Towards sustainable cotton farming

Validating the impact of Better Cotton on cotton farmers in India

Haki Pamuk, Nina Motovska and Fedes van Rijn

Endline report

WAGENINGEN
UNIVERSITY & RESEARCH

Photo credit:Jerry Horbert/Shutterstock.com

Table of Contents

WAGENINGEN UNIVERSITY & RESEARCH

Summary

Many cotton farmers follow unsustainable farming practices, for example overusing synthetic inputs (e.g., pesticides and fertilisers) which have negative impacts for the environment and farm workers' health, as well as for farmers' livelihoods. Better Cotton's goal is to make global cotton production better and more sustainable by introducing better farming practices and eliminating the overuse of these inputs through capacity-building programmes.

This study evaluates the impact of Better Cotton on the profitability of cotton farmers in India, developing an evaluation method that Better Cotton can use to monitor the effects of similar programmes in the future. Specifically, the study tests the link between Better Cotton capacity-building activities and the cost and profitability of farmers. For this purpose, it captures data from two groups of farmers: (i) farmers supported by Better Cotton, and (ii) farmers that would be supported after this evaluation. We used data from over 800 farmers supported or set to be supported by three Better Cotton Programme Partners at Jalna and Nagpur in Maharashtra and Adilabad in Telangana. The data was collected at three points in time: the baseline in 2019 for season 2018-19, the midline in 2020 for season 2019-20, and the endline in 2022 for season 2021-22. We collected information on several intermediate (e.g., farming practices adoption) and ultimate outcomes (e.g., farming costs) and on impact indicators (e.g., profitability), designed according to the projects' theory of change.

The contribution of capacity-building activities to the increased profitability among farmers was limited between the 2018-19 and 2019-20 seasons. This might be, because, during the Covid-19 pandemic, the farmers were contacted by phone, and they did not recall attending many in-person trainings their first season with Better Cotton (2019-20).

Summary cont'd

The results of the endline evaluation is as follows:

- In the 2021/2022 season, over 75% of farmers participated in the majority of Better Cotton capacity-building activities, much higher than participation rates reported by farmers in the midline report.
- The activities led to a higher use of good agricultural and decent work practices, as well as record-keeping in Nagpur. Farmers decreased synthetic pesticide and fertiliser use, while increasing biopesticide use. This resulted in a decrease in herbicide, pesticide and fertiliser costs among Better Cotton farmers in Nagpur compared to similar farmers that have not yet participated in the programme.
- Thanks to Better Cotton support, Better Cotton farmers in Nagpur received around US$0.135/kg, equivalent to a 13% higher price than the price control group farmers received in the 2021-22 season (and 20% higher than their baseline prices). This effect is yet to be observed in Adilabad.
- Between the 2018-19 and 2021-22 seasons, Better Cotton contributed to an increase in farmers' annual profitability of $82 per acre, equivalent to about $500 income for an average cotton farmer in the region.
- There is one caveat to the results. The evaluation identified that yields decreased in general, and in Nagpur, the yields of Better Cotton farmers decreased more than those of similar farmers not yet supported by Better Cotton. Further research is needed to understand the reason behind this.

Background information & objective

Background and objective: to validate the impact of Better Cotton on cotton farmers in India, now and in the future

Many smallholder cotton farmers live in poverty and follow unsustainable farming practices, for example overusing synthetic inputs (e.g. insecticides, herbicides, fertilisers), which have negative impacts for the environment and for their health, and can be costly. There are also incidences of child labour use. Better Cotton's goal is to make the global cotton production more sustainable. To contribute to a more sustainable cotton sector, Better Cotton conducts capacity building programmes to train farmers on good agricultural practices, record keeping, use of minimum personal protective equipment (PPE) for pesticide application, and decent work practices, such as the elimination of child labour in cotton farming. Most of these programmes are financed by the Better Cotton Growth and Innovation Fund (GIF), among others. This study has two objectives:

1. Validate the impact of Better Cotton on the performance of participating cotton farmers in India

2. Develop a method that Better Cotton can use to monitor the impact of similar programmes in the future. This new method will allow the organization to identify control groups that are comparable to Better Cotton-supported farmers and includes data collection at the outset prior to the organisation's involvement.

