

Measuring Attribution: Propcom Mai-karfi in Nigeria using the Comparison Group Method for an intervention in the Tractor Sector

Synopsis

Measuring impact in private sector development programs is important but also challenging. This case is part of a larger guidance paper that provides an overview of the most common attribution methods, and offers guidance on how to select the most appropriate attribution method for the diversity of interventions and within their context. This paper also documents how four programs have selected and implemented four different attribution methods. This case explains how Propcom Mai-karfi selected the Comparison Group Method attribution method and why Propcom Mai-karfi considers it to be the most appropriate method for an intervention in the Tractor Sector, as well as how they carried out the measurements.

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This case describes how the programs have addressed a typical challenge in results measurement. The aim of the case is to provide insights that will be useful to other practitioners facing a similar challenge. The authors do not represent the DCED, nor do the views expressed in the case necessarily reflect the views of the DCED and DFID.

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1 Propcom Mai-karfi

[Propcom Mai-karfi](#) (PM) is an innovative, market-driven program funded by the United Kingdom's Department for International Development ([DFID](#)) that aims to reduce poverty in northern Nigeria. The program works with government, the private sector and businesses to enable rural markets to work better for the poor.

The program uses a 'making markets work for the poor' approach in creating systemic changes in agricultural and rural markets in northern Nigeria. The goal of the program is to increase incomes for the poor. The program expects to trigger at least GBP 100 million of additional public and private investments in the agricultural sector that will benefit at least 500,000 poor people in northern Nigeria, of which 50% will be women. They will see their incomes increased by up to 50%.

PM is a five-year project (2013-2017) with a budget of some GBP 27 million and is managed by [Palladium](#)². The program employs about 15 intervention managers, who manage around 11 ongoing interventions in eight markets. The intervention managers are supported by seven Results Measurement (RM) staff.

The program seeks to improve the competitiveness and efficiency of markets so that there is more innovation, investment and opportunities for entrepreneurs. The program will stimulate a variety of changes in selected markets which will include:

- improved commercial relationships between large processors, traders and poor farmers in markets such as soy and poultry;
- increased investment by the private sector in rural markets upon which poor farmers, entrepreneurs and consumers rely for access to important goods and services, such as fertilizer, seeds, tractors, soap, and Shea kernels.

This case focuses on one intervention in the tractor market.

The tractor market.

The tractor market in Nigeria is small, but has the potential to be vast. Farmers would be able to reduce their ploughing costs and increase their yields if they had access to tractor services. There are only some 20,000 tractors in Nigeria, with only 50% of these operational; it is estimated that there is a market for about 60,000 tractors.

However, tractor vendors focus mainly on selling to the central and state governments, rather than tapping into the potential demand in the private sector. PM thus aims to develop a private sector-led tractor market in Nigeria. PM supports the creation of innovative financing mechanisms and marketing systems for tractors, assists the government to review existing policies to make them more conducive to private sector actors, and strengthens the tractor owners and operators' associations to lobby and offer skills training for their members.

² Formerly known as GRM International



Photo taken by Nick Cavanagh

2 The intervention

One of the options that PM researched was to introduce tractor leasing into Nigeria.

A partnership was formed with a bank, First City Monument Bank ([FCMB](#)), a tractor vendor Springfield Agro Limited ([SFAL](#)) and two associations of tractor service providers, Tractor Operators and Hiring Facilities Association in Nigeria (TOHFAN) and Tractor Owners and Operators Association of Nigeria (TOOAN). The objective was to assist the bank to lease tractors to members of the associations.

To be able to do so, the agreement included three important safety mechanisms. All tractors were provided with GPS tracking systems. These allowed the owner to track his operator (and ensure all fees were paid) and also enabled the bank to know the whereabouts of the tractor. Secondly, a default buffer deposit fund was created as a safeguard for the lessor to recover costs in case of defaulting tractor lessees. Thirdly, a buy-back guarantee was provided by the tractor vendor to the lessor in case of defaulting lessees.

The association members, independent tractor service providers, were thus able to lease tractors and offer ploughing and other services to farmers. During the pilot phase in 2014, some 27 tractors were leased in four states of Nigeria. The pilot project was instrumental in triggering more banks and tractor vendors to start offering similar tractor leasing services. In order to promote this 'crowding in' of other market players, this intervention aimed to show to the Government of Nigeria that leasing tractors is viable business but that it is hampered at present by unfavorable credit risk guarantees set by the financial sector regulators.

