell a sufficient amount at fairs, or about promises not kept by UNOPS.

  Some farmers appeared to have understood that the project would be in charge of selling their oil, whereas the project

> *"They told us you will sell at a dream price, but we sold at 60 DH a liter; based on what they said, we thought we would sell at 90 or 100 DH." – Young farmer, Focus Group*

was tasked only with training them to identify potential markets. In one area, according to a UNOPS respondent, an aggregator had offered a price of 40 DH/liter but the farmers were expecting a price of 60 DH/L. Believing UNOPS would sell it for them at that price, they refused to sell to the aggregator. After 4-5 months, they realized that they could not get 60 DH/L for their oil and went back to their initial decision to sell to the aggregator. However, when the oil was analyzed, its acidity level had increased and the aggregator then refused to buy it. These divergent views of the field workers' assistance in terms of marketing and commercialization suggest a communication problem.

- **Harvest planning and storage of olive oil.** Another obstacle to commercialization identified by an EIG president concerned the surface area covered by the EIG. More specifically, the surface area covered by the EIG is very large and managing the storage of olives at harvest time to minimize the delay between harvesting and processing requires considerable efforts. Moreover, storage of olives is a major problem for a number of focus group participants. The lack of storage sites and containers, which are expensive, as well as a lack of nearby PUs, constitutes a major obstacle to obtaining large quantities of high-quality olive oil. This problem could be solved in part if harvests were planned according to a precise schedule so that the quantities harvested would be adapted to the capacity level of the PUs as part of an integrated system. The project attempts to solve this problem by providing EIGs with new, large-capacity PUs. Unfortunately, these activities were delayed and the PUs had not yet been built by the end of the project.

- **Inadequate support to EIGs for commercialization.** Nineteen EIGs (90.5%) of the 21 EIGs surveyed by NORC at the beginning of 2013 reported that they had been mentored or supervised by TC-5A after the EIG was formed. This supervision was intended chiefly for construction of PUs and participation in fairs and exhibitions rather than for the development of market plans and supervision for establishing sales contracts that would have enabled EIGs to sell at more favorable prices. Furthermore, only half of the EIGs participated in fairs/exhibitions. Table 2.9 lists the activities and the number and percentage of the 19 EIGs that received this supervision. Only 31.6% were supervised for the creation of a marketing plan and only 15.8% for sales contracts.

## Table 2.9 Supervision of EIGs

| Supervision activity | Number of EIGs | Percentage |
|---|---|---|
| Selection of the site for the PU | 11 | 57.9 |
| Participation in fairs/exhibitions | 10 | 52.6 |
| Creation of a label | 8 | 42.1 |
| Creation of a marketing plan | 6 | 31.6 |
| Sales contracts | 3 | 15.8 |
| Supervision for all steps | 3 | 15.8 |
| Training | 2 | 10.5 |
| Oversight during the PU construction work | 1 | 5.3 |
| Other | 2 | 10.5 |

N=19

The mentoring/supervision that was performed was appreciated. Of the 19 EIGs, 53% were very satisfied and 42% were quite satisfied with the mentoring/supervision. The positive aspects identified were primarily the mentoring by experts and the advice that they received (nine EIGs indicated this). Just one EIG indicated that it was not satisfied because it received promises that were not kept. The weaknesses identified were chiefly criticisms of the quality of the TC-5A team representatives (five EIGs indicated this).

### Inclusion of the Gender Approach

As part of the FTTP's gender mainstreaming operational strategy (GMOS), one of the objectives of the TC-5A contract was to strengthen the capacities of women in the olive production sector. This objective places emphasis on the importance of the presence and participation of women in the training, since women have to cope with numerous structural and cultural barriers in the olive sector. For this reason, it was essential to design a plan for "putting into practice positive discrimination toward women to encourage them to greater participation" (UNOPS 2012 Annual Report). The entire MCC has a gender mainstreaming policy that had to be integrated into the APP programs from the outset. For the APP's Fruit Tree Productivity Project (FTPP), there were two axes for integrating gender: the cross axis and the pilot project axis. The cross axis involves all aspects related to training, mentoring, and upgrading. On average, 10% of participants in training modules were women (for both the adult modules and the SDFRY modules). The pilot project axis involves income-generating activities for women (there are 14 projects spread across Morocco, 6 in oasis areas and 8 in other areas). Two independent evaluations were performed regarding the cross axis and the pilot project axis. Consequently, this report does not discuss the gender aspect in depth.

***Strengths:***

- Recruitment and organization of separate sessions for women
- Presence of female field workers

***Areas for improvement:***

- Need to account for the illiteracy of women
- Lack of women in the PAO and PU training
- Membership of female cooperatives in the EIGs
- Pilot projects

***Strengths:***

- **Recruitment and organization of separate sessions for women.** The project had planned for the activities to be adapted to the conditions of women. However, the project initially faced difficulties in recruiting women for the training due to cultural constraints. The TC-5A contractor tried to overcome this obstacle by going directly to households and asking for permission to allow the women to take part in the training. Some field workers also cited having to hold awareness-raising sessions for a week or longer at the mosque, for example. Finally, the project also organized training sessions just for women and came to them by organizing the sessions close to their places of residence. When the training location is far away from their residence, women cannot travel and stay for several days because the men do not always agree to this.

> *"There is a cultural block that somewhat hinders the participation of women. There are perimeters where it is not possible for women to go out and receive training." – Field worker, UNOPS*

- **Presence of female field workers.** The project also provided for the recruitment of female field workers in each area in order to better recruit and supervise women farmers. Female field workers have easier contact with women and can more easily build relationships of trust more easily [sic]. However, there are differences between areas. Taza, in particular, had good female field workers, as did the Beni-Mellal area, whereas the Taounate area poses a problem for gender mainstreaming. These problems are historical and are anchored in the culture of the area.

***Areas for improvement:***

- **Accounting for the illiteracy of women.** As mentioned earlier in this report, many women are illiterate. It is therefore important that training be adapted to their abilities. To respond to this level of illiteracy, training must focus more on the practical

> *"Most women are illiterate [and] the training sessions are largely in the classroom, so for this reason we are excluded or we don't profit much, and since we also want to learn many things, we wish there was more practical training in the field." – Female farmer, Focus Group*

aspect in the field than on the theoretical aspect in the classroom. This also affects the creation of female cooperatives, since they are not able to fill out the required administrative documents.

- **PAO and PU training.** One problem concerning women and PAO training stems from the fact that PAO training is directed at boards of directors. But few women are members of these boards of directors except in female cooperatives. The UGP recommended including women who are not members of boards of directors but who are active and can demonstrate aptitude so as to prepare them to be able to become board members in the future. For PU training as well, there are few female technicians and managers.

- **Membership of female cooperatives in EIGs.** Another problem that was cited multiple times involves the difficulties that female cooperatives have particularly in paying their share in order to join EIGs. This is not an omission on the part of the TC-5A contractor since a budget was not allocated for aiding female cooperatives, but it could be a consideration for future projects.

- **Pilot projects.** The pilot projects received mixed reactions. Some women indicated that they benefitted from the program and think that it is a success. One woman in area 1 mentioned that "the field worker helped us a lot in setting up the pilot project for women for building a basin for vegetable wastewater." This feeling was not shared in other areas. Other women farmers mentioned having prepared a pilot project application but that they did not receive any follow-up and that the field worker never got back in touch with them. This seems to have been a communication problem. All those who submitted an application for a pilot project expected to receive aid, whereas there was only one application for which aid was not guaranteed.

> *"The pilot projects for women are extremely inadequate. At the start, 45 projects were proposed in the area; 15 were able to be executed [and] of these 15, only 6 were pre-selected. Of the 6, funding was obtained for 2." – Female farmer, Focus Group*

### 2.3.4 Sustainability

The sustainability of the Fruit Tree Productivity Project's successes is a major objective of the MCA-Morocco Compact. The creation of lasting changes requires a long-term strategy, appropriate policies, and an infrastructure and a community of key players who are engaged in the activity. All the respondents agree regarding the fact that a three-to-four year program is not sufficient to have a significant impact on the sector, and that it is absolutely necessary for the government and the MAPM to establish a strategy in order for the activities initiated by the project to continue, especially the mentoring activities. Thus, during the last year of the TC-5A contract, the project made a lot of efforts to ensure the transition of the activities with different institutions, including the departments of the MAPM (DPAs/DRAs) and the PAOs and EIGs.

In this section we examine the actions taken to ensure the sustainability of the project, as well as the risks to this sustainability.

***Strengths:***

- Strategy of perimeter transfers
- Creation of service-provider cooperatives
- Adoption of good practices in agricultural techniques

***Risks to sustainability:***

- Operationality of the Office National du Conseil Agricole (ONCA) and USGAV
- Adoption of agricultural techniques by farmers
- Operationality of PAOs and PUs
- Adoption of good PU management practices
- Construction of PUs under the Catalyst Fund
- Upgrading of existing PUs
- Establishment of partnership contracts between PUs and PAOs/EIGs
- Local market preferences

***Strengths:***

- **Strategy of perimeter transfers.** The last year of the project was dedicated to establishing a transition strategy between the project and the departments of the MAPM, especially the DRAs. In fact, the DRAs will be tasked with ensuring the continuity of the EIG mentoring and actions. With the creation of EIGs, the goal is for all support to farmers to go through the EIG. The EIGs will manage the new PUs, as well as the assistance to farmers' cooperatives. Thus the assistance that the MAPM will provide in terms of supplying material and small equipment will be carried out through the EIGs. The MCA's objective was to create about fifty EIGs, but only about twenty were able to benefit from the Catalyst Fund. Therefore the Ministry will take charge of all the EIGs at the end of the program. The national strategy consists of reorganizing the entire olive-growing sector based on the same model by grouping first-order organizations into second-order organizations and obtaining a group of EIGs, each of which will be responsible for approximately 5,000 ha. This strategy falls within the vision of the Green Morocco Plan, the third foundation of Pillar II of which focuses on self-aggregation.

  To these ends, the project prepared transfer files for the perimeters with which it had worked. The perimeters become transferable when they are "finished," i.e., when: (1) there is a registered cooperative, (2) the technical training is completed, (3) the PAO training is completed, and (4) an increase of 20 points or more in the adoption of pruning and soil working techniques has been

noted. These transfer files contain a whole battery of documents, including: (1) the perimeter's feasibility study and action plan, (2) the information sheet on the perimeter, including the location map if there is one, (3) an exhaustive list of beneficiaries, with an indication of those who are PAO members, (4) individual farmer monitoring sheets, (5) the PAO monitoring sheet, (6) the information sheet on the demonstration/learning platform, (7) the information sheet on the "integrated pest management" platform, if any, (8) a consolidated list of beneficiaries trained in the technical modules, (9) a consolidated list of beneficiaries trained in the PAO modules, and (10) the information sheet on the youth cooperatives.

A closing ceremony is organized to make the transfer of each perimeter official. This ceremony includes a representative from the MAPM, the president of the perimeter's EIG or cooperative, and a representative of the TC-5A contractor.

- **Creation of service-provider cooperatives.** One of the objectives of the TC-5A project was to prepare for the next generation to take over the farms in rural areas by training young farmers who could then become service providers. The achievements in terms of SDFRY training were very encouraging and it was felt that young people are very motivated to receive training and to apply new agricultural techniques. Several youth cooperatives were formed. By the end of the project, around thirty service cooperatives had been created by SDFRY.[15] These cooperatives are viewed as being an essential element for ensuring quality in each perimeter that must continue to be supervised and aided with grants.

- **The adoption of good practices in agricultural techniques** also increased, especially in perimeters where there were demonstrations and among farmers who participated in the training. According to our impact assessment, adoption of good practices recommended during the training increased among farmers who participated in training, particularly with respect to pruning, construction of impluviums, and use of vibrators for harvesting. See the Impact Assessment section.

***Risks to sustainability:***

- **Operationality of the Office National du Conseil Agricole (ONCA) and the Unité de Soutien aux GIE et d'Appui à la Valorisation (USGAV).** The Office National du Conseil Agricole

[15] TC-5A Final Report.

(ONCA) was created as part of the reorganization of the MAPM and will be tasked with training, mentoring, supervising, and providing technical assistance to farmers. Work Centers (WCs) will be under the umbrella of ONCA and no longer under the Provincial Directorates, and the Regional Directorates will be responsible for overseeing all work. The ONCA will be able to issue requests for proposals to establish contracts with consultant firms like for TC-5A. Creation of the ONCA had already commenced at the end of 2013, but the ONCA was not yet operational at the end of the TC-5A program. The organizational chart was in the process of being drawn up and the structures of the ONCA were not well established yet. Another unit, the Unité de Soutien aux GIE et d'Appui à la Valorisation (USGAV) attached to the Direction de Développement des Filières de Production, was created to support the EIGs. The MAPM is in the process of transferring staff from the UGP to this new unit, but this unit is not operational yet. It will therefore be difficult for the ONCA and USGAV to ensure transition. The DRAs and the EIGs and cooperatives will have to ensure this transition.

- **Adoption of agricultural techniques by farmers.** The last UNOPS quarterly report stated an increase in the rate of adoption of agricultural techniques of over 20% for most techniques, including soil work (construction of basins and impluviums) and fertilization, pruning, and good harvesting practices (use of crates, tarpaulins, and reasonable tree-beating). This adoption rate was calculated based on the number of beneficiaries in the perimeters. In fact, our impact assessment shows encouraging results regarding the adoption of good practices. Our results indicate that farmers who participated in the training increased their adoption of certain practices, particularly pruning and construction of basins, compared with farmers who did not take part in the training (see the Impact Assessment section).

  However, with respect to the adoption of new agricultural techniques, observations of the olive tree plots of a limited sample of farmers (24 in all, six per area) who received training showed that even if a farmer adopted the techniques, he did not necessarily apply them to all of his trees. It was seen that soil work and basins were adopted for almost all trees (more than 90% of trees), while phytosanitary treatments, impluviums, and harvesting by reasonable tree-beating were adopted for only about 70% of trees and pruning for only 60% of trees.

  Our interviews also uncovered some reasons for the non-adoption of new techniques by those who participated in training. Some did not have the means to purchase the necessary tools and materials, and others mentioned a lack of skilled labor. Finally, sometimes it is not possible for farmers to apply new agricultural techniques when the land does not belong solely to them (in the case of inheritances that are still jointly owned, for example) and the ownership status of their land prevents them from applying certain techniques like pruning. Lastly, sloped land and land that is far away also make the adoption of some techniques difficult.

In order for Moroccan production to increase significantly on the national level, it is therefore imperative that mentoring of farmers be continued and it will be necessary for the government to target a greater number of farmers.

- **Operationality of PAOs and PUs.** One of the upstream TC-5A activities consists of assisting PAOs in developing and becoming operational so that they can help farmers gain greater negotiating and selling power. TC-5A also had to assist associations in converting into cooperatives and mentor them so they could become members of second-order professional organizations, i.e., EIGs. To achieve this objective of sustainability at the end of the Compact, the PAOs in the TC-5A intervention areas must be viable. This means that they must be able to effectively take over the management and development of their organization. Indicators of this level of operationality include the ability to keep administrative records, regularly organize meetings, manage dues, and provide services to PAO members.

> *"The UNOPS program will end in 2013 and I find that it is a little too early for us to quit right now because there are cooperatives that are in the process of being formed and others that have problems. This is why supervision is being requested. Despite the fact that a director and a technician are going to be recruited, for example to obtain ONSSA [National Office for Food Safety] approval, I am requesting that they be supervised." – EIG president*

Although the number of PAOs increased considerably as a result of support from the FTPP project, these PAOs are still very young and are not yet fully operational. Our PAO survey indicates that, in the perimeters included in the impact assessment, the essential elements for the existence of PAOs are present: almost all PAOs (99%) have a clearly defined and registered legal status and clearly written bylaws (95%), and at least 85% of PAOs have records on general meetings, meetings of the administrative office/board of directors, member meetings, and legal records. Most (73%) hold general meetings at least once a year. Meetings of the administrative office/board of directors are held regularly – 46% hold them at least once a quarter and 46% hold them on an irregular basis. From a financial standpoint, PAOs are less organized, with 52% having financial reports and 62% having banking records.

In contrast, these PAOs have not been able to be very active yet. Half have a head office, fewer than half have offered services or organized activities for their members, and less than a quarter have played a role in operations related to the olive tree sector, such as pruning, harvesting, and soil work. The majority (73%) depend on membership fees as a source of funding.

A comparison of PAOs that were trained by TC-5A with those that were not showed that there are few statistically significant differences between them in 2013 (Table 2.10)[16] except for the fact that trained PAOs did more awareness-raising with their members (50% of trained PAOs vs. 25% of non-trained PAOs offered awareness-raising). Although there were no significant differences for the other variables, trained PAOs might be more involved in operations related to the olive-growing sector than non-trained PAOs. However, it does not appear that there was any difference between trained and non-trained PAOs with respect to quality control of their members' products, their knowledge of price information, and their request for funding.

**Table 2.10** Trained and non-trained PAOs: 2013 intermediate-term results

| Questions | Trained PAOs (%) | Non-trained PAOs (%) |
|---|---|---|
| **Type of service/activities offered** | | |
| training | 32.2 | 20.0 |
| technical support | 17.8 | 20.0 |
| mentoring | 41.1 | 25.0 |
| awareness-raising | 50.0* | 25.0* |
| funding of operations | 1.1 | 0.0 |
| provision of inputs | 1.1* | 10* |
| commercialization of harvests | 3.3 | 5.0 |
| renting of farm implements | 4.4 | 5.0 |
| management advice | 3.3 | 0.0 |
| marketing | 0.0 | 0.0 |
| defending of interests | 3.3 | 0.0 |
| advocacy/lobbying | 1.1 | 0.0 |
| organizing of demonstrations | 2.2 | 0.0 |
| N | 90 | 20 |
| **Olive-growing operations in which the PAO played a role** | | |
| mineral fertilization | 2.2 | 0.0 |
| organic fertilization | 4.4 | 0.0 |
| phytosanitary treatment | 2.2 | 5.0 |
| pruning | 26.7 | 15.0 |
| soil work | 11.1 | 5.0 |
| impluvium construction | 7.8 | 0.0 |
| irrigation | 3.3 | 0.0 |
| harvesting | 23.3 | 5.0 |
| transporting | 4.4 | 0.0 |

[16] This comparison is a 2013 descriptive comparison. This is not a double-differences analysis and any changes cannot be attributed to the project with certainty.

| Questions | Trained PAOs (%) | Non-trained PAOs (%) |
|---|---|---|
| storage | 2.2 | 0.0 |
| commercialization | 4.4 | 0.0 |
| processing | 10.0 | 0.0 |
| production of quality oil | 8.9 | 0.0 |
| bottling | 1.1 | 0.0 |
| environmental protection | 4.4 | 0.0 |
| reuse of by-products | 0.0 | 0.0 |
| other, specify | 2.2 | 5.0 |
| N | 90 | 20 |
| **PAO performs quality control of products** | 17.2 | 15.0 |
| N | 93 | 20 |
| **PAO keeps informed of olive sales price for:** | | |
| processing units | 32.3 | 35.0 |
| middlemen | 33.3 | 35.0 |
| *souks* | 45.2 | 45.0 |
| on the market | 0,0 | 0.0 |
| N | 93 | 20 |
| **PAO keeps informed of olive oil sales price for:** | | |
| middlemen | 29.0 | 35.0 |
| *souks* | 40.9 | 45.0 |
| on the market | 1.1 | 0.0 |
| N | 93 | 20 |
| **Requested funding for a project during the past 3 years** | 31.5 | 45.0 |
| N | 92 | 90 |

Finally, for cooperatives that have not been formed yet, the process of obtaining registration remains very long. This could pose an obstacle to the sustainability of the program because participants could lose interest if procedures are slow and the results are not immediate. However, the DRAs could capitalize on the project's effort with the ODCO [Cooperation Development Office] to process registration applications quickly. In addition, draft Law no. 02-11 reforming Law 24-83 (establishing the general status of cooperatives and missions of the Office du Développement de la Coopération [ODCO]) will relax the formalities and time periods required for creating cooperatives.[17]

[17] The number of members required for forming a cooperative will be lowered from 7 to only 5 members. In addition, the condition of obtaining registration in order to operate will be eliminated, and thus the cooperative can start operations after making a simple declaration to the authorities and filing its application. The territoriality requirement is also eliminated.

Because the goal is for these PAOs to work together in their perimeter to supervise farmers with respect to the entire set of technical measures in order to send quality produce to the EIGs for processing, it is very important that the Ministry ensures that these PAOs become operational. Furthermore, the lack of mentoring for PAOs that have not yet been formed into cooperatives or EIGs poses a risk that the project's success will be concentrated on a small percentage of the target population. However, with the adoption of the new law (no. 02-11), it would be possible for legal entities to become members of cooperatives, which would allow farmers to pool resources and strategic expertise to resolve the difficulties mentioned. This same law is innovative in that it authorizes cooperatives to convert into public companies.[18]

At the beginning of 2013, the EIGs appeared to have been successfully formed.[19] Twenty-one EIGs were created between December 2010 and November 2012, and all had received their registration prior to 2013. Nineteen (90%) reported that they had received TC-5A aid for the creation of the EIG. Twenty EIGs (95%) had legal status and were made up of an average of seven cooperatives, with a minimum of two and a maximum of 12 cooperatives. In 95% of EIGs, all the cooperatives or all but one cooperative had paid their contribution. The amount of the contribution was, on average, 113,000 DH, with the minimum being 10,000 DH and the maximum being 222,000 DH. Most EIGs (71%) were part of an EIG federation. It seems that the Al Alfiya label was not very well known yet because only three EIGs mentioned the name of this federation as being Al Alfiya and nine EIGs stated that the name of the federation was "Association Nationale de GIE [National EIG Association]" or "Association Nationale de Producteurs d'Olive/Huile d'Olive [National Association of Olive/Olive Oil Producers]." Only two EIGs said they had marketed oil under the Al Alfiya label.

These EIGs are not fully operational yet. Although 86% had been trained in EIG management, only 52% had clearly written bylaws, 62% met regularly, and 33% had provided training to their members. Furthermore, only 9 (43%) had a PU. These PUs were modern, two-phase PUs with a mean capacity of 20 quintals per hour.

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[18] Public companies could then have greater access to financial resources. Commercial banks grant credit more readily to public companies. Moreover, a public company can raise funds through a public offering by issuing shares and thus can increase its capital. In addition, public companies have an advantage with respect to the integration of qualified human resources. Even if they are not farmers, some investors may buy shares and be appointed to management bodies to contribute their know-how in business management.

[19] In September 2012, TC-5A worked with 21 EIGs. The NORC team received a list of these 21 EIGs and surveyed them in 2013.

According to the 11th UNOPS Mentoring Report, the mentored EIGs all used good practices (use of nets, manual or reasonable tree-beating harvesting, use of crates, and processing within 48 h), and 4 EIGs in area 1, for example, produced 65 T of oil, 88% of which was superior quality. Another EIG, the Zoyout Ait Atab EIG, even received a trophy for its oil at the Mediterranean olive oil exhibition in Meknes, which had an international jury (Spain, USA, Italy, Greece, and Morocco). Despite these encouraging signs of superior-quality olive oil production, commercialization by EIGs is still very poor. Only ten EIGs (48%) had been trained in marketing/commercialization, and only two EIGs (10%) had sales contracts – one with a superstore and another with a middleman. Only six EIGs (29%) had sold oil during the 2012-2013 season. They mainly marketed extra virgin oil at a mean price of 45.5 DH per liter. Table 2.11 shows the quantities sold and the mean prices per liter. Only three EIGs had sold oil during the 2011-2012 season (an average of 1.8 tons of extra virgin oil at a mean price of 37.7 DH per liter. Five EIGs had a bottling service and six had a label under which they marketed the oil.

**Table 2.11** Oil sold by EIGs in the 2012-2013 season

| Entity | Number of EIGs that sold | Average quantity sold | Mean price (DH/L) |
|---|---|---|---|
| Extra virgin | 6 | 24.3 | 45.5 (min. 33; max. 55) |
| Virgin | 4 | 1.3 | 42.5 (min. 40; max. 50) |
| Standard-Ordinary | 3 | 6 | 38 (min. 35; max. 40) |

n=6

The commercialization constraints mentioned by the EIGs were: oil prices that are not lucrative because the market does not value the oil and does not distinguish between quality olive oil and *souk* olive oil, a lack of advertising, and a lack of understanding on the part of farmers of the future-oriented vision of EIGs and of what goes on in cooperatives.

Even though only six EIGs had sold oil during the last season, ten had participated in national exhibitions or fairs, with three even participating in an international exhibition or fair, and eight carried out “taste-test” type marketing operations. But the marketing actions were not structured yet, because only six had a marketing action plan.

All the EIGs in our survey thought that their EIG would be in existence for more than 10 years. The risks to continued existence that they identified were chiefly poor marketing of the oil (mentioned by 11 EIGs), poor management of the EIG, and competition or conflict among the member cooperatives (mentioned by a few EIGs). Our results indicate that the low level of operationality of the EIGs makes it necessary for the Ministry to ensure that they become operational. Additionally, EIGs are viewed as key entities for commercialization, but only 42% of

the project cooperatives are members of an EIG. Future efforts to overcome the challenges relating to commercialization must include these cooperatives, either by having them join an EIG or by targeting them directly.

- **Construction of PUs under the Catalyst Fund.** The construction of new PUs under the Catalyst Fund was delayed. Construction was not able to begin until the first quarter of 2013. It was expected that the new PUs would be completed in August 2013 and that the installation of equipment would begin once the buildings were constructed. This means that the PUs will not be able to become operational until after the end of the TC-5A program, while the EIGs have only just been formed. Therefore, it is essential that the government makes sure there is a system for taking charge of these PUs, especially since the EIGs do not yet have experience managing PUs of this size (plus only 11 EIGs have been trained in PU management[20]) and the program is ending before the EIGs have been mentored for at least one olive-growing season.

- **Upgrading of existing PUs.** Another important activity with respect to the sustainability of the project involves the adoption of a business plan by PUs so they can be upgraded. The process of pre-auditing PUs by UNOPS and of assisting in the drafting of business plans led to increased knowledge on the part of private PUs in terms of upgrading their PU to meet national and international standards. However, there was decline in interest in private PUs once the Catalyst Fund arrived, because the Catalyst Fund criteria make funding available only for EIGs and not for private entities. Given the scope of the work to be carried out in order to upgrade, most PUs lost their motivation. By the end of the program, UNOPS had completed 110 business plans but only 43 PUs had signed their commitment letter, whereas the objective was to upgrade at least 100 PUs. The HACCP upgrade was started by 34 PUs that are involved in this action. By the end of the program, 16 PUs had performed more than 80% of the fit-up work, while the other 18 PUs had not yet gone beyond a 50% achievement rate.[21] This lack of motivation is problematic. A number of PUs are not yet compliant with the new environmental law, but they don't have the means or the willingness to upgrade. Our survey of PUs indicates that approximately 66% of managers made modifications to their PUs during the last growing season

> *"The PUs appreciated the training, but there is an obstacle to funding to comply with recommendations (upgrading actions). This is what makes them not agree to carry out business plans. They give up. The scope of the work is so large that they lose their motivation." – UNOPS, Area Team*

[20] EIG survey data from the beginning of 2013.

[21] TC-5A Final Report.

(2012-2013), which is a first step in the right direction. Most of them (78%) made site improvements, which is often one of the modifications necessary to comply with the new law.

Observations of PUs showed that the objective of putting a quality system in place (especially for HACCP superior quality) can be difficult to achieve given the abilities of the PU technicians. The system design and the vast number of its components and their articulations are fundamental aspects that are only accessible to persons with at least a bachelor's + 4 level university education. The HACCP system is implemented in PUs with oversight by UNOPS experts. It is doubtful that it will be appropriated by the staff of PUs. Our surveys indicate that the program succeeded in raising the awareness of only a small number of PU managers regarding the concepts of good hygiene practices (GHP) and HACCP. Approximately 37% of managers (33 PUs) who attended training were familiar with these concepts.

- **Adoption of good PU management practices.** The adoption of good PU management practices was not observed in our survey results. The tables below (2.12 and 2.13) present data from the surveys of PU training participants for 2011 (prior to their participation in the training) and for 2013 (after their participation in the training). Although it is not possible to attribute the changes observed to the intervention with certainty,[22] we observed an improvement in knowledge in terms of HACCP principles among PU training participants and an increase in the percentage of PUs that provide training for their employees.

**Table 2.12** PUs 2011 and 2013: GHP and HACCP

| | Year | | | |
|---|---|---|---|---|
| | 2011 | | 2013 | |
| | % | Number | % | Number |
| Are you familiar with good hygiene practices (GHP)? | 20.0 | 15 | 35.5 | 27 |
| Are you familiar with the HACCP principles? | 12.0** | 9 | 35.5** | 27 |

**p<0.01

As Table 2.13 shows, there are no significant changes in practices between 2011 and 2013 except for the conducting of training for employees, which increased from 2.6% to 27.6% of PUs. Although the differences were not statistically significant for the other variables, the changes observed are encouraging and are moving in the right direction. Therefore it may be that our sample was to small to detect these differences statistically. For example, the percentage of PUs

[22] The PU survey respondents were PU managers and technicians who were selected by the project and invited to take part in the training. As described in Section 3 on the impact assessment, the attribution of causality between the project and the outcomes requires a counterfactual, which does not exist for the PU survey.

that use aerated crates for storing their olives before crushing them increased from 14.5% to 30.7%, and the percentage of PUs that store oil in stainless steel containers increased from 17.1% to 32.9%. The percentage of PUs that avoided contact with air during bottling of the oil also increased, from 67.1% to 77%. The survey data also suggest more frequent cleaning of processing equipment, an increase in staff training, and a reduction in waste disposal in watercourses.

**Table 2.13** PUs 2011 and 2013: intermediate-term results

| | | Year | | | |
|---|---|---|---|---|---|
| | | 2011 | | 2013 | |
| | | % | Number | % | Number |
| How are the olives transported to the unit? | In open crates | 21.1 | 16 | 26.3 | 20 |
| | In closed crates | 0 | 0 | 3.9 | 3 |
| | In bags | 76.3 | 58 | 75 | 57 |
| | In bulk | 19.7 | 15 | 18.4 | 14 |
| Where do you store the olives before crushing them? | Non-enclosed open space | 21.1 | 16 | 31.6 | 24 |
| | Uncovered shed | 18.4 | 14 | 34.2 | 26 |
| | Site with roof | 60.5 | 46 | 57.9 | 44 |
| | Other | 1.3 | 1 | 1.3 | 1 |
| How do you store the olives before crushing them? | On the ground | 21.1 | 16 | 18.7 | 14 |
| | In bags | 69.7 | 53 | 88 | 66 |
| | In non-aerated crates | 2.6* | 2 | 5.3* | 4 |
| | In aerated crates | 14.5 | 11 | 30.7 | 23 |
| | Other | 3.9 | 3 | 0 | 0 |
| Number of storage days before crushing | Crushed the same day | 19.7 | 15 | 23.7 | 18 |
| | 1-2 days | 51.3 | 39 | 44.7 | 34 |
| | 3-5 days | 14.5 | 11 | 15.8 | 12 |
| | 6-7 days | 7.9 | 6 | 14.5 | 11 |
| | 8-30 days | 6.6 | 5 | 1.3 | 1 |
| In what type of container do you store the oil obtained? | Plastic | 72.4 | 55 | 61.8 | 47 |
| | Stainless steel | 17.1 | 13 | 32.9 | 25 |
| | Earthen (nquire) | 23.7 | 18 | 23.7 | 18 |
| Where do you store the oil obtained? | In a room with no windows | 22.4 | 17 | 14.9 | 11 |
| | In a room with windows | 63.2 | 48 | 82.4 | 61 |
| | Outdoors or in an uncovered site | 5.3 | 4 | 1.4 | 1 |
| | In an underground tank (nquire) | 15.8** | 12 | 1.4** | 1 |
| Is the oil in contact with air during storage? | Sealed | 67.1 | 51 | 77 | 57 |
| | Open air | 32.9 | 25 | 23 | 17 |
| Oil stored in a controlled atmosphere | | 2.7 | 2 | 2.6 | 2 |
| % having a bottling service | | 9.3 | 7 | 11.8 | 9 |
| Type of bottle | Clear plastic | 0 | 0 | 22.2 | 2 |
| | Clear glass | 25 | 2 | 66.7 | 6 |
| | Colored glass | 85.7 | 6 | 66.7 | 6 |
| | Cans/plastic barrels | 95 | 19 | 100 | 22 |

| | | Year | | | |
|---|---|---|---|---|---|
| | | 2011 | | 2013 | |
| | | % | Number | % | Number |
| How is the oil transported to the customer? | Glass bottle | 5 | 1 | 0 | 0 |
| | Plastic bottle | 5 | 1 | 0 | 0 |
| | Other | 5.3 | 1 | 13.6 | 3 |
| % that made modifications to the unit during the past 2 growing seasons | | 62.2 | 46 | 71.1 | 54 |
| Type of modification | Site improvements | 62.2 | 46 | 71.1 | 54 |
| | Equipping with machinery and fittings | 37.5 | 18 | 20.4 | 11 |
| | Renovation of equipment | 10.4 | 5 | 13 | 7 |
| | Acquisition of measuring and control equipment | 2.1 | 1 | 5.6 | 3 |
| | Construction of toilet facilities | 16.7 | 8 | 9.3 | 5 |
| | Water purification | 4.2 | 2 | 1.9 | 1 |
| | Other | 10.4 | 5 | 16.7 | 9 |
| Cleaning frequency | Every 0-8 hours | 5.3 | 4 | 7.9 | 6 |
| | Every 9-16 hours | 17.1 | 13 | 30.3 | 23 |
| | End of each day | 55.3 | 42 | 40.8 | 31 |
| | Every 2 days | 1.3 | 1 | 3.9 | 3 |
| | Less often than once every 2 days | 21.1 | 16 | 17.1 | 13 |
| What type of waste is produced by your processing process? | Vegetable wastewater | 59.2 | 45 | 64.5 | 49 |
| | Olive cake | 60.5 | 46 | 64.5 | 49 |
| | Mixture of olive cake + vegetable wastewater | 43.4 | 33 | 35.5 | 27 |
| | Wash water | 84.2 | 64 | 72.4 | 55 |
| Where do you dispose of this waste? Vegetable wastewater | Watercourse | 4.4 | 2 | 0 | 0 |
| | Agricultural field | 2.2 | 1 | 0 | 0 |
| | Vacant lot | 2.2 | 1 | 6.1 | 3 |
| | Drainage basin | 88.9 | 40 | 91.8 | 45 |
| | Other | 2.2 | 1 | 2 | 1 |
| Where do you dispose of this waste? Mixture of olive cake + vegetable wastewater | Watercourse | 3 | 1 | 0 | 0 |
| | Agricultural field | 6.1 | 2 | 0 | 0 |
| | Vacant lot | 9.1 | 3 | 7.4 | 2 |
| | Drainage basin | 78.8 | 26 | 92.6 | 25 |
| | Other | 3 | 1 | 0 | 0 |
| Where do you dispose of this waste? Wash water | Watercourse | 23.4 | 15 | 14.5 | 8 |
| | Agricultural field | 0 | 0 | 1.8 | 1 |
| | Vacant lot | 4.7 | 3 | 10.9 | 6 |
| | Drainage basin | 70.3 | 45 | 65.5 | 36 |
| | Other | 1.6 | 1 | 7.3 | 4 |
| % that provided training for employees during the last growing season | | 2.6*** | 2 | 27.6*** | 21 |

* p<0.1, ** p<0.05, *** p<0.01

- **Establishment of partnership contracts between PUs and PAOs/EIGs.** One of the goals of the TC-5A contract was to integrate upstream and downstream and establish connections between

farmers (via PAOs) and PUs to ensure speedy processing in order to obtain virgin- and extra virgin-quality oil. After the addition of the Catalyst Fund, the project concentrated its actions on the creation of EIGs and their own PUs rather than on the creation of these partnership contracts with existing PUs. As a result, according to UNOPS, a total of only 21 contracts (which represents 6% of the cooperatives) had been drawn up by the end of the program. However, not all PAOs are members of an EIG (although this is the long-term goal); 192 of the 356 farmers' cooperatives (54%) involved in the project do not belong to an EIG[23] and so do not have access to a PU through an EIG. In addition, our survey at the beginning of 2013 showed that only 43% of EIGS had a PU to provide a schedule for the processing of the members' olives.