We developed an evaluation method that identifies the causal impact of Better Cotton capacity building in India to identify the causal effect of Better Cotton on the performance of Better Cotton farmers. Better Cotton support covers a wide range of issues concerning the environment, farm and markets, and seeks to create an impact in several areas, including labour conditions, health and safety and market access (please see Better Cotton's Theory of Change in Appendix 1 for the full list of impact areas). This report focuses on the impact of Better Cotton on the profitability of cotton farmers and cover Better Cotton outcomes related to profitability. The key research question of this report is: "*What is the impact of Better Cotton support on the profitability of supported cotton farmers*?" This report presents the evaluation findings using baseline and endline data. It provides details on the impact of Better Cotton activities during the 2021-2022 cotton season. It also summarises the findings of the midline evaluation, conducted for the 2019-2020 season.

Better Cotton programme, Theory of Change & Indicators

Better Cotton support to improve cotton farming in India through sustainable practices from 2019-20 to 2021-22 season

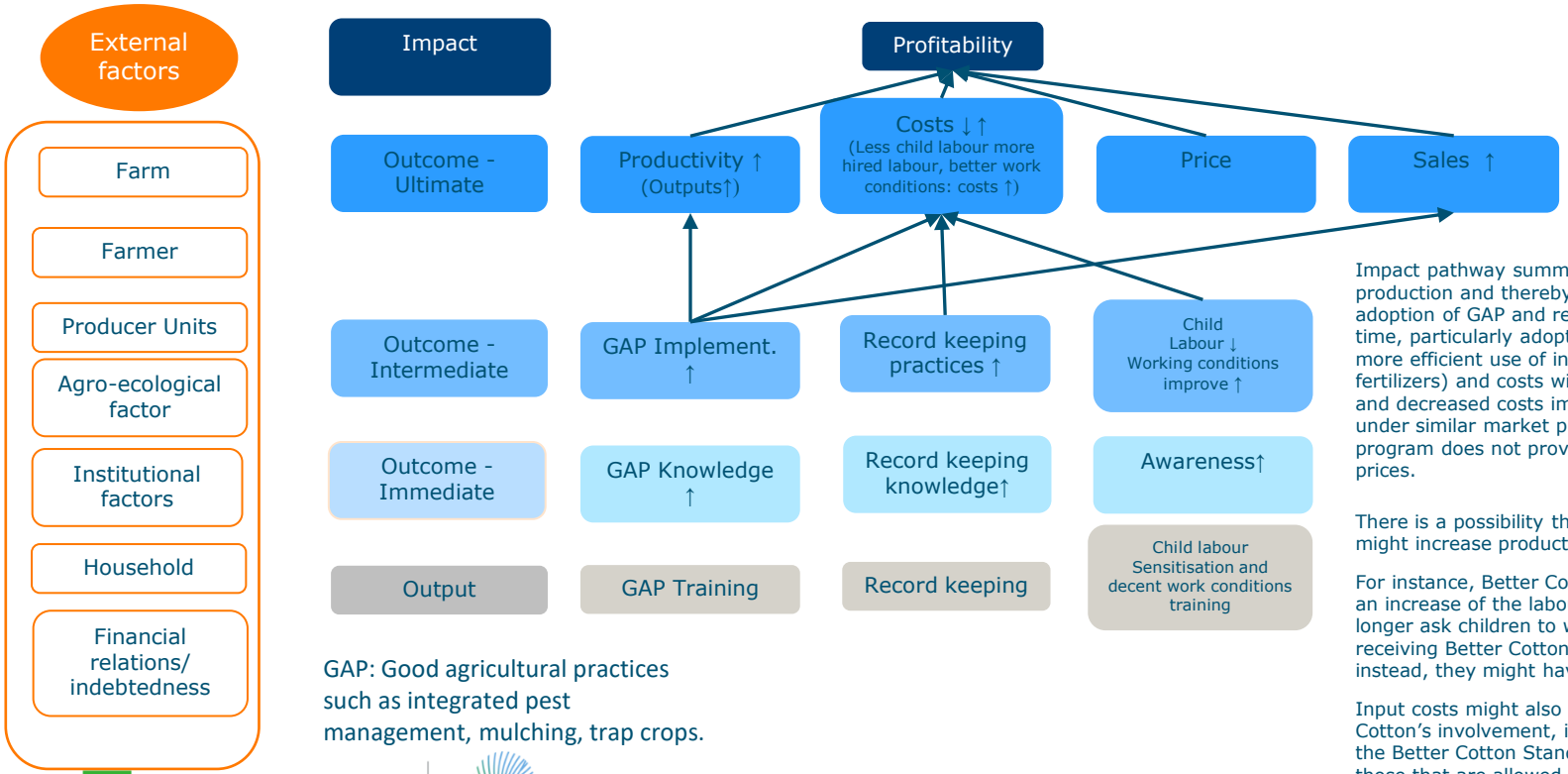
Better Cotton and its Programme Partners (PPs) have promoted Good Agricultural Practices (GAP) related to cotton farming (described below) and have informed farmers on how they can implement the following practices.