Mechanized ploughing is cheaper than using animal or human labor, hence tractors services are expected to lead to a cost saving for the farmers. In addition, land that is ploughed by

tractors leads to higher yields because it results in more loosened soil, which is better for the crops. The intervention thus leads to increased income for smallholders arising from both cost saving and increased yield.

3 Selecting the attribution method

The five questions that help to select the most appropriate attribution method to assess income changes for the target beneficiaries are answered here and show why Comparing Groups (CG) is the most appropriate attribution method for this intervention. The intervention is supposed to lead to increased income for smallholders arising from both cost saving and increased yield. These two changes need to be assessed.

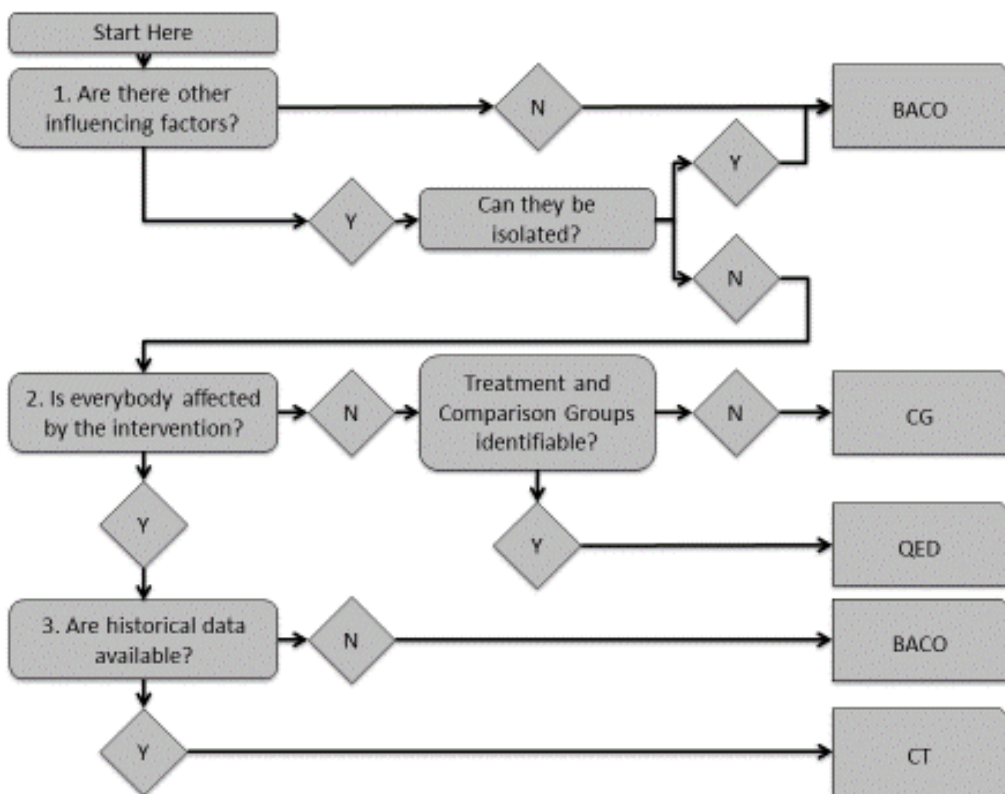


Figure1 Attribution Selection Aid

Q1 Are there other influencing factors?

The intervention leads to two changes: reduced costs of ploughing³ and increased yields. The change in the cost of ploughing is the result of the cost of the new tractor services, compared to the cost of the alternatives: animal traction or human labor. These costs may vary over time. The change in yields is influenced by many other factors, such as the type of seeds, cultivation practices, the prevalence of diseases, and the weather. *Yes, there are other influencing factors.*

³ In fact, tractor services are not limited to ploughing, but also used for harrowing and other tasks

Can these influencing factors be isolated?

The potential cost savings as a result of replacing human or animal traction by mechanized ploughing, may be influenced by changes in these labor and animal traction costs. However, changes in labor market price, or the costs of animal traction, can be measured before and after the intervention and can be 'kept constant'. To measure the cost saving element of the intervention, it is sufficient to compare the Before and After situation of the farmers. *Yes, to measure the cost savings, other influencing factors can be isolated.*

However, the change in yields is influenced by many other factors, such as inputs, practices, diseases and the weather, and these factors cannot be isolated. *No, to measure the increase in yields, other influencing factors cannot be isolated.*

Q2 Is everybody affected by the intervention?