- **Oil certification cost.** The certification costs that must be paid each year are high. The cost price of labeled oil could be very high if the volumes of oil produced are limited (assuming certification fees of 500,000 DH, the markup would be 25 DH/L for a production of 20 T but only 10 DH/L for a production of 50 T). Thus, with overhead and operating costs, the cost price of oil could exceed 60 DH/L for small productions, which would make retail prices deterrent or even inaccessible (80-120 DH). Even with negotiating to reduce certification costs, it is difficult to sell large volumes without a very elaborate marketing plan and an aggressive commercial policy, which currently has not been achieved. Moreover, the label cannot generate its full effect right away. It will take several years to gain recognition and credibility. This period depends on the effectiveness of the label promotion policy, but especially on how strictly the system is managed to win the trust of the market and of consumers.

- **Local market preferences.** Another risk to the sustainability of the program involves local market preferences concerning olive oil. The objective of the TC-5A program was to improve the quality of olive oil and to create a label to indicate to consumers that the oil is quality oil. However, Moroccan consumers prefer oils of character with very pronounced tastes and aromas and favor a direct relationship with producers with whom they have established relationships of trust over time. Thus short channels based on the recommendations of key influencers or social network circles (family or acquaintances) are preferred. Fairs and exhibitions (the one in Meknes, for example) are viewed by consumers as points of sale of authentic products and not a space for the discovery of products to then buy elsewhere. There is therefore a risk of a product-market mismatch. Labeled oil is aimed at a mostly Moroccan customer segment that appreciates oils of character. These consumers are used to using these oils that come from their regions of origin

[23] UNOPS monitoring data, September 2013.

(Azilal, Taounate, Ouezzane, etc.). They remain very attached to these oils of [local] provenance. Also, they have developed buying behaviors over time, purchasing directly from PUs (either themselves or via trusted middlemen). Purchases are made all at once in bulk and large volumes to meet personal or giving needs. It is not certain that these majority customers for these oils would accept prices that are more than twice as high when authenticity is not currently guaranteed in their eyes. The modern distribution system is not trusted to capture the large consumer population. The Moroccan government must therefore continue to work on this through communication and by strengthening enforcement of the law prohibiting bulk sales of olive oils to consumers and the PU registration law. These measures can contribute toward giving the quality of packaged oils on the market credibility. Similarly, strictness in the Al Alfiya label certification system would reassure customers regarding the expected quality.

In general, the consensus is that the TC-5A activities should not cease with the end of the MCA-Morocco Compact in 2013. Rather, they should permit the initiation of increased production of olives and other tree fruits that would continue beyond the Compact. This would enable a large portion of the rural population in Morocco to be involved in the large-scale production of high-value agricultural products and cause these Moroccan agricultural products to gain greater recognition on the international level. These improvements in production and access to selling markets should thus continue and be multiplied after the end of the Compact. As one of the WCs surveyed mentioned, *"the effects will not be obvious for 5 to 10 years. For the Ministry, the problem is clear. This is why we will continue helping farmers even though the project is ending. They simply need to work and organize. The Ministry's policy is aimed at helping them for aggregation."*

# 3. Impact Assessment

The design of the impact assessment of the olive tree orchard rehabilitation in rain-fed areas project is based on measurement of the net change in the agricultural income of olive-producer households that can be attributed to the intervention. NORC will therefore endeavor to answer the following main research questions defined by the APP's Direction du Suivi-Evaluation [Monitoring and Evaluation Directorate]:

- What is the impact of the olive tree orchard rehabilitation component on farmers' incomes in the targeted rain-fed areas?
- Did olive production improve in volume and value?
- Were the popularized techniques adopted by farmers?
- Has there been an improvement in the quality of the olive oil produced?
- Did the professional agricultural organizations play their role in the development of the olive-growing sector?
- Has the knowledge generated by the project spread in the vicinity of the perimeters in which the project was implemented?
- What are the differences in the impact of the project activities by gender, age, income?
- What are the unexpected impacts of rehabilitation?

The major principle of the impact assessment is the construction of a counterfactual, i.e., to identify what would have occurred if the intervention had not taken place. To create this counterfactual, NORC collected data from matched perimeters[24] that were randomized to either the treatment group, which received the intervention, or the control group, which did not receive the intervention. The assessment is designed to capture the differences between the treatment perimeters and the control perimeters, as well as the differences over time from baseline in 2010 to the final monitoring in 2013. The assessment plan uses the "difference-in-differences" or "double-differences" method.

[24] A perimeter is a group of neighboring plots of land and represents a geographical area measuring 200-250 hectares.

## 3.1 Methodology

### 3.1.1 Assessment Indicators

The estimated project results were drafted during the process of developing the MCA-Morocco Compact. It was projected that olive tree rehabilitation and intensification would increase net agricultural income by 15.6% by the end of the third year of implementation of the project, revenue from olive production by 29.8%, and also olive tree productivity, assuming actual price stability.[25] The ultimate goal of the rehabilitation program is to contribute toward reducing poverty among rural households located in rain-fed areas.

Thus the primary indicators of the impact assessment are:

- Net agricultural income of farmers[26]
- Revenue from olive production
- Quantity of olives produced
- Quantity of olive oil produced and sold

Besides these indicators, the impact assessment also examines the effects of the intervention on the intermediate-term results to be achieved, namely:

- Adoption rate of recommended agricultural practices, particularly:
    - Pruning: one of the major practices for increasing olive production. There are several types of pruning, including pruning to shape adult trees, pruning for young trees, and rejuvenation pruning.
    - Soil work, including construction of basins/impluviums: our assessment concerns olive tree orchards in rain-fed areas, so basins and impluviums are essential tools for collecting rainwater and irrigating orchards.
    - Fertilization: Reasonable fertilization to permit hardiness and increased productivity of trees, as well as better-caliber olives.
    - Phytosanitary treatments: pest control (insects, fungi, etc.) contributes to increasing the yield and quality of olives.

[25] These targets, calculated based on the June 2012 M&E plan, differ from the original targets. In 2010 and 2011, it was projected that net agricultural income would increase 8.4% and [both] revenue from olive production and olive tree productivity would increase 30.8%.
[26] See Appendix D for the definition and calculation of agricultural income.

- Good harvesting practices, including use of a vibrator, tarpaulins, and transporting in open crates: olives must be high quality in order to get quality oil. Harvesting by the traditional tree-beating method damages the fruit and the tree, which then produces less the next year. An objective of the intervention was thus to induce farmers to practice reasonable tree-beating or use vibrators for mechanical harvesting. Similarly, use of tarpaulins and transporting olives in open crates are the best practices for safeguarding the initial quality of the olives.

All these practices were, in fact, covered in the farmer training provided for in the TC-5A contract in the form of four separate modules: Module 1 – olive tree pruning, Module 2 – soil work and construction of basins, Module 3 – phytosanitary treatments, and Module 4 – olive harvesting.

### 3.1.2 Methodology of the Impact Assessment

***General Considerations***

The issue we tried to solve in the assessment of the impact of this intervention is the construction of a counterfactual, i.e., identifying what would have occurred if the intervention had not taken place. The approach used to establish the *causal* impact of an intervention is an essential consideration for any impact assessment. This is, in fact, because in most interventions, the results of interest are affected not only by the intervention itself but also by a whole panoply of other factors. As an example, in the current context we expect that beneficiaries will experience increases in agricultural income as a result of their participation in the program. However, changes in agricultural income are also affected by inclement weather, prices, access to credit, and other factors unrelated to the intervention. Consequently, the assessment must not simply measure changes in terms of results for beneficiaries. The assessment must also include an approach for identifying observed changes stemming from the project rather than from other factors.

To distinguish the impact of the intervention from the influence of other factors, impact assessments use the Neyman-Rubin causal model or "potential outcomes framework." [27] The model's guiding principle governing the definition of the causal impact of the intervention on an outcome for the beneficiary population requires that we take into account what could have occurred with this beneficiary population over the same period if there had been no intervention. Naturally, insofar as the

[27] Rubin, Donald (1974). "Estimating Causal Effects of Treatments in Randomized and Non-randomized Studies," Journal of Educational Psychology, 66, 688-701.

beneficiaries participated in the intervention, we are not able to directly observe what could have happened to them without the intervention.

Since we cannot observe the effects on the beneficiaries in the absence of the program, a plausible alternative consists of measuring the outcomes for a group of similar individuals over the same period. The outcomes for this control (or "comparison") group are used to represent counterfactual scenarios, i.e., hypothetical outcomes for the beneficiaries in the absence of the program. This representation is accurate because the factors other than the intervention that influence the outcomes affect the beneficiaries as well as the control group in the same way.

The model of excellence for identifying a control group is generally considered to be the randomized controlled trial (RCT) approach. This is an experimental study incorporating randomized assignment to treatment and control groups. Under such an approach, a larger group of potential beneficiaries is selected prior to implementation and individual units are randomly assigned to either the treatment group or the control group. In the case of a sufficiently large sample, a control group that is established in this manner provides a very reliable indicator of the counterfactual scenario, inasmuch as the individual units have an equal chance of being assigned to either of the groups. In the event that randomization proves impossible, a quasi-experimental alternative model can be used to approximate a control group. However, these alternatives run the risk of selection bias due to underlying differences between the treatment groups and control groups.

***Assessment Methodology***

The assessment of the MCA-Morocco olive tree orchard rehabilitation and intensification in rain-fed areas activity uses the reference model in terms of RCT approach called matched-pairs cluster randomization design in which cluster refers to the intervention perimeter. In fact, the olive tree orchard rehabilitation of the Fruit Tree Productivity Project (FTPP) was planned for 45,000 hectares of olive trees spread over 17 provinces. This area, which includes several rain-fed regions in Morocco, was divided into groups of neighboring plots of land called "perimeters." A perimeter represents a geographical area measuring on average 200-250 hectares of olive trees. From an analytical point of view, these groups of plots are thus viewed as clusters. The cluster system permits organization of the logistics of the intervention where the treatment is applied to a large block like small units/plots of land, on the one hand, and an attempt to control variability factors by grouping the plots by homogeneous groups and eliminating the effects of certain potential confounding variables (co-variables), on the other hand.

The perimeters included in this impact assessment had to be composed of 70 perimeters[28] in Tranche 2 of the TC-1A contract[29], which began receiving the TC-5A consultant's intervention toward the end of 2010-beginning of 2011. They were identified based on historical records concerning farmland covered by other agricultural programs and State interventions.[30] They were also studied for eligibility in the intervention based on a certain number of criteria. These criteria include: geographical location in non-irrigated, rain-fed agricultural areas suited to the olive tree species, reasonable distance to markets, accessibility, existence of a passable road and paths, existence of technical mentoring staff, proximity to technical services, existence of an equipment supply and maintenance infrastructure, rainfall greater than 350 mm, topographical characteristics (5-50% slope), suitable soil, *Melk* or similar status of plots, predominance of small- and medium-sized farms (≤ 5 ha), orchard age greater than 10 years, current density of at least 50 trees/ha, and the potential beneficiaries' commitment to and compliance with rehabilitation actions.

For each perimeter included in the intervention, a "matched pair" of perimeters was thus initially identified. The two perimeters in each matched pair were selected to be as much alike as possible based on the criteria mentioned above. Then one perimeter from each pair was randomly chosen to participate in the project, while the other was assigned to the control group. As a result of this randomization procedure, the group of perimeters in the control group is a particularly accurate representation of what could have occurred in the treatment group in the absence of the project. [31]

The assessment also incorporates the difference-in-differences or "double-differences" methodology, i.e., the farmers in the treatment and control groups were surveyed before the start of the intervention to obtain a baseline, and these same farmers were also surveyed at the end of the project. Consequently, we are able to compare the change in outcomes between the two groups before and after the program (see Figure 3.1). The result is an analysis based on the double-differences method that can be reflected by the following equation: $(T_F\text{-}T_B) – (C_F\text{-}C_B)$ where T represents the treatment perimeters and C refers to the control perimeters, while B refers to the baseline and F refers to the final situation.

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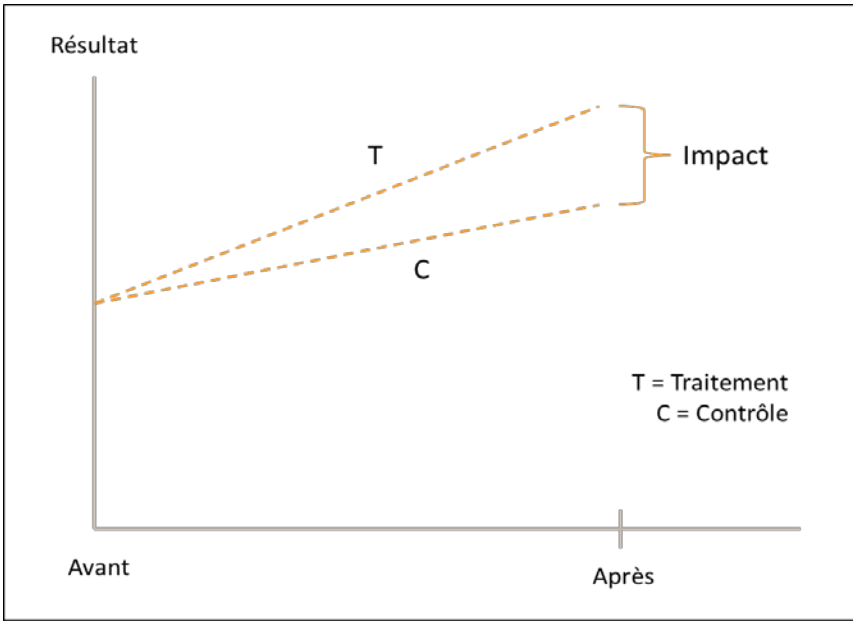
[28] The exact number of treatment perimeters changed for various reasons. See Section 3.1.3.
[29] "Étude de faisabilité technique et environnementale du projet arboriculture en zone pluviale [Technical and Environmental Feasibility Study of the Fruit Tree in Rain-Fed Area Project]." Tranche 2 of this contract involves the 2010 treatment perimeters; these perimeters make up Tranche 1 of the TC-5A contract tasked with implementing the program.
[30] These perimeters do not represent a random sample of olive tree orchards in rain-fed areas in Morocco or of the total intervention area of the Fruit Tree Productivity Project. This means that no inferences can be drawn from the results with respect to the rest of the population under the current circumstances. So any generalization of the results of this study should therefore be done with caution.
[31] An independent contractor was tasked with the randomization step for this assessment under the ME-5B contract.

**Figure 3.1** Differences-in-differences




An issue that the assessment methodology must include is the voluntary adoption of the intervention. The project offers training to all farmers growing olives in the treatment perimeters, but not all farmers elect to participate in the training. From the standpoint of identifying an appropriate control group, we are faced with a problem. The difficulty stems from the fact that farmers who want to participate in training are slightly different from those who do not participate, which can have a marked effect on the results. As an example, farmers who take part in training will have a tendency to be more open from an entrepreneurial or business standpoint than those who do not participate. When we analyze the outcomes for these farmers, we have to make a distinction between the outcomes of the program's impact and the outcomes that stem from the fact that farmers participating in the intervention could have a more entrepreneurial spirit. Consequently, a valid control group must be composed of a subset of farmers in the control perimeters who would have participated in training and who therefore supposedly have a similar entrepreneurial spirit. This presents a challenge because we are not in a position to determine which farmers in the control perimeters would have opted to take part in the training.

There are several assessment approaches for handling the issue of the voluntary adoption of the intervention. Our assessment includes three modeling approaches, which are:

- **Intention-to-treat (ITT):** this approach takes into account the average impact of the program on those to whom the program was offered and not on those who participated in it. Consequently, we compare the average outcomes for all farmers in the treatment perimeters with those in the control perimeters. The ITT analysis has the advantage of definitively

eliminating any bias that may arise as a result of a voluntary adoption of the project. However, it has the disadvantage of underestimating the benefits of the program, particularly if the participation rate is low. Grouping program beneficiaries with other farmers in the treatment areas who opted not to participate in the training further complicates detection of the impact. The ITT analysis is used a lot in medical trials to explain the fact that some members of the treatment group do not comply with treatment, and it is frequently used in impact assessments of development programs (e.g., Behrman and Hoddinot 2005,[32] Karlan and Zinman 2010,[33] Schady and Paxson 2010[34]).

- **Treatment-on-the-treated (TOT):** in a second approach, we ignore the effects of selection bias introduced by voluntary adoption. Here we compare the average outcomes for farmers who participated in the training with the average outcomes for farmers who did not participate in the training. This is called "treatment-on-the-treated" inasmuch as we account for the impact of the treatment only on the farmers treated. For the reasons described above, this approach runs the risk of not providing an accurate estimation of the program's impact because we cannot distinguish between the effects of the program and those of other factors that might have favored the participation of some farmers. Our TOT estimation of the impact combines both the project's impact and the impact of the selection bias. However, the TOT estimation is still used as a practical exercise, since it provides an upper limit on the potential impact.[35] While the TOT estimation has a tendency to overestimate the impact, it may prove safer to conclude that the program's impact cannot be greater than the TOT estimation. Furthermore, the TOT results can be more convincing for some variables with little risk of selection bias. As an example, our results illustrate that farmers who participated in the training were more likely to start pruning their trees. Although our TOT estimations do not rule out the possibility that these farmers could have pruned their trees without the program, it is reasonable to assume that major changes in the pruning rate among trained farmers result directly from the program.

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[32] Behrman, Jere and John Hoddinott (2005). "Programme Evaluation With Unobserved Heterogeneity and Selective Implementation: The Mexican PROGRESA Impact on Child Nutrition," Oxford Bulletin of Economics and Statistics, August 2005, vol. 67, iss. 4, pp. 547-569.
[33] Karlan, Dean and Jonathan Zinman (2010). "Expanding Credit Access: Using Randomized Supply Decisions to Estimate the Impacts," Review of Financial Studies, January 2010, v. 23, iss. 1, pp. 433-64.
[34] Schady, Norbert and Christina Paxson (2010). "Does Money Matter? The Effects of Cash Transfers on Child Health and Development in Rural Ecuador," Economic Development and Cultural Change, October 2010, v. 59, iss. 1, pp. 187-229.
[35] Under the assumption that voluntary participation does not bias our estimations downward, i.e., that farmers who opt to participate in training would otherwise have experienced the same or better results compared with those who opt not to participate in training.

- **Treatment-on-the-treated with instrumental variable (TOT-IV):** another approach takes into account TOT but uses the technique of instrumental variables to deal with the issue of selection bias. Our TOT-IV estimation uses a randomized assignment to treatment as an instrument for participation in the program. This approach eliminates selection bias as long as certain hypotheses are met. These hypotheses, described by Anagrist, Imbens and Rubin (1996),[36] are the following: the treatment perimeters must be randomly selected, the farmers in the control group cannot participate in the training, and the training must only affect outcomes for those who participated in it. In the present context, it is important to note that these hypotheses are not met perfectly. Our data indicate that some farmers in the control group responded that they took part in TC-5A training. Furthermore, the training can affect farmers in the treatment perimeters who did not participate in it if they learn the agricultural practices from farmers who did participate. Nevertheless, insofar as these hypotheses closely correspond to our context, the TOT-IV approach will provide a useful estimation of the impact. Ashraf, Gine and Karlan (2009)[37] use this approach to evaluate agricultural training and an assistance program in Kenya as part of a model similar to ours. Cattaneo et al. (2009)[38] also use this strategy to identify the important and significant impacts of a housing project in Mexico.

Our approach for the assessment consists of estimating these three model types in order to be able to compare the results. Each of these models provides diverse observations and has advantages and disadvantages. The approach of the ITT model is the most convincing with regard to elimination of selection bias, but it runs the risk of not being able to detect impacts that might occur. In contrast, the TOT model is the most sensitive in terms of impact detection but it does not take into account the problem of selection bias. The TOT-IV model provides a good intermediate approach but requires assumptions that may be doubtful in the present context. By incorporating the three approaches and comparing the results, we obtain a more solid and richer set of results than if we had used only one model.

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[36] Angrist J., G. Imbens and D. Rubin (1996). "Identification of Causal Effects Using Instrumental Variables," Journal of the American Statistical Association 91 (434) pp. 444-54.
[37] Ashraf, Nava, Xavier Gine, and Dean Karlan (2009). "Finding Missing Markets (and a Disturbing Epilogue): Evidence from an Export Crop Adoption and Marketing Intervention in Kenya," American Journal of Agricultural Economics 91 (4) pp. 973-990.
[38] Cattaneo, Matias, Sebastian Galiani, Paul Gertler, Sebastian Martinez, and Rocio Titiunik (2009). "Housing, Health, and Happiness," American Economic Journal: Economic Policy 1 (1) pp. 75-105.

### 3.1.3 Changes in Status of Perimeters

Impact assessments become complicated when units (i.e., perimeters in the context of this assessment) assigned to the control group change group along the way and receive treatment, or when treatment units that should have participated in the intervention do not end up participating in it after all. This situation occurred in the case of some perimeters in this assessment. At the start there were 71 pairs of treatment and control perimeters, but there were changes in the assignment of these perimeters to the treatment and control groups for several reasons: (1) some control perimeters were located next to treatment perimeters (in fact, these were large perimeters that had been divided in two) and it was decided to group them into a single treatment perimeter (8 pairs where both perimeters became treatment perimeters); (2) some perimeters refused the TC-5A activities (5 pairs affected); (3) some control perimeters received treatment anyway for various reasons, for example, the TC-1A consultant had conducted feasibility studies in the control perimeter by mistake or the control perimeter was part of another intervention tranche (5 control perimeters that became treatment perimeters). After all these changes, there are a total of 84 treatment perimeters (three of which only received a portion of the intervention before refusal by the population) and 58 control perimeters (two of which refused the intervention and never received any training) that are included in the impact assessment. Of the original 71 pairs, 53 pairs remain. (See Appendix A for the background on each perimeter. The "compromised" pairs are highlighted.)

Despite these changes, the original design of the assessment remains rigorous since the majority of the treatment/control pairs were not compromised.

## 3.2 Data

### 3.2.1 Description of the Sample and Data Collection

For each data collection, surveys of farmers were conducted in the treatment and control perimeters. The sample of farmers was drawn from lists of farmers who had plots of land in the treatment and control perimeters using a multilevel sampling plan. The farmers were randomly selected in each perimeter using a systematic sample. Proportional assignment was then used to distribute the total farmer sample among the various perimeters (distribution proportional to the number of farmers in each perimeter). Thus the same farmers were surveyed in each survey.

NORC collected data from farmers each year between 2010 and 2013, i.e., a total of four data collections were performed with farmers. The data collections in 2010 and 2011 correspond to the baseline. In actuality, the implementation of the activity was delayed and consequently the 2011 data were collected prior to the start of the activity, or in four perimeters at the very start of the activity;

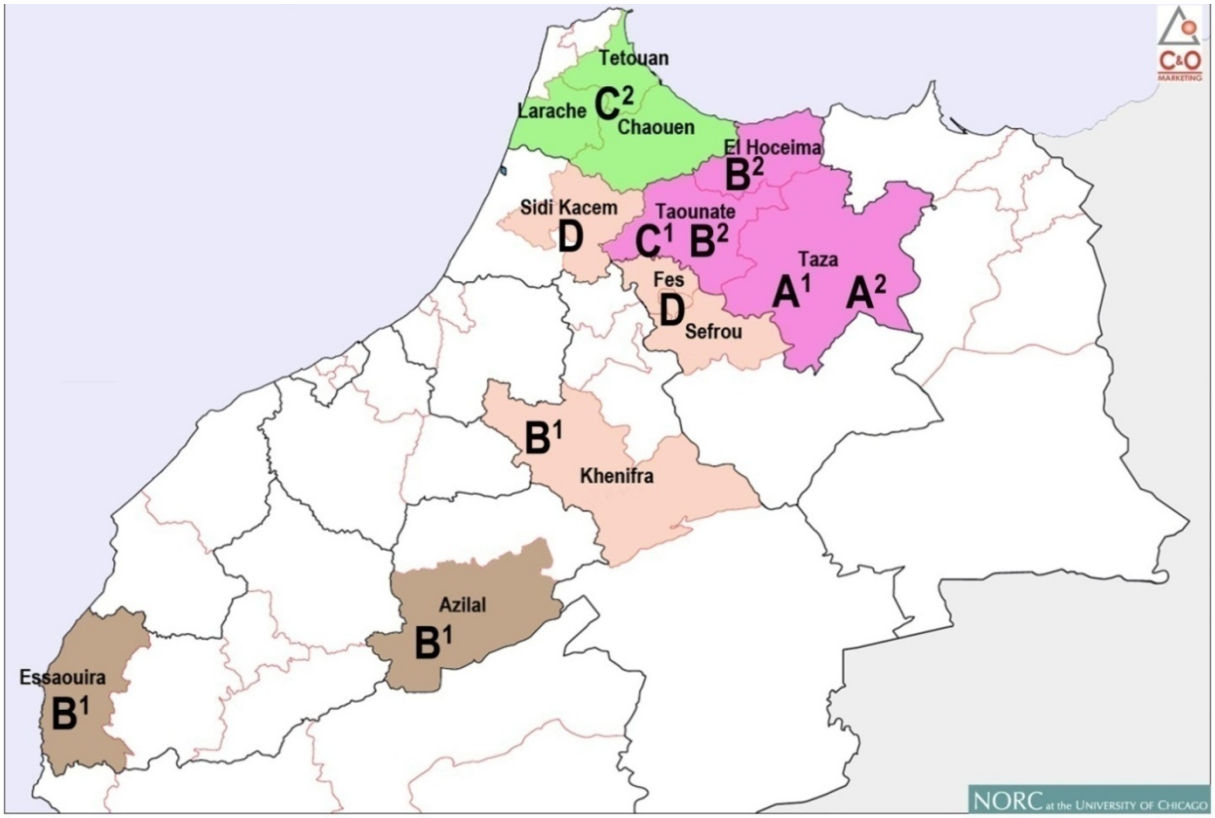
therefore they can also be considered baseline data. We thus used the 2011 data as the baseline data for the impact assessment analysis.[39]

The data collection was performed by NORC's Moroccan subcontractor, C&O Marketing, using standardized training and well-defined protocols for the field work. The 2011-2013 surveys were conducted in February to March of each year. All researchers and supervisors participated in a one-week training session covering interviewing techniques, the objectives of the questionnaires, and role-playing, among other topics. The C&O Marketing teams, made up each year of about thirty researchers, were distributed over 7 geographical areas corresponding to the regions and provinces covered by the impact assessment: (1) El Haouz-Essaouira, (2) Khenifra-Azilal, (3) Taza, (4) El Hoceima-Taounate, (5) Larache-Tetouan-Chefchaouen, (6) Sidi Kacem, (7) Fes-Sefrou. The field researcher staff includes retired ministry experts (qualified by the acronym DVD: Départs volontaires définitifs [voluntary permanent departures]) with considerable experience in agricultural development and in data collection in the field. When the questionnaires arrived at the head office, they went through a coding step before being blinded using a blinding mechanism designed on SPSS Data Entry. Each questionnaire was double-entered by independent data entry agents, and any difference between the two entries was rechecked to determine the correct response.

[39] The questionnaire underwent changes between 2010 and 2011, and the data collection protocol was also changed and improved. It was therefore deemed more relevant to use the 2011 data rather than the 2010 data as the baseline data.

**Figure 3.2** Areas covered by the farmer survey

**Performance evaluation and impact assessment of the rehabilitation and intensification of olive tree orchards in rain-fed areas activity**




The response rates for each survey are high, at over 85% for each survey round (see Appendix B for further details on the response rates).

### 3.2.2 Descriptive Data

In this section, we first present the descriptive statistics of our survey conducted with farmers for all the variables that we use in the analysis in order to get a preliminary overview of trends over time for each of the indicators. For each of the three surveys (2011, 2012, and 2013), we have included the means and standard deviations for the entire sample, as well as the data according to perimeter type, treatment or control. In addition, we also present the data for the farmers who indicated that they had participated in one of the project training sessions and for those who did not participate in the training. We are particularly interested in any possible difference between the treatment and control groups, and between the farmers who participated in training and those who did not, at baseline, as well as any overall trends between 2011 and 2013 for the treatment and control groups that might give us an initial indication of the possible impact of the project, which is examined in greater detail in the next

section. Our sample for the impact analysis is composed of a total of 1,606 farmers[40] for each year, 724 of whom were from the control perimeters and 882 of whom were from the treatment perimeters. In all, 294 farmers reported that they had attended at least one training session.

**Note**: in the tables below, * denotes a statistically significant difference between the treatment and control perimeters at baseline (2011). The statistically significant differences between the treatment and control perimeters for the intermediate and final situations (2012 and 2013) are not indicated. The results of the econometric models presented in Section 3.3 are more relevant for determining differences at the end of the project and the possible impact of TC-5A.

Table 3.1 shows the basic characteristics of households and heads of household by perimeter type and for the entire sample. At baseline, heads of household have a mean age of 56.6 years, and 95.9% of heads of household are men. The majority of heads of household have some form of education, with 14% of them having completed secondary school. Very few of them, only 2.9%, state that they received formal training in farming. The mean household size is 6.2 members. Most olive trees seem to have achieved full productivity and, on average, 82.7% are at least 10 years old. The treatment and control groups exhibit very similar results at baseline.

In comparing farmers who participated in the training with those who did not take part at baseline, we note several interesting differences. Households with women as heads tend to be much less likely to participate in training, since only 2.7% of households with a female head of household took part in the training versus 4.1% of households with a female head of household who did not attend the training sessions. Additionally, 12.6% of households that participated in the training had previously received formal farming training compared with 2.4% of households that did not participate in the training.

[40] Only the 'panel' farmers, i.e., those who participated in the three surveys, 2011, 2012, and 2013, were included in the analysis of the impact assessment.