Soil, nutrient, and water management	Crop management
Cover crops	Correct use of pesticide and pest control methods
Manure compost	Disease & weed management
Mulching	Integrated pest management, identification of highly hazardous pesticides and alternative methods to control pests, use of neem oil spray/ neem extract
Soil Testing	Leaving spaces between rows of cotton
Timely & appropriate application and judicious use of fertilisers.	Rotation of cotton with other crops, and intercropping
Water management, efficient irrigation (e.g., furrow irrigation)	Trap and border crops

The PPs introduced these practices through activities such as farmer trainings, demonstration plots, WhatsApp messages, SMS messages, phone calls to the farmers, announcements and rallies in the villages. Farmers were also regularly reminded and shown how to keep records of pesticides used. They also organized street plays, screening of movies, participatory appraisal of natural resources. The list of activities conducted from 2018-19 to 2020-21 season can be found in the Appendix 2. Through these activities, Better Cotton aimed to improve the knowledge of individual farmers and to facilitate interactions between farmers to encourage peer learning.

Better Cotton and WUR co-developed a simplified Theory of Change (ToC) in 2019 for this study to identify Better Cotton's impact pathways from the introduction of GAP to increase the profitability of small-scale cotton farmers during this project.

Theory of Change: Testing a simplified intervention logic of Better Cotton to assess the cost and profitability effect



GAP: Good agricultural practices such as integrated pest management, mulching, trap crops.

Impact pathway summary: Farmers' productivity, production and thereby sales improve with the adoption of GAP and record-keeping. At the same time, particularly adoption of GAP will lead to a more efficient use of inputs (pesticides and fertilizers) and costs will decrease. Improved sales and decreased costs improve farmers' profitability under similar market prices. Better Cotton program does not provide a premium for cotton prices.

There is a possibility that Better Cotton support might increase production costs.

For instance, Better Cotton support might lead to an increase of the labour costs when families no longer ask children to work in the field after receiving Better Cotton training on child labour; instead, they might have to hire additional labour.

Input costs might also increase following Better Cotton's involvement, if pesticides prohibited under the Better Cotton Standard were cheaper than those that are allowed.