Not all farmers in Nigeria will have access to these tractor services. It should therefore be possible to compare farmers that do use these services with other farmers that do not use these services.

No, not everybody will be affected.

Are a treatment and comparison group identifiable?

The tractor service providers offer their services to any farmer who is willing to pay for them. It is impossible to identify those farmers at the start of the intervention. Identifying the treatment group is thus best done after the tractor service providers have actually provided the service to the farmers.

To identify a comparison group, one could identify a region where there are no tractor services and sample farmers who do not have access to tractor services. However, if the influencing factors that affect the yields are different, then different regions are non-comparable. *That implies that a Quasi Experimental Design, where in advance it is determined who will, and who will not, make use of the services, is impossible.*

In many cases, the tractor operator will go to a village where he suspects a lot of demand, and offers his services to interested farmers. Only at that point in time can the treatment group be identified. Given the limited number of tractor operators, dispersed throughout the regions, it is unlikely that those farmers that did not hire his services, will be serviced by another tractor operator later. *In principle, these farmers form the comparison group; their yields are the counterfactual for those farmers that used the tractor services.*

To compare the Before and After situation of both groups, it is necessary for them to be exposed to the same influencing factors (seeds, practices, weather). There should be no 'hidden' characteristic that makes the treatment group achieve different yields from the comparison group due to that characteristic that makes some farmers hire, and some other farmers not hire, the tractor services. This needed to be verified and the ways in which PM carried out the verification is explained in section 5.

Q3 Are historical data available?⁴

There are some historical data available, yet they are insufficiently reliable and up to date to be of use in analyzing the trend and the reasons why changes in the trend are due (or not) to the tractor intervention. There are too many different factors influencing the various districts differently. *No, historical data (only) are insufficient.*

Conclusion

To measure the change in costs, the project could use a Before and After Comparison With Opinion (holding factors constant). To measure the change in yields, the project concluded that it should use the *Comparison Group (CG)* method by comparing the difference in yields between the users and non-users. To increase efficiency, and use the same surveys for both assessments, the project opted to apply the CG method to assess changes in both costs and yields.

4 Comparison Groups (CG)

This section will describe how the project measured the impact of the intervention by measuring the cost savings and the change in yields. For both measurements, they identified users and non-users during the base-line, and returned to the same respondents one season later to measure the end-line. The project however faced a number of challenges in doing so. Some of these were related to a number of assumptions that did not hold, and some were due to practical challenges while doing field research. As a result, PM is developing alternative methods to assess the impact and share its important lessons with the reader.

Constructing the base-line.

The (pilot) leasing scheme resulted in 27 tractors being leased across four states: Kaduna, Kano, Katsina⁵ and Niger.

⁴ In real life, it is not necessary to continue answering the questions. In this case, we have answered the other questions too to show that other attribution methods are not appropriate

⁵ Tractors move and plough the fields based on the rain cycle across the various geographical zones. Tractors that were leased in Katsina were found to be operating in Jigawa State during the surveys.



Figure 2 Map of Nigeria

PM's plan was to track all 27 operators in May 2014 and sample some 50 – 100 farmers who used the tractor services and to identify in the same villages some 50 farmers that did not use the services. The basis for the sampling size was a combination of the desired level of rigor⁶ and the costs of measuring. The tractors (15 out of 27) were randomly selected. Although ideally the non-user-group is equal in size, PM realized that finding the non-users was even more difficult and so they accepted that they would only be able to find 50 non-users during the research period⁷.

The objective was to compare the costs of ploughing between both groups at the time of ploughing. Assuming that their initial situation was identical (ploughing the land using human or animal traction) any reduction in costs would lead to additional income.

⁶ That would lead to approximately a 10% error of margin and 90% level of confidence