## Table 3.1 Household characteristics, by perimeter type

| | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. |
| Age of head of household | 56.9 | 14.6 | 59.2 | 14.9 | 60.1 | 14.9 | 56.4 | 15.3 | 57.4 | 15.0 | 58.2 | 15.0 | 56.6 | 15.0 | 58.2 | 14.9 | 59.1 | 14.9 |
| Households with a woman as head of household (%) | 3.7 | 19.0 | 5.3 | 22.3 | 4.6 | 20.9 | 4.4 | 20.6 | 5.2 | 22.3 | 5.9 | 23.6 | 4.1 | 19.9 | 5.2 | 22.3 | 5.3 | 22.4 |
| Education level of head of household: primary/Koranic (%) | 35.9 | 48.0 | 40.6 | 49.1 | 37.6 | 48.5 | 33.3 | 47.2 | 31.6 | 46.5 | 31.6 | 46.5 | 34.5 | 47.6 | 35.7 | 47.9 | 34.3 | 47.5 |
| Education level of head of household: secondary and above (%) | 16.6 | 37.2 | 13.1 | 33.8 | 13.1 | 33.8 | 11.8 | 32.3 | 9.2 | 28.9 | 9.1 | 28.7 | 14.0 | 34.7 | 11.0 | 31.3 | 10.9 | 31.2 |
| Head of household has formal farming training (%) | 2.1 | 14.3 | 3.0 | 17.2 | 2.2 | 14.7 | 3.5 | 18.4 | 4.3 | 20.3 | 3.7 | 19.0 | 2.9 | 16.7 | 3.7 | 19.0 | 3.1 | 17.2 |
| Size of household | 6.4 | 3.3 | 6.3 | 3.2 | 6.3 | 3.3 | 6.1 | 3.3 | 6.0 | 3.0 | 5.9 | 2.9 | 6.2 | 3.3 | 6.1 | 3.1 | 6.1 | 3.1 |
| Size of household: adults only | 4.6 | 2.4 | 4.6 | 2.3 | 4.5 | 2.3 | 4.4 | 2.2 | 4.3 | 2.2 | 4.3 | 2.1 | 4.5 | 2.3 | 4.4 | 2.3 | 4.4 | 2.2 |
| Percentage of olive trees under 10 years old per farmer (%) | 17.1 | 30.1 | 18.2 | 29.1 | 16.4 | 27.2 | 17.5 | 30.7 | 19.9 | 30.2 | 20.9 | 30.9 | 17.3 | 30.4 | 19.1 | 29.7 | 18.9 | 29.4 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1,606 | |

## Table 3.2 Household characteristics, by participation in training

| | Farmers who did not participate in the training | | | | | | Farmers who did participate in the training | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Age of head of household | 56.5 | 15.0 | 58.3 | 14.8 | 59.2 | 14.7 | 54.0 | 14.2 | 55.3 | 14.4 | 55.9 | 14.5 |
| Households with a woman as head of household (%) | 4.1 | 19.9 | 5.2 | 22.2 | 5.4 | 22.6 | 2.7 | 16.3 | 2.7 | 16.3 | 3.1 | 17.3 |
| Education level of head of household: primary/Koranic (%) | 34.8 | 47.6 | 35.4 | 47.8 | 32.4 | 46.8 | 40.8 | 49.2 | 41.8 | 49.4 | 36.7 | 48.3 |
| Education level of head of household: secondary and above (%) | 13.6 | 34.3 | 10.3 | 30.5 | 9.9 | 29.8 | 18.4 | 38.8 | 15.7 | 36.4 | 21.1 | 40.9 |
| Head of household has formal farming training (%) | 2.4 | 15.2 | 2.4 | 15.4 | 1.2 | 10.8 | 12.6 | 33.2 | 11.9 | 32.4 | 17.0 | 37.6 |
| Size of household | 6.3 | 3.3 | 6.1 | 3.1 | 6.1 | 3.1 | 7.0 | 3.8 | 6.7 | 3.0 | 6.7 | 3.1 |
| Size of household: adults only | 4.6 | 2.3 | 4.4 | 2.3 | 4.4 | 2.2 | 4.9 | 2.5 | 4.9 | 2.4 | 4.8 | 2.3 |
| Percentage of olive trees under 10 years old per farmer (%) | 16.9 | 30.2 | 18.4 | 29.6 | 18.9 | 29.8 | 15.2 | 27.9 | 18.9 | 28.0 | 21.8 | 30.1 |
| n | 1,693 | | 1,693 | | 1,693 | | 294 | | 294 | | 294 | |

Table 3.3 shows membership in PAOs. Initially, a total of 9.7% of households were members of PAOs, with only a slight increase in 2013. Our survey also asks whether these PAOs provide technical assistance in the area of olive growing, which they do in most cases. We note an important difference between the treatment and control groups in terms of membership in a PAO. Farmers in the treatment perimeters were almost 50% more likely to be PAO members at baseline, and almost two times more likely to be members of PAOs that provide significant technical assistance. These differences are even more pronounced when farmers who attended the training are compared with those who did not participate, which we might have expected. Farmers are recruited into training through their PAOs. Moreover, farmers who elected to join PAOs are also more likely to seek other ways to improve productivity, for example, by participating in the training offered by the program. In addition, before the actual start of the TC-5A project, the TC-1A had already gone to all the treatment perimeters and supposedly encouraged farmers to create PAOs in order to benefit from the project.

## Table 3.3 Membership in PAOs

| | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. |
| Farmer is member of a PAO (%) | 7.2* | 25.9 | 8.9 | 28.4 | 8.0 | 27.2 | 11.8* | 32.3 | 10.0 | 30.0 | 11.5 | 31.9 | 9.7 | 29.7 | 9.5 | 29.3 | 9.9 | 29.9 |
| Farmer is member of a PAO that offers services (technical assistance, training, etc.) (%) | 5.5* | 22.9 | 7.5 | 26.3 | 7.2 | 25.8 | 10.7* | 30.9 | 8.7 | 28.2 | 10.5 | 30.7 | 8.3 | 27.7 | 8.2 | 27.4 | 9.0 | 28.7 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1,606 | |

| | Farmers who did not participate in the training | | | | | | Farmers who did participate in the training | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Farmer is member of a PAO (%) | 7.5 | 26.4 | 7.8 | 26.8 | 6.8 | 25.2 | 28.4 | 45.2 | 37.1 | 48.4 | 40.1 | 49.1 |
| Farmer is member of a PAO that offers services (technical assistance, training, etc.) (%) | 6.6 | 24.8 | 7.0 | 25.5 | 5.8 | 23.4 | 25.2 | 43.5 | 33.3 | 47.2 | 38.1 | 48.6 |
| n | 1,693 | | 1,693 | | 1,693 | | 294 | | 294 | | 294 | |

Our survey also collected data on a variety of unfavorable events that could have consequences on olive production, and these are presented in Tables 3.4 and 3.5. Some of them are quite common, because over half of farmers experienced problems related to diseased trees or insect attacks during each of the three study surveys. The prevalence of some of these shocks changed considerably over time, particularly those related to weather. In fact, 19.1% of farmers experienced damage from excessive rain in 2011, but only 11.1% of them experienced this in 2013, while the percentage of farmers who experienced problems due to drought increased from 6.4% in 2011 to 28.9% in 2013. Problems connected with high heat also increased markedly, rising from 11.6% at the start to 24.6% during the last survey. It is also noted that at baseline, farmers in the control perimeters were more susceptible to cold and hail than those in the treatment perimeters. On the whole, experiences with respect to adverse events were generally similar for the treatment and control groups, as well as between farmers who participated in the training and those who did not participate. A notable exception is that farmers who did not take part in the training were more likely to experience drought in 2013 than those who did participate, with 27.2% of non-participating farmers reporting these problems compared with 19.7% of program participants.

## Table 3.4 Unfavorable events ("shocks"), by perimeter type

| Percentage of households that experienced the following stress on olive tree orchards: | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. |
| Diseases (%) | 61.6 | 48.7 | 65.5 | 47.6 | 62.2 | 48.5 | 57.4 | 49.5 | 59.2 | 49.2 | 57.4 | 49.5 | 59.3 | 49.2 | 62.0 | 48.6 | 59.5 | 49.1 |
| Insects (%) | 57.6 | 49.5 | 61.2 | 48.8 | 54.1 | 49.9 | 55.7 | 49.7 | 57.8 | 49.4 | 51.5 | 50.0 | 56.5 | 49.6 | 59.3 | 49.1 | 52.7 | 49.9 |
| Injuries (%) | 47.4 | 50.0 | 42.3 | 49.4 | 45.6 | 49.8 | 42.2 | 49.4 | 37.9 | 48.5 | 37.8 | 48.5 | 44.5 | 49.7 | 39.9 | 49.0 | 41.3 | 49.3 |
| Parasites (%) | 47.1 | 50.0 | 48.9 | 50.0 | 44.9 | 49.8 | 43.7 | 49.6 | 43.5 | 49.6 | 37.2 | 48.4 | 45.2 | 49.8 | 46.0 | 49.9 | 40.7 | 49.1 |
| Rodents and birds (%) | 19.1 | 39.3 | 16.3 | 37.0 | 14.2 | 35.0 | 18.5 | 38.8 | 14.6 | 35.4 | 10.1 | 30.1 | 18.7 | 39.0 | 15.4 | 36.1 | 12.0 | 32.5 |
| Excessive rain (%) | 19.1 | 39.3 | 11.2 | 31.5 | 11.9 | 32.4 | 19.1 | 39.3 | 12.4 | 32.9 | 10.4 | 30.6 | 19.1 | 39.3 | 11.8 | 32.3 | 11.1 | 31.4 |
| Drought (%) | 6.4 | 24.4 | 11.2 | 31.5 | 29.1 | 45.5 | 6.5 | 24.6 | 11.5 | 31.9 | 28.7 | 45.3 | 6.4 | 24.5 | 11.3 | 31.7 | 28.9 | 45.3 |
| Cold (%) | 19.6* | 39.7 | 22.0 | 41.4 | 17.0 | 37.6 | 14.4* | 35.1 | 20.6 | 40.5 | 20.0 | 40.0 | 16.8 | 37.4 | 21.2 | 40.9 | 18.6 | 38.9 |
| Heat (%) | 12.6 | 33.2 | 15.1 | 35.8 | 21.6 | 41.1 | 10.9 | 31.2 | 15.7 | 36.4 | 27.1 | 44.5 | 11.6 | 32.1 | 15.4 | 36.1 | 24.6 | 43.1 |
| Strong wind (%) | 41.2 | 49.3 | 42.3 | 49.4 | 31.8 | 46.6 | 34.2 | 47.5 | 37.0 | 48.3 | 30.3 | 46.0 | 37.4 | 48.4 | 39.4 | 48.9 | 31.0 | 46.2 |
| Hail (%) | 12.4* | 33.0 | 15.5 | 36.2 | 16.3 | 37.0 | 7.6* | 26.5 | 10.9 | 31.2 | 12.7 | 33.3 | 9.8 | 29.7 | 13.0 | 33.6 | 14.3 | 35.0 |
| Other unexpected events (%) | 3.5 | 18.3 | 10.5 | 30.7 | 10.5 | 30.7 | 2.5 | 15.6 | 6.8 | 25.2 | 8.1 | 27.2 | 2.9 | 16.9 | 8.5 | 27.9 | 9.2 | 28.9 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1,606 | |

## Table 3.5 Unfavorable events ("shocks"), by participation in training

| Percentage of households that experienced the following stress on olive tree orchards: | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. |
| Diseases (%) | 61.6 | 48.7 | 65.5 | 47.6 | 62.2 | 48.5 | 57.4 | 49.5 | 59.2 | 49.2 | 57.4 | 49.5 | 59.3 | 49.2 | 62.0 | 48.6 | 59.5 | 49.1 |
| Insects (%) | 57.6 | 49.5 | 61.2 | 48.8 | 54.1 | 49.9 | 55.7 | 49.7 | 57.8 | 49.4 | 51.5 | 50.0 | 56.5 | 49.6 | 59.3 | 49.1 | 52.7 | 49.9 |
| Injuries (%) | 47.4 | 50.0 | 42.3 | 49.4 | 45.6 | 49.8 | 42.2 | 49.4 | 37.9 | 48.5 | 37.8 | 48.5 | 44.5 | 49.7 | 39.9 | 49.0 | 41.3 | 49.3 |
| Parasites (%) | 47.1 | 50.0 | 48.9 | 50.0 | 44.9 | 49.8 | 43.7 | 49.6 | 43.5 | 49.6 | 37.2 | 48.4 | 45.2 | 49.8 | 46.0 | 49.9 | 40.7 | 49.1 |
| Rodents and birds (%) | 19.1 | 39.3 | 16.3 | 37.0 | 14.2 | 35.0 | 18.5 | 38.8 | 14.6 | 35.4 | 10.1 | 30.1 | 18.7 | 39.0 | 15.4 | 36.1 | 12.0 | 32.5 |
| Excessive rain (%) | 19.1 | 39.3 | 11.2 | 31.5 | 11.9 | 32.4 | 19.1 | 39.3 | 12.4 | 32.9 | 10.4 | 30.6 | 19.1 | 39.3 | 11.8 | 32.3 | 11.1 | 31.4 |
| Drought (%) | 6.4 | 24.4 | 11.2 | 31.5 | 29.1 | 45.5 | 6.5 | 24.6 | 11.5 | 31.9 | 28.7 | 45.3 | 6.4 | 24.5 | 11.3 | 31.7 | 28.9 | 45.3 |
| Cold (%) | 19.6 | 39.7 | 22.0 | 41.4 | 17.0 | 37.6 | 14.4 | 35.1 | 20.6 | 40.5 | 20.0 | 40.0 | 16.8 | 37.4 | 21.2 | 40.9 | 18.6 | 38.9 |
| Heat (%) | 12.6 | 33.2 | 15.1 | 35.8 | 21.6 | 41.1 | 10.9 | 31.2 | 15.7 | 36.4 | 27.1 | 44.5 | 11.6 | 32.1 | 15.4 | 36.1 | 24.6 | 43.1 |
| Strong wind (%) | 41.2 | 49.3 | 42.3 | 49.4 | 31.8 | 46.6 | 34.2 | 47.5 | 37.0 | 48.3 | 30.3 | 46.0 | 37.4 | 48.4 | 39.4 | 48.9 | 31.0 | 46.2 |
| Hail (%) | 12.4 | 33.0 | 15.5 | 36.2 | 16.3 | 37.0 | 7.6 | 26.5 | 10.9 | 31.2 | 12.7 | 33.3 | 9.8 | 29.7 | 13.0 | 33.6 | 14.3 | 35.0 |
| Other unexpected events (%) | 3.5 | 18.3 | 10.5 | 30.7 | 10.5 | 30.7 | 2.5 | 15.6 | 6.8 | 25.2 | 8.1 | 27.2 | 2.9 | 16.9 | 8.5 | 27.9 | 9.2 | 28.9 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1,606 | |

The data on a variety of olive-related production practices, a number of which were promoted during the program training, are presented in Tables 3.6 and 3.7. The frequency with which farmers employed these practices varies considerably. Some were very common. In 2011, 92.4% harvested with tarpaulins placed on the ground, 81.9% of farmers did soil work, and 88% of farmers who stored olive oil did so in suitable food-grade plastic containers. In contrast, fewer than one percent used antibacterial treatments, cared for damaged trees, performed phytosanitary treatments, or used vibrators. In general, the use of production methods during the survey was similar between the treatment and control groups at baseline (except for soil work, pruning of adult trees, and use of plastic containers), while we tended to see farmers who participated in the training employ these practices at a higher rate than those who did not participate.

## Table 3.6 Agricultural practices, by perimeter type

| Farmer did the following work: | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Application of fertilizer (%) | 13.6 | 34.3 | 14.5 | 35.3 | 11.8 | 32.3 | 16.9 | 37.5 | 14.3 | 35.0 | 12.9 | 33.5 | 15.4 | 36.1 | 14.4 | 35.1 | 12.4 | 32.9 |
| Application of manure (%) | 29.7 | 45.7 | 28.2 | 45.0 | 21.9 | 41.4 | 26.7 | 44.3 | 25.7 | 43.7 | 22.5 | 41.8 | 28.0 | 44.9 | 26.8 | 44.3 | 22.2 | 41.6 |
| Insect control (%) | 3.5 | 18.3 | 2.4 | 15.2 | 1.7 | 12.8 | 4.2 | 20.1 | 1.7 | 12.9 | 2.5 | 15.6 | 3.9 | 19.3 | 2.0 | 14.0 | 2.1 | 14.4 |
| Parasite control (%) | 2.2 | 14.7 | 0.6 | 7.4 | 0.4 | 6.4 | 1.8 | 13.4 | 0.6 | 7.5 | 0.7 | 8.2 | 2.0 | 14.0 | 0.6 | 7.5 | 0.6 | 7.5 |
| Bacterial disease control (%) | 1.1 | 10.5 | 0.7 | 8.3 | 0.1 | 3.7 | 0.8 | 8.9 | 0.3 | 5.8 | 0.2 | 4.8 | 0.9 | 9.6 | 0.5 | 7.1 | 0.2 | 4.3 |
| Wound care (%) | 0.6 | 7.4 | 0.3 | 5.3 | 0.0 | 0.0 | 0.9 | 9.5 | 0.8 | 8.9 | 0.1 | 3.4 | 0.8 | 8.6 | 0.6 | 7.5 | 0.1 | 2.5 |
| Application of other phytosanitary treatments (%) | 0.7 | 8.3 | 0.4 | 6.4 | 0.8 | 9.1 | 0.6 | 7.5 | 0.2 | 4.8 | 0.1 | 3.4 | 0.6 | 7.9 | 0.3 | 5.6 | 0.4 | 6.6 |
| Soil work (%) | 79.1* | 40.7 | 82.7 | 37.9 | 85.7 | 35.0 | 84.2* | 36.5 | 85.9 | 34.8 | 86.8 | 33.9 | 81.9 | 38.5 | 84.5 | 36.2 | 86.3 | 34.4 |
| Construction of basins/impluviums (%) | 2.1 | 14.3 | 1.7 | 12.8 | 3.6 | 18.6 | 3.7 | 19.0 | 2.5 | 15.6 | 4.3 | 20.3 | 3.0 | 17.0 | 2.1 | 14.4 | 4.0 | 19.6 |
| Other land improvement (%) | 11.2 | 31.5 | 6.9 | 25.4 | 5.0 | 21.8 | 9.1 | 28.7 | 6.9 | 25.4 | 3.1 | 17.2 | 10.0 | 30.0 | 6.9 | 25.4 | 3.9 | 19.4 |
| Hydro-agricultural work (%) | 3.9 | 19.3 | 2.9 | 16.8 | 2.6 | 16.0 | 4.2 | 20.1 | 0.8 | 8.9 | 1.3 | 11.1 | 4.1 | 19.7 | 1.7 | 13.1 | 1.9 | 13.5 |
| Pruning (%) | 42.2 | 49.4 | 51.1 | 50.0 | 42.4 | 49.5 | 44.6 | 49.7 | 48.6 | 50.0 | 44.5 | 49.7 | 43.5 | 49.6 | 49.8 | 50.0 | 43.5 | 49.6 |
| Pruning of adult trees (%) | 82.2* | 38.3 | 89.4 | 30.8 | 90.9 | 28.9 | 87.5* | 33.2 | 87.9 | 32.7 | 93.9 | 24.0 | 85.2 | 35.6 | 88.6 | 31.8 | 92.5 | 26.3 |
| Pruning of young trees (%) | 73.2 | 44.4 | 69.6 | 46.1 | 52.1 | 50.0 | 69.0 | 46.3 | 67.4 | 46.9 | 56.3 | 49.7 | 70.8 | 45.5 | 68.4 | 46.5 | 54.5 | 49.8 |
| Mechanical harvesting (%) | 0.3 | 5.3 | 0.3 | 5.3 | 0.4 | 6.4 | 0.3 | 5.8 | 0.3 | 5.8 | 0.5 | 6.7 | 0.3 | 5.6 | 0.3 | 5.6 | 0.4 | 6.6 |
| Farmer has access to a vibrator (%) | 0.3 | 5.3 | 0.6 | 7.4 | 0.3 | 5.3 | 0.7 | 8.2 | 0.7 | 8.2 | 1.4 | 11.6 | 0.5 | 7.0 | 0.6 | 7.9 | 0.9 | 9.3 |
| Harvesting with tarpaulins (%) | 91.9 | 27.3 | 94.9 | 21.9 | 97.7 | 15.0 | 92.9 | 25.8 | 94.4 | 23.0 | 96.9 | 17.4 | 92.4 | 26.5 | 94.7 | 22.5 | 97.3 | 16.3 |
| Transporting in crates (%) | 1.0 | 9.8 | 1.4 | 11.7 | 1.7 | 12.8 | 2.4 | 15.3 | 2.0 | 14.2 | 2.3 | 14.9 | 1.7 | 13.1 | 1.7 | 13.1 | 2.0 | 14.0 |
| Oil stored in plastic container (%) | 82.4* | 38.4 | 93.2 | 25.3 | 95.7 | 20.6 | 93.3* | 25.1 | 88.0 | 32.7 | 94.3 | 23.3 | 88.0 | 32.6 | 90.5 | 29.4 | 95.0 | 22.0 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1,606 | |

## Table 3.7 Agricultural practices, by participation in training

| Farmer did the following work: | Farmers who did not participate in the training | | | | | | Farmers who did participate in the training | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Application of fertilizer (%) | 14.8 | 35.5 | 13.5 | 34.2 | 12.2 | 32.7 | 18.8 | 39.2 | 15.3 | 36.1 | 23.1 | 42.2 |
| Application of manure (%) | 28.0 | 44.9 | 26.3 | 44.1 | 21.5 | 41.1 | 32.9 | 47.1 | 32.0 | 46.7 | 34.7 | 47.7 |
| Insect control (%) | 3.4 | 18.2 | 1.6 | 12.5 | 1.8 | 13.4 | 5.5 | 22.8 | 3.7 | 19.0 | 4.8 | 21.3 |
| Parasite control (%) | 1.8 | 13.2 | 0.4 | 6.4 | 0.3 | 5.4 | 2.4 | 15.3 | 1.4 | 11.6 | 2.4 | 15.3 |
| Bacterial disease control (%) | 0.8 | 9.1 | 0.4 | 6.0 | 0.2 | 4.2 | 1.4 | 11.6 | 1.0 | 10.1 | 0.7 | 8.2 |
| Wound care (%) | 0.6 | 7.7 | 0.4 | 6.0 | 0.1 | 2.4 | 1.0 | 10.1 | 1.4 | 11.6 | 0.0 | 0.0 |
| Application of other phytosanitary treatments (%) | 0.5 | 6.9 | 0.2 | 4.9 | 0.4 | 6.0 | 1.4 | 11.6 | 0.3 | 5.8 | 0.3 | 5.8 |
| Soil work (%) | 80.7 | 39.5 | 83.1 | 37.5 | 85.3 | 35.4 | 89.7 | 30.4 | 86.7 | 34.0 | 90.8 | 28.9 |
| Construction of basins/impluviums (%) | 2.9 | 16.8 | 2.1 | 14.2 | 3.1 | 17.3 | 3.1 | 17.3 | 1.0 | 10.1 | 8.2 | 27.4 |
| Other land improvement (%) | 9.8 | 29.8 | 6.6 | 24.9 | 3.4 | 18.0 | 7.5 | 26.4 | 6.1 | 24.0 | 3.4 | 18.2 |
| Hydro-agricultural work (%) | 3.6 | 18.6 | 1.8 | 13.2 | 1.4 | 11.8 | 6.5 | 24.6 | 1.7 | 13.0 | 3.1 | 17.3 |
| Pruning (%) | 41.4 | 49.3 | 46.9 | 49.9 | 39.4 | 48.9 | 49.0 | 50.1 | 57.0 | 49.6 | 64.0 | 48.1 |
| Pruning of adult trees (%) | 84.9 | 35.8 | 88.8 | 31.6 | 92.9 | 25.7 | 86.6 | 34.2 | 91.0 | 28.7 | 89.4 | 30.9 |
| Pruning of young trees (%) | 69.4 | 46.1 | 67.0 | 47.1 | 52.7 | 50.0 | 73.4 | 44.4 | 68.1 | 46.8 | 54.8 | 49.9 |
| Mechanical harvesting (%) | 0.2 | 4.2 | 0.2 | 4.9 | 0.4 | 5.9 | 1.7 | 13.0 | 1.4 | 11.6 | 2.0 | 14.2 |
| Farmer has access to a vibrator (%) | 0.3 | 5.4 | 0.4 | 6.4 | 0.3 | 5.4 | 1.4 | 11.6 | 3.7 | 19.0 | 4.8 | 21.3 |
| Harvesting with tarpaulins (%) | 92.9 | 25.7 | 94.7 | 22.4 | 97.5 | 15.5 | 93.9 | 24.0 | 95.3 | 21.1 | 96.2 | 19.3 |
| Transporting in crates (%) | 1.4 | 11.6 | 1.4 | 11.6 | 1.7 | 13.0 | 2.0 | 14.2 | 4.8 | 21.3 | 4.8 | 21.3 |
| Oil stored in plastic container (%) | 87.5 | 33.2 | 91.4 | 28.2 | 93.5 | 24.8 | 89.2 | 31.5 | 89.6 | 30.9 | 100.0 | 0.0 |
| n | 1,693 | | 1,693 | | 1,693 | | 294 | | 294 | | 294 | |

Tables 3.8 and 3.9 show the outcome data relating to the commercialization of olive oil. At baseline, 38.2% of farmers had their olive oil processed in modern PUs, but in 2013 this percentage had risen to over half. We observe similar rates of increase in this respect between the treatment and control groups. At baseline, farmers tended to process about two thirds of their olive harvest into oil (this rate changed little between 2011 and 2013), but only 5.3% of the total harvest was also sold on the market. This last percentage dropped over time (in 2013, 2.6% of the production was sold), while households tended to consume a larger proportion of their production in 2013. We also observe a substantial increase in the sales price of a liter of olive oil from an average of 23.7 DH/L in 2011 to 36.1 DH/L in 2013, probably due to the poor harvest in 2013. In general, the treatment and control perimeters did not differ significantly in terms of these variables at baseline. An interesting fact is that similar results are also observed with farmers who participated in the training compared with those who did not take part.

## Table 3.8 Processing and olive oil, by perimeter type

| | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. |
| Principal PU: modern (%) | 36.2 | 48.1 | 43.8 | 49.7 | 51.8 | 50.0 | 39.8 | 49.0 | 46.5 | 49.9 | 53.9 | 49.9 | 38.2 | 48.6 | 45.3 | 49.8 | 52.9 | 49.9 |
| Principal PU: semi-modern (%) | 18.7 | 39.0 | 16.3 | 37.0 | 11.3 | 31.7 | 16.6 | 37.2 | 15.1 | 35.8 | 7.5 | 26.3 | 17.5 | 38.0 | 15.6 | 36.3 | 9.2 | 28.9 |
| Percentage of olives processed (%) | 66.8 | 29.4 | 65.7 | 27.6 | 66.2 | 30.6 | 65.0 | 28.3 | 64.6 | 28.6 | 66.6 | 31.1 | 65.9 | 28.8 | 65.1 | 28.2 | 66.4 | 30.9 |
| Percentage of olives processed and sold (%) | 5.2 | 16.4 | 4.3 | 11.9 | 2.2 | 9.5 | 5.4 | 15.9 | 3.9 | 14.2 | 3.0 | 12.4 | 5.3 | 16.1 | 4.1 | 13.2 | 2.6 | 11.1 |
| Olive oil sales price (DH/L) | 22.9* | 5.6 | 27.2 | 6.2 | 35.3 | 4.2 | 24.2* | 5.4 | 29.1 | 5.8 | 36.7 | 3.8 | 23.7 | 5.5 | 28.2 | 6.1 | 36.1 | 4.0 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1,606 | |

## Table 3.9 Processing and olive oil, by participation in training

| | Farmers who did not participate in the training | | | | | | Farmers who did participate in the training | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Principal PU: modern (%) | 36.2 | 48.1 | 43.5 | 49.6 | 50.0 | 50.0 | 35.7 | 48.0 | 44.9 | 49.8 | 55.4 | 49.8 |
| Principal PU: semi-modern (%) | 16.8 | 37.4 | 15.8 | 36.5 | 9.2 | 28.9 | 19.1 | 39.3 | 15.3 | 36.1 | 14.3 | 35.1 |
| Percentage of olives processed (%) | 66.2 | 28.9 | 65.4 | 28.5 | 67.1 | 31.6 | 63.6 | 28.0 | 60.0 | 30.5 | 64.9 | 30.7 |
| Percentage of olives processed and sold (%) | 5.1 | 16.1 | 4.1 | 13.6 | 2.4 | 10.6 | 6.1 | 16.6 | 4.2 | 11.2 | 4.1 | 15.1 |
| Olive oil sales price (DH/L) | 23.4 | 5.3 | 27.7 | 6.2 | 35.8 | 4.3 | 24.0 | 5.7 | 28.9 | 4.6 | 36.6 | 4.0 |
| n | 1,693 | | 1,693 | | 1,693 | | 294 | | 294 | | 294 | |

Finally, the results related to production, income, and profits are presented in Tables 3.10 and 3.11. In comparing the treatment and control groups, we see great similarities as well as a few differences at baseline. In particular, olive production was 11.4% higher in the treatment perimeters (2,436 kg in the treatment perimeters versus 2,186 kg in the control perimeters), while household income was 7.9% higher (9,463 DH for households in the treatment perimeters versus 8,767 DH for those in the control perimeters), although these differences were not statistically significant. The tables clearly illustrate the olive harvest problems in 2013. Production, profits, and income related to olives all decreased appreciably, with income from olive oil down by half compared with that in 2011. At the same time, we see big differences in most of these variables between farmers who opted to participate in the training and those who did not participate. Net agricultural income and olive production were both close to 50% higher at baseline for farmers who participated in the training (11,645 DH on average for net agricultural income and an average of 3,209 kg in total olive production for farmers who participated in the training versus 7,790 DH in net agricultural income and 2,251 kg in total olive production for those who did not participate), while revenue from the sale of olive oil was almost two times higher (1,277 DH for those who participated versus 651 DH for those who did not participate in the training).

From the standpoint of the analysis, it is important to bear in mind that the differences at baseline that we observe between these groups do not in themselves represent a problem. Our double-differences methodology controls all initial differences between the results of the treatment and control perimeters, and our other estimation strategies address the potential selection bias for farmers who elect to participate in the training. The only concern is knowing whether the differences in the baseline conditions indicate different trajectories in the results over time, independently of the project.

## Table 3.10 Production and income, by perimeter type

| | Control perimeters | | | | | | Treatment perimeters | | | | | | All perimeters | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. | mean | stand. dev. |
| Agricultural revenue (DH) | 14,663 | 16,855 | 15,453 | 15,553 | 12,584 | 14,090 | 14,504 | 16,864 | 15,694 | 16,499 | 12,285 | 12,920 | 14,576 | 16,855 | 15,586 | 16075 | 12,420 | 13,456 |
| Revenue from olives (DH) | 7,935 | 9,127 | 8,775 | 8,221 | 5,400 | 5,765 | 8,036 | 9,465 | 9,090 | 10,625 | 5,211 | 5,952 | 7,990 | 9,312 | 8,948 | 9,614 | 5,297 | 5,867 |
| Revenue from the sale of olive oil (DH) | 606 | 2,357 | 720 | 2,458 | 294 | 1,276 | 807 | 2,607 | 653 | 2,259 | 378 | 1,362 | 717 | 2,499 | 683 | 2,350 | 340 | 1,324 |
| Net agricultural income (DH) | 7,594 | 12,936 | 9,138 | 11,854 | 8,196 | 11,299 | 7,603 | 12,854 | 8,708 | 12,468 | 7,758 | 10,403 | 7,599 | 12,887 | 8,902 | 12,193 | 7,956 | 10,815 |
| Net income from olives (DH) | 4,969 | 9,139 | 6,503 | 7,189 | 4,093 | 4,792 | 5,303 | 9,220 | 6,660 | 9,537 | 3,906 | 5,440 | 5,152 | 9,183 | 6,589 | 8,557 | 3,990 | 5,157 |
| Net household income (DH) | 8,767 | 17,464 | 10,467 | 33,227 | 10,586 | 13,690 | 9,463 | 16,462 | 10,092 | 16,992 | 9,717 | 12,552 | 9,149 | 16,919 | 10,261 | 25,610 | 10,108 | 13,081 |
| Revenue from olives per tree (DH) | 70 | 95 | 72 | 69 | 45 | 59 | 69 | 71 | 90 | 107 | 42 | 56 | 69 | 83 | 81 | 92 | 43 | 57 |
| Total olive production (kg) | 2,186 | 2,226 | 1,970 | 1,844 | 1,154 | 1,152 | 2,436 | 2,578 | 2,048 | 2,067 | 1,190 | 1,308 | 2,323 | 2,428 | 2013 | 1,969 | 1,174 | 1,240 |
| Total olive oil production (L) | 291 | 574 | 270 | 391 | 183 | 506 | 292 | 681 | 252 | 345 | 185 | 755 | 291 | 635 | 260 | 366 | 184 | 651 |
| n | 724 | | 724 | | 724 | | 882 | | 882 | | 882 | | 1,606 | | 1,606 | | 1606 | |

## Table 3.11 Production and income, by participation in training

| | Farmers who did not participate in the training | | | | | | Farmers who did participate in the training | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2011 | | 2012 | | 2013 | | 2011 | | 2012 | | 2013 | |
| | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation | mean | standard deviation |
| Agricultural revenue (DH) | 14,593 | 17,925 | 15,331 | 17,149 | 12,297 | 13,830 | 21,730 | 23,117 | 22,436 | 23,345 | 18,026 | 16,301 |
| Revenue from olives (DH) | 7,711 | 9,069 | 8,335 | 8,614 | 5,150 | 5,531 | 11,311 | 12,258 | 12,979 | 14,998 | 7,582 | 8,051 |
| Revenue from the sale of olive oil (DH) | 651 | 2373 | 663 | 2,328 | 320 | 1,445 | 1,277 | 3,522 | 1,037 | 2,765 | 531 | 1,513 |
| Net agricultural income (DH) | 7,790 | 13,561 | 8,718 | 13,143 | 7,838 | 11,184 | 11,645 | 18,447 | 13,474 | 19,056 | 10,134 | 12,932 |
| Net income from olives (DH) | 5,006 | 8967 | 6,066 | 7,449 | 3,871 | 4,843 | 7,319 | 11,729 | 9,931 | 14,206 | 5330 | 7,647 |
| Net household income (DH) | 9,259 | 17,082 | 9,622 | 16,475 | 9,885 | 13,349 | 12,545 | 19,081 | 17,251 | 51,096 | 13,264 | 19,144 |
| Revenue from olives per tree (DH) | 70.8 | 80.6 | 79.5 | 91.3 | 44.6 | 54.1 | 71.6 | 115.4 | 71.5 | 64.8 | 50.1 | 79.0 |
| Total olive production (kg) | 2,251 | 2,391 | 1,881 | 1,841 | 1,172 | 1,269 | 3,209 | 3,199 | 2,788 | 2,613 | 1,548 | 1,303 |
| Total olive oil production (L) | 278 | 492 | 252 | 343 | 175 | 368 | 393 | 995 | 376 | 507 | 288 | 1,243 |
| n | 1,693 | | 1,693 | | 1,693 | | 294 | | 294 | | 294 | |

## Participation in Training

As we mentioned, the training was offered to all farmers in the treatment perimeters, but only some farmers chose to participate. To aid in the design of future projects, it is useful to understand the reasons why the farmers opted to participate in the training. In this section, we perform regression analyses to examine more systematically the characteristics of the farmers who participated in the training.

Our modeling approach is determined by the fact that the dependent variable is a probability, in our case the probability that an individual in a treatment perimeter will elect to participate in a project training session. There are two different types of approach in the assessment field for modeling probabilities in regression models: linear probability models, which use the ordinary least squares (OLS) method, and non-linear models such as probit or logit. Each method has advantages and disadvantages. Probit and logit models involve more realistic hypotheses than linear probability models and, in particular, can be more accurate in terms of projecting values that are outside the sample. However, linear probability models can provide more flexibility and simplicity, and the existing literature has recently shown that the hypotheses for linear probability models are reasonable for typical situations. Thus, we present the results of both model types, linear and non-linear, in order to guarantee that the results are coherent and not dependent on the modeling approach used.

Table 3.12 presents the regression results for which the dependent variable is a dump variable representing participation in the training and the sample is limited to the treatment perimeters. For both models (linear and non-linear), the coefficients of each variable can be interpreted as the increase in the probability that a farmer in a treatment perimeter will participate in a training session associated with the increase by one unit of the variable in question.[41] For several variables we divide the values among the categories “low,” “medium,” and “high,” such that the lower third of the values is assigned to the “low” category, the middle third to the “medium” category, and the upper third to the “high” category. We use this approach to take into account any possible nonlinearities and to ensure that the overall trends in the data are presented correctly by the results.