Theory of Change: Selecting indicators at each stage

Subject according to Theory of Change of Better Cotton	Outcome variables	Variable's expected direction of change after Better Cotton support
Immediate outcome variables		
Knowledge on Good Agricultural Practices (GAP)	Awareness on GAPs, index (0-13) (List of GAPs and the method we construct the index is in Appendix 3).	Increase
Intermediate outcome variables		
Adoption of GAP	Implementing GAP, index (0-13)	Increase
Use of biofertiliser	Farmer uses biofertiliser	Increase
Use of biopesticide	Farmer uses biopesticide	Increase
Record keeping	Farmer keeps records of farming activities, (0/1)	Increase
Child labour	Farmer hires child labor for a cotton farming activity, (0/1)	Decrease
Decent work practices	Training hired workers in cotton on health & safety (0/1)	Increase
	Use of minimum protective and safety equipment (0/1)	Increase
Correct and safe use of pesticides	Keeping pesticides separately (0/1)	Increase
	Keeping pesticide away from water, food, and children (0/1)	Increase
Ultimate outcome variables		
Costs (per 100 kg of cotton)	Input costs (fertilizers and pesticides), INR in logarithms	Decrease
	Labor costs, INR in logarithms	Ambiguous
	Irrigation costs, INR in logarithms	Decrease
	Transportation, INR in logarithms	Not targeted
	Land lease costs, INR in logarithms	Not targeted
	Total costs, INR in logarithms	Decrease
Productivity	Production of cotton per acre in logarithms	Increase
Sales	Sale of seed cotton per 100 kg in logarithms	Not targeted
	Price of seed cotton per 100 kg in logarithms	Not targeted
Impact variable		
Profitability	Income from Cotton per acre, INR.	Positive

The survey variables used to construct the indicators are in Appendix 4.

Method & Sampling

Method: a pipeline approach based on data from farmers supported by Better Cotton at different moments in time

We organized a new data collection strategy including baseline data.

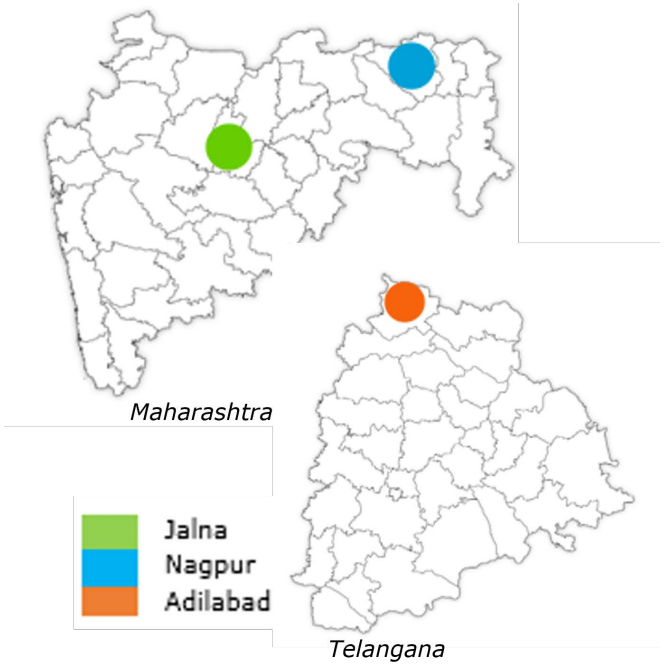
- Baseline and midline data were collected from **two cohorts** of farmers: farmers from Better Cotton villages that were supported by Better Cotton in 2019/2020 (cohort 2019/2020 – treatment group) and farmers from control group villages that would not be supported until 2020/2021 season (cohort 2020/2021 – control group).
- Data was collected at three points: baseline data collection before farmers received support (starting from July 2019), midline and endline data collection after cohort 2019/2020 received support. In the study regions, the cotton production season starts in July with preparation and finishes in the following April with the sale of all cotton harvested.
- In this report, we use data from Better Cotton villages (cohort 2019/2020) and control villages (cohort 2020/2021) to compare the change in the outcomes of farmers from those villages, while controlling for baseline difference using econometric models.