⁷ PM had encountered similar challenges in a previous study

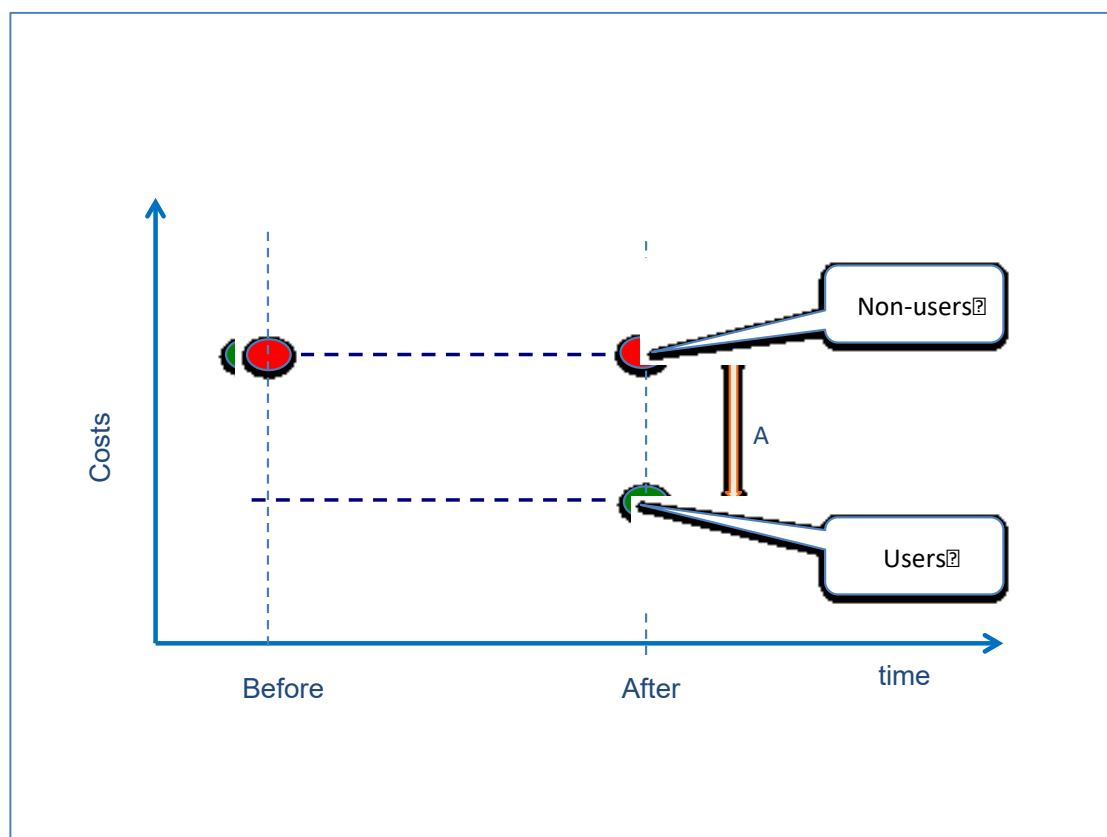


Figure 3 Comparing ploughing costs between users and non-users

In Figure 3 the green dot in the 'After' situation reflects the farmers that did use the tractor services, while the red dot reflects those farmers that did not use the tractors services. Both dots are at the same spot in the 'Before' situation: it was assumed that both groups were at the same spot when designing the assessment and was verified during the fieldwork, as explained below.

Tracking the operators turned out to be very labor intensive. The PM realized that the planned two weeks would not be enough, increased the field days to four weeks, and was then able to cover 71 users and 44 non-users. PM decided not to increase the period (or increase the number of enumerators) again to undertake more interviews: the costs would be too high in relation to the added value of achieving higher confidence levels. Moreover, comparing the cost-savings was not easy because farmers used the tractor services for different types of activities like single or double ploughing, single or double harrowing, and ridging.

The impact assessments

The intervention is supposed to lead to increased income because of both the cost savings and increased yield. These two changes need to be assessed.

Assessing income changes due to cost savings

PM only compared and reported on the cost savings for double harrowing and double ploughing as these were the services mostly used by the farmers. The sample size was too

small to report credibly on the cost savings for the other few remaining services. Comparing the costs between users and non-users (at the same point in time) for double ploughing and double harrowing showed a cost reduction of NGN 13,930 (57%) and NGN 14,930 (51%) respectively.

Method	Costs
Average cost of double ploughing per hectare using tractors	NGN 10,478
Average cost of ploughing per hectare using human labor	NGN 24,408
Costs savings per hectare	NGN 13,930
Average cost of double harrowing per hectare using tractors	NGN 13,466
Average cost of harrowing per hectare using human labor	NGN 27,904
Costs savings per hectare	NGN 14,438

Table 1: comparing the costs

Assessing income changes due to increased yields

The plan was to return to the same group of users and non-users to measure the end-line, and compare the yields. An increase in yields would lead to more sales and thus an additional increase in income. PM had realized before they undertook the study that farmers would not be able to recall the costs of land preparation, hence two surveys would be necessary: one survey when ploughing took place, and one survey after harvesting. At the end of the first season, the project undertook an interim assessment.