The most important result that emerges is the fact that farmers who are members of PAOs are much more likely to participate in training – they have a 27.9 percentage point higher probability according to the linear probability model and a 19.4 percentage point higher probability according to the logit

[41] The marginal effects are presented for the logit models.

model. There are two potential factors that can explain this result. The first is that farmers may hear about training through their PAOs or through their interactions with other PAO members, so that PAO members are more aware of training. This is especially likely since the project relied on PAOs to help them recruit farmers into the training. The second factor is that farmers may opt to become a member of a PAO because they are more open to commercialization or to learning new agricultural techniques in order to increase their production and are consequently more open to and seek out agricultural training.

The results also show that owners of larger farms that make more profit have a higher probability of participating in training. Those whose number of olive trees falls into the “high” category have a 10.3-10.7 higher probability of participating in training than farmers with fewer olive trees, while those whose profits (net income from olives) fall into the “high” category have a 6.6-6.9 percentage point higher probability of participating in training. This implies that training programs aimed at small farmers or less prosperous farmers should raise the awareness of this type of farmer directly or in a targeted manner in order to motivate them to participate.

A certain number of other coefficients are also statistically significant. Our results show that young farmers have a greater tendency to attend training, as well as famers who indicated they had problems with parasites or damaged trees. This last result could reflect the fact that farmers who have experienced this type of unfavorable situation have a greater tendency to look for training in order to learn new techniques for dealing with these problems. Alternatively, these results could reflect how skilled farmers are in recognizing these problems rather than the actual frequency of the problems. It may be that farmers who are able to correctly identify problems related to injuries and parasites in our survey have a greater tendency to understand the value of training and participate in it, even if these farmers do not tend to have more problems related to injuries and parasites.

Our results also indicate that other variables do not have a significant impact on the probability of participating in training. Education level, gender of the head of household, and household size, as well as the presence of a number of other unfavorable shocks and the proportion of olives processed, are not statistically significant in either of the two models.

## Table 3.12 Participation in training

| | OLS | | Logit (marginal effects) | |
|---|---|---|---|---|
| | Coef. | S.E. | Coef. | S.E. |
| **Characteristics of head of household** | | | | |
| Female head of household | -0.0249 | (0.0519) | -0.0441 | (0.0798) |
| Age | -0.00154+ | (0.000850) | -0.00156+ | (0.000844) |
| Any schooling | 0.0314 | (0.0289) | 0.0299 | (0.0285) |
| PAO member | 0.279*** | (0.0502) | 0.194*** | (0.0328) |
| **Household members by age** | | | | |
| <16 years | 0.00728 | (0.00624) | 0.00627 | (0.00501) |
| 16 years and older | 0.00312 | (0.00546) | 0.00318 | (0.00477) |
| **Characteristics in 2011** | | | | |
| Shock: injuries | 0.0609+ | (0.0310) | 0.0601* | (0.0287) |
| Shock: parasites | 0.0612+ | (0.0359) | 0.0584+ | (0.0353) |
| Shock: diseases | 0.0119 | (0.0324) | 0.00892 | (0.0322) |
| Shock: insects | -0.0297 | (0.0279) | -0.0251 | (0.0277) |
| Shock: pests/birds | 0.0270 | (0.0342) | 0.0234 | (0.0296) |
| Shock: excessive rain | -0.00374 | (0.0359) | -0.00397 | (0.0340) |
| Shock: drought | -0.0790 | (0.0496) | -0.0887 | (0.0596) |
| Shock: cold | -0.0124 | (0.0393) | -0.0127 | (0.0418) |
| Shock: heat | 0.0102 | (0.0403) | 0.0141 | (0.0397) |
| Shock: wind | -0.0297 | (0.0351) | -0.0282 | (0.0332) |
| Shock: hail | 0.0141 | (0.0412) | 0.0124 | (0.0385) |
| Other shocks | 0.0421 | (0.0653) | 0.0356 | (0.0509) |
| **Number of olive trees** | | | | |
| Total number of olive trees, medium | 0.0393 | (0.0338) | 0.0529 | (0.0386) |
| Total number of olive trees, high | 0.103** | (0.0367) | 0.107** | (0.0384) |
| **Net income from olives** | | | | |
| Net income from olives, medium | 0.0206 | (0.0264) | 0.0274 | (0.0294) |
| Net income from olives, high | 0.0688+ | (0.0406) | 0.0658+ | (0.0365) |
| **Proportion of olives processed** | | | | |
| Proportion of olives processed, medium | -0.0220 | (0.0257) | -0.0203 | (0.0279) |
| Proportion of olives processed, high | -0.00748 | (0.0412) | -0.00973 | (0.0384) |
| Participation rate | 0.192 | | 0.192 | |
| Adj. R squared/Pseudo R squared | 0.110 | | | |
| N | 1,209 | | 1,209 | |

+ p<0.1, * p<0.05,** p<0.01, *** p<0.001

## 3.3 Results

In this section, we present the empirical models that we use to assess the project's impact on the results described in the previous section and on the results of the statistical analysis. We discuss the interpretation of the results and the conclusions in the next section.

### 3.3.1 Econometric Models

Our base model uses a fixed-effects double-differences approach to evaluate the effect of the treatment. The overall presentation is as follows:

$$Y_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 \delta_{2010} + \beta_3 \delta_{2011} + \beta_4 \delta_{2012} + \gamma(\delta_{post} \times \delta_{treat}) + \alpha_i + \varepsilon_{ijt}$$

Where:

$Y_{iit}$ is result Y for household i located in perimeter j at time t, where the 31 possible results are those described in Section 3.2;

$X_{ijt}$ is a vector of the control variables;

$\delta_{2010}, \delta_{2011}, \delta_{2012}$ are time variables corresponding to each survey;

$\delta_{post}$ is a dummy variable equal to 1 for the post-treatment periods;

$\delta_{treat}$ is a dummy variable equal to 1 for the treatment group;

$\alpha_i$ is a fixed effect at the household level;

$\varepsilon_{it}$ is a random error term;

$\beta_i$ are the parameters to be evaluated; and

$\gamma$ is the estimation of the impact.

The project's impact is measured by the coefficient of the interaction term $\gamma$ between treatment status and time period. Therefore, when we speak of "effect," we are comparing the results obtained for the treatment group after treatment with the treatment group before treatment, and for the control group before and after treatment.

To be able to estimate the model, certain hypotheses must be stated. In fact, several criteria must be defined: defining the characteristics of the treatment group, defining the control variables that have to be taken into account, and defining the post-treatment period. In order to ensure the robustness of our results, our models are estimated based on a number of different hypotheses so that they can then be compared with one another. These hypotheses can be classified into three main groups:

***Definition of the Treatment Group***

The most important hypothesis is the definition of the treatment group, i.e., the variable $\delta_{treat}$. As already explained in the assessment methodology section, we estimate three types of models: intention-to-treat (ITT), treatment-on-the-treated (TOT), and treatment-on-the-treated with instrumental variable (TOT-IV). Each of these models is based on a different approach for defining the treatment group. For the ITT model, the treatment group – olive oil producers, for example – corresponds to the group in the treatment perimeters without taking into account whether this group did or did not participate in training in connection with the project. For the TOT model, the treatment group corresponds to the group that participated in training in connection with the program, and thus the criteria relating to a possible selection [bias] are not taken into account.

In regard to the TOT-IV model, the treatment group also corresponds to the group that participated in training, but it takes into account a possible selection bias by using instrumental variables. The application of instrumental variables makes use of the method relating to ordinary least squares estimators (2SLS) by means of which the actual participation in training is instrumentalized with the proposal made to households to participate in training. Thus we first estimate:

$$Tr_{ij} = \beta_0 + \beta_1 \delta_j + e_{ij}$$

Where $Tr_{ij}$ represents the participation of farmer i located in perimeter j in one of the training session, $\delta_j$ is a dummy variable equal to 1 if the farmer is in a treatment perimeter, and $e_{ij}$ is a random error term. We then use the projected values of $Tr_{ij}$ derived from the estimations of $\beta_0$ and $\beta_1$ and the values of $\delta_j$ as $\delta_{treat}$ in the base model that appears above.

***Control Variables***

For the estimation of the model, it is important to take into consideration the choice of $X_{ijt}$, i.e., the control variables. Control variables can be used to adjust for differences not connected with the program among the different farmers so that the model can more accurately assess the impact. However, it is advisable not to use too many control variables because this could lead to "overadjustment" of the model and, consequently, confounding of a portion of the program's impact with the impact of other differences among the farmers. It is therefore advisable to exercise good judgment when choosing the variables to be used. It is also important to keep in mind that our specification of the fixed-effects model automatically controls the characteristics relating to the farmer, household, or perimeter that do not vary over time. Thus, we only have to take into account the additional control variables that do change over time.

We estimate our models by using three different approaches for selecting the control variables. First of all, we evaluate a model without any control variables by using only household-related fixed effects and time variables. Secondly, we estimate the model by using a limited number of control variables. For these models, our control variables are: the number of adults making up the household, as well as the incidence of twelve different types of "shocks" that could affect production, which are presented in detail in the Data section. Our third specification is based on a larger set of control variables, such as household size and variables relating to the various shocks, as well as the household's membership in a PAO that provides services to its members, whether the household has made different investments in its plots of land or relating to irrigation, and the percentage of trees under 10 years old.

***Definition of the Post-Treatment Period***

Finally, we use three different approaches for measuring the impact based on the way we represent the post-treatment period. As mentioned earlier, the project-related training began before the second survey round (2012) in all the perimeters except one, and the training continued between the second (2012) and third (2013) survey in most cases. Consequently, our first approach uses two different treatment variables that correspond to the second and third survey rounds. This approach enables two different estimations of the impact to be obtained, one for the impact between the first and second survey round, and the second estimation measures the impact between the second and third survey round. While this approach could potentially provide a more accurate estimation of the program's impact, it could also make it more difficult to detect. Thus our second approach uses a single treatment variable. It defines the treatment period as being any time after the first survey. Finally, to make sure that the estimations relating to the second survey do not reflect an intermediate impact that could falsify the results, we use a model that includes only the data collected during the first and third surveys (2011 and 2013), where the third survey represents the post-treatment period. It is noted that for our TOT-IV model, we take into account only the second and third definition of the post-treatment period, and so we only need to choose one instrumental variable for each equation.

### 3.3.2 Results

As mentioned above, we use several model specifications to ensure that our results are not dependent on specific hypotheses. Thus, we have a large number of results to present – since we estimated our models for 31 possible outcomes of the intervention, the results total 744 regressions. To manage the presentation of the results, for each model we present only the coefficients and standard errors for our variables that measure impact, omitting the control variables. In addition, we present just one specification, the most appropriate one, for each ITT, TOT, and TOT-IV model, which permits an accurate representation of all of the results. The rest of the results appear in Appendix E. The selected

specification includes the set of controls described in the previous section for the three models. Moreover, the models presented used separate impact measurements for the 2012 and 2013 surveys for the ITT and TOT models, and the impact measurement combining both years for the TOT-IV model.

***Production Practices***

The results showing the impact on production practices are presented in Table 3.13. Our estimations for the ITT model, which appear in the first four columns of the table, do not reveal any significant impacts of the project on production practices. We also note certain negative, albeit not statistically significant, results during the second survey; these results are probably skewed.

As we could expect, our estimations for the TOT model show statistically significant impacts for several production practices, particularly in the third survey. As the coefficient of the TOT model shows in Table 3.13, the probability of using manure increased 7.68 percentage points. Given that at baseline, 32.9% of farmers in the perimeters that took part in the training applied manure in 2011 (Table 3.7), this corresponds to a 23.4% increase in the probability of using manure. Pruning was performed by 48.97% of the group of farmers who participated in the training at baseline and the coefficient of the TOT model indicates that the probability of performing pruning increased 19 percentage points, which corresponds to an increase of 38.8%. With respect to harvesting with vibrators, the probability increased 2.61 percentage points, corresponding to an increase of 191.9% compared with the baseline value of 0.01% for those who participated in the training. Finally, the probability of constructing impluviums increased 5.08 percentage points, corresponding to an increase of 166% compared with the baseline value of 3.06%.

**Table 3.13** Results of the estimations – Production practices

| | Intention-to-treat (ITT) | | | | | Treatment-on-the-treated (TOT) | | | | | Treatment-on-the-treated with instrumental variable (TOT-IV) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | 2nd or 3rd round *treatment | standard error | n |
| Application of fertilizer (%) | -0.0496** | 0.0215 | -0.0318 | 0.0219 | 4,539 | -0.0489* | -0.0264 | 0.0492 | 0.0335 | 5,588 | -0.0266 | 0.0177 | 5,439 |
| Application of manure (%) | -0.00512 | 0.0308 | 0.0221 | 0.0355 | 4,538 | -0.00269 | -0.0399 | 0.0768** | 0.0385 | 5,587 | 0.0103 | 0.0225 | 5,438 |
| Insect control (%) | -0.021 | 0.0135 | -0.00472 | 0.0124 | 4,539 | -0.0055 | -0.0138 | 0.0155 | 0.0141 | 5,588 | -0.0068 | 0.00764 | 5,439 |
| Parasite control (%) | -0.00425 | 0.00792 | -0.00558 | 0.00798 | 4,539 | 0.00309 | 0.00907 | 0.00857 | 0.00997 | 5,588 | 0.000961 | 0.00476 | 5,439 |
| Bacterial disease control (%) | -0.00768 | 0.00581 | -0.00522 | 0.0048 | 4,539 | -0.00242 | -0.00917 | 0.00274 | 0.00929 | 5,588 | -0.00751** | 0.00365 | 5,439 |
| Wound care (%) | -0.00475 | 0.00623 | -0.00529 | 0.00507 | 4,539 | 0.00299 | 0.00746 | -0.00374 | -0.00474 | 5,588 | -0.00517 | 0.00316 | 5,439 |
| Application of other phytosanitary treatments (%) | -0.00352 | 0.00445 | -0.00601 | 0.00536 | 4,539 | -0.00379 | -0.00741 | -0.0112 | -0.00722 | 5,588 | -0.00673** | 0.00316 | 5,439 |
| Soil work (%) | -0.0201 | 0.0297 | -0.037 | 0.0314 | 4,539 | -0.0464 | -0.0287 | -0.0428 | -0.0319 | 5,588 | -0.0366* | 0.0201 | 5,439 |
| Pruning (%) | -0.0595 | 0.0385 | -0.00884 | 0.0513 | 4,535 | 0.0273 | 0.0356 | 0.190*** | 0.0412 | 5,584 | -0.0141 | 0.0255 | 5,436 |
| Pruning of adult trees (%) | -0.0404 | 0.0454 | 0.00524 | 0.0475 | 2,018 | 0.0227 | 0.042 | -0.0694 | -0.0469 | 2,435 | -0.00837 | 0.0343 | 2,355 |
| Pruning of young trees (%) | 0.0214 | 0.064 | 0.0705 | 0.0839 | 2,001 | 0.0309 | 0.0581 | 0.051 | 0.072 | 2,412 | 0.0433 | 0.0517 | 2,332 |
| Mechanical harvesting (%) | 0.000968 | 0.0038 | 0.00565 | 0.0037 | 4,539 | -0.00215 | -0.0073 | 0.00361 | 0.0122 | 5,588 | 0.00203 | 0.00361 | 5,439 |
| Farmer has access to a vibrator (%) | 0.000122 | 0.00483 | 0.00735 | 0.00588 | 4,539 | 0.0262* | 0.015 | 0.0261* | 0.0139 | 5,588 | 0.00779* | 0.00437 | 5,439 |
| Harvesting with tarpaulins (%) | -0.0171 | 0.0247 | -0.0222 | 0.0248 | 4,321 | -0.00768 | -0.0218 | -0.0271 | -0.0189 | 5,334 | -0.0202 | 0.0125 | 5,189 |
| Transporting in crates (%) | -0.00499 | 0.0105 | -0.00558 | 0.00839 | 4,539 | 0.00847 | 0.0139 | 0.0164 | 0.0129 | 5,588 | -0.00238 | 0.00697 | 5,439 |
| Oil stored in plastic container (%) | -0.328** | 0.149 | -0.179 | 0.145 | 440 | -0.0779 | -0.157 | -0.0104 | -0.183 | 513 | -0.175 | 0.131 | 486 |
| Principal PU: modern (%) | -0.00827 | 0.059 | -0.0109 | 0.0523 | 4,539 | 0.037 | 0.0479 | 0.0543 | 0.0451 | 5,588 | 0.00396 | 0.0234 | 5,439 |
| Principal PU: semi-modern (%) | 0.00469 | 0.0469 | -0.0152 | 0.0362 | 4,539 | -0.0417 | -0.0381 | 0.0237 | 0.0406 | 5,588 | 0.0139 | 0.0179 | 5,439 |
| Construction of basins/impluviums | -0.00437 | 0.0147 | -0.00214 | 0.0189 | 4,539 | -0.0114 | -0.0138 | 0.0508** | 0.0229 | 5,588 | -0.0107 | 0.00917 | 5,439 |
| Percentage of olives processed (%) | 0.0087 | 0.0215 | 0.0181 | 0.0296 | 4,362 | -0.0272 | -0.0238 | -0.00391 | -0.0246 | 5,383 | 0.00963 | 0.0162 | 5,237 |
| Percentage of olives processed and sold (%) | -0.00662 | 0.0124 | -0.00047 | 0.0129 | 4,060 | 0.000517 | 0.0108 | 0.00337 | 0.0122 | 4,978 | -0.00226 | 0.00753 | 4,845 |

Finally, our estimations for the TOT-IV model confirm the increased use of vibrators, but do not show the impact on the other variables. The coefficients are not statistically significant, with the exception of three coefficients that are significant but negative: bacterial disease control, application of other phytosanitary treatments, and soil work. Nevertheless, it is not very likely that these results are due to an actual impact of the program. These negative coefficients could reflect a lower incidence among the beneficiaries of problems that could lead to the use of these practices, for example, tree care is not useful unless the trees need it. In fact, it is possible that the practice of pruning leads to a reduction in the probability of diseases occurring. Pruning permits good sunlight and better air circulation. It is done by getting rid of dead or dried out wood and branches that cross one another resulting in injuries, which can cause diseases to set in. Alternatively, it is possible that these results are skewed or are due to the error of some hypotheses behind the TOT-IV approach described in the Methodology section.

The interpretation of these results must take into account the differences in the modeling methods. It should be remembered that our results of the TOT method measure the impact for farmers who participated in the various training sessions without taking into consideration the possible selection bias. Consequently, our conclusions clearly show that farmers who participated in the various training sessions made certain changes in their production practices in terms of pruning, use of a vibrator, and construction of impluviums. However, except for the use of vibrators, these results are not confirmed by the ITT and TOT-IV models, which do take into account selection bias. Thus, we cannot know whether the increases that the TOT model highlights are due to the impact of the program, or whether the farmers who take part in training are those who would have changed their production practices even without training or are those who were more motivated to change their practices and therefore more actively sought to participate in training.

***Yield, Productivity, and Income***

The impacts on yield, productivity, and income-related results appear in Table 3.14. We do not see a statistically significant positive impact on any of the results for any of the three models. Additionally, the fact that most of the coefficients are negative and that the standard errors are high suggests that the absence of an observed impact is not due to problems associated with sample size or other measurement problems. It should be noted that the TOT and TOT-IV models show a negative impact on the total quantity of olives produced (coefficient -309.5 for the TOT model and -176.7 for the TOT-IV model), which corresponds to a decrease of about 7-10% compared with baseline (an average olive production of 3,209 kg for the group of farmers who participated in the training in 2011). This could be due to the short lapse of time during which the assessment was performed. A significant part of the program consisted of increasing the number of people who use pruning techniques, and our results indicate that the majority of farmers who participated in the training actually started pruning

their trees. However, pruning olive trees can initially reduce yield before production increases again. Consequently, this result could be the effect of the initial reduction in the orchard's yield due to pruning.

## Table 3.14 Results of the estimations – Productivity and income

| | Intention-to-treat (ITT) | | | | | Treatment-on-the-treated (TOT) | | | | | Treatment-on-the-treated with instrumental variable (TOT-IV) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | 2nd or 3rd round *treatment | standard error | n |
| Total quantity of olive oil produced (L) | -45.67 | 31.49 | -17.43 | 23.86 | 4,076 | 0.283 | 33.5 | 12.52 | 45.79 | 5,014 | -23.76 | 19.79 | 4,876 |
| Olive oil sales price (DH/L) | 0.598 | 0.96 | 1.148 | 1.326 | 781 | 0.21 | 0.938 | 1.358 | 1.247 | 949 | 0.752 | 0.871 | 921 |
| Agricultural revenue (DH) | 234.4 | 1,203 | 476.4 | 1,140 | 4,539 | 995.8 | 995.1 | 14.48 | 1,094 | 5,588 | 560.3 | 628.9 | 5,439 |
| Revenue from olives (DH) | -162.8 | 820.3 | -140.3 | 630.5 | 4,539 | 908.2 | 837.4 | -334.6 | -622.9 | 5,588 | -104.3 | 367.2 | 5,439 |
| Revenue from the sale of olive oil (DH) | -338.3** | 157 | -146.2 | 138.7 | 4,539 | -155.3 | -211.9 | -232.5 | -177.2 | 5,588 | -183.5* | 100.3 | 5,439 |
| Net agricultural income (DH) | -277.1 | 941.1 | 469.8 | 999 | 4,539 | 748.9 | 1,009 | -389.7 | -1,120 | 5,588 | 10.6 | 602.6 | 5,439 |
| Net income from olives (DH) | -199.7 | 700.2 | -70.76 | 611.8 | 4,539 | 1,137 | 799.7 | -103.7 | -620.9 | 5,588 | -190.7 | 374 | 5,439 |
| Net household income (DH) | -1,345 | 1,723 | -783 | 1,218 | 4,539 | 4,049 | 3,428 | 1,147 | 1,560 | 5,588 | -415.3 | 811.5 | 5,439 |
| Revenue from olives per tree (DH) | 14.04 | 13.92 | -4.655 | 6.17 | 4,539 | -5.613 | -7.402 | 7.04 | 6.167 | 5,588 | 2.811 | 3.926 | 5,439 |
| Total olive production (kg) | -181.8 | 216 | -129.9 | 147 | 4,539 | -57.65 | -191.6 | -309.5** | -154 | 5,588 | -176.7** | 88.84 | 5,439 |

## 3.4 Conclusions

**The farmers who participated in the project training considerably increased their adoption of several of the good practice techniques explained during the training.** The farmers who participated in the training increased their probability of using manure by 23.4%, pruning by 38.8%, harvesting with vibrators by 191.9%, and digging impluviums by 166%. The application of basin and impluvium construction was also observed in the field by the NORC horticultural specialist and by the UGP. According to the UGP, the training on basins and impluviums was applied quickly because there are drought problems and farmers implement what can benefit them with the least financial expense. The results of our models, which account for selection bias, do not enable us to rule out the possibility that farmers would have been able to make these changes in their production practices even without the project. However, given that these techniques were important axes of the training, it is probable that the estimations above do reflect the project's impact on production practices.

Conversely, our quantitative results indicate that **farmers did not increase their adoption of certain other good practices that were presented during the training.** These include: use of tarpaulins during harvesting, storage of harvested olives in crates rather than in bags, use of fertilizers or pesticides, recourse to modern processing units, and storage of oil in food-grade plastic containers. The main criticism of the project from farmers concerns the lack of financial assistance or provision of material so they could apply the techniques learned during the training, which may explain the lack of change in the adoption rates for these agricultural practices. Farmers did not have the means to procure the tools and equipment needed to put into practice the entire set of technical measures. For example, they cannot purchase the fertilizers or pesticides to perform the phytosanitary treatment. The project's hypothesis is also that these practices will be adopted gradually with market integration and startup of the Catalyst Fund PUs.

**We do not observe any positive impact of the program on outcomes related to production, productivity, and income.** The results studied by the assessment were: the quantity of olives and olive oil produced, the percentage of the harvest processed and sold as olive oil, sales and prices received for olive oil, revenue and profits obtained from olives, agricultural income and profits overall, olive yield per tree, and household income. The only one of these outcomes for which our analysis detected an impact was a decrease in the overall production of olives as a result of the project. This may be due to short-term production declines as a result of the adoption of pruning techniques (particularly rejuvenation pruning) or incorrect application of the pruning schedule or pruning technique.

There are several possible explanations for the fact that we did not observe any improvement in terms of production and productivity. One possibility is that **the assessment period was too short to be able to detect impacts.** The project training took place in 2011 and 2012, and the last survey was conducted at the beginning of 2013. Thus, the assessment covers only one or, at most, two harvests since the training. For three reasons, in particular, this may be an insufficient period of time for there to be an impact.

First, the training places strong emphasis on the promotion of pruning techniques. These techniques are supposed to increase yields considerably, but only over the long term. In some cases, pruning may decrease yields in the beginning, especially if the schedule and technique are not mastered.[42] Thus, an assessment covering only one or two harvests after pruning may not reveal any impact. Practically all the people surveyed by NORC during interviews conducted with resource persons reiterated this opinion. The UNOPS and UGP technicians, as well as those from the WCs and DPAs, think that a period of 2 years is very short for observing significant impacts on olive productions, especially since the hand-over of some perimeters to UNOPS was delayed.

> *"Training is not enough for olive production to double in two years. This is impossible, despite the quality of the training and the trainers." – DPA member*

Additionally, field observations and discussions with staff tasked with implementation suggest that farmers are likely to gradually adopt the good practices included in the training. At the start, many farmers chose to experiment with the techniques on only some of their trees, rather than applying them right away to the entire orchard. The NORC horticultural specialist performed observations of 24 plots of land of farmers randomly selected in each of the intervention areas at the end of 2012. These observations showed that the degree of adoption of the different techniques by the beneficiaries varies from one perimeter to another and from one area to another. Farmers adopted the olive tree maintenance techniques in part and learning was progressive. All the maintenance components cannot be applied in record time to an orchard where no technical measures were being carried out. Farmers seem to have understood the maintenance techniques well, but the application involves a portion of farmers and concerns primarily pruning and soil work (basins and impluviums), as our quantitative results confirm. As an example, among observed farmers who participated in the project training, 95% applied the pruning techniques but, on average, farmers performed pruning on only 57% of the plot of land observed. With respect to impluviums, 80% of farmers applied the technique but on only 69% of

[42] "Pruning Mature Bearing Olive Trees," G. Stephen Sibbett in The Olive Production Manual, 2nd ed. G. Steven Sibbett, Louise Ferguson, Margaret Lindstrand, eds. University of California (System). Division of Agriculture and Natural Resources. UCANR Publications, 2005. pp. 55-59.

their trees. In contrast, only 60% of farmers applied the phytosanitary treatment techniques and did so on 75% of the orchard observed. Consequently, the full impact of the project will not be achieved until farmers adopt all the techniques that were covered in the training.

Finally, we can expect that a portion of the program's impact will occur through a demonstration effect. Some farmers who did not participate in the training will see the positive outcomes for farmers who did participate and will then learn to adopt the new techniques themselves. The full impact of the demonstration effect will probably not be visible for several seasons. This demonstration effect is already partially apparent with Operation Harvest and with the field schools set up by the project.

Another possible explanation of the absence of any observed impact might be that the techniques included in the training are not appropriate to the context and cannot result in increased yields. However, our data and interviews suggest that this is not the case. The performance evaluation shows that the content of the training is generally good quality and adapted to the Moroccan context. The modules were developed by local experts and were the subject of considerable research and bibliographic work. Furthermore, the field schools arose out of the collaboration between the TC-5A contract teams and researchers in the TC-4A consortium, namely, the applied research, adaptation, and new technology transfer program. The TC-5A expert who supervised the development of the training modules was previously the TC-4A team leader and contributed to developing this collaboration to create an exchange of information and knowledge on the best and most recent production techniques. Thus the group of TC-4A researchers contributed to bringing the TC-5A trainers up to speed and developing learning platforms (field schools) in keeping with these agricultural practices. These field schools are viewed as one of the strengths of the TC-5A contract that needs to be continued.

Alternatively, the absence of any impact could derive from the incomplete or ineffective implementation of the program by the executing partner. The performance evaluation might actually suggest that the implementation of the intervention did not completely meet the objectives that were initially set. In particular, the number of beneficiaries who participated in the training is well below the initial objectives. The mission of the TC-5A consultant was to train 33,000 farmers. Initially, each farmer was to be trained in the four training modules, but the definition of a trained farmer was changed over the course of the project and it was decided that a farmer is considered trained when he has participated in at least one training module. According to this definition, 29,481 farmers were trained in the end. However, the people surveyed in our interviews with resource persons agree regarding the point that the initial objective of 33,000 beneficiaries for the four modules was a particularly ambitious objective that is hard to achieve for a project with a length of only a few years.

> *"Training alone does not work; you need a transmission element. It's the field worker who will give the farmer confidence." – UGP member*

Nevertheless, even though the numbers trained did not reach the objectives, the TC-5A contractor could have increased mentoring so that the farmers who participated in the training would truly apply what they learned. In this sense, the field worker is the primary link between the training and the field and must take over to get farmers to implement what they have learned. But a criticism that came up multiple times is that the field workers are overloaded with responsibilities and that they were more focused on the creation of cooperatives and EIGs than on mentoring farmers. It can therefore be wondered whether the adoption rate for some techniques would have gone up with increased mentoring and supervision.

However, the project faced outside constraints that were hard for it to control. One of these constraints concerns the ownership status of the land farmed. Some farmers inherited their land or are co-owners with other farmers, which makes application of new techniques difficult if these other farmers are reluctant. It may also be that some farmers do not own the plots of land on which their olive trees are planted. In some cases, their own land is delimited by the foliage (circumference of the olive tree branches directly overhead). Thus pruning their olive trees would mean reducing the surface area of their land, which is not desirable. Another feature of farming, especially in mountain areas, is intercropping. Farmers in these areas prefer to diversify their farming activity in order to have better food/financial security and so they cultivate the free spaces under the olive trees, particularly with cereals and legumes. However, these crops do not have the same needs from a technical standpoint as olive trees. The schedules do not coincide and so it is difficult to go back on the plot to work on the olive trees without trampling the other crops. Thus the farmer avoids applying some olive-growing practices in order to safeguard these intercrops. It is difficult in just a few years to convince farmers to change their practices to leave a strip of land on either side of the intercrops in order to facilitate work on the trees. Finally, as previously mentioned, it is hard for farmers to apply the techniques when they do not have the financial resources to procure the necessary material.

Without an increase in olive production, it is not surprising that we did not observe any increase in income. Moreover, the PAOs, which can assist farmers in marketing their produce and negotiating better sales prices, were not all operational by the end of the project. Finally, one of the major challenges confronting the project remains that of marketing the oil and creating a greater demand for high-quality oil. The Al Alfiya label was recently registered and the new PUs and EIGs are not yet functional, which means that they cannot yet process a large quantity of high-quality oil even if the market for this oil did exist.

Lastly, the absence of any impact observed among the sample of farmers could be due to problems connected with the assessment. These problems could stem from a compromised assessment model, poor-quality data, or an inadequate sample size. In the present case, we think that this possibility is highly unlikely. The model based on randomized pairs is very rigorous and even though there were a few cases of contamination of control perimeters, these were relatively minor and the original model remained largely intact. The data collected for the assessment are high quality. Throughout the data collection process, good practices were followed with respect to quality control, supervision of researchers, and data processing, and the data tally with the conclusions of other studies. The fact that we did not observe a significant impact, even in the absence of any adjustment to account for selection bias, as well as the fact that the coefficients of the results tend to be negative or to have high standard deviations, suggests that a larger-size sample would not have led to different conclusions.

***Limits of the Impact Assessment***

In interpreting the results of the impact assessment, a certain number of warnings and limits must be borne in mind. First, as has been said, the length of time during which the assessment took place may not have been sufficient for the project's impact to be perceptible. Some good practices, such as pruning, take time to start improving yields, and farmers may choose to change their behavior only to a limited extent in the beginning. Thus the fact that we did not observe any impact cannot be considered proof of the project's failure in terms of increasing production and income.

A second area of concern, which was described in the methodology section, is that the fact that farmers voluntarily opt to participate or not participate in the program complicates the analysis and introduces the possibility of a selection bias. To the extent possible, our assessment strategy takes into account the possibility of a selection bias, but we cannot rule out this possibility entirely.

Finally, the precise definition of a "treatment group" proved difficult in the context of this project. In addition to the farmers in the treatment perimeters who participate in the training, there may be supplemental "contamination" effects from olive producers who do not take part but who learn good practices by observing participating farmers or demonstration plots. If this is the case, the hypotheses underlying the TOT-IV estimator as a solution to the selection bias are not met. Our data also show that, in fact, a large number of olive producers in the control areas attended the training. As a result, the control areas benefit to a certain degree from the project and so comparing the treatment and control groups could lead to an underestimation of the impacts. Finally, although the contamination of the control group was limited with respect to farmer training, our PAO data show that a large number of PAOs in the control areas benefitted from the project. Insofar as this changed farmers' outcomes, this would also result in an underestimation of the impacts. See Appendix F for more information on the PAO training and the results obtained from the PAO survey.

***Suggestions for Future Research***

Our data could be used for future research in a number of ways. First, this analysis could be repeated with a new set of data collected after another 1-2 years. As described in the report, our results suggest that the length of the assessment was not sufficient for the project's impact to be seen. Thus an additional analysis over a longer period of time could reveal the true impact of the project in terms of production, income, and poverty reduction. If the assessment were to be resumed in the future, it might also be useful to take into account the impact of the Catalyst Fund. By the end of the project, the new PUs of the EIGs aided by the Catalyst Fund were not yet functional, but they will be by the end of 2013 and will probably be able to participate in the 2013-2014 olive crop year. Our data indicate that the Catalyst Fund dealt with two EIGs made up of cooperatives in our control perimeters. Thus this would have to be taken into account in future econometric analyses.

On the other hand, a detailed, in-depth analysis of the relationship between production practices and outcomes such as profits and yields could indicate to us which practices are associated with improved outcomes, and to what degree. It would be useful to study the impact of the practices included in the training, as well as other production decisions, on yields, profits, and income. Such an analysis could potentially incorporate GIS climate and rainfall data from other sources in order to control theses factors and improve the accuracy of the results.