Time for data collection	Farmers from Better Cotton villages that are supported in 2019-20 season (Better Cotton cohort)	Farmers from control villages that might have been supported in 2020-21 (Control cohort) or later
July 2019	Treatment group, before support	Control group, no support
December 2020	Treatment group, after 1 seasons support	Control group, no support in Maharashtra and 1 season of support in Telangana[1]
April-May 2022	Treatment group, after 3 seasons of support	Control group, no support in Maharashtra or 2 years of support in Telangana[1]

[1, 2] Details on support are summarised in Appendix 5.

Data: selection of three Programme Partners (PPs) with potential for upscaling in key geographical focus areas

- We sampled farmers from Maharashtra (MH) and Telangana (TG) states in India, taking into account the logistics and upscaling strategy of Better Cotton. A more detailed explanation of the sampling procedure is in Appendix 6.
- Baseline and midline data was collected from three Better Cotton Civil Society Programme Partners (PPs): World Wide Fund for Nature (WWF-India) in Jalna, Deshpande Foundation (DF) in Adilabad and Ambuja Cement Foundation (ACF) in Nagpur. These partners were selected because they had potential to scale up operations in 2020/2021 in the selected states. Endline data was collected from two of the three PPs. WWF in Jalna was excluded from the data collection, as it had implemented the programme on a far smaller scale in MH in 2021/2022, and therefore no significant effect was expected for Better Cotton farmers.
- More detailed information can be found in Appendix 17



Baseline data and interviews suggest some differences between Better Cotton cohort and Better Cotton cohort 2020-21 villages

Based on interviews with PP program managers, field and project coordinators, and field facilitators in 2019, we found that certain villages are quite similar due to their proximity (within a maximum radius of 30 km for all PPs). Potential spill-overs programme effect are expected to be limited in the short term as a result of constraints information sharing. At the same time, we found some key production differences based on the opinion of interviewees:

	Better Cotton cohort farmers	Control cohort farmers
DF	• Long history of cotton farming • High soil quality • High share of cotton in total income • Big land holding and high production • High percentage of tribal groups • Low access to education	• Short history of cotton farming • Low soil quality accord • Low share of cotton in total income • Small land holding and low production • Low percentage of tribal groups • High access to education
WWF	• Bad access to irrigation facilities	• Good access to irrigation facilities
ACF	• Homogenous caste • Close to a large city	• Heterogenous caste • Far away to a large city

Using our baseline data, we compared the socio-economic indicators, input costs and yields between cohorts and states. Baseline socio-economic characteristics, importance of cotton in household income, land allocations and key intermediate and impact outcomes (yields-Appendix 7, input costs-Appendix 8, and profitability) are different among cohorts and states. We took into account these baseline differences and used statistical methods to match Better Cotton-supported and non-supported farmers in terms of contextual characteristics.

Sample description

- For the baseline and midline studies, data was collected from 68 villages; 34 were Better Cotton villages (Better Cotton cohort) and 34 were control villages (control cohort). The research team randomly selected 20 farmers from each village using lists provided by PPs, amounting to 1,360 farmers in total. All 1,360 farmers participated in the baseline study. 1,130 out of 1,360 farmers participated in the midline study.
- With the exclusion of WWF from the sample, in endline the data was collected from 40 villages, and 817 out of 1,000 farmers from ACF and DF participated in the endline study. In the 2021-22 season, this attrition did not lead to a significant bias for our endline results.
- The endline survey participation rate was 79% in Adilabad and 88% in Nagpur. When compared to Nagpur, in Adilabad, more of the sampled households did not have time or were not willing to participate in the endline survey.

State	PP	District	Block	Cohort	# of villages	# of respondents (baseline)	# of respondents (midline)	# of respondents (endline)
Maharashtra	ACF	Nagpur	Hingana	Better Cotton farmers, 2019-20	8	160	145	157
Maharashtra	ACF	Nagpur	Umred	Control, 2020-21	8	160	122	126
Maharashtra	WWF	Jalna	Jalna	Better Cotton farmers, 2019-20	9	180	150	-
Maharashtra	WWF	Jalna	Ghansawangi	Control, 2020-21	9	180	148	-
Telangana	DF	Adilabad	Talamadugu, Tamsi	Better Cotton farmers, 2019-20	17	340	249	279
Telangana	DF	Adilabad	Jainath	Control, 2020-21	17	340	316	255
Total					**68**	**1360**	**1130**	**817**

Endline identification strategy

Endline report identification strategy: comparing farmers from Better Cotton vs control villages

We used two econometric models to identify the impact of Better Cotton in Better Cotton cohort villages, in order to account for baseline differences and test the robustness of our results to changes in model specifications.

1. A standard difference-in-differences (DiD) model using data from 960 farmers in the baseline and 814 farmers in the endline survey for whom profit data is available. A detailed model specification can be found in Appendix 9.

2. Matching difference-in-differences (Matching DiD) model that matches Better Cotton farmers (Better Cotton cohort) and control group farmers (control cohort) by farmer age, social class, cotton land size, share of irrigated land, years of education, and share of income from cotton. The matching balances the baseline characteristics as shown in Appendix 10. The model then estimates a first difference model, comparing means using 814 observations and a propensity score weighted according to the similarity of characteristics between the Better Cotton cohort and control cohort. The model is explained in Appendix 11.

Both models estimated the impact of Better Cotton by comparing any changes experienced by the Better Cotton cohort farmers from 2018-19 to 2021-22, with those experienced by the control cohort farmers. In the models, Better Cotton farmers comprised farmers from villages in the Better Cotton cohort and the control group farmers comprised farmers from villages in the control cohort. The models controlled for baseline village, PPs, district, state level and household level differences. However, they have different positive and negative aspects, as shown in Appendix 12. The endline identification approach assumes that the majority of farmers in Better Cotton cohort villages received Better Cotton training and the control cohort farmers did not receive any support. This was in line with the PPs' and farmers' reports. *In the midline report, we have used other identification strategies due to low participation rates in capacity-building activities. You can find all midline identification strategies in Appendix 13.*

Matching DiD is a more robust model; however, it uses a smaller sample size, sometimes making it harder to detect a statistical effect. Therefore, the endline presented in this study will mainly rely on the estimate from the matching model. We benefit from the estimates of the DiD when estimates from both models are similar, but the Matching DiD model can detect statistical effects due to the smaller sample size.

Spillover of programme to control villages in Adilabad in Telangana creates challenges for the identification strategy.

The endline evaluation uses data from two program partners (PPs), ACF and DF, implementing the Better Cotton programme in the study.

Spillover of Better Cotton activities in midline and endline: The initial timeline of the study was 1 year. It was expected, at the inception of the study, that the control cohort would be added to the programme in season 2020-21, however due to the Covid-19 pandemic, the impact study was extended, and the programme expansion was halted for season 2020-21. Despite the halt in expansion, DF reported that it had shared information on good farming practices with the control cohort (control group) farmers in Adilabad. DF conducted the training primarily through mobile phones due to Covid-19. The other PP operational in Nagpur (MH), ACF, reported that they had not conducted any training or support activities with the control cohort as of January 2022, while ACF maintained the control group during the period of the study and did not include them in the programme.

Spillover of Better Cotton activities in endline: In the 2021-22 season, ACF did not expand and did not include control cohort villages in its programme. DF kept the scope of capacity-building activities in control cohort villages. The research team detected that DF capacity-building activities were almost equally intensive between the two groups in 2021-22.

Implications for endline evaluation results: Our evaluation strategy is based on comparing the evolution of farming outcomes between Better Cotton and the control group villages. The difference between the two indicates the effect of Better Cotton. Control cohort villages in Nagpur were not included, while they were included in Adilabad (and therefore it was hard to detect Better Cotton impact in Adilabad).

This report presents the evaluation results for Adilabad in Telangana and Nagpur in Maharashtra separately to address this concern.

Data collection process & survey description for each evaluation phase