At the end of the harvesting season, the program returned to the sampled users and non-users with the objective of measuring a possible change in yields. Comparing the yields between the two groups, and assuming that they were exposed to the same other influencing factors, would enable PM to assess the Difference-in-Difference.

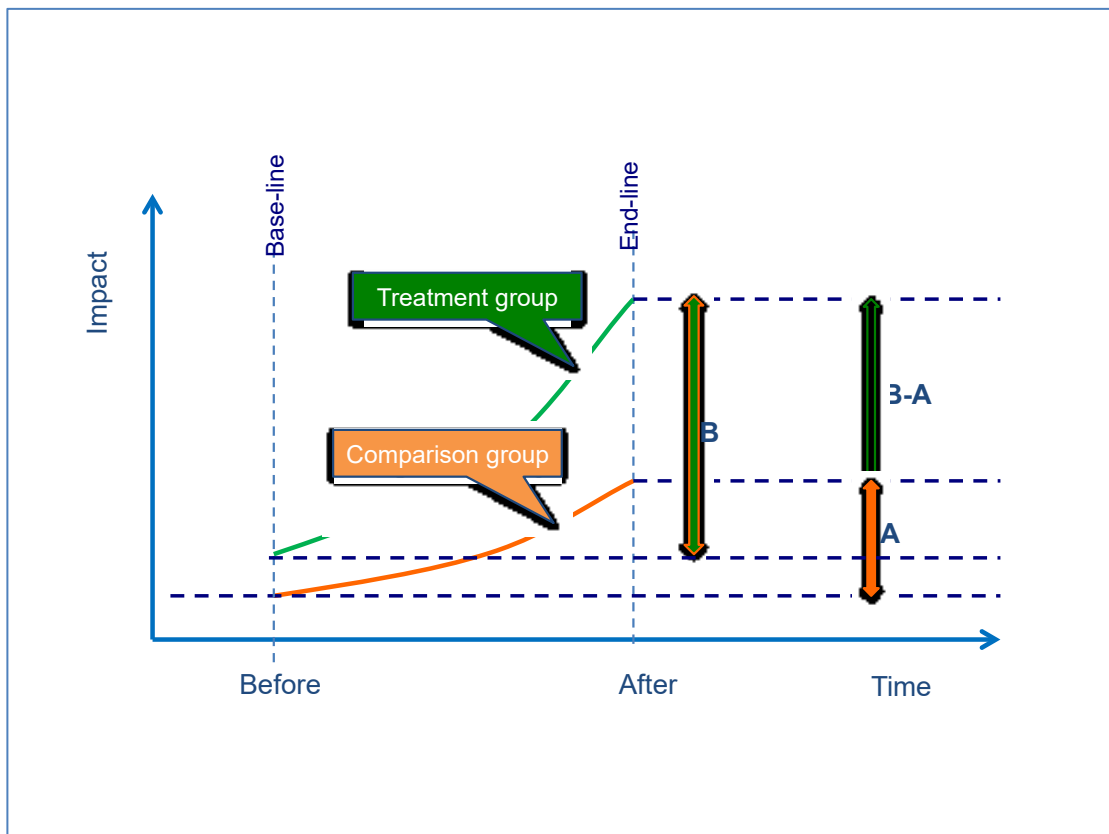


Figure 4 Comparing yields between users and non-users

However, given the success of the intervention with most farmers in the villages renting the tractor services, PM had sampled the few remaining non-users in the same village or in neighboring villages. Some of these non-users turned out to be migrant farmers, a group distinctively different from the majority of farmers. Some of them were also located in villages that were exposed to other planting conditions. Moreover, from the relatively small sample (44), some had moved and could not be traced after the harvest season. A further complicating factor was that farmers used the ploughing services to plant five combinations of crops: 1 rice only, 2 maize only, 3 rice and maize, 4 rice and tomato and 5 maize and sorghum. Hence, productivity changes varied and with these additional five strata, the sample size should have been much bigger⁸.

PM thus concluded that the limited number of respondents (across four states and 15 tractor operators) could not be used to assess the DiD for the increased productivity due to ploughing services.