# 4. Conclusions and Recommendations

For the MCA-Morocco olive tree orchard rehabilitation and intensification in rain-fed areas activity, the theory of change from the intervention is as follows: the training of farmers in improved olive production and processing techniques will lead to an increased volume and value of their olive and olive oil production, the effect of which will be to increase income from these activities and increase all of their agricultural income. Thus, the intervention is based on the hypothesis that the training of farmers in improved olive-growing techniques would lead to an adoption of these techniques, and this would lead to an increase in their agricultural income, if other improvements took place along the value chain.

This plan is ambitious and requires the development and better operation of professional agricultural organizations (associations, cooperatives, and SOPOs/EIGs), as well as access to upgraded processing units and markets that promote virgin and extra virgin olive oil, to handle an increased production. The TC-5A project largely achieved its goals in terms of the number of PUs to be trained, but only 81% of PAOs were trained (see Section 2.3.3). Moreover, 96% of treatment perimeters have at least one PAO, but 18% of them were still “in the process of being created” at the end of the project. The numbers to be achieved for farmer training were also ambitious: 33,000 farmers were to be trained in good olive-growing practices. Although the project almost achieved this target, only 60% of the total population of farmers in the targeted perimeters received any training, and most took part in only one training module.

Our impact assessment and performance evaluation of the project indicate that the results are mixed at the end of the MCA-Morocco Compact. As we have described in this report, the ultimate goals of this process were not achieved. No improvement in production, productivity, or agricultural income was detected at project end (see Section 3.3.2). The adoption of some good practices was observed, although, with the exception of the use of vibrators for harvesting, these results could be explained by selection bias (see Section 3.3.2). The short intervention period could explain, to a certain degree, the absence of any impact. Since farmers may continue to adopt good practices, a future evaluation after one or two olive-growing seasons could more definitively detect an increase in the rate of adoption of good practices and an impact on production and possibly agricultural income. Additionally, most farmers took part in only one training module (and not in the four modules as initially planned), and those who participated in the training did not adopt the good practices universally (see Section 2.3.3). These rates of farmer participation in the training, combined with a low level of mentoring, could explain in part the project's lack of impact.

Because PAOs and PUs constitute key intermediaries in the valorization of olives, their creation and training are important steps for improving the olive value chain. A few positive developments have been observed along the Moroccan olive value chain (although any change observed cannot be clearly attributed to the intervention since an impact assessment was not performed for these two groups). Some PAOs that participated in the training improved some of their services to their members (see Section 2.3.4). Some PU managers who participated in the training increased their knowledge concerning olive oil production, and 43 of the 110 PUs that developed a business plan with the supervision of TC-5A signed commitment letters for improving their processing unit. Although the intervention was more focused on EIGs and on assistance in the creation of new PUs than on assistance to private PUs for their upgrading, the increase in the knowledge of good olive oil production practices among private PUs was a positive aspect of the intervention.

**Lessons Learned**

Our impact assessment and performance evaluation pointed out several learned lessons that should be taken into account in the design of future projects similar to the TC-5A contract. In particular:

- Our training observations indicate that the content of the training was ambitious but too technical for the participants targeted by the intervention. Some concepts were not understood by the beneficiaries. The content of training should therefore be adapted to the skill and ability level of PAO members and PU managers.

- Similar to the previous point regarding the need for content corresponding to the participants' skill level, given the education level of the beneficiaries, the teaching approach must include more practical training sessions rather than theoretical training in the classroom.

- Each field worker had too heavy a task load as well as too large a geographical area to cover. If the budget for other projects permits, each field worker should therefore be responsible for a more limited geographical area so as to provide more intensive mentoring and supervision to a greater number of beneficiaries. This would also enable them to recruit beneficiaries directly, especially farmers with small farms, rather than count on PAOs for participant recruitment.

- The beneficiaries regretted the lack of concrete assistance. This was a primary reason why a number of them were not able to apply the techniques learned. The project should therefore consider including better supervision of farmers and PU managers for the acquisition or financing of small equipment and for performing the work required to upgrade the PUs. A

component such as the Catalyst Fund should have been put in place from the start of the project.

**Recommendations for the Sustainability of the Project**

The TC-5A contract constituted a key first step in the development of the sector, through training, mentoring, and organization of farmers into cooperatives and EIGs capable of producing virgin and extra virgin olive oil. The addition of the Catalyst Fund in 2011 constituted a strong incentive for the grouping of cooperatives into SOPOs in the project intervention and non-intervention areas. However, the full effect of the Catalyst Fund will not be known before at least one or two agricultural cycles and will depend on the level of assistance that beneficiaries of the Catalyst Fund receive during the initial PU operationalization phase. Much remains to be done to continue developing the sector and increase agricultural income. The following recommendations concern the activities to be conducted to ensure the sustainability of what has already been achieved as a result of the program and to ensure its success in the future.

A major challenge for farmers and the newly formed EIGs is the marketing of oil. Our performance evaluation provides numerous anecdotes of cooperatives that were able to produce high-quality oil but then faced difficulties in marketing this oil at favorable prices, which is discouraging for these beneficiaries. This challenge also involves the autonomy of EIGs in developing markets (marketing and commercialization activities). The training received cannot develop the capabilities of these organizations in these domains. Moreover, even with supervision from the project, the bulk of the volumes were sold at exhibitions (e.g., at SIAM in Meknes) or through the acquaintance networks of the TC-5A contractor's staff. The image of the area (authentic local products) is capitalized on at exhibitions, while chain of trust is used for social networks. These organizations must recruit marketing and sales specialists to reason out their commercial approach (market actions, business practices and logo positioning, design, packaging, labeling, product line) and develop a negotiation and contracting procedure. This represents a cost that will have to be borne while awaiting the return on investment. This is a challenge given the financial limitations associated with the newness of the EIGs and cooperatives. It is therefore essential that future government programs assist cooperatives and EIGs in developing this marketing aspect.

While the EIGs are improving their marketing skills, they can expand their use of platforms, such as Maroc Taswiq, that are positioned around local products and have a modern distribution network with a network of stores in the country and a website that markets internationally.

Upgrading the PUs also remains problematic. Few had the means to implement the business plans that TC-5A helped them develop. To ensure the development of the olive sector, it is crucial that future

projects focus more on the downstream side and assist the PUs in complying with Laws 28-07 and 10-95. In addition, the MAPM must continue the training and mentoring of farmers and PAOs, whether through the current outreach services or through the ONCA and USGAV, in order to expand the adoption of good cultivation practices. Without adequate access to a production of high-quality olives, the EIGs and their new PUs cannot produce good-quality oil.

Finally, an important lack that must be dealt with is the lack (perceived or real) of a large local market for high-quality oil. One recommendation would be to initiate market studies to get a handle on the profiles of potential consumers of Al Alfiya oils in order to adapt the marketing mix, i.e., type of packaging, prices, distribution and promotion channels. It is necessary to broaden the field of target customers to collectives (restaurants, cafés, hotels), as well as solidarity-based fair trade niches. This is imperative in order to be able to sell the 12,000 T of oil projected for the 20 EIGs that are supposed to market under the Al Alfiya label.

The oversight and certification system must be supported and promoted by the public authorities to strengthen the credibility of these products and thus consumer trust. The State can intervene via two important actions: pushing consumers toward quality products (including Al Alfiya-labeled oils) by promoting the health benefits of virgin and extra virgin oil and strictly enforcing the 1996 law prohibiting the sale of bulk olive oils on the market and by developing a financial support system to encourage PUs to package oils.

In the end, the sustainability of the TC-5A project will depend on the qualifications of the entity that will take over the TC-5A contract to provide the required services and the willingness of the government entities that will fund and ensure the implementation of future activities.

## APPENDIX A – Background on the Perimeters

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 1 | Control | Kelaâ | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 1 | Treatment | Jbel Tounes* | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 2 | Control | Touissa | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 2 | Treatment | Tazrout | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 3 | Control | Jlaoulawa Bouziri | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 3 | Treatment | Adrou | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 4 | Control | Masnaoua | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 4 | Treatment | Jbel Ain Barrhout* | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 5 | Control | Bni Rbiâ* | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 5 | Treatment | Azaba* | Gharb-Chrarda-Beni Hssen | Sidi Kacem | |
| 6 | Control | Bir Douar | Tanger-Tetouan | Larache | |
| 6 | Treatment | Taoughanda | Tanger-Tetouan | Larache | |
| 7 | Control | Pressa/Tassart | Tanger-Tetouan | Tetouan | |
| 7 | Treatment | Haouta-Khriba | Tanger-Tetouan | Larache | |
| 8 | Control | Ain Sman | Tanger-Tetouan | Larache | |
| 8 | Treatment | Bab Kbira | Tanger-Tetouan | Larache | |
| 9 | Control | Koudiat Essata | Tanger-Tetouan | Larache | |
| 9 | Treatment | Ain Abrak | Tanger-Tetouan | Larache | |
| 10 | Control | Ain Salem | Tanger-Tetouan | Larache | |
| 10 | Treatment | Al Kolla | Tanger-Tetouan | Larache | |
| 11 | Control | Zinat | Tanger-Tetouan | Tetouan | |
| 11 | Treatment | Beni Moussa | Tanger-Tetouan | Tetouan | |
| 12 | Control | Zraib | Tanger-Tetouan | Larache | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 12 | Treatment | Manjra | Tanger-Tetouan | Larache | |
| 13 | Control | Amtel | Tanger-Tetouan | Tetouan | |
| 13 | Treatment | Ain Bouamer | Tanger-Tetouan | Larache | |
| 14 | Control | Kaouss(**) | Tanger-Tetouan | Larache | |
| 14 | Treatment | Ouattah(**) | Tanger-Tetouan | Larache | |
| 15 | Control | Azarif | Tanger-Tetouan | Chefchaouen | |
| 15 | Treatment | Bouàaloune | Tanger-Tetouan | Chefchaouen | |
| 16 | Treatment | Habbajine Hamria 1* | Tanger-Tetouan | Chefchaouen | This perimeter was grouped with Habbajine Hamria 2 and becomes a treatment perimeter (large Habbajine Hamria treatment perimeter). |
| 16 | Treatment | Habbajine Hamria 2* | Tanger-Tetouan | Chefchaouen | |
| 17 | Control | Brikcha-Libabra | Tanger-Tetouan | Chefchaouen | |
| 17 | Treatment | Ktita | Tanger-Tetouan | Chefchaouen | |
| 18 | Treatment | Ltaoua 1* | Tanger-Tetouan | Chefchaouen | This perimeter was grouped with Ltaoua 2 and becomes a treatment perimeter (large Ltaoua treatment perimeter). |
| 18 | Treatment | Ltaoua 2* | Tanger-Tetouan | Chefchaouen | |
| 19 | Control | Amalou | Tanger-Tetouan | Chefchaouen | |
| 19 | Treatment | Nefzi | Tanger-Tetouan | Chefchaouen | |
| 20 | Treatment | Ain Beida 1* | Tanger-Tetouan | Chefchaouen | This perimeter was grouped with Ain Beida 2 and becomes a treatment perimeter (large Ain Beida treatment perimeter). |
| 20 | Treatment | Ain Beida 2* | Tanger-Tetouan | Chefchaouen | |
| 21 | Control | Beni Mhamed | Taza-Al Hoceima-Taounate | Taounate | |
| 21 | Treatment | Boussfoul Extension | Taza-Al Hoceima-Taounate | Taounate | |
| 22 | Control | Sidi Ahmed | Taza-Al Hoceima-Taounate | Taounate | |
| 22 | Treatment | Bouassem | Taza-Al Hoceima-Taounate | Taounate | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 23 | Control | Zaouia | Taza-Al Hoceima-Taounate | Taounate | |
| 23 | Treatment | Ouled Taleb | Taza-Al Hoceima-Taounate | Taounate | |
| 24 | Control | Beni Snoun | Taza-Al Hoceima-Taounate | Taounate | |
| 24 | Treatment | Ain Mohammed | Taza-Al Hoceima-Taounate | Taounate | |
| 25 | Treatment | Louab and Hbalat | Taza-Al Hoceima-Taounate | Taounate | This perimeter was a control perimeter but received the intervention. |
| 25 | Treatment | Sidi Mokhfi | Taza-Al Hoceima-Taounate | Taounate | |
| 26 | Control | Beni Berber | Taza-Al Hoceima-Taounate | Taounate | |
| 26 | Treatment | Jaaouna Ain Aicha | Taza-Al Hoceima-Taounate | Taounate | |
| 27 | Control | Ngoucht | Taza-Al Hoceima-Taounate | Taounate | |
| 27 | Treatment | Bouzarhoune | Taza-Al Hoceima-Taounate | Taounate | |
| 28 | Control | El Qods | Taza-Al Hoceima-Taounate | Taounate | |
| 28 | Treatment | Astar | Taza-Al Hoceima-Taounate | Taounate | |
| 29 | Control | Dar Dar | Taza-Al Hoceima-Taounate | Taounate | |
| 29 | Treatment | Chtata | Taza-Al Hoceima-Taounate | Taounate | |
| 30 | Control | Bourdoud | Taza-Al Hoceima-Taounate | Taounate | |
| 30 | Treatment | Laazib Ain Amlalou | Taza-Al Hoceima-Taounate | Taounate | |
| 31 | Control | Bouazzoune | Taza-Al Hoceima-Taounate | Taounate | |
| 31 | Treatment | Ain Mediouna/Ksil | Taza-Al Hoceima-Taounate | Taounate | |
| 32 | Control | Ras Kodia | Taza-Al Hoceima-Taounate | Taounate | |
| 32 | Treatment | Beni Oulid/Aghbalou | Taza-Al Hoceima-Taounate | Taounate | |
| 33 | Control | Ouled Meriane | Fes-Boulemane | Sefrou | |
| 33 | Treatment refused | Moutaouakila | Fes-Boulemane | Sefrou | Perimeter refused the program and training was stopped. |
| 34 | Control | Dar Hakoune | Fes-Boulemane | Sefrou | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 34 | Treatment | El Menzel | Fes-Boulemane | Sefrou | |
| 35 | Control | Moukhtara | Fes-Boulemane | Sefrou | |
| 35 | Treatment refused | Marbouha | Fes-Boulemane | Sefrou | Perimeter refused the program and training was stopped. |
| 36 | Control | Ait Said Bratel | Fes-Boulemane | Sefrou | |
| 36 | Treatment | Izdoudene | Meknes-Tafilalet | Khenifra | |
| 37 | Control | Boughioul Danane | Fes-Boulemane | Sefrou | |
| 37 | Treatment | Rhorfat | Fes-Boulemane | Sefrou | |
| 38 | Control | Sidi Said | Meknes-Tafilalet | Khenifra | |
| 38 | Treatment | Sidi Bouali | Meknes-Tafilalet | Khenifra | |
| 39 | Control | Gabgab | Fes-Boulemane | Fes | |
| 39 | Treatment | Ouled Ben Abdelkader | Fes-Boulemane | Fes | |
| 40 | Treatment | Ben Malek | Fes-Boulemane | Fes | This perimeter was grouped with Ben Malek-Jouira (pair 42) and becomes a treatment perimeter (large Ben Malek treatment perimeter). |
| 40 | Treatment | Jnane Louta-Sidi Msahl | Fes-Boulemane | Fes | |
| 41 | Control | Ain Sanya | Fes-Boulemane | Fes | |
| 41 | Treatment | Biada | Fes-Boulemane | Fes | |
| 42 | Control | Ouled Amrane | Fes-Boulemane | Fes | |
| 42 | Treatment | Ben Malek-Jouira | Fes-Boulemane | Fes | |
| 43 | Treatment | Bab Elharcha 2 | Taza-Al Hoceima-Taounate | Taza | |
| 43 | Treatment | Touahar | Taza-Al Hoceima-Taounate | Taza | This perimeter was grouped with Touaher 2 (pair 45) and becomes a treatment perimeter (large Touaher treatment perimeter). |
| 44 | Control | Nkhila | Taza-Al Hoceima-Taounate | Taza | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 44 | Treatment | Ouerghine | Taza-Al Hoceima-Taounate | Taza | |
| 45 | Control | Lakhzana 2 | Taza-Al Hoceima-Taounate | Taza | |
| 45 | Treatment | Touaher 2 | Taza-Al Hoceima-Taounate | Taza | |
| 46 | Control | Beni Khlifa | Taza-Al Hoceima-Taounate | Taza | |
| 46 | Treatment | Faj Tahar Bouayach | Taza-Al Hoceima-Taounate | Taza | |
| 47 | Control | Jbarna | Taza-Al Hoceima-Taounate | Taza | |
| 47 | Treatment | Elkhandak | Taza-Al Hoceima-Taounate | Taza | |
| 48 | Control | Bouharma | Taza-Al Hoceima-Taounate | Taza | |
| 48 | Treatment | Boujrid | Taza-Al Hoceima-Taounate | Taza | |
| 49 | Treatment | Bni Abdellah 2 | Taza-Al Hoceima-Taounate | Taza | |
| 49 | Treatment | Sidi Abdelleh Ghazi | Taza-Al Hoceima-Taounate | Taza | The initial results of the randomization performed by the French consultant show that this perimeter was originally a control perimeter but the TC-1A consultant studied it and prepared the rehabilitation action plan and it was treated by TC-5A. |
| 50 | Treatment | Oued Sebt | Taza-Al Hoceima-Taounate | Taza | |
| 50 | Treatment | Sidi Bouissa 2 | Taza-Al Hoceima-Taounate | Taza | This perimeter was grouped with Sidi Bouissa (pair 62) and becomes a treatment perimeter (large Sidi Bouissa treatment perimeter). |
| 51 | Treatment | Boumlale | Taza-Al Hoceima-Taounate | Taza | |
| 51 | Treatment | El Karkour 2 | Taza-Al Hoceima-Taounate | Taza | This perimeter was grouped with El Karkour perimeter in the 2008 tranche, which will be treated by TC-5A and which is not part of the evaluation protocol. The large El Karkour treatment perimeter will thus now be part of the evaluation protocol. |
| 52 | Control | Karia | Taza-Al Hoceima-Taounate | Taza | |
| 52 | Treatment | Bni Abdlah | Taza-Al Hoceima-Taounate | Taza | |
| 53 | Control | Lakhzana | Taza-Al Hoceima-Taounate | Taza | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 53 | Treatment | Msila | Taza-Al Hoceima-Taounate | Taza | |
| 54 | Treatment | Kardoussa | Taza-Al Hoceima-Taounate | Taza | This perimeter was a control perimeter but received the intervention. |
| 54 | Treatment | Oed Ben Tata - Left | Taza-Al Hoceima-Taounate | Taza | |
| 55 | Treatment | El Khandak 2 | Taza-Al Hoceima-Taounate | Taza | This perimeter was grouped with El Khandek (pair 47) and becomes a treatment perimeter (large El Khandak treatment perimeter). |
| 55 | Treatment | Ain Zekkour | Taza-Al Hoceima-Taounate | Taza | The TC-1A consultant began its study but this perimeter then turned out not to be eligible from a social standpoint because the population refused to agree to the project. A second attempt at studying this perimeter was made by TC-1A, which was finally able to get the population to go along with it. The feasibility study and rehabilitation action plan have already been done. This perimeter was treated by TC-5A. |
| 56 | Control | Iharchliene | Taza-Al Hoceima-Taounate | Taza | |
| 56 | Treatment | Taghzout/Tarzout | Taza-Al Hoceima-Taounate | El Hoceima | The TC-1A consultant made a mistake with this perimeter, thinking it to be a treatment perimeter. The feasibility study and action plan have already been done by this consultant. This perimeter will thus be treated by TC-5A and the Iharchliene perimeter becomes a control perimeter. |
| 57 | Treatment refused | Krakra | Taza-Al Hoceima-Taounate | Taza | Perimeter refused the program and never received training. |
| 57 | Treatment | Mrilou | Taza-Al Hoceima-Taounate | Taza | The TC-1A consultant made a mistake with this perimeter, thinking it was a treatment perimeter. The feasibility study and action plan have already been done by this consultant. This perimeter was treated by TC-5A. |
| 58 | Control | Boufakrane | Taza-Al Hoceima-Taounate | Taza | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 58 | Treatment | Laila (Boujrid 2) | Taza-Al Hoceima-Taounate | Taza | |
| 59 | Control | Smamda | Taza-Al Hoceima-Taounate | Taza | |
| 59 | Treatment | Beni Ourdal | Taza-Al Hoceima-Taounate | Taza | |
| 60 | Treatment | Beni Arjfa | Taza-Al Hoceima-Taounate | Taza | This perimeter was a control perimeter but received the intervention. |
| 60 | Treatment | Tighzratine | Taza-Al Hoceima-Taounate | Taza | |
| 61 | Control | Tarrist | Taza-Al Hoceima-Taounate | El Hoceima | |
| 61 | Treatment | Machkour Bouchtat | Taza-Al Hoceima-Taounate | El Hoceima | |
| 62 | Control | Bab Jnanae | Taza-Al Hoceima-Taounate | Taza | |
| 62 | Treatment | Sidi Bouissa | Taza-Al Hoceima-Taounate | Taza | |
| 63 | Treatment | Mtioua | Taza-Al Hoceima-Taounate | Taza | The TC-1A consultant made a mistake with this perimeter, thinking it was a treatment perimeter. The feasibility study and action plan have already been done by this consultant. This perimeter was treated by TC-5A. |
| 63 | Treatment | Sebt Lakdim | Taza-Al Hoceima-Taounate | Taza | |
| 64 | Control | Moulay Aissa Ben Driss Tamadoute | Tadla-Azilal | Azilal | |
| 64 | Treatment | Tamright | Tadla-Azilal | Azilal | The TC-1A consultant made a mistake regarding this pair and switched the treatment and control perimeters. |
| 65 | Control | Assemssil Oulad Ghennam | Tadla-Azilal | Azilal | |
| 65 | Treatment | Ait Ouizgane | Tadla-Azilal | Azilal | Incomplete sampling frame for this perimeter. |
| 66 | Control | Moulay Aissa Ben Driss Tamadoute | Tadla-Azilal | Azilal | |
| 66 | Treatment | Amdghouss | Tadla-Azilal | Azilal | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 67 | Treatment refused | Tisqui Aval | Tadla-Azilal | Azilal | The population refused to agree to the project and never received training. Incomplete sampling frame for this perimeter. |
| 67 | Treatment | Assemssil Oulad Maammer | Tadla-Azilal | Azilal | The TC-1A consultant made a mistake regarding this pair and switched the treatment and control perimeters. Thus Tisqui Aval became a treatment perimeter. But during the eligibility analysis for this perimeter, it turned out that the population refused to agree to the project. The TC-1A consultant then went back to the original situation, considering Assemssil Oulad Maammer a treatment perimeter and Tisqui Aval a control perimeter. The feasibility study and action plan for Assemssil Oulad Maammer have already been done by this consultant. This perimeter was treated by TC-5A. |
| 68 | Control | Moulay Aissa Ben Driss Ait Ouabit | Tadla-Azilal | Azilal | |
| 68 | Treatment | Assemssil Moulay Aissa Ben Driss | Tadla-Azilal | Azilal | |
| 69 | Treatment refused | Ait Totesse | Tadla-Azilal | Azilal | This perimeter was a control perimeter but received the intervention as part of the 2010 tranche and then refused, and training was stopped. |
| 69 | Treatment | Moulay Aissa Ben Driss North | Tadla-Azilal | Azilal | The TC-1A consultant made a mistake regarding this pair and switched the treatment and control perimeters. But during the eligibility analysis for the Ait Totesse perimeter, it turned out that the population refused to agree to the project. The TC-1A consultant then went back to the original situation. |
| 70 | Control | Lbouihat | Marrakech-Tensift-El Haouz | Essaouira | |
| 70 | Treatment | El Garaa | Marrakech-Tensift-El Haouz | Essaouira | |

| Pair no. | Assignment at end of contract | Location of perimeter | Region | Province | Comments |
|---|---|---|---|---|---|
| 71 | Control | Ait Lhaj Taibi | Marrakech-Tensift-El Haouz | Essaouira | |
| 71 | Treatment | Sidi Boulnouar | Marrakech-Tensift-El Haouz | Essaouira | |

## APPENDIX B – Sampling and Response Rate

### Farmer Sample

The sampling was done using a sampling frame prepared via a listing exercise conducted by the Ministry of Agriculture and Maritime Fisheries (MAPM).

Proportional assignment was used to distribute the total farmer sample among the various perimeters. The farmers' age was used to sort the farmers within each perimeter. A systematic sample was then selected within each perimeter. For perimeters in which the number of farmers is less than 20, a census of farmers in these perimeters was included in the sample to guarantee not only adequate coverage of these perimeters but also a sufficient number of respondents for the analysis. It should also be noted that this random sample of farmers in each perimeter does not permit the study results to be reported at the perimeter level. Rather, they will be reported at a larger aggregate level (such as the regional level) by comparing treatment cases with control cases.

**Response Rate:**

The definition of response rate by the American Association of Public Opinion Research (AAPOR)[43] is the following: number of completed surveys divided by the number of eligible respondents in the sample. Cooperation rate refers to the proportion of surveys completed in relation to all farmers contacted, and contact rate concerns the proportion of people contacted in relation to all eligible farmers in the sample. These rates are presented in Table B.1 for each of the surveys.

[43]"Standard Definitions: Final Dispositions of Case Codes and Outcome Rates of Surveys". Revised in 2011. http://aapor.org/Content/NavigationMenu/AboutAAPOR/StandardsampEthics/StandardDefinitions/StandardDefinitions2011.pdf

## Table B.1 Response rate - Farmer surveys (%)

| Rate type | | Treatment | Control |
|---|---|---|---|
| Response rate (number of surveys completed in parentheses) | 2011 | 87.2 (1,561) | 88.6 (973) |
| | 2012 | 82.9 (1,599) | 86.9 (823) |
| | 2013 | 88.3 (1,522) | 89.7 (783) |
| Cooperation rate | 2011 | 93.6 | 94.2 |
| | 2012 | 86.9 | 89.0 |
| | 2013 | 91.2 | 91.4 |
| Contact rate | 2011 | 93.2 | 94.1 |
| | 2012 | 95.4 | 97.7 |
| | 2013 | 96.8 | 98.2 |
| Ineligible rate | 2011 | 0.03 | 0.02 |
| | 2012 | 0.01 | 0.00 |
| | 2013 | 0.00 | 0.00 |

### PAO Sample

Table B.2 presents the response, cooperation, contact, and refusal rates for each of the surveys of professional agricultural organizations. The figures in parentheses indicate the number of surveys completed for each survey. It should be noted that not all PAOs have olive production activities. The number of panel PAOs between 2010 and 2013 is 49 PAOs, 41 of which have olive production activities.

## Table B.2 Response rate - PAO surveys (%)

| Rate type | 2010 | 2012 | 2013 |
|---|---|---|---|
| Response rate (number of surveys completed in parentheses) | 68.6 (74, with 50 being olive production PAOs) | 95.7 (88, with 72 being olive production PAOs) | 97.4 (158, with 129 being olive production PAOs) |
| Cooperation rate | 96 | 96.7 | 97.4 |
| Contact rate | 71.4 | 98.9 | 100 |
| Refusal rate | 4.3 | 3.3 | 2.6 |
| Ineligible rate | 10.3 | 4.2 | 9.5 |

## PU Sample

Table B.3 presents the response, cooperation, contact, and refusal rates for each of the surveys of processing units. The figures in parentheses indicate the number of surveys completed for each survey. The number of panel PUs between 2011 and 2013 is 93 PUs.

**Table B.3** Response rate - PU surveys (%)

| Rate type | 2011 | 2012 | 2013 |
|---|---|---|---|
| Response rate<br>(number of surveys completed in parentheses) | 90.5<br>(142) | 88.3<br>(128) | 80.3<br>(111) |
| Cooperation rate | 92.8 | 90.8 | 83.6 |
| Contact rate | 97.5 | 97.2 | 96.1 |
| Refusal rate | 7.0 | 0.09 | 11.2 |
| Ineligible rate | 6.5 | 0.06 | 0.0 |

## Collection of Additional Data for the Performance Evaluation

The samples were limited to the perimeters that were part of the impact assessment and were selected for the purpose of including respondents from each of the four TC-5A program implementation areas. Theses areas are made up of the following provinces:

- Area 1: Larache, Ouezzane, Tetouan
- Area 2: Al Hoceima, Sefrou, Taounate, Zouagha Moulay Yacoub
- Area 3: Al Haouz, Azilal, Essaouira, Khenifra
- Area 4: Taza

In addition, the samples for each group of respondents were selected based on the following criteria:

- Focus groups with farmers and sons and daughters of farmers and rural youth (SDFRY):

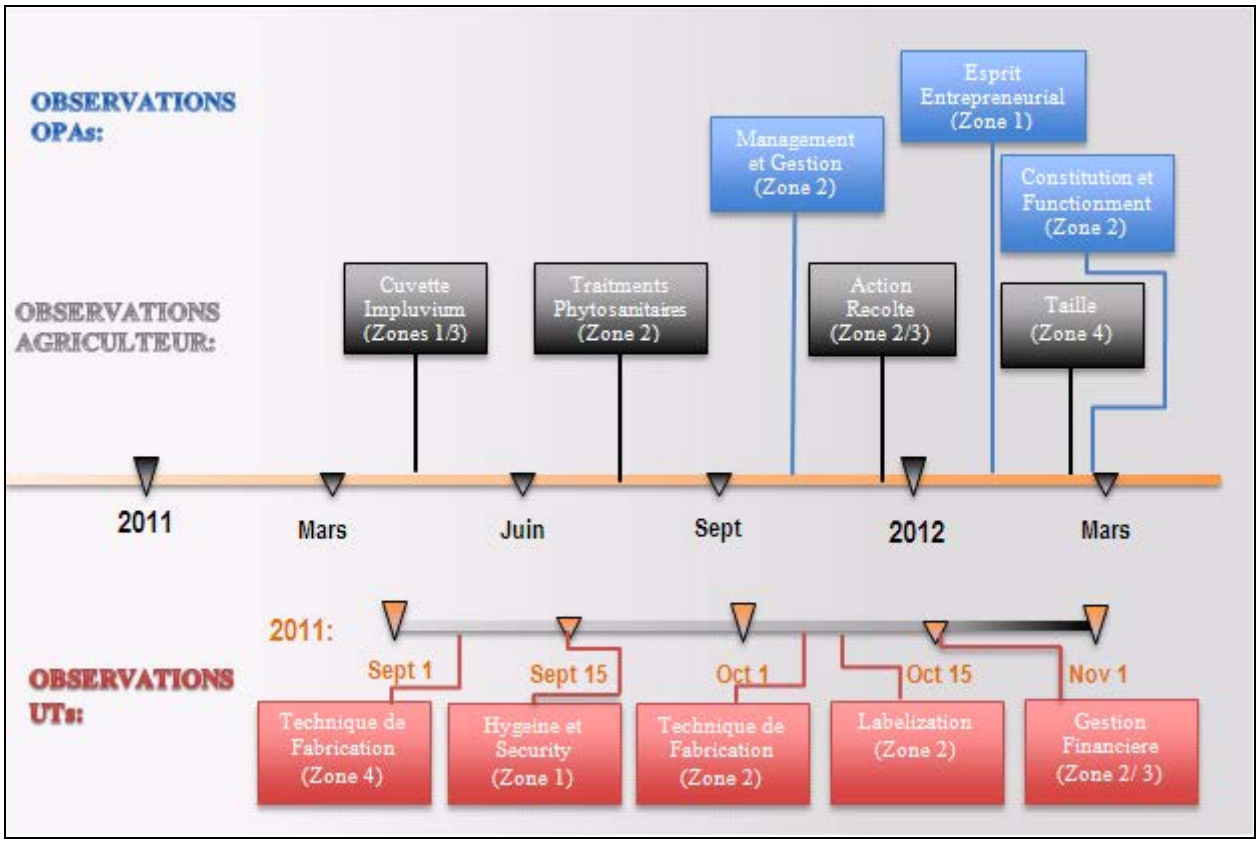
- Four farmer focus groups were organized, one in each intervention area, to capture differences in implementation of the project between the different area teams as well as cultural differences among women in these different regions.

- Seven focus groups with SDFRY were conducted in all the areas. The choice of perimeters was limited to those for which NORC received a list of beneficiaries who participated in the TC-5A training. From this list, NORC selected perimeters that were affiliated with the same WC in order to minimize travel distances for the focus group participants. The moderator of the focus group then randomly selected the individuals from these perimeters who would take part in the focus groups so as to have all the perimeters and all the training modules represented.

- Observations of farmers' plots: For these observations, NORC was limited to perimeters for which lists of individuals who participated in the training were available. From these lists, NORC selected the perimeters for which the TC-5A consultant had completed all of the training modules. The NORC horticultural expert then selected two perimeters in each of the four implementation areas. In each of these perimeters, we randomly selected two male farmers and one female farmer (if possible) using the list of farmers who had been trained. Each farmer first answered a series of questions about the training session he/she had participated in and the techniques he/she had used on his/her plots of land. The horticultural expert then visited the largest plot to complete his evaluation of the quality of the techniques applied.

- Training observations: In 2011 and the beginning of 2012, the horticultural expert, sociology expert, and food-processing expert performed 16 observations of farmer, SDFRY, PAO, and processing unit training so that all the training teams in all the intervention areas were observed. An attempt was also made to observe all the training modules. The specific choice of training to observe was made by each expert based on his schedule and the teams and modules to be observed. The experts filled out an observation chart with scores for each module observed. Figure B.1 shows the areas and periods in which these observations were performed in 2011 and 2012. The methodology adopted for these observations was the following:
    - Observe at least one training session for each module
    - Observe at least one training session of each type in each area
    - Observe at least one training session for each type of beneficiary

**Figure B.1** Observation Schedule




- Interview with EIG presidents: NORC received a list of 18 presidents of EIGs that were part of the Catalyst Fund component of the program. Of this list, 10 EIGs are also affiliated with the perimeters in the NORC impact assessment. NORC then selected one EIG president in each area.

- Interviews with the DPAs and WCs: NORC received a list of DPAs and WCs associated with the perimeters in the impact assessment. One DPA and one WC were selected in each program area. The people who participated in interviews at the beginning of 2012 were excluded from the selection at the end of 2012.

- Interviews with the TC-5A consultant's core team: the NORC team interviewed the team leader and the professional agricultural organization, arboriculture, food-processing industry, and marketing specialists.

- Interviews with the TC-5A consultant's area teams: the NORC team opted to interview the professional organization, horticulture, and food-processing specialists and one field worker in each UNOPS area team to cover the three groups of beneficiaries and the training, technical support, and mentoring activities. A group of male and female field workers was selected. The

people who participated in interviews at the beginning of 2012 were excluded from the selection at the end of 2012.

- Representatives of the UGP: the NORC team interviewed all the UGP specialists except the water and soil conservation in rain-fed areas specialist because the performance evaluation does not include the environmental aspect. We interviewed the horticulture, professional organization, valorization and marketing, training and research, and gender specialists.

The interviews with UGP resource persons and the TC-5A consultant's core team were conducted by two NORC data collection and evaluation experts based in the United States. The other interviews, focus groups, and observations were conducted by local NORC experts and the C&O team (for the interviews at the beginning of 2012), who were trained by the NORC team in good practices for conducting interviews and focus groups. The focus group interviewers and field workers worked in two-person teams,[44] with one person conducting the interview while the other person took notes. This was especially important for interviews that could not be recorded.

Table B.4 below summarizes the samples for the different data collections carried out for the performance evaluation.

**Table B.4** Summary of the data collection

| Type of data collection | Respondent | Location | Number |
|---|---|---|---|
| | **2010** | | |
| **Survey** | PAO | All areas | 74 |
| | **2011** | | |
| **Survey** | PU | All areas | 142 |
| | **End of 2011/Beginning of 2012** | | |
| **Focus group** | SDFRY | All areas | 4 |
| **Focus group** | Farmers | Area 2 | 1 |
| **Observations** | Farmer training | All areas | 4 |
| **Observations** | SDFRY training | All areas | 4 |
| **Observations** | PAO training | Areas 1, 2, 3 | 3 |
| **Observations** | PU training | All areas | 5 |
| **Interviews** | EIG presidents | All areas | 4 |

[44] Except for the interviews conducted by the C&O team, in which they did not work in pairs.

| Type of data collection | Respondent | Location | Number |
|---|---|---|---|
| **Interviews** | TC-5A consultant's core team | Rabat | 5 |
| **Interviews** | TC-5A area teams | All areas | 16 |
| **Interviews** | UGP members | Rabat | 5 |
| **Interviews** | DPA agents | All areas | 4 |
| **Interviews** | WC agents | All areas | 4 |
| **Survey** | PAO | All areas | 88 |
| **Survey** | PU | All areas | 128 |
| **End of 2012/Beginning of 2013** | | | |
| **Focus group** | SDFRY | Areas 1, 3, 4 | 3 |
| **Focus group** | Female farmers | Areas 1, 3 | 2 |
| **Observations** | Farmers' plots of land | All areas | 24 |
| **Observations** | Processing units | All areas | 12 |
| **Interviews** | EIG presidents | All areas | 4 |
| **Interviews** | TC-5A consultant's core team | Rabat | 5 |
| **Interviews** | TC-5A area teams | All areas | 16 |
| **Interviews** | UGP members | Rabat | 5 |
| **Interviews** | DPA agents | All areas | 4 |
| **Interviews** | WC agents | All areas | 4 |
| **Start of 2013** | | | |
| **Survey** | PAO | All areas | 158 |
| **Survey** | PU | All areas | 111 |
| **Focus group** | Female farmers | Areas 2, 4 | 2 |

## APPENDIX C – Questionnaires

The survey questionnaires were created by experts in the sectors in question and by NORC survey specialists, and in consultation with the APP, MAPM, and other key players. The initial drafts of the questionnaires were based in part on questionnaires used in World Bank agricultural surveys and household surveys and on other questionnaires used by the Moroccan Ministry of Agriculture and Maritime Fisheries and were adapted based on the indicators of specific interest to our evaluation. The Moroccan experts in olive production, agricultural economy, rural sociology, and agricultural statistics whom NORC uses reviewed the preliminary versions of the questionnaire to verify that they were consistent with the evaluation indicators and the practices of Moroccan small farms. After revision of these preliminary versions by the APP monitoring-evaluation team and experts from the UGP and MAPM, the questionnaires were translated into Arabic to conduct pre-tests and the pilot test. This appendix presents the questionnaires that were used for the last survey in 2013.

*[Questionnaires included in PDF files in a separate folder]*

## APPENDIX D – Definition of Net Agricultural Income

*Agricultural income* includes all income derived from agricultural activity and includes gross revenue, i.e., sales from farming, to which are added budget payments and other revenue. Gross revenue net of operating expenses (or operating costs) gives net operating income. If we take into account depreciation of the various equipment, then we get *net agricultural income*. In this context, net income relates to revenue net the different costs the farm is faced with. Thus *net agricultural income* is a long-term measure of the capacity of farms to develop or survive as a result of their agricultural activity.

In other words, net agricultural income is the difference, at the farm level and over a given period of time, between the value of gross production and the value of all variable and fixed expenses, including depreciation, pertaining to agricultural activities. Gross production is the sum of revenue from the sale of harvests of primary productions and by-products, direct payments, and revenue from agricultural activities. It also includes self-consumption and any other quantity of unsold production (kept to be sold later, for example), evaluated at market price. Expenses consist of operating costs (production, storage, and marketing costs or inputs and temporary workers) and fixed costs (wages of permanent farm workers, farm capital costs, including buildings and agricultural equipment related to livestock and plant production, hydro-agricultural works, and land rental value).

The goal of the intervention is to increase the production and quality of olives and olive oil in order to increase agricultural income. It is therefore important to distinguish between net income from the olive-production activity and net income from other agricultural activities. To evaluate these indicators, we calculate the net cash flow from olives only and then net cash flow from all other crops grown. This net cash flow takes into account operating costs but does not include long-term capital costs (in contrast to net agricultural income).

Table D.1 below describes the revenues and expenses/costs included in each type of income calculated.

## Table D.1 Agricultural Income Revenue and Expenses

| | Revenue | Expenses and costs |
|---|---|---|
| **Net income – Olives** | Cash receipts:<br>▪ Sale of olive production<br>▪ Sale of olive oil production<br>▪ Sale of production of products derived from olives (olive cake, vegetable wastewater, etc.)<br>In-kind receipts (evaluated at market price):<br>▪ Value of unsold production of olives and olive oil (given, self-consumed, and kept for later sale/stock) | ▪ Transporting of olives and olive oil<br>▪ Processing of olives<br>▪ Inputs and small equipment for olive cultivation<br>▪ Operating costs of production of products derived from olives<br>▪ Workers hired for olive cultivation:<br>▸ Cash payments<br>▸ In-kind payments |
| **Net income – Other crops** | Cash receipts:<br>▪ Sale of production of other crops<br>In-kind receipts (evaluated at market price):<br>Value of unsold production (given and not given) | ▪ Inputs, small equipment, and transport for cultivation of other crops<br>▪ Workers hired for cultivation of other crops:<br>▸ Cash payments<br>▸ In-kind payments |
| **Net agricultural income** | Revenue pertaining to livestock and plant production:<br>*Cash receipts:*<br>▪ Sale of production of olives, olive oil, and products derived from olives<br>▪ Sale of production of other crops<br>▪ Sale of livestock and products derived from livestock rearing<br>*In-kind receipts (evaluated at market price):*<br>▪ Value of unsold production of olives, olive oil<br>▪ Sale of unsold production of other crops<br>▪ Value of unsold production of products derived from livestock rearing<br>Other revenue:<br>▪ Cash and in-kind payments for non-operating work (as farm worker)<br>▪ Cash and in-kind receipts from land rental<br>▪ Cash and in-kind receipts from land given in partnership<br>▪ Cash receipts from the leasing of agricultural equipment | ▪ Operating costs from olives (inputs, small equipment, transport, and processing)<br>▪ Operating costs from other crops (inputs, small equipment, transport)<br>▪ Operating costs from livestock rearing (feed, veterinary expenses, etc.)<br>▪ Cash and in-kind payments to farm workers hired (olives, other crops, etc.)<br>▪ Purchasing of livestock<br>▪ Purchasing of equipment (amounts depreciated over the useful life of the equipment)<br>▪ Hydro-agricultural investments (amount depreciated over the average useful life of the hydro-agricultural works)<br>▪ Depreciation costs for agricultural buildings (amounts depreciated over the useful life of the buildings)<br>▪ Value of the production of olives, olive oil, and other crops given (*zakat*, given to heirs, given as rent/in partnership) |

## APPENDIX E – Complete Regression Results

**Table E.1** Intention-to-treat, no controls, 2nd round and 3rd round separated

| | INTENTION-TO-TREAT: NO CONTROLS TREATMENTS SEPARATED | | | | | |
|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0358 | 0.0221 | -0.0229 | 0.0234 | 4,804 | 0.004 |
| Application of manure | 0.00497 | 0.0332 | 0.0371 | 0.0358 | 4,803 | 0.008 |
| Insect control | -0.0139 | 0.015 | 0.00103 | 0.0128 | 4,804 | 0.007 |
| Parasite control | 0.00419 | 0.00917 | 0.0067 | 0.0111 | 4,804 | 0.008 |
| Bacterial disease control | -0.000369 | 0.00745 | 0.00404 | 0.00764 | 4,804 | 0.003 |
| Wound care | 0.00165 | 0.00737 | -0.0024 | 0.00612 | 4,804 | 0.003 |
| Application of other phytosanitary treatments | -0.00063 | 0.00523 | -0.00593 | 0.00577 | 4,804 | 0.001 |
| Soil work | -0.0186 | 0.0289 | -0.0409 | 0.0323 | 4,802 | 0.005 |
| Pruning | -0.0483 | 0.0416 | -0.00337 | 0.0582 | 4,798 | 0.008 |
| Pruning of adult trees | -0.0515 | 0.041 | 3.69E-05 | 0.0433 | 2,188 | 0.02 |
| Pruning of young trees | 0.0434 | 0.0598 | 0.099 | 0.0803 | 2,170 | 0.044 |
| Mechanical harvesting | 0 | 0.00394 | -0.000249 | 0.00432 | 4,815 | 0 |
| Farmer has access to a vibrator | -0.00277 | 0.0053 | 0.0068 | 0.00777 | 4,815 | 0.002 |
| Harvesting with tarpaulins | -0.0184 | 0.0246 | -0.0147 | 0.0244 | 4,573 | 0.015 |
| Transporting in crates | -0.00755 | 0.0116 | -0.00805 | 0.00996 | 4,815 | 0 |
| Oil stored in plastic container | -0.297*** | 0.108 | -0.235* | 0.136 | 485 | 0.118 |
| Principal PU: modern | -0.00918 | 0.059 | -0.0143 | 0.0543 | 4,815 | 0.035 |
| Principal PU: semi-modern | 0.00877 | 0.0493 | -0.0174 | 0.0382 | 4,815 | 0.021 |
| Construction of basins/impluviums | -0.00832 | 0.0144 | -0.00955 | 0.0199 | 4,815 | 0.004 |
| Percentage of olives processed | 0.00953 | 0.0214 | 0.0129 | 0.0273 | 4,614 | 0 |
| Percentage of olives processed and sold | -0.0063 | 0.0123 | 0.00332 | 0.0129 | 4,282 | 0.012 |
| Total quantity of olive oil produced (L) | -24.09 | 37.12 | -7.339 | 32.5 | 4,319 | 0.027 |
| Olive oil sales price (DH/L) | 0.667 | 0.814 | -0.012 | 1.328 | 839 | 0.615 |
| Agricultural revenue (DH) | 403.7 | 1428 | -128.4 | 1383 | 4,815 | 0.021 |
| Revenue from olives (DH) | 218.3 | 947.9 | -280.9 | 685 | 4,815 | 0.07 |
| Revenue from the sale of olive oil (DH) | -266.3 | 185.3 | -116.3 | 142.4 | 4,815 | 0.014 |
| Net agricultural income (DH) | -436.8 | 1023 | -443.8 | 1085 | 4,815 | 0.004 |
| Net income from olives (DH) | -175.7 | 774.3 | -516.3 | 634.6 | 4,815 | 0.033 |
| Net household income (DH) | -1,066 | 1647 | -1,524 | 1253 | 4,815 | 0.002 |
| Revenue from olives per tree (DH) | 18.38 | 14.7 | -1.99 | 7.072 | 4,779 | 0.072 |
| Total olive production (kg) | -170.8 | 228.8 | -211.3 | 157.1 | 4,815 | 0.124 |

**Table E.2** Intention-to-treat, no controls, 2nd round and 3rd round combined

| | INTENTION-TO-TREAT: NO CONTROLS TREATMENTS COMBINED | | | |
|---|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0294 | 0.0184 | 4,804 | 0.004 |
| Application of manure | 0.021 | 0.0303 | 4,803 | 0.007 |
| Insect control | -0.00642 | 0.0125 | 4,804 | 0.006 |
| Parasite control | 0.00544 | 0.00963 | 4,804 | 0.008 |
| Bacterial disease control | 0.00184 | 0.00724 | 4,804 | 0.003 |
| Wound care | -0.000377 | 0.00641 | 4,804 | 0.003 |
| Application of other phytosanitary treatments | -0.00328 | 0.00502 | 4,804 | 0.001 |
| Soil work | -0.0297 | 0.0283 | 4,802 | 0.005 |
| Pruning | -0.0258 | 0.0446 | 4,798 | 0.008 |
| Pruning of adult trees | -0.0292 | 0.0378 | 2,188 | 0.018 |
| Pruning of young trees | 0.0674 | 0.0577 | 2,170 | 0.043 |
| Mechanical harvesting | -0.000125 | 0.00362 | 4,815 | 0 |
| Farmer has access to a vibrator | 0.00202 | 0.00517 | 4,815 | 0.001 |
| Harvesting with tarpaulins | -0.0166 | 0.0223 | 4,573 | 0.015 |
| Transporting in crates | -0.0078 | 0.00898 | 4,815 | 0 |
| Oil stored in plastic container | -0.278*** | 0.0981 | 485 | 0.116 |
| Principal PU: modern | -0.0117 | 0.0512 | 4,815 | 0.035 |
| Principal PU: semi-modern | -0.00431 | 0.0407 | 4,815 | 0.021 |
| Construction of basins/impluviums | -0.00893 | 0.0143 | 4,815 | 0.004 |
| Percentage of olives processed | 0.0112 | 0.0206 | 4,614 | 0 |
| Percentage of olives processed and sold | -0.00155 | 0.0114 | 4,282 | 0.011 |
| Total quantity of olive oil produced (L) | -16.2 | 29.12 | 4,319 | 0.027 |
| Olive oil sales price (DH/L) | 0.413 | 0.771 | 839 | 0.615 |
| Agricultural revenue (DH) | 137.6 | 1168 | 4,815 | 0.021 |
| Revenue from olives (DH) | -31.31 | 596.5 | 4,815 | 0.069 |
| Revenue from the sale of olive oil (DH) | -191.3 | 147 | 4,815 | 0.014 |
| Net agricultural income (DH) | -440.3 | 853.1 | 4,815 | 0.004 |
| Net income from olives (DH) | -346 | 537.4 | 4,815 | 0.033 |
| Net household income (DH) | -1,295 | 1205 | 4,815 | 0.002 |
| Revenue from olives per tree (DH) | 8.21 | 6.783 | 4,779 | 0.068 |
| Total olive production (kg) | -191 | 159.8 | 4,815 | 0.124 |

**Table E.3** Intention-to-treat, no controls, 1st round and 3rd round only

| | INTENTION-TO-TREAT: NO CONTROLS 1ST AND 3RD ROUNDS | | | |
|---|---|---|---|---|
| | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0229 | 0.0234 | 3,201 | 0.006 |
| Application of manure | 0.0371 | 0.0358 | 3,200 | 0.014 |
| Insect control | 0.00102 | 0.0128 | 3,201 | 0.008 |
| Parasite control | 0.0067 | 0.0112 | 3,201 | 0.009 |
| Bacterial disease control | 0.00405 | 0.00764 | 3,201 | 0.005 |
| Wound care | -0.0024 | 0.00613 | 3,201 | 0.006 |
| Application of other phytosanitary treatments | -0.00594 | 0.00578 | 3,201 | 0.001 |
| Soil work | -0.0429 | 0.0325 | 3,201 | 0.01 |
| Pruning | -0.00253 | 0.0582 | 3,199 | 0 |
| Pruning of adult trees | 0.0198 | 0.0439 | 1,391 | 0.028 |
| Pruning of young trees | 0.089 | 0.0828 | 1,376 | 0.088 |
| Mechanical harvesting | -0.000249 | 0.00432 | 3,210 | 0 |
| Farmer has access to a vibrator | 0.0068 | 0.00777 | 3,210 | 0.002 |
| Harvesting with tarpaulins | -0.0149 | 0.0248 | 3,040 | 0.025 |
| Transporting in crates | -0.00805 | 0.00996 | 3,210 | 0.001 |
| Oil stored in plastic container | -0.429*** | 0.134 | 274 | 0.429 |
| Principal PU: modern | -0.0143 | 0.0543 | 3,210 | 0.065 |
| Principal PU: semi-modern | -0.0174 | 0.0382 | 3,210 | 0.038 |
| Construction of basins/impluviums | -0.00955 | 0.0199 | 3,210 | 0.002 |
| Percentage of olives processed | 0.013 | 0.0276 | 3,068 | 0 |
| Percentage of olives processed and sold | 0.0023 | 0.013 | 2,865 | 0.018 |
| Total quantity of olive oil produced (L) | -5.088 | 33.65 | 2,840 | 0.064 |
| Olive oil sales price (DH/L) | 0.244 | 1.304 | 530 | 0.78 |
| Agricultural revenue (DH) | -128.4 | 1383 | 3,210 | 0.017 |
| Revenue from olives (DH) | -280.9 | 685 | 3,210 | 0.086 |
| Revenue from the sale of olive oil (DH) | -116.3 | 142.3 | 3,210 | 0.022 |
| Net agricultural income (DH) | -443.8 | 1085 | 3,210 | 0.001 |
| Net income from olives (DH) | -516.3 | 634.5 | 3,210 | 0.015 |
| Net household income (DH) | -1,524 | 1253 | 3,210 | 0.004 |
| Revenue from olives per tree (DH) | -2.122 | 7.076 | 3,186 | 0.089 |
| Total olive production (kg) | -211.3 | 157 | 3,210 | 0.211 |

**Table E.4** Intention-to-treat, partial controls, 2nd round and 3rd round separated

| | INTENTION-TO-TREAT: PARTIAL CONTROLS TREATMENTS SEPARATED | | | | | |
|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0385* | 0.0216 | -0.0249 | 0.0228 | 4,804 | 0.011 |
| Application of manure | 0.00564 | 0.0327 | 0.0337 | 0.0362 | 4,803 | 0.021 |
| Insect control | -0.0129 | 0.0149 | 0.000638 | 0.0128 | 4,804 | 0.022 |
| Parasite control | 0.00473 | 0.00921 | 0.0068 | 0.0108 | 4,804 | 0.015 |
| Bacterial disease control | 6.22E-05[*] | 0.00747 | 0.00441 | 0.00762 | 4,804 | 0.007 |
| Wound care | 0.00154 | 0.00732 | -0.00247 | 0.00613 | 4,804 | 0.007 |
| Application of other phytosanitary treatments | -0.000388 | 0.00514 | -0.00602 | 0.00585 | 4,804 | 0.008 |
| Soil work | -0.0146 | 0.0285 | -0.0328 | 0.0299 | 4,802 | 0.035 |
| Pruning | -0.0479 | 0.0399 | -0.00367 | 0.0527 | 4,798 | 0.027 |
| Pruning of adult trees | -0.0497 | 0.0417 | -0.00277 | 0.0443 | 2,188 | 0.03 |
| Pruning of young trees | 0.0284 | 0.0591 | 0.0924 | 0.0761 | 2,170 | 0.076 |
| Mechanical harvesting | 0.000323 | 0.00392 | 0.000185 | 0.0045 | 4,815 | 0.003 |
| Farmer has access to a vibrator | -0.00287 | 0.00522 | 0.00642 | 0.00753 | 4,815 | 0.005 |
| Harvesting with tarpaulins | -0.0175 | 0.0248 | -0.0136 | 0.0245 | 4,573 | 0.02 |
| Transporting in crates | -0.00711 | 0.0115 | -0.00814 | 0.00991 | 4,815 | 0.005 |
| Oil stored in plastic container | -0.325*** | 0.113 | -0.186 | 0.129 | 485 | 0.213 |
| Principal PU: modern | -0.00795 | 0.0566 | -0.019 | 0.05 | 4,815 | 0.057 |
| Principal PU: semi-modern | 0.00806 | 0.0475 | -0.0147 | 0.0366 | 4,815 | 0.032 |
| Construction of basins/impluviums | -0.00638 | 0.0141 | -0.00486 | 0.0197 | 4,815 | 0.018 |
| Percentage of olives processed | 0.0127 | 0.0199 | 0.0156 | 0.027 | 4,614 | 0.009 |
| Percentage of olives processed and sold | -0.00637 | 0.0124 | 0.00375 | 0.0131 | 4,282 | 0.016 |
| Total quantity of olive oil produced (L) | -24.56 | 37.05 | -9.195 | 32.43 | 4,319 | 0.032 |
| Olive oil sales price (DH/L) | 0.673 | 0.871 | 0.549 | 1.32 | 839 | 0.634 |
| Agricultural revenue (DH) | 487 | 1393 | -88.85 | 1364 | 4,815 | 0.039 |
| Revenue from olives (DH) | 229.8 | 919.6 | -278.4 | 684.9 | 4,815 | 0.081 |
| Revenue from the sale of olive oil (DH) | -279.6 | 185.8 | -130.6 | 146.4 | 4,815 | 0.016 |
| Net agricultural income (DH) | -425.3 | 1002 | -472.3 | 1078 | 4,815 | 0.014 |
| Net income from olives (DH) | -168.8 | 750.3 | -498.5 | 626.9 | 4,815 | 0.041 |
| Net household income (DH) | -1,074 | 1654 | -1,431 | 1223 | 4,815 | 0.007 |
| Revenue from olives per tree (DH) | 18.63 | 14.23 | -1.266 | 6.588 | 4,779 | 0.095 |
| Total olive production (kg) | -168.1 | 222.1 | -211.8 | 158.2 | 4,815 | 0.136 |

[*sic]

**Table E.5** Intention-to-treat, partial controls, 2nd round and 3rd round combined

| | INTENTION-TO-TREAT: PARTIAL CONTROLS TREATMENTS COMBINED | | | |
|---|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0317* | 0.018 | 4,804 | 0.011 |
| Application of manure | 0.0196 | 0.0305 | 4,803 | 0.021 |
| Insect control | -0.00617 | 0.0124 | 4,804 | 0.022 |
| Parasite control | 0.00576 | 0.00947 | 4,804 | 0.015 |
| Bacterial disease control | 0.00222 | 0.00723 | 4,804 | 0.007 |
| Wound care | -0.000451 | 0.00634 | 4,804 | 0.006 |
| Application of other phytosanitary treatments | -0.00319 | 0.005 | 4,804 | 0.008 |
| Soil work | -0.0237 | 0.0271 | 4,802 | 0.035 |
| Pruning | -0.0259 | 0.041 | 4,798 | 0.026 |
| Pruning of adult trees | -0.0293 | 0.0388 | 2,188 | 0.029 |
| Pruning of young trees | 0.0561 | 0.0551 | 2,170 | 0.075 |
| Mechanical harvesting | 0.000255 | 0.00368 | 4,815 | 0.003 |
| Farmer has access to a vibrator | 0.00175 | 0.00512 | 4,815 | 0.004 |
| Harvesting with tarpaulins | -0.0156 | 0.0224 | 4,573 | 0.02 |
| Transporting in crates | -0.00762 | 0.00888 | 4,815 | 0.005 |
| Oil stored in plastic container | -0.282*** | 0.101 | 485 | 0.205 |
| Principal PU: modern | -0.0135 | 0.0481 | 4,815 | 0.057 |
| Principal PU: semi-modern | -0.00324 | 0.0389 | 4,815 | 0.032 |
| Construction of basins/impluviums | -0.00562 | 0.0143 | 4,815 | 0.018 |
| Percentage of olives processed | 0.0141 | 0.0196 | 4,614 | 0.009 |
| Percentage of olives processed and sold | -0.00142 | 0.0115 | 4,282 | 0.016 |
| Total quantity of olive oil produced (L) | -17.38 | 29.66 | 4,319 | 0.032 |
| Olive oil sales price (DH/L) | 0.629 | 0.797 | 839 | 0.634 |
| Agricultural revenue (DH) | 200.7 | 1174 | 4,815 | 0.039 |
| Revenue from olives (DH) | -22.87 | 605.5 | 4,815 | 0.081 |
| Revenue from the sale of olive oil (DH) | -205.5 | 149.6 | 4,815 | 0.016 |
| Net agricultural income (DH) | -448.7 | 863.9 | 4,815 | 0.014 |
| Net income from olives (DH) | -332.7 | 535.6 | 4,815 | 0.041 |
| Net household income (DH) | -1,251 | 1189 | 4,815 | 0.007 |
| Revenue from olives per tree (DH) | 8.761 | 7.239 | 4,779 | 0.091 |
| Total olive production (kg) | -189.9 | 159.9 | 4,815 | 0.136 |

**Table E.6** Intention-to-treat, partial controls, 1st round and 3rd round only

| | INTENTION-TO-TREAT: PARTIAL CONTROLS 1ST AND 3RD ROUNDS | | | |
|---|---|---|---|---|
| | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0213 | 0.0233 | 3,201 | 0.015 |
| Application of manure | 0.0353 | 0.0353 | 3,200 | 0.025 |
| Insect control | -0.000352 | 0.0135 | 3,201 | 0.025 |
| Parasite control | 0.00486 | 0.0108 | 3,201 | 0.02 |
| Bacterial disease control | 0.00314 | 0.00766 | 3,201 | 0.012 |
| Wound care | -0.00279 | 0.0062 | 3,201 | 0.018 |
| Application of other phytosanitary treatments | -0.00635 | 0.00599 | 3,201 | 0.015 |
| Soil work | -0.0319 | 0.0289 | 3,201 | 0.053 |
| Pruning | -0.00164 | 0.0504 | 3,199 | 0.043 |
| Pruning of adult trees | 0.016 | 0.0453 | 1,391 | 0.049 |
| Pruning of young trees | 0.0911 | 0.0744 | 1,376 | 0.158 |
| Mechanical harvesting | 0.000825 | 0.00445 | 3,210 | 0.005 |
| Farmer has access to a vibrator | 0.00695 | 0.00752 | 3,210 | 0.009 |
| Harvesting with tarpaulins | -0.0135 | 0.0253 | 3,040 | 0.034 |
| Transporting in crates | -0.00855 | 0.0102 | 3,210 | 0.006 |
| Oil stored in plastic container | -0.385*** | 0.139 | 274 | 0.697 |
| Principal PU: modern | -0.0181 | 0.0484 | 3,210 | 0.115 |
| Principal PU: semi-modern | -0.0202 | 0.0356 | 3,210 | 0.065 |
| Construction of basins/impluviums | -0.00248 | 0.0194 | 3,210 | 0.022 |
| Percentage of olives processed | 0.0121 | 0.0275 | 3,068 | 0.018 |
| Percentage of olives processed and sold | 0.0025 | 0.0133 | 2,865 | 0.025 |
| Total quantity of olive oil produced (L) | -4.975 | 33.85 | 2,840 | 0.08 |
| Olive oil sales price (DH/L) | 0.273 | 1.663 | 530 | 0.809 |
| Agricultural revenue (DH) | -5.144 | 1357 | 3,210 | 0.036 |
| Revenue from olives (DH) | -276.8 | 673.2 | 3,210 | 0.096 |
| Revenue from the sale of olive oil (DH) | -133.8 | 145.6 | 3,210 | 0.025 |
| Net agricultural income (DH) | -401.4 | 1084 | 3,210 | 0.011 |
| Net income from olives (DH) | -454.2 | 627.5 | 3,210 | 0.026 |
| Net household income (DH) | -1,379 | 1238 | 3,210 | 0.014 |
| Revenue from olives per tree (DH) | -1.822 | 6.86 | 3,186 | 0.096 |
| Total olive production (kg) | -207 | 154.1 | 3,210 | 0.222 |

**Table E.7** Intention-to-treat, full controls, 2nd round and 3rd round separated

| | INTENTION-TO-TREAT: FULL CONTROLS TREATMENTS SEPARATED | | | | | |
|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0496** | 0.0215 | -0.0318 | 0.0219 | 4,539 | 0.02 |
| Application of manure | -0.00512 | 0.0308 | 0.0221 | 0.0355 | 4,538 | 0.035 |
| Insect control | -0.021 | 0.0135 | -0.00472 | 0.0124 | 4,539 | 0.029 |
| Parasite control | -0.00425 | 0.00792 | -0.00558 | 0.00798 | 4,539 | 0.019 |
| Bacterial disease control | -0.00768 | 0.00581 | -0.00522 | 0.0048 | 4,539 | 0.013 |
| Wound care | -0.00475 | 0.00623 | -0.00529 | 0.00507 | 4,539 | 0.011 |
| Application of other phytosanitary treatments | -0.00352 | 0.00445 | -0.00601 | 0.00536 | 4,539 | 0.007 |
| Soil work | -0.0201 | 0.0297 | -0.037 | 0.0314 | 4,539 | 0.042 |
| Pruning | -0.0595 | 0.0385 | -0.00884 | 0.0513 | 4,535 | 0.038 |
| Pruning of adult trees | -0.0404 | 0.0454 | 0.00524 | 0.0475 | 2,018 | 0.035 |
| Pruning of young trees | 0.0214 | 0.064 | 0.0705 | 0.0839 | 2,001 | 0.088 |
| Mechanical harvesting | 0.000968 | 0.0038 | 0.00565 | 0.0037 | 4,539 | 0.007 |
| Farmer has access to a vibrator | 0.000122 | 0.00483 | 0.00735 | 0.00588 | 4,539 | 0.007 |
| Harvesting with tarpaulins | -0.0171 | 0.0247 | -0.0222 | 0.0248 | 4,321 | 0.021 |
| Transporting in crates | -0.00499 | 0.0105 | -0.00558 | 0.00839 | 4,539 | 0.009 |
| Oil stored in plastic container | -0.328** | 0.149 | -0.179 | 0.145 | 440 | 0.276 |
| Principal PU: modern | -0.00827 | 0.059 | -0.0109 | 0.0523 | 4,539 | 0.061 |
| Principal PU: semi-modern | 0.00469 | 0.0469 | -0.0152 | 0.0362 | 4,539 | 0.04 |
| Construction of basins/impluviums | -0.00437 | 0.0147 | -0.00214 | 0.0189 | 4,539 | 0.051 |
| Percentage of olives processed | 0.0087 | 0.0215 | 0.0181 | 0.0296 | 4,362 | 0.01 |
| Percentage of olives processed and sold | -0.00662 | 0.0124 | -0.000471 | 0.0129 | 4,060 | 0.022 |
| Total quantity of olive oil produced (L) | -45.67 | 31.49 | -17.43 | 23.86 | 4,076 | 0.034 |
| Olive oil sales price (DH/L) | 0.598 | 0.96 | 1.148 | 1.326 | 781 | 0.633 |
| Agricultural revenue (DH) | 234.4 | 1203 | 476.4 | 1140 | 4,539 | 0.055 |
| Revenue from olives (DH) | -162.8 | 820.3 | -140.3 | 630.5 | 4,539 | 0.096 |
| Revenue from the sale of olive oil (DH) | -338.3** | 157 | -146.2 | 138.7 | 4,539 | 0.018 |
| Net agricultural income (DH) | -277.1 | 941.1 | 469.8 | 999 | 4,539 | 0.02 |
| Net income from olives (DH) | -199.7 | 700.2 | -70.76 | 611.8 | 4,539 | 0.048 |
| Net household income (DH) | -1,345 | 1723 | -783 | 1218 | 4,539 | 0.014 |
| Revenue from olives per tree (DH) | 14.04 | 13.92 | -4.655 | 6.17 | 4,539 | 0.127 |
| Total olive production (kg) | -181.8 | 216 | -129.9 | 147 | 4,539 | 0.157 |

**Table E.8** Intention-to-treat, full controls, 2nd round and 3rd round combined

| | INTENTION-TO-TREAT: FULL CONTROLS TREATMENTS COMBINED | | | |
|---|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0408** | 0.0176 | 4,539 | 0.019 |
| Application of manure | 0.00841 | 0.0294 | 4,538 | 0.035 |
| Insect control | -0.0129 | 0.012 | 4,539 | 0.028 |
| Parasite control | -0.00491 | 0.00763 | 4,539 | 0.019 |
| Bacterial disease control | -0.00646 | 0.005 | 4,539 | 0.013 |
| Wound care | -0.00502 | 0.00556 | 4,539 | 0.011 |
| Application of other phytosanitary treatments | -0.00476 | 0.00455 | 4,539 | 0.007 |
| Soil work | -0.0285 | 0.0284 | 4,539 | 0.041 |
| Pruning | -0.0343 | 0.0391 | 4,535 | 0.037 |
| Pruning of adult trees | -0.0207 | 0.0414 | 2,018 | 0.034 |
| Pruning of young trees | 0.0424 | 0.0599 | 2,001 | 0.087 |
| Mechanical harvesting | 0.00329 | 0.0033 | 4,539 | 0.007 |
| Farmer has access to a vibrator | 0.00371 | 0.0048 | 4,539 | 0.006 |
| Harvesting with tarpaulins | -0.0196 | 0.0227 | 4,321 | 0.021 |
| Transporting in crates | -0.00528 | 0.00787 | 4,539 | 0.009 |
| Oil stored in plastic container | -0.283** | 0.129 | 440 | 0.269 |
| Principal PU: modern | -0.00959 | 0.0501 | 4,539 | 0.061 |
| Principal PU: semi-modern | -0.00519 | 0.038 | 4,539 | 0.039 |
| Construction of basins/impluviums | -0.00326 | 0.0145 | 4,539 | 0.051 |
| Percentage of olives processed | 0.0133 | 0.0214 | 4,362 | 0.01 |
| Percentage of olives processed and sold | -0.00361 | 0.0114 | 4,060 | 0.022 |
| Total quantity of olive oil produced (L) | -32.52 | 22.74 | 4,076 | 0.033 |
| Olive oil sales price (DH/L) | 0.796 | 0.833 | 781 | 0.633 |
| Agricultural revenue (DH) | 354.5 | 987.3 | 4,539 | 0.055 |
| Revenue from olives (DH) | -151.6 | 558.9 | 4,539 | 0.096 |
| Revenue from the sale of olive oil (DH) | -243.0* | 131.5 | 4,539 | 0.017 |
| Net agricultural income (DH) | 93.6 | 835.1 | 4,539 | 0.019 |
| Net income from olives (DH) | -135.7 | 539.6 | 4,539 | 0.048 |
| Net household income (DH) | -1,066 | 1201 | 4,539 | 0.014 |
| Revenue from olives per tree (DH) | 4.763 | 6.365 | 4,539 | 0.122 |
| Total olive production (kg) | -156.1 | 153.1 | 4,539 | 0.157 |

**Table E.9** Intention-to-treat, full controls, 1st round and 3rd round only

| | INTENTION-TO-TREAT: FULL CONTROLS 1ST AND 3RD ROUNDS | | | |
|---|---|---|---|---|
| | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0306 | 0.0222 | 3,035 | 0.025 |
| Application of manure | 0.0228 | 0.0349 | 3,034 | 0.046 |
| Insect control | -0.00616 | 0.0127 | 3,035 | 0.031 |
| Parasite control | -0.00845 | 0.00795 | 3,035 | 0.024 |
| Bacterial disease control | -0.00757 | 0.00492 | 3,035 | 0.015 |
| Wound care | -0.006 | 0.00461 | 3,035 | 0.021 |
| Application of other phytosanitary treatments | -0.00725 | 0.00599 | 3,035 | 0.014 |
| Soil work | -0.0389 | 0.0302 | 3,035 | 0.065 |
| Pruning | -0.0107 | 0.049 | 3,033 | 0.06 |
| Pruning of adult trees | 0.0176 | 0.051 | 1,285 | 0.057 |
| Pruning of young trees | 0.0749 | 0.0791 | 1,271 | 0.191 |
| Mechanical harvesting | 0.00524 | 0.00366 | 3,035 | 0.015 |
| Farmer has access to a vibrator | 0.00623 | 0.00575 | 3,035 | 0.009 |
| Harvesting with tarpaulins | -0.0241 | 0.0251 | 2,880 | 0.04 |
| Transporting in crates | -0.00662 | 0.00851 | 3,035 | 0.005 |
| Oil stored in plastic container | -0.453*** | 0.146 | 251 | 0.783 |
| Principal PU: modern | -0.0223 | 0.0507 | 3,035 | 0.117 |
| Principal PU: semi-modern | -0.0141 | 0.0358 | 3,035 | 0.084 |
| Construction of basins/impluviums | -0.000703 | 0.019 | 3,035 | 0.04 |
| Percentage of olives processed | 0.0108 | 0.0297 | 2,908 | 0.023 |
| Percentage of olives processed and sold | -0.00175 | 0.013 | 2,724 | 0.04 |
| Total quantity of olive oil produced (L) | -19.47 | 28.29 | 2,687 | 0.113 |
| Olive oil sales price (DH/L) | 0.798 | 1.655 | 492 | 0.839 |
| Agricultural revenue (DH) | 509.7 | 1149 | 3,035 | 0.04 |
| Revenue from olives (DH) | -197.6 | 609.4 | 3,035 | 0.102 |
| Revenue from the sale of olive oil (DH) | -134.4 | 136.5 | 3,035 | 0.035 |
| Net agricultural income (DH) | 531.8 | 1014 | 3,035 | 0.021 |
| Net income from olives (DH) | -4.264 | 607.1 | 3,035 | 0.037 |
| Net household income (DH) | -870.9 | 1224 | 3,035 | 0.029 |
| Revenue from olives per tree (DH) | -5.139 | 6.977 | 3,035 | 0.12 |
| Total olive production (kg) | -122.8 | 144.5 | 3,035 | 0.254 |

**Table E.10** Treatment-on-the-treated, no controls, 2nd round and 3rd round separated

| | TREATMENT-ON-THE-TREATED: NO CONTROLS TREATMENTS SEPARATED | | | | | |
|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0221 | 0.0232 | 0.0704** | 0.0312 | 5,941 | 0.004 |
| Application of manure | 0.00559 | 0.0362 | 0.0830** | 0.0345 | 5,940 | 0.007 |
| Insect control | 0.00102 | 0.013 | 0.00915 | 0.0175 | 5,941 | 0.005 |
| Parasite control | 0.00342 | 0.00853 | 0.0148 | 0.0157 | 5,941 | 0.007 |
| Bacterial disease control | 0.00131 | 0.0106 | -0.000306 | 0.0103 | 5,941 | 0.002 |
| Wound care | 0.00546 | 0.00936 | -0.00488 | 0.00507 | 5,941 | 0.004 |
| Application of other phytosanitary treatments | -0.0079 | 0.0076 | -0.00909 | 0.00802 | 5,941 | 0.002 |
| Soil work | -0.0530** | 0.0251 | -0.0321 | 0.0272 | 5,939 | 0.004 |
| Pruning | 0.0306 | 0.0357 | 0.174*** | 0.0398 | 5,935 | 0.012 |
| Pruning of adult trees | 0.0152 | 0.0389 | -0.0548 | 0.0445 | 2,649 | 0.02 |
| Pruning of young trees | 0.0128 | 0.0553 | 0.0549 | 0.0705 | 2,625 | 0.041 |
| Mechanical harvesting | -0.00399 | 0.0092 | 0.00163 | 0.0134 | 5,958 | 0.001 |
| Farmer has access to a vibrator | 0.0226 | 0.014 | 0.034 | 0.0216 | 5,958 | 0.007 |
| Harvesting with tarpaulins | -0.00984 | 0.0223 | -0.0227 | 0.0168 | 5,672 | 0.013 |
| Transporting in crates | 0.0272 | 0.0171 | 0.0237 | 0.0158 | 5,958 | 0.003 |
| Oil stored in plastic container | -0.0658 | 0.138 | 0.112 | 0.168 | 571 | 0.073 |
| Principal PU: modern | 0.0186 | 0.0451 | 0.0602 | 0.0445 | 5,958 | 0.035 |
| Principal PU: semi-modern | -0.0274 | 0.037 | 0.0286 | 0.0404 | 5,958 | 0.017 |
| Construction of basins/impluviums | -0.0121 | 0.0094 | 0.0492** | 0.0225 | 5,958 | 0.009 |
| Percentage of olives processed | -0.0285 | 0.0238 | 0.00449 | 0.0228 | 5,720 | 0.001 |
| Percentage of olives processed and sold | 0.00248 | 0.00968 | 0.00135 | 0.011 | 5,277 | 0.012 |
| Total quantity of olive oil produced (L) | 7.1 | 35.41 | -13.92 | 32.89 | 5,340 | 0.028 |
| Olive oil sales price (DH/L) | -0.576 | 0.967 | 0.153 | 1.277 | 1,030 | 0.613 |
| Agricultural revenue (DH) | -31.1 | 1,239 | -1,403 | 1,410 | 5,958 | 0.021 |
| Revenue from olives (DH) | 1,046 | 1,066 | -1,164 | 756.1 | 5,958 | 0.066 |
| Revenue from the sale of olive oil (DH) | -251.6 | 271.9 | -413.9** | 195.8 | 5,958 | 0.015 |
| Net agricultural income (DH) | 900.8 | 1,176 | -1,558 | 1,475 | 5,958 | 0.005 |
| Net income from olives (DH) | 1,552 | 1,024 | -852.1 | 820.9 | 5,958 | 0.033 |
| Net household income (DH) | 4,347 | 3,039 | 111.6 | 1,709 | 5,958 | 0.003 |
| Revenue from olives per tree (DH) | -8.345 | 9.354 | 5.14 | 6.751 | 5,906 | 0.053 |
| Total olive production (kg) | -50.09 | 218.3 | -579.9*** | 173.5 | 5,958 | 0.119 |

**Table E.11** Treatment-on-the-treated, no controls, 2nd round and 3rd round combined

| | TREATMENT-ON-THE-TREATED: NO CONTROLS TREATMENTS COMBINED | | | |
|---|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.013 | 0.0169 | 5,941 | 0.001 |
| Application of manure | 0.0272 | 0.0265 | 5,940 | 0.006 |
| Insect control | -0.00147 | 0.0105 | 5,941 | 0.005 |
| Parasite control | 0.0126 | 0.00938 | 5,941 | 0.008 |
| Bacterial disease control | 0.000742 | 0.00682 | 5,941 | 0.002 |
| Wound care | 0.000561 | 0.00509 | 5,941 | 0.003 |
| Application of other phytosanitary treatments | -0.0038 | 0.0046 | 5,941 | 0.001 |
| Soil work | -0.0416 | 0.0254 | 5,939 | 0.005 |
| Pruning | -0.0206 | 0.0379 | 5,935 | 0.006 |
| Pruning of adult trees | -0.0139 | 0.0348 | 2,649 | 0.017 |
| Pruning of young trees | 0.0686 | 0.0526 | 2,625 | 0.042 |
| Mechanical harvesting | 0.000547 | 0.00373 | 5,958 | 0 |
| Farmer has access to a vibrator | 0.00554 | 0.00459 | 5,958 | 0.002 |
| Harvesting with tarpaulins | -0.0146 | 0.0195 | 5,672 | 0.013 |
| Transporting in crates | -0.000741 | 0.0077 | 5,958 | 0.001 |
| Oil stored in plastic container | -0.211** | 0.0944 | 571 | 0.102 |
| Principal PU: modern | -0.00263 | 0.0449 | 5,958 | 0.035 |
| Principal PU: semi-modern | 0.00367 | 0.0363 | 5,958 | 0.016 |
| Construction of basins/impluviums | -0.0115 | 0.013 | 5,958 | 0.004 |
| Percentage of olives processed | 0.00677 | 0.0206 | 5,720 | 0.001 |
| Percentage of olives processed and sold | 0.00175 | 0.0099 | 5,277 | 0.012 |
| Total quantity of olive oil produced (L) | -4.289 | 24.86 | 5,340 | 0.028 |
| Olive oil sales price (DH/L) | 0.361 | 0.735 | 1,030 | 0.613 |
| Agricultural revenue (DH) | -200.4 | 1,106 | 5,958 | 0.021 |
| Revenue from olives (DH) | -130.5 | 523.5 | 5,958 | 0.063 |
| Revenue from the sale of olive oil (DH) | -141.3 | 134.3 | 5,958 | 0.014 |
| Net agricultural income (DH) | -843.4 | 824.1 | 5,958 | 0.004 |
| Net income from olives (DH) | -500.3 | 463.9 | 5,958 | 0.03 |
| Net household income (DH) | -1,692 | 1,095 | 5,958 | 0.002 |
| Revenue from olives per tree (DH) | 3.947 | 6.113 | 5,906 | 0.052 |
| Total olive production (kg) | -235.9 | 146.9 | 5,958 | 0.116 |

**Table E.12** Treatment-on-the-treated, no controls, 1st round and 3rd round only

| | TREATMENT-ON-THE-TREATED: NO CONTROLS 1ST AND 3RD ROUNDS | | | |
|---|---|---|---|---|
| | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | 0.0707** | 0.0312 | 3,958 | 0.005 |
| Application of manure | 0.0797** | 0.0342 | 3,957 | 0.013 |
| Insect control | 0.0092 | 0.0175 | 3,958 | 0.005 |
| Parasite control | 0.0149 | 0.0157 | 3,958 | 0.008 |
| Bacterial disease control | -0.000309 | 0.0103 | 3,958 | 0.004 |
| Wound care | -0.00492 | 0.0051 | 3,958 | 0.006 |
| Application of other phytosanitary treatments | -0.00908 | 0.008 | 3,958 | 0.002 |
| Soil work | -0.0309 | 0.0271 | 3,958 | 0.008 |
| Pruning | 0.175*** | 0.0399 | 3,956 | 0.01 |
| Pruning of adult trees | -0.0494 | 0.0466 | 1,690 | 0.033 |
| Pruning of young trees | 0.0196 | 0.0741 | 1,669 | 0.086 |
| Mechanical harvesting | 0.00163 | 0.0134 | 3,972 | 0 |
| Farmer has access to a vibrator | 0.034 | 0.0216 | 3,972 | 0.014 |
| Harvesting with tarpaulins | -0.0207 | 0.0171 | 3,789 | 0.022 |
| Transporting in crates | 0.0237 | 0.0157 | 3,972 | 0.004 |
| Oil stored in plastic container | 0.0952 | 0.196 | 326 | 0.274 |
| Principal PU: modern | 0.0602 | 0.0445 | 3,972 | 0.065 |
| Principal PU: semi-modern | 0.0286 | 0.0404 | 3,972 | 0.029 |
| Construction of basins/impluviums | 0.0492** | 0.0225 | 3,972 | 0.007 |
| Percentage of olives processed | 0.0024 | 0.0233 | 3,815 | 0 |
| Percentage of olives processed and sold | 0.00235 | 0.0115 | 3,531 | 0.02 |
| Total quantity of olive oil produced (L) | -7.806 | 33.04 | 3,534 | 0.063 |
| Olive oil sales price (DH/L) | -0.518 | 1.503 | 649 | 0.761 |
| Agricultural revenue (DH) | -1,403 | 1,410 | 3,972 | 0.022 |
| Revenue from olives (DH) | -1,164 | 756.1 | 3,972 | 0.082 |
| Revenue from the sale of olive oil (DH) | -413.9** | 195.8 | 3,972 | 0.024 |
| Net agricultural income (DH) | -1,558 | 1,475 | 3,972 | 0.001 |
| Net income from olives (DH) | -852.1 | 820.8 | 3,972 | 0.016 |
| Net household income (DH) | 111.6 | 1,709 | 3,972 | 0.001 |
| Revenue from olives per tree (DH) | 4.31 | 6.713 | 3,936 | 0.078 |
| Total olive production (kg) | -579.9*** | 173.5 | 3,972 | 0.2 |

**Table E.13** Treatment-on-the-treated, partial controls, 2nd round and 3rd round separated

| | TREATMENT-ON-THE-TREATED: PARTIAL CONTROLS TREATMENTS SEPARATED | | | | | |
|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0281 | 0.0229 | 0.0699** | 0.0311 | 5,941 | 0.01 |
| Application of manure | -0.000787 | 0.0352 | 0.0812** | 0.0348 | 5,940 | 0.015 |
| Insect control | 0.000666 | 0.013 | 0.00643 | 0.0171 | 5,941 | 0.017 |
| Parasite control | 0.00392 | 0.0086 | 0.0156 | 0.0156 | 5,941 | 0.012 |
| Bacterial disease control | 0.00143 | 0.0107 | -0.000142 | 0.0105 | 5,941 | 0.005 |
| Wound care | 0.0056 | 0.00932 | -0.00477 | 0.005 | 5,941 | 0.006 |
| Application of other phytosanitary treatments | -0.00826 | 0.0075 | -0.00898 | 0.00788 | 5,941 | 0.008 |
| Soil work | -0.0436* | 0.0261 | -0.0353 | 0.0273 | 5,939 | 0.036 |
| Pruning | 0.0273 | 0.0344 | 0.177*** | 0.0397 | 5,935 | 0.028 |
| Pruning of adult trees | 0.011 | 0.0399 | -0.0645 | 0.0437 | 2,649 | 0.031 |
| Pruning of young trees | 0.0166 | 0.0559 | 0.063 | 0.0719 | 2,625 | 0.07 |
| Mechanical harvesting | -0.00391 | 0.0091 | 0.00149 | 0.0135 | 5,958 | 0.003 |
| Farmer has access to a vibrator | 0.0226 | 0.0138 | 0.0348 | 0.0215 | 5,958 | 0.011 |
| Harvesting with tarpaulins | -0.00746 | 0.0218 | -0.0254 | 0.0175 | 5,672 | 0.02 |
| Transporting in crates | 0.0271 | 0.0171 | 0.0232 | 0.0158 | 5,958 | 0.006 |
| Oil stored in plastic container | -0.0796 | 0.15 | 0.0909 | 0.18 | 571 | 0.143 |
| Principal PU: modern | 0.0178 | 0.0458 | 0.0453 | 0.0423 | 5,958 | 0.053 |
| Principal PU: semi-modern | -0.0249 | 0.0368 | 0.036 | 0.0406 | 5,958 | 0.027 |
| Construction of basins/impluviums | -0.00865 | 0.0101 | 0.0516** | 0.0223 | 5,958 | 0.022 |
| Percentage of olives processed | -0.0251 | 0.0237 | 0.00264 | 0.0227 | 5,720 | 0.008 |
| Percentage of olives processed and sold | 0.00299 | 0.00949 | 0.00251 | 0.0109 | 5,277 | 0.017 |
| Total quantity of olive oil produced (L) | 4.868 | 35.38 | -16.91 | 32.03 | 5,340 | 0.031 |
| Olive oil sales price (DH/L) | -0.0962 | 0.958 | 0.324 | 1.377 | 1,030 | 0.627 |
| Agricultural revenue (DH) | 106.5 | 1,215 | -1,461 | 1,395 | 5,958 | 0.035 |
| Revenue from olives (DH) | 1,066 | 1,073 | -1,263* | 754.3 | 5,958 | 0.076 |
| Revenue from the sale of olive oil (DH) | -261.7 | 266.5 | -414.3** | 193.2 | 5,958 | 0.017 |
| Net agricultural income (DH) | 946.1 | 1,161 | -1,649 | 1,492 | 5,958 | 0.013 |
| Net income from olives (DH) | 1,577 | 1,035 | -926.1 | 830.4 | 5,958 | 0.041 |
| Net household income (DH) | 4,376 | 3,029 | 192.8 | 1,716 | 5,958 | 0.009 |
| Revenue from olives per tree (DH) | -7.471 | 8.922 | 3.715 | 6.704 | 5,906 | 0.074 |
| Total olive production (kg) | -54.9 | 219.6 | -592.0*** | 175.1 | 5,958 | 0.129 |

**Table E.14** Treatment-on-the-treated, partial controls, 2nd round and 3rd round combined

| | TREATMENT-ON-THE-TREATED: PARTIAL CONTROLS TREATMENTS COMBINED | | | |
|---|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0153 | 0.0168 | 5,941 | 0.006 |
| Application of manure | 0.0298 | 0.0266 | 5,940 | 0.014 |
| Insect control | -0.00103 | 0.0105 | 5,941 | 0.017 |
| Parasite control | 0.0134 | 0.00944 | 5,941 | 0.012 |
| Bacterial disease control | 0.00112 | 0.00686 | 5,941 | 0.005 |
| Wound care | 0.00071 | 0.00508 | 5,941 | 0.005 |
| Application of other phytosanitary treatments | -0.00328 | 0.0046 | 5,941 | 0.007 |
| Soil work | -0.0357 | 0.0245 | 5,939 | 0.036 |
| Pruning | -0.0257 | 0.036 | 5,935 | 0.022 |
| Pruning of adult trees | -0.0143 | 0.0352 | 2,649 | 0.028 |
| Pruning of young trees | 0.0654 | 0.0501 | 2,625 | 0.07 |
| Mechanical harvesting | 0.000702 | 0.00373 | 5,958 | 0.002 |
| Farmer has access to a vibrator | 0.00548 | 0.00473 | 5,958 | 0.005 |
| Harvesting with tarpaulins | -0.0137 | 0.0196 | 5,672 | 0.02 |
| Transporting in crates | -0.000863 | 0.0076 | 5,958 | 0.004 |
| Oil stored in plastic container | -0.226** | 0.0864 | 571 | 0.178 |
| Principal PU: modern | -0.00201 | 0.0421 | 5,958 | 0.053 |
| Principal PU: semi-modern | 0.00406 | 0.0348 | 5,958 | 0.026 |
| Construction of basins/impluviums | -0.0105 | 0.0131 | 5,958 | 0.017 |
| Percentage of olives processed | 0.0098 | 0.0198 | 5,720 | 0.007 |
| Percentage of olives processed and sold | 0.00229 | 0.00986 | 5,277 | 0.017 |
| Total quantity of olive oil produced (L) | -6.59 | 25.13 | 5,340 | 0.031 |
| Olive oil sales price (DH/L) | 0.537 | 0.776 | 1,030 | 0.627 |
| Agricultural revenue (DH) | -120.9 | 1,109 | 5,958 | 0.035 |
| Revenue from olives (DH) | -157.1 | 527.6 | 5,958 | 0.072 |
| Revenue from the sale of olive oil (DH) | -145.9 | 134.8 | 5,958 | 0.016 |
| Net agricultural income (DH) | -881.7 | 836.4 | 5,958 | 0.011 |
| Net income from olives (DH) | -550.1 | 463.7 | 5,958 | 0.038 |
| Net household income (DH) | -1,763 | 1,094 | 5,958 | 0.007 |
| Revenue from olives per tree (DH) | 3.803 | 6.413 | 5,906 | 0.074 |
| Total olive production (kg) | -238.4 | 147.3 | 5,958 | 0.126 |

**Table E.15** Treatment-on-the-treated, partial controls, 1st round and 3rd round only

| | TREATMENT-ON-THE-TREATED: PARTIAL CONTROLS 1ST AND 3RD ROUNDS | | | |
|---|---|---|---|---|
| | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | 0.0743** | 0.031 | 3,958 | 0.011 |
| Application of manure | 0.0825** | 0.0344 | 3,957 | 0.017 |
| Insect control | 0.0074 | 0.017 | 3,958 | 0.019 |
| Parasite control | 0.0147 | 0.0153 | 3,958 | 0.014 |
| Bacterial disease control | -0.000347 | 0.0106 | 3,958 | 0.01 |
| Wound care | -0.00495 | 0.0049 | 3,958 | 0.013 |
| Application of other phytosanitary treatments | -0.00905 | 0.0079 | 3,958 | 0.012 |
| Soil work | -0.033 | 0.0273 | 3,958 | 0.041 |
| Pruning | 0.183*** | 0.04 | 3,956 | 0.042 |
| Pruning of adult trees | -0.055 | 0.046 | 1,690 | 0.048 |
| Pruning of young trees | 0.0211 | 0.0746 | 1,669 | 0.14 |
| Mechanical harvesting | 0.00123 | 0.0135 | 3,972 | 0.004 |
| Farmer has access to a vibrator | 0.0332 | 0.0213 | 3,972 | 0.018 |
| Harvesting with tarpaulins | -0.0257 | 0.0174 | 3,789 | 0.033 |
| Transporting in crates | 0.0216 | 0.016 | 3,972 | 0.008 |
| Oil stored in plastic container | 0.143 | 0.2 | 326 | 0.608 |
| Principal PU: modern | 0.0359 | 0.0415 | 3,972 | 0.11 |
| Principal PU: semi-modern | 0.0373 | 0.041 | 3,972 | 0.053 |
| Construction of basins/impluviums | 0.0523** | 0.0223 | 3,972 | 0.025 |
| Percentage of olives processed | -0.00213 | 0.023 | 3,815 | 0.013 |
| Percentage of olives processed and sold | 0.00384 | 0.0114 | 3,531 | 0.026 |
| Total quantity of olive oil produced (L) | -13.65 | 33.14 | 3,534 | 0.078 |
| Olive oil sales price (DH/L) | 0.265 | 1.547 | 649 | 0.787 |
| Agricultural revenue (DH) | -1,424 | 1,406 | 3,972 | 0.038 |
| Revenue from olives (DH) | -1,322* | 752.6 | 3,972 | 0.091 |
| Revenue from the sale of olive oil (DH) | -420.8** | 189.9 | 3,972 | 0.028 |
| Net agricultural income (DH) | -1,615 | 1,496 | 3,972 | 0.009 |
| Net income from olives (DH) | -948.4 | 836.5 | 3,972 | 0.025 |
| Net household income (DH) | 7.027 | 1,697 | 3,972 | 0.01 |
| Revenue from olives per tree (DH) | 3.689 | 6.688 | 3,936 | 0.085 |
| Total olive production (kg) | -604.9*** | 173.8 | 3,972 | 0.209 |

**Table E.16** Treatment-on-the-treated, full controls, 2nd round and 3rd round separated

| | TREATMENT-ON-THE-TREATED: FULL CONTROLS TREATMENTS SEPARATED | | | | | |
|---|---|---|---|---|---|---|
| | 2nd round *treatment | standard error | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0489* | 0.0264 | 0.0492 | 0.0335 | 5,588 | 0.014 |
| Application of manure | -0.00269 | 0.0399 | 0.0768** | 0.0385 | 5,587 | 0.026 |
| Insect control | -0.0055 | 0.0138 | 0.0155 | 0.0141 | 5,588 | 0.021 |
| Parasite control | 0.00309 | 0.00907 | 0.00857 | 0.00997 | 5,588 | 0.017 |
| Bacterial disease control | -0.00242 | 0.0092 | 0.00274 | 0.00929 | 5,588 | 0.008 |
| Wound care | 0.00299 | 0.00746 | -0.00374 | 0.00474 | 5,588 | 0.008 |
| Application of other phytosanitary treatments | -0.00379 | 0.0074 | -0.0112 | 0.00722 | 5,588 | 0.008 |
| Soil work | -0.0464 | 0.0287 | -0.0428 | 0.0319 | 5,588 | 0.043 |
| Pruning | 0.0273 | 0.0356 | 0.190*** | 0.0412 | 5,584 | 0.038 |
| Pruning of adult trees | 0.0227 | 0.042 | -0.0694 | 0.0469 | 2,435 | 0.035 |
| Pruning of young trees | 0.0309 | 0.0581 | 0.051 | 0.072 | 2,412 | 0.082 |
| Mechanical harvesting | -0.00215 | 0.0073 | 0.00361 | 0.0122 | 5,588 | 0.004 |
| Farmer has access to a vibrator | 0.0262* | 0.015 | 0.0261* | 0.0139 | 5,588 | 0.014 |
| Harvesting with tarpaulins | -0.00768 | 0.0218 | -0.0271 | 0.0189 | 5,334 | 0.02 |
| Transporting in crates | 0.00847 | 0.0139 | 0.0164 | 0.0129 | 5,588 | 0.009 |
| Oil stored in plastic container | -0.0779 | 0.157 | -0.0104 | 0.183 | 513 | 0.207 |
| Principal PU: modern | 0.037 | 0.0479 | 0.0543 | 0.0451 | 5,588 | 0.057 |
| Principal PU: semi-modern | -0.0417 | 0.0381 | 0.0237 | 0.0406 | 5,588 | 0.033 |
| Construction of basins/impluviums | -0.0114 | 0.0138 | 0.0508** | 0.0229 | 5,588 | 0.059 |
| Percentage of olives processed | -0.0272 | 0.0238 | -0.00391 | 0.0246 | 5,383 | 0.009 |
| Percentage of olives processed and sold | 0.000517 | 0.0108 | 0.00337 | 0.0122 | 4,978 | 0.023 |
| Total quantity of olive oil produced (L) | 0.283 | 33.5 | 12.52 | 45.79 | 5,014 | 0.035 |
| Olive oil sales price (DH/L) | 0.21 | 0.938 | 1.358 | 1.247 | 949 | 0.636 |
| Agricultural revenue (DH) | 995.8 | 995.1 | 14.48 | 1,094 | 5,588 | 0.048 |
| Revenue from olives (DH) | 908.2 | 837.4 | -334.6 | 622.9 | 5,588 | 0.089 |
| Revenue from the sale of olive oil (DH) | -155.3 | 211.9 | -232.5 | 177.2 | 5,588 | 0.018 |
| Net agricultural income (DH) | 748.9 | 1,009 | -389.7 | 1,120 | 5,588 | 0.017 |
| Net income from olives (DH) | 1,137 | 799.7 | -103.7 | 620.9 | 5,588 | 0.047 |
| Net household income (DH) | 4,049 | 3,428 | 1,147 | 1,560 | 5,588 | 0.013 |
| Revenue from olives per tree (DH) | -5.613 | 7.402 | 7.04 | 6.167 | 5,588 | 0.1 |
| Total olive production (kg) | -57.65 | 191.6 | -309.5** | 154 | 5,588 | 0.144 |

**Table E.17** Treatment-on-the-treated, full controls, 2nd round and 3rd round combined

| | TREATMENT-ON-THE-TREATED: FULL CONTROLS TREATMENTS COMBINED | | | |
|---|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | -0.0282* | 0.0165 | 5,588 | 0.012 |
| Application of manure | 0.0109 | 0.026 | 5,587 | 0.024 |
| Insect control | -0.00915 | 0.0097 | 5,588 | 0.021 |
| Parasite control | 0.00082 | 0.00712 | 5,588 | 0.016 |
| Bacterial disease control | -0.00659 | 0.0042 | 5,588 | 0.009 |
| Wound care | -0.00364 | 0.0042 | 5,588 | 0.008 |
| Application of other phytosanitary treatments | -0.00433 | 0.0041 | 5,588 | 0.008 |
| Soil work | -0.0417 | 0.0258 | 5,588 | 0.043 |
| Pruning | -0.0313 | 0.0348 | 5,584 | 0.032 |
| Pruning of adult trees | -0.00539 | 0.0384 | 2,435 | 0.031 |
| Pruning of young trees | 0.0496 | 0.0547 | 2,412 | 0.083 |
| Mechanical harvesting | 0.00188 | 0.00353 | 5,588 | 0.003 |
| Farmer has access to a vibrator | 0.00758* | 0.00447 | 5,588 | 0.009 |
| Harvesting with tarpaulins | -0.0178 | 0.0205 | 5,334 | 0.02 |
| Transporting in crates | -0.00192 | 0.0069 | 5,588 | 0.008 |
| Oil stored in plastic container | -0.267** | 0.117 | 513 | 0.254 |
| Principal PU: modern | 0.00612 | 0.0448 | 5,588 | 0.057 |
| Principal PU: semi-modern | 0.000331 | 0.0345 | 5,588 | 0.032 |
| Construction of basins/impluviums | -0.0123 | 0.0132 | 5,588 | 0.054 |
| Percentage of olives processed | 0.0104 | 0.0213 | 5,383 | 0.009 |
| Percentage of olives processed and sold | -0.00199 | 0.0098 | 4,978 | 0.023 |
| Total quantity of olive oil produced (L) | -27.29 | 19.6 | 5,014 | 0.036 |
| Olive oil sales price (DH/L) | 0.727 | 0.844 | 949 | 0.635 |
| Agricultural revenue (DH) | 43.3 | 920.1 | 5,588 | 0.047 |
| Revenue from olives (DH) | -258.3 | 489.5 | 5,588 | 0.088 |
| Revenue from the sale of olive oil (DH) | -189.4* | 111.6 | 5,588 | 0.019 |
| Net agricultural income (DH) | -271.4 | 796.5 | 5,588 | 0.016 |
| Net income from olives (DH) | -335.3 | 464.5 | 5,588 | 0.046 |
| Net household income (DH) | -1,410 | 1,125 | 5,588 | 0.011 |
| Revenue from olives per tree (DH) | 1.071 | 5.457 | 5,588 | 0.099 |
| Total olive production (kg) | -206.5 | 138.3 | 5,588 | 0.144 |

**Table E.18** Treatment-on-the-treated, full controls, 1st round and 3rd round only

| | TREATMENT-ON-THE-TREATED: FULL CONTROLS 1ST AND 3RD ROUNDS | | | |
|---|---|---|---|---|
| | 3rd round *treatment | standard error | n | R-squared |
| Application of fertilizer | 0.0537 | 0.0327 | 3,734 | 0.018 |
| Application of manure | 0.0831** | 0.0389 | 3,733 | 0.035 |
| Insect control | 0.0173 | 0.0142 | 3,734 | 0.024 |
| Parasite control | 0.00711 | 0.00939 | 3,734 | 0.021 |
| Bacterial disease control | 0.00438 | 0.00918 | 3,734 | 0.009 |
| Wound care | -0.00422 | 0.0044 | 3,734 | 0.015 |
| Application of other phytosanitary treatments | -0.0101 | 0.0073 | 3,734 | 0.013 |
| Soil work | -0.0416 | 0.0325 | 3,734 | 0.052 |
| Pruning | 0.193*** | 0.0431 | 3,732 | 0.058 |
| Pruning of adult trees | -0.0575 | 0.0563 | 1,553 | 0.051 |
| Pruning of young trees | -0.00443 | 0.0773 | 1,533 | 0.173 |
| Mechanical harvesting | 0.00317 | 0.0123 | 3,734 | 0.006 |
| Farmer has access to a vibrator | 0.0232* | 0.0137 | 3,734 | 0.018 |
| Harvesting with tarpaulins | -0.0275 | 0.0197 | 3,571 | 0.035 |
| Transporting in crates | 0.015 | 0.0128 | 3,734 | 0.008 |
| Oil stored in plastic container | -0.192 | 0.452 | 296 | 0.614 |
| Principal PU: modern | 0.0454 | 0.0444 | 3,734 | 0.115 |
| Principal PU: semi-modern | 0.0169 | 0.0409 | 3,734 | 0.069 |
| Construction of basins/impluviums | 0.0505** | 0.0221 | 3,734 | 0.047 |
| Percentage of olives processed | -0.00233 | 0.0247 | 3,598 | 0.019 |
| Percentage of olives processed and sold | 0.00696 | 0.0133 | 3,339 | 0.038 |
| Total quantity of olive oil produced (L) | -17.08 | 20.46 | 3,324 | 0.11 |
| Olive oil sales price (DH/L) | 1.466 | 1.356 | 594 | 0.828 |
| Agricultural revenue (DH) | 146.4 | 1,180 | 3,734 | 0.035 |
| Revenue from olives (DH) | -436.7 | 644.4 | 3,734 | 0.095 |
| Revenue from the sale of olive oil (DH) | -203.7 | 171.5 | 3,734 | 0.034 |
| Net agricultural income (DH) | -346.9 | 1,225 | 3,734 | 0.015 |
| Net income from olives (DH) | -256.5 | 732.8 | 3,734 | 0.036 |
| Net household income (DH) | 922.3 | 1,612 | 3,734 | 0.021 |
| Revenue from olives per tree (DH) | 9.161 | 6.108 | 3,734 | 0.099 |
| Total olive production (kg) | -281.7* | 154.6 | 3,734 | 0.228 |

**Table E.19** Treatment-on-the-treated with instrumental variable, no controls, 2nd round and 3rd round combined

| | TREATMENT-ON-THE-TREATED WITH INSTRUMENTAL VARIABLE: NO CONTROLS TREATMENTS COMBINED | | |
|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n |
| Application of fertilizer | -0.026 | 0.0183 | 4,645 |
| Application of manure | 0.021 | 0.0233 | 4,644 |
| Insect control | -0.0068 | 0.00859 | 4,645 |
| Parasite control | 0.00608 | 0.00603 | 4,645 |
| Bacterial disease control | 0.00164 | 0.00442 | 4,645 |
| Wound care | -0.0031 | 0.00402 | 4,645 |
| Application of other phytosanitary treatments | -0.0062 | 0.00381 | 4,645 |
| Soil work | -0.0277 | 0.0206 | 4,643 |
| Pruning | -0.0151 | 0.0266 | 4,640 |
| Pruning of adult trees | -0.0328 | 0.0338 | 2,101 |
| Pruning of young trees | 0.0636 | 0.0508 | 2,083 |
| Mechanical harvesting | -0.0002 | 0.00379 | 4,656 |
| Farmer has access to a vibrator | 0.00191 | 0.00478 | 4,656 |
| Harvesting with tarpaulins | -0.0192 | 0.0135 | 4,419 |
| Transporting in crates | -0.0097 | 0.00775 | 4,656 |
| Oil stored in plastic container | -0.242** | 0.101 | 456 |
| Principal PU: modern | -0.0097 | 0.0239 | 4,656 |
| Principal PU: semi-modern | 0.00847 | 0.0185 | 4,656 |
| Construction of basins/impluviums | -0.0071 | 0.00986 | 4,656 |
| Percentage of olives processed | 0.0102 | 0.0165 | 4,459 |
| Percentage of olives processed and sold | -0.0022 | 0.00813 | 4,143 |
| Total quantity of olive oil produced (L) | -14.33 | 24.39 | 4,173 |
| Olive oil sales price (DH/L) | 0.49 | 0.874 | 808 |
| Agricultural revenue (DH) | 222.9 | 691.9 | 4,656 |
| Revenue from olives (DH) | -62.02 | 432.4 | 4,656 |
| Revenue from the sale of olive oil (DH) | -225.9** | 113.1 | 4,656 |
| Net agricultural income (DH) | -332.7 | 653.3 | 4,656 |
| Net income from olives (DH) | -310.3 | 446.4 | 4,656 |
| Net household income (DH) | -433.7 | 847.4 | 4,656 |
| Revenue from olives per tree (DH) | 7.714* | 4.424 | 4,621 |
| Total olive production (kg) | -216.7** | 97.44 | 4,656 |

**Table E.20** Treatment-on-the-treated with instrumental variable, no controls, 1st round and 3rd round only

| | TREATMENT-ON-THE-TREATED WITH INSTRUMENTAL VARIABLE: NO CONTROLS 1ST AND 3RD ROUNDS | | |
|---|---|---|---|
| | 3rd round *treatment | standard error | n |
| Application of fertilizer | -0.112 | 0.119 | 3,095 |
| Application of manure | 0.243 | 0.151 | 3,094 |
| Insect control | -0.0031 | 0.0575 | 3,095 |
| Parasite control | 0.0372 | 0.0449 | 3,095 |
| Bacterial disease control | 0.0186 | 0.0301 | 3,095 |
| Wound care | -0.0278 | 0.0243 | 3,095 |
| Application of other phytosanitary treatments | -0.0507* | 0.0268 | 3,095 |
| Soil work | -0.219 | 0.135 | 3,095 |
| Pruning | 0.12 | 0.178 | 3,093 |
| Pruning of adult trees | 0.0425 | 0.171 | 1,329 |
| Pruning of young trees | 0.303 | 0.265 | 1,314 |
| Mechanical harvesting | -0.002 | 0.0253 | 3,104 |
| Farmer has access to a vibrator | 0.0382 | 0.0325 | 3,104 |
| Harvesting with tarpaulins | -0.0899 | 0.0905 | 2,937 |
| Transporting in crates | -0.0567 | 0.0493 | 3,104 |
| Oil stored in plastic container | -2.4 | 1.99 | 253 |
| Principal PU: modern | -0.0151 | 0.159 | 3,104 |
| Principal PU: semi-modern | -0.0065 | 0.12 | 3,104 |
| Construction of basins/impluviums | -0.0185 | 0.0683 | 3,104 |
| Percentage of olives processed | 0.0731 | 0.109 | 2,964 |
| Percentage of olives processed and sold | 0.0128 | 0.0535 | 2,769 |
| Total quantity of olive oil produced (L) | 7.124 | 141.8 | 2,742 |
| Olive oil sales price (DH/L) | 1.283 | 4.051 | 508 |
| Agricultural revenue (DH) | 1,500 | 4668 | 3,104 |
| Revenue from olives (DH) | -670.6 | 2520 | 3,104 |
| Revenue from the sale of olive oil (DH) | -750.2 | 723.2 | 3,104 |
| Net agricultural income (DH) | -976.6 | 4407 | 3,104 |
| Net income from olives (DH) | -1,904 | 2759 | 3,104 |
| Net household income (DH) | -5,767 | 5707 | 3,104 |
| Revenue from olives per tree (DH) | -4.061 | 21.9 | 3,081 |
| Total olive production (kg) | -1,219* | 624.5 | 3,104 |

**Table E.21** Treatment-on-the-treated with instrumental variable, partial controls, 2nd round and 3rd round combined

| | TREATMENT-ON-THE-TREATED WITH INSTRUMENTAL VARIABLE: PARTIAL CONTROLS TREATMENTS COMBINED | | |
|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n |
| Application of fertilizer | -0.0284 | 0.0184 | 4,645 |
| Application of manure | 0.0188 | 0.0233 | 4,644 |
| Insect control | -0.0064 | 0.00857 | 4,645 |
| Parasite control | 0.00655 | 0.00604 | 4,645 |
| Bacterial disease control | 0.00216 | 0.00444 | 4,645 |
| Wound care | -0.0031 | 0.00404 | 4,645 |
| Application of other phytosanitary treatments | -0.006 | 0.00382 | 4,645 |
| Soil work | -0.0234 | 0.0204 | 4,643 |
| Pruning | -0.0142 | 0.0264 | 4,640 |
| Pruning of adult trees | -0.0334 | 0.0341 | 2,101 |
| Pruning of young trees | 0.0549 | 0.0506 | 2,083 |
| Mechanical harvesting | 0.00021 | 0.00381 | 4,656 |
| Farmer has access to a vibrator | 0.00162 | 0.0048 | 4,656 |
| Harvesting with tarpaulins | -0.0186 | 0.0135 | 4,419 |
| Transporting in crates | -0.0095 | 0.00777 | 4,656 |
| Oil stored in plastic container | -0.235** | 0.11 | 456 |
| Principal PU: modern | -0.013 | 0.0238 | 4,656 |
| Principal PU: semi-modern | 0.00973 | 0.0185 | 4,656 |
| Construction of basins/impluviums | -0.0037 | 0.00984 | 4,656 |
| Percentage of olives processed | 0.0129 | 0.0165 | 4,459 |
| Percentage of olives processed and sold | -0.002 | 0.00817 | 4,143 |
| Total quantity of olive oil produced (L) | -15.92 | 24.49 | 4,173 |
| Olive oil sales price (DH/L) | 0.736 | 0.904 | 808 |
| Agricultural revenue (DH) | 259.4 | 688.6 | 4,656 |
| Revenue from olives (DH) | -66.64 | 431.9 | 4,656 |
| Revenue from the sale of olive oil (DH) | -241.3** | 113.6 | 4,656 |
| Net agricultural income (DH) | -358.8 | 652.8 | 4,656 |
| Net income from olives (DH) | -306.7 | 446.6 | 4,656 |
| Net household income (DH) | -447.5 | 847.5 | 4,656 |
| Revenue from olives per tree (DH) | 8.007* | 4.392 | 4,621 |
| Total olive production (kg) | -216.3** | 97.22 | 4,656 |

**Table E.22** Treatment-on-the-treated with instrumental variable, partial controls, 1st round and 3rd round only

| | TREATMENT-ON-THE-TREATED WITH INSTRUMENTAL VARIABLE: PARTIAL CONTROLS 1ST AND 3RD ROUNDS | | |
|---|---|---|---|
| | 3rd round *treatment | standard error | n |
| Application of fertilizer | -0.106 | 0.123 | 3,095 |
| Application of manure | 0.235 | 0.156 | 3,094 |
| Insect control | -0.0115 | 0.0592 | 3,095 |
| Parasite control | 0.0283 | 0.0464 | 3,095 |
| Bacterial disease control | 0.0142 | 0.0312 | 3,095 |
| Wound care | -0.0298 | 0.0252 | 3,095 |
| Application of other phytosanitary treatments | -0.0506* | 0.0277 | 3,095 |
| Soil work | -0.172 | 0.138 | 3,095 |
| Pruning | 0.142 | 0.18 | 3,093 |
| Pruning of adult trees | 0.0231 | 0.173 | 1,329 |
| Pruning of young trees | 0.315 | 0.261 | 1,314 |
| Mechanical harvesting | 0.00417 | 0.0263 | 3,104 |
| Farmer has access to a vibrator | 0.0399 | 0.0337 | 3,104 |
| Harvesting with tarpaulins | -0.0895 | 0.0933 | 2,937 |
| Transporting in crates | -0.0622 | 0.0511 | 3,104 |
| Oil stored in plastic container | 0.251 | 1.249 | 253 |
| Principal PU: modern | -0.0522 | 0.161 | 3,104 |
| Principal PU: semi-modern | -0.0174 | 0.122 | 3,104 |
| Construction of basins/impluviums | 0.0231 | 0.07 | 3,104 |
| Percentage of olives processed | 0.0707 | 0.113 | 2,964 |
| Percentage of olives processed and sold | 0.0165 | 0.0555 | 2,769 |
| Total quantity of olive oil produced (L) | 6.089 | 145.4 | 2,742 |
| Olive oil sales price (DH/L) | 2.36 | 4.572 | 508 |
| Agricultural revenue (DH) | 2,230 | 4805 | 3,104 |
| Revenue from olives (DH) | -659.4 | 2601 | 3,104 |
| Revenue from the sale of olive oil (DH) | -890.5 | 750.3 | 3,104 |
| Net agricultural income (DH) | -738.8 | 4548 | 3,104 |
| Net income from olives (DH) | -1,563 | 2846 | 3,104 |
| Net household income (DH) | -5,036 | 5883 | 3,104 |
| Revenue from olives per tree (DH) | -2.285 | 22.74 | 3,081 |
| Total olive production (kg) | -1,216* | 642.5 | 3,104 |

**Table E.23** Treatment-on-the-treated with instrumental variable, full controls, 2nd round and 3rd round combined

| | TREATMENT-ON-THE-TREATED WITH INSTRUMENTAL VARIABLE: FULL CONTROLS TREATMENTS COMBINED | | |
|---|---|---|---|
| | 2nd or 3rd round *treatment | standard error | n |
| Application of fertilizer | -0.0388** | 0.0187 | 4,391 |
| Application of manure | 0.00854 | 0.0238 | 4,390 |
| Insect control | -0.0117 | 0.00826 | 4,391 |
| Parasite control | -0.005 | 0.00541 | 4,391 |
| Bacterial disease control | -0.00708* | 0.0039 | 4,391 |
| Wound care | -0.00649* | 0.00354 | 4,391 |
| Application of other phytosanitary treatments | -0.00696* | 0.00358 | 4,391 |
| Soil work | -0.0265 | 0.0215 | 4,391 |
| Pruning | -0.0199 | 0.0276 | 4,388 |
| Pruning of adult trees | -0.0228 | 0.0368 | 1,938 |
| Pruning of young trees | 0.0396 | 0.0549 | 1,921 |
| Mechanical harvesting | 0.00342 | 0.00344 | 4,391 |
| Farmer has access to a vibrator | 0.00391 | 0.00435 | 4,391 |
| Harvesting with tarpaulins | -0.0216 | 0.0139 | 4,177 |
| Transporting in crates | -0.0056 | 0.0075 | 4,391 |
| Oil stored in plastic container | -0.201 | 0.139 | 413 |
| Principal PU: modern | -0.009 | 0.0249 | 4,391 |
| Principal PU: semi-modern | 0.00751 | 0.019 | 4,391 |
| Construction of basins/impluviums | -0.0017 | 0.00994 | 4,391 |
| Percentage of olives processed | 0.011 | 0.0172 | 4,217 |
| Percentage of olives processed and sold | -0.0043 | 0.00819 | 3,928 |
| Total quantity of olive oil produced (L) | -31.08 | 22.83 | 3,939 |
| Olive oil sales price (DH/L) | 0.83 | 0.956 | 754 |
| Agricultural revenue (DH) | 726.2 | 641.8 | 4,391 |
| Revenue from olives (DH) | -48.8 | 393.3 | 4,391 |
| Revenue from the sale of olive oil (DH) | -241.9** | 108.7 | 4,391 |
| Net agricultural income (DH) | 341.4 | 610.8 | 4,391 |
| Net income from olives (DH) | -6.925 | 401.8 | 4,391 |
| Net household income (DH) | -178.1 | 839.5 | 4,391 |
| Revenue from olives per tree (DH) | 6.179 | 4.119 | 4,391 |
| Total olive production (kg) | -140.1 | 91.71 | 4,391 |

**Table E.24** Treatment-on-the-treated with instrumental variable, full controls, 1st round and 3rd round only

| | TREATMENT-ON-THE-TREATED WITH INSTRUMENTAL VARIABLE: FULL CONTROLS 1ST AND 3RD ROUNDS | | |
|---|---|---|---|
| | 3rd round *treatment | standard error | n |
| Application of fertilizer | -0.185 | 0.136 | 2,936 |
| Application of manure | 0.177 | 0.173 | 2,935 |
| Insect control | -0.0432 | 0.0644 | 2,936 |
| Parasite control | -0.0597 | 0.0457 | 2,936 |
| Bacterial disease control | -0.0566* | 0.0294 | 2,936 |
| Wound care | -0.0468* | 0.0259 | 2,936 |
| Application of other phytosanitary treatments | -0.0647** | 0.0307 | 2,936 |
| Soil work | -0.22 | 0.159 | 2,936 |
| Pruning | 0.116 | 0.205 | 2,934 |
| Pruning of adult trees | 0.0364 | 0.203 | 1,228 |
| Pruning of young trees | 0.255 | 0.305 | 1,214 |
| Mechanical harvesting | 0.0332 | 0.0241 | 2,936 |
| Farmer has access to a vibrator | 0.0398 | 0.0352 | 2,936 |
| Harvesting with tarpaulins | -0.16 | 0.108 | 2,784 |
| Transporting in crates | -0.0453 | 0.0532 | 2,936 |
| Oil stored in plastic container | -0.627 | 0.81 | 232 |
| Principal PU: modern | -0.0811 | 0.184 | 2,936 |
| Principal PU: semi-modern | 0.0116 | 0.136 | 2,936 |
| Construction of basins/impluviums | 0.0326 | 0.0778 | 2,936 |
| Percentage of olives processed | 0.069 | 0.128 | 2,811 |
| Percentage of olives processed and sold | -0.0078 | 0.0586 | 2,634 |
| Total quantity of olive oil produced (L) | -70.81 | 121.2 | 2,595 |
| Olive oil sales price (DH/L) | 3.489 | 4.361 | 474 |
| Agricultural revenue (DH) | 7,094 | 5010 | 2,936 |
| Revenue from olives (DH) | 540.6 | 2721 | 2,936 |
| Revenue from the sale of olive oil (DH) | -742.2 | 782.1 | 2,936 |
| Net agricultural income (DH) | 5,647 | 4793 | 2,936 |
| Net income from olives (DH) | 1,647 | 2846 | 2,936 |
| Net household income (DH) | -2,302 | 6370 | 2,936 |
| Revenue from olives per tree (DH) | -9.989 | 25.18 | 2,936 |
| Total olive production (kg) | -505.1 | 643.1 | 2,936 |

## APPENDIX F – Additional PU Results

The following tables result from additional analyses that were performed on the PU sample. We present the 2013 descriptive data for the PUs, as well as a comparison for the panel cases only between 2011 and 2013 for the PUs.

## Table F.1 Profile of processing units 2011 and 2013

| | | Trained by UNOPS according to the PU | | | | | |
|---|---|---|---|---|---|---|---|
| | | No | | Yes | | Total | |
| | | % | Number | % | Number | % | Number |
| Region (2011) | Fes-Boulemane | 17.6 | 3 | 23.7 | 18 | 22.6 | 21 |
| | Marrakech-Tensift-El Haouz | 5.9 | 1 | 7.9 | 6 | 7.5 | 7 |
| | Meknes-Tafilalet | 0.0 | 0 | 3.9 | 3 | 3.2 | 3 |
| | Tadla-Azilal | 0.0 | 0 | 7.9 | 6 | 6.5 | 6 |
| | Tanger-Tetouan | 11.8 | 2 | 18.4 | 14 | 17.2 | 16 |
| | Taza-Al Hoceima-Taounate | 64.7 | 11 | 38.2 | 29 | 43.0 | 40 |
| Region (2013) | Fes-Boulemane | 17.6 | 3 | 23.7 | 18 | 22.6 | 21 |
| | Marrakech-Tensift-El Haouz | 5.9 | 1 | 7.9 | 6 | 7.5 | 7 |
| | Meknes-Tafilalet | 0.0 | 0 | 3.9 | 3 | 3.2 | 3 |
| | Tadla-Azilal | 0.0 | 0 | 7.9 | 6 | 6.5 | 6 |
| | Tanger-Tetouan | 11.8 | 2 | 18.4 | 14 | 17.2 | 16 |
| | Taza-Al Hoceima-Taounate | 64.7 | 11 | 38.2 | 29 | 43.0 | 40 |
| Year of creation (2011) | Prior to 2006 | 76.5 | 13 | 40.8 | 31 | 47.3 | 44 |
| | 2006 - 2009 | 17.6 | 3 | 48.7 | 37 | 43.0 | 40 |
| | 2010 | 5.9 | 1 | 10.5 | 8 | 9.7 | 9 |
| | 2011 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| | 2012 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Year of creation (2013) | Prior to 2006 | 64.7 | 11 | 38.2 | 29 | 43.0 | 40 |
| | 2006 - 2009 | 17.6 | 3 | 43.4 | 33 | 38.7 | 36 |
| | 2010 | 17.6 | 3 | 14.5 | 11 | 15.1 | 14 |
| | 2011 | 0.0 | 0 | 3.9 | 3 | 3.2 | 3 |
| | 2012 | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Type of PU (2011) | Semi-modern | 29.4% | 5 | 32.9% | 25 | 32.3% | 30 |
| | Modern | 70.6% | 12 | 67.1% | 51 | 67.7% | 63 |
| Type of PU (2013) | Semi-modern | 29.4% | 5 | 32.9% | 25 | 32.3% | 30 |
| | Modern | 70.6% | 12 | 67.1% | 51 | 67.7% | 63 |

## Table F.2 Profile of processing units 2011 and 2013: oil production

| | Trained by UNOPS according to the PU | | | | | |
|---|---|---|---|---|---|---|
| | No | | Yes | | Total | |
| | Mean | N | Mean | N | Mean | N |
| Total liters of olive oil obtained (2011) Fes-Boulemane (2013 [sic] | 177,650 | 15 | 153,279 | 59 | 158,219 | 74 |
| Total liters of olive oil obtained (2013) Fes-Boulemane | 116,998 | 17 | 91,427 | 75 | 96,152 | 92 |
| % of oil obtained from the service provision (2011) | 86.9 | 11 | 85.8 | 42 | 86.0 | 53 |
| % of oil obtained from the service provision (2013) | 84.9 | 15 | 83.1 | 75 | 83.4 | 90 |

## Table F.3 Profile of processing units 2011 and 2013: sources and destinations

| | | Year | | | |
|---|---|---|---|---|---|
| | | 2011 | | 2013 | |
| | | % | Number | % | Number |
| Source of olives | Olive trees of PU owners | 69.7 | 46 | 65.3 | 47 |
| | Contract with agribusiness (standing) | 18.5 | 12 | 6.9 | 5 |
| | Broker | 26.2 | 17 | 23.6 | 17 |
| | Market | 13.8 | 9 | 25.0 | 18 |
| | Farmers | 15.4 | 10 | 30.6 | 22 |
| Destination of oil | Direct sale by the unit to private end consumers | 84.2 | 48 | 95.5 | 63 |
| | Sale to middlemen | 50.9 | 29 | 40.9 | 27 |
| | Sale to private individuals in *souks* | 1.8 | 1 | 3.0 | 2 |
| | Sale to industrial units | 8.8 | 5 | 6.1 | 4 |
| | Sale overseas | 3.5 | 2 | 1.5 | 1 |

## Table F.4 PUs 2011 and 2013: final results – partnerships

| | | Year | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2011 | | | 2013 | | |
| | | % | N | Mean number | % | N | Mean number |
| Partnerships | Professional agricultural organizations | 5.3 | 4 | 2.5 | 1.3 | 1 | 1 |
| | Farmers, as aggregator | 3.9 | 3 | 176.33 | 0 | 0 | . |
| | *Hamams*/furnaces | 0 | 0 | . | 0 | 0 | . |
| | Industrial units | 2.6 | 2 | 3 | 0 | 0 | . |
| | Middlemen | 6.6 | 5 | 1.75 | 2.6 | 2 | 1 |
| | Foreign customers | 2.6 | 2 | 1 | 1.3 | 1 | . |
| | Other | 2.7 | 2 | 1 | 0 | 0 | . |

## Table F.5 PUs 2011 and 2013: final results

| | | Year | | | |
|---|---|---|---|---|---|
| | | 2011 | | 2013 | |
| | | % | Number | % | Number |
| During the last growing season, did your revenue cover your expenses and generate profits? | Yes, we had profits | 57.1 | 40 | 51.4 | 38 |
| | Our sales covered our expenses but we did not have any profits | 30.0 | 21 | 41.9 | 31 |
| | No, we had losses | 12.9 | 9 | 6.8 | 5 |
| % that had put a quality assurance system in place | No | 88.2 | 67 | 94.7 | 72 |
| | Yes | 5.3 | 4 | 2.6 | 2 |
| | I do not understand this concept | 6.6 | 5 | 2.6 | 2 |
| If so, which one? | HACCP | 25.0 | 1 | 50.0 | 1 |
| | ISO 22000 | 0.0 | 0 | 0.0 | 0 |
| | PIAQ | 0.0 | 0 | 0.0 | 0 |
| | ISO 18000 | 0.0 | 0 | 0.0 | 0 |
| | Other | 50.0 | 2 | 100.0 | 2 |
| Do you do labeling under your own brand? | | 100 | 7 | 100 | 9 |
| If so, do you use labels? | | 85.7 | 6 | 100 | 9 |
| Type of label | Protected designation of origin (PDO) (with all indications monitored for the production of quality olive oil (traceability)) | 50 | 3 | 55.6 | 5 |
| | Geographic indications | 66.7 | 4 | 55.6 | 5 |
| | Controlled-origin label (certifies a superior level of quality) | 16.7 | 1 | 33.3 | 3 |
| | Organic farming | 66.7 | 4 | 11.1 | 1 |
| | Virgin/Extra virgin | 66.7 | 4 | 33.3 | 3 |
| Conducted “taste test” type marketing operations | | 5.4 | 4 | 2.6 | 2 |
| Participation in national trade exhibitions/fairs or expos | | 13.5 | 10 | 11.8 | 9 |
| Participation in international trade exhibitions/fairs or expos | | 2.7 | 2 | 6.6 | 5 |
| Participation in quality olive oil competitions | | 9.5 | 7 | 7.9 | 6 |
| Do you have the following types of advertising media? | Fliers on your products | 5.3 | 4 | 2.6 | 2 |
| | Signs | 6.6 | 5 | 6.6 | 5 |
| | Business cards | 18.4 | 14 | 18.4 | 14 |
| | Other | 1.3 | 1 | 3.9 | 3 |

## Table F.6 PUs 2011 and 2013: percentage of virgin and extra virgin oil

| | Year | | | | | |
|---|---|---|---|---|---|---|
| | 2011 | | | 2013 | | |
| | Mean | Median | N | Mean | Median | N |
| % virgin | 17.1 | 0 | 31 | 49.7 | 50 | 32 |
| % extra virgin | 31.3 | 20 | 38 | 51 | 50 | 39 |

*"This is a relevant program that has come just in time to fill the void in the region. As you know, the Ministry suffers from a lack of human resources and logistics for executing this program, namely in terms of close mentoring." – DPA member*

*"The Catalyst Fund also played an important role because the farmer sees that the goal of all this upstream training is to produce well and better, he now knows that he is acting in a well-organized structure and that he is a member in that unit; it [the CF] played an important role."– UGP member*

*"But the obstacle I am faced with today is the PUs' lack of financial means. In fact, for each of the 30 PUs I deal with, I diagnose insufficiencies, I make a business plan, I present it to the PU with a commitment letter to be signed. But no one has signed yet: they find that the amount to be invested for the upgrade is greater than their income. They ask us to fund this upgrade for them, but we cannot. Our action is limited to technical and theoretical assistance." – PU expert, UNOPS*

*"Thus they have the text in French and the text, the slide show in Arabic and then the brochures, so everything is there. You just have to stress the messages that need to be given. I think this worked, this method. This is why there is a certain homogeneity in the training at the farmer and SDFRY level"– UNOPS member, Core team*

*"There was a problem with staff numbers from the start. There was not enough staff. The field worker's intervention area was extensive. Moreover, sometimes the core team asks for information about an area that requires traveling 20 km. The workload exceeds the field worker's ability" – WC member*

*"They would work in a team, but each field worker has his/her area of specialization, because the APP presumed trainers/field workers with the five years of training required in the ToR. It was not the case to find experienced trainers/field workers with good skills right from the start." – UNOPS member, Rabat*

*"From a financial standpoint, the financial system is a bit cumbersome. It is somewhat lacking. Normally, if it were another entity,, private entities that do not have other rigid requirements and regulations like the UN, this could alleviate things." – UNOPS, Rabat*

*"It has been almost six months since the project ended and a tremendous number of activities still remain to be implemented. If there is an extension of the project, then the mechanisms and channels of communication will be well regulated, well oiled. Currently, I would say that the communication system is weak, whether it is within our team, with the central team, or between our team and other partners, the DPAs, WCs. If I had to grade it on a scale of 1 to 10, I would say it was a 4." – UNOPS member, Area team*

*"There was a lack of coordination with the Ministry departments. It was difficult to follow their program. The problem that arose was that we were not informed until the day before. We needed to be given more time to allow us to arrange our schedules." – DPA member*

*"The period proposed for the training was rejected because not all the farmers can participate due to the harvest. Dialogue stopped at this level. No, there was not enough consultation." – EIG president*

*"I was not informed all the time, especially during outings for practice sessions. I don't know why. I had asked them to let me know. Even if the site of the demonstration is far away, I am prepared to travel, no problem. But they don't tell me." – Female farmer, Focus Group*

*"[...] receipt of the perimeters sporadically. There was the first series of 97 perimeters, then we had to wait 8 months to get the second series. That is to say the pace, that is the speed, we operated with 2 or 3 speeds. There were perimeters at the end in which we had completed 2 years, and others not even one year, and others not even 6 months. So, in other words, taken all together, we have about 240 perimeters, but, when all is said and done, we have only 100-120 perimeters that were monitored for 2 full years, others 1.5 years, and others 6 months, and this heterogeneity bothered us." - UNOPS member, Rabat*

*“Thanks to the training, we now know the steps that have to be followed to have quality olive oil, as well as how to do pruning, how to fertilize our orchards, how to do phytosanitary treatments.” – Female farmer, Focus Group*

*“For the modules aimed at PAO members, in my opinion, they are adapted to experienced members, whereas the PAOs have just been created. The content was not adapted to the managerial skills and abilities of the PAO members. There was a gap between the training content and the ability of the members to understand it.” – WC member*

*“Most women are illiterate [and] the training sessions are largely in the classroom, so for this reason we are excluded or we don’t profit much, and since we also want to learn many things, we wish there was more practical training in the field.” – Female farmer, Focus Group*

*“At the level of the Ministry of Agriculture, whether for the DPA or the WCs, we don’t have the necessary technical staff to mentor the farmers; this program has helped us a lot” – DPA member*

*“Yes, the UNOPS agents are always with us at our meetings, but the decision-making is ours alone. They mentor us and help us. The helped us especially at the level of the local administrations and authorities. When we run up against a problem, we call them to help us. They are the ones who contacted the heads of the different administrations.” – EIG president*

*“I discovered field schools thanks to this program. Previously, there was one outreach approach. Now we talk about field schools. It is a new, practical, and effective tool.” – WC member*

*“This activity (supervision) is not yet where it should be and was not implemented in full this year. The first year was for raising the awareness of the people and mobilizing them (they focused on the recruitment of farmers), so the field workers did not perform supervision everywhere and mentoring suffered.” – UNOPS member, Rabat*

*“Young people need multiple training sessions combining both learning and practice. For this reason, they need supervision and monitoring for 2 or more years.” –DPA member*

*“Last year, UNOPS agents supervised us during the harvest period. This is why we succeeded in having quality oil on a national scale with an acidity level of 0.2 and a peroxide level of 4.4 and 4.2. I can say that our knowledge was not all correct prior to the arrival of UNOPS. They are the ones who enabled us to improve this knowledge regarding quality, techniques, and valorization.” – Farmer, Focus Group*

*“Thanks to [name], our field worker, we were able to take a lot of trips and do a lot of training, and we visited different fairs in the country. It isn’t like before when we didn’t know anything about what was going on outside our* douar*.” – Female farmer, Focus Group*

*“They told us you will sell at a dream price, but we sold at 60 DH a liter; based on what they said, we thought we would sell at 90 or 100 DH.” – Young farmer, Focus Group*

*“There is a cultural block that somewhat hinders the participation of women. There are perimeters where it is not possible for women to go out and receive training.” – Field worker, UNOPS*

*““Most women are illiterate [and] the training sessions are largely in the classroom, so for this reason we are excluded or we don’t profit much, and since we also want to learn many things, we wish there was more practical training in the field.” – Female farmer, Focus Group*

*“The pilot projects for women are extremely inadequate. At the start, 45 projects were proposed in the area; 15 were able to be executed [and] of these 15, only 6 were pre-selected. Of the 6, funding was obtained for 2.” – Female farmer, Focus Group*

*“The UNOPS program will end in 2013 and I find that it is a little too early for us to quit right now because there are cooperatives that are in the process of being formed and others that have problems. This is why supervision is being requested. Despite the fact that a director and a technician are going to be recruited, for example to obtain ONSSA [National Office for Food Safety] approval, I am requesting that they be supervised.” – EIG president*

*“The PUs appreciated the training, but there is an obstacle to funding to comply with recommendations (upgrading actions). This is what makes them not agree to carry out business plans. They give up. The scope of the work is so large that they lose their motivation." – UNOPS, Area team*

**Performance evaluation and impact assessment of the rehabilitation and intensification of olive tree orchards in rain-fed areas activity**

*“Training is not enough for olive production to double in two years. This is impossible, despite the quality of the training and the trainers.” – DPA member*

*“Training alone does not work; you need a transmission element. It’s the field worker who will give the farmer confidence.” – UGP member*

[page ii - Figure 1]

**Program goal** **Increase economic growth and reduce poverty in the targeted areas**

**Project objective** **Reduce the volatility of agricultural production and increase the volume and value of fruit tree production**

**Extension and intensification of olive, almond, and fig tree orchards in rain-fed areas**
**Results:**
Diversification and increase of the productivity of fruit trees with high added value

**Irrigation and intensification of olive trees in PMH areas**
**Results:**
Increase in the productivity of olive trees and effectiveness of support through irrigation

**Irrigation and intensification of date trees in oasis areas**
**Results:**
Increase in the productivity of date trees and effectiveness of support through irrigation

[page iv - Figure 2]

| Activities | Results | | | Goal |
|---|---|---|---|---|
| Training of young men as experts | Local experts available for consultation | | | |
| Training and technical assistance for farmers and professional agricultural organizations | Use of good cultivation practices | Better health of trees | Increase in olive yields | |
| | Development of partnerships with processors and distributors | Better quality of olives | Increase in quantity of oil produced | |
| | Creation of second-order organizations | | | |
| Setting up of a price information system | Better price information | Better price obtained for sale of olives and oil | Increase in value of production/products | Increase in agricultural income |
| Upgrading of processing units | | | | |
| Training of valorization and commercialization operators | Use of standard- and superior-quality oil production systems | Better quality olive oil | | |
| Training in marketing | Increase in marketing activities | Increase in customers for olives and olive products | Increase in sales | |
| Pilot projects for women | | | | |

[page v - Figure 3]

**Upstream** **Downstream**

**Training, Technical Support Mentoring** **Training, Technical Support, Mentoring**

**Field Schools** **Marketing/Commercialization**

Farmers Processing Units

EIGs **Standard/Superior Certification**

Sons/Daughters Cooperatives PUs

**Price Information System** **Catalyst Fund**

**Pilot Projects**

[page 4 - Figure 1.1]

**Upstream** **Downstream**

**Training, Technical Support Mentoring** **Training, Technical Support, Mentoring**

**Field Schools** **Marketing/Commercialization**

Farmers Processing Units

EIGs **Standard/Superior Certification**

Sons/Daughters Cooperatives PUs

**Price Information System** **Catalyst Fund**

**Pilot Projects**

[page 63 - Figure 3.1]

**Result**

**Impact**

**T = Treatment**
**C = Control**

**Before** **After**

[p. 123 - Figure B.1]

| | | | | | |
|---|---|---|---|---|---|
| **PAO OBSERVATIONS:** | | | | Entrepreneurial Spirit (Area 1) | |
| | | | Management and Administration (Area 2) | | Formation and Operation (Area 2) |
| **FARMER OBSERVATIONS:** | Basin/Impluvium (Areas 1/3) | Phytosanitary Treatments (Area 2) | | Action Harvest (Area 2/3) | Pruning (Area 4) |
| **2011** | March | June | Sept | **2012** | March |
| 2011 | Sept. 1 | Sept. 15 | Oct. 1 | Oct. 15 | Nov. 1 |
| **PU OBSERVATIONS:** | Manufacturing Technique (Area 4) | Hygiene and Safety (Area 1) | Manufacturing Technique (Area 2) | Labeling (Area 2) | Financial Management (Area 2/3) |