Seeking alternatives

PM needs to reflect whether and then how it could measure and report the additional income due to the increase in yield resulting from the tractor services (in addition to the cost savings already reported). In principle, applying the CG method is an appropriate attribution method, but it turned out that identifying the non-user group was not successful. PM should reflect on the possibility of identifying another non-user group that is exposed to the same external factors and which reacts to these external factors in the same way as the user-group. If the answer is negative, PM, using the attribution selection aid again and knowing what they know now, can identify alternatives.

The impact assessment report showed that most farmers are convinced that tractor services lead to better yields: fewer weeds, improved soil fertility, loosened soil, and better soil moisture retention⁹. PM has also undertaken a field study that shows the differences in Soil Compaction Rates between land that is ploughed traditionally and land that is ploughed using the tractor services; the less compacted soil of the latter leads to better yields. The question is thus not whether, but by how much, yields have increased.

Secondary research might confirm what the average yield increase could be per crop. If the increase is not that much, or if the cost of measuring is extremely high, PM might opt not to measure and thus not report the income effect due to the yield increase.

If PM wishes to measure and report the income effect due to the yield increase, PM needs to identify (again) what the main influencing factors are (besides the tractor services) and then determine how to isolate or measure them. Probably weather is the most influential factor, but PM needs to ensure that other factors such as farmers changing seeds or using/not using fertilizers or pesticides, do not influence the measurement. These factors are hard to isolate. Most farmers do use the tractor services when they become available in an area. If weather is most influential (and changing per season) then PM cannot use a simple Before and After Comparison with Opinion (BACO) for farmers that shifted from manual to tractor ploughing. PM can search for an area where there will be no other tractor services but that is exposed to the same climatic conditions and sample the comparison

⁸ See the sample size calculator on the DCED website

⁹ See table 28 of the Impact Assessment Report

group from that area. Another complementary option is for the project to select a small number of plots representative of the sub-climates, plough half of them manually and plough the other half using tractors and then compare the yields of both methods¹⁰.

The lesson learned from the above challenges is probably that 'not all that changes must be measured'. Ploughing using tractors that leads to cost savings, and thus increased income, has been assessed. These cost savings are considerable and are relatively easy to measure. The cost of measuring the change in yields appears high and is only used to report additional income. The information is not used to adjust the intervention or sector strategy. PM might argue, therefore, that it will not measure and report the income change for the above stated reasons.



Photo taken by Jide Adeniyi-Jones

5 The research in practice

For each assessment PM makes a research plan that specifies the research questions and the methodology. The questionnaires were developed and tested before the team went to the field.

The team

¹⁰ This implies that PM actually 'controls' the plot (same crops, same practices, same inputs) in order to measure the difference between manual ploughing and tractor ploughing

The team consisted of three PM staff: one Intervention Manager and two staff members. They were responsible for the research, and for training and supervising the four research officers and three enumerators.

PM finds it important that staff are responsible for measuring the impact of their interventions. They are supported by the RM department and the RM manager is responsible for the quality assurance of the actual measurement. PM finds it challenging to outsource surveys: these services are expensive and the quality of the research is not always satisfactory. Moreover, PM's procurement procedures require that outsourcing is done through a competitive bidding process which is time consuming.

The time consuming and strenuous nature of research

Tractor operators start the day as early as 6am and end as late as 7pm. In most cases enumerators had to set out early to meet the operators with their first customers of the day in some of the most remote areas of northern Nigeria. The roads in the area are quite bad which made the exercise strenuous. There were instances where large farms had to be measured with a GPS device. It was quite exhausting.

PM had to extend the data collection from an initial two weeks in May with an additional two weeks in June to be able to cover a reasonable number of respondents. This significantly increased the cost of data collection. Most of the costs incurred are de facto the time and travel costs of the PM staff during the research.

Adjusting the GPS tracking system

The study also revealed some of the limitations of the GPS tracking system. The software was not designed in a way that allowed PM to map out easily where the farmers were and to estimate their plot sizes. PM is currently in talks with the GPS company to make modifications to the software so that PM obtains information on all tractor operators and how many plots they service and for each of them their location and size.

Other Case Studies on Attribution

- [A practical framework to select appropriate attribution methods](#), introducing and explaining the attribution selection aid.
- [The intervention of MDF with Acelda in Timor Leste](#), illustrating the use of a before and after with opinion (BACO) method.
- [Samarth-NDMP intervention in the ginger sector in Nepal](#), illustrating the use of a quasi-experimental (QED) method.
- [The Alliances Lesser Caucasus Programme \(ALCP\) in Georgia](#), illustrating how a single impact assessment could assess attribution for multiple interventions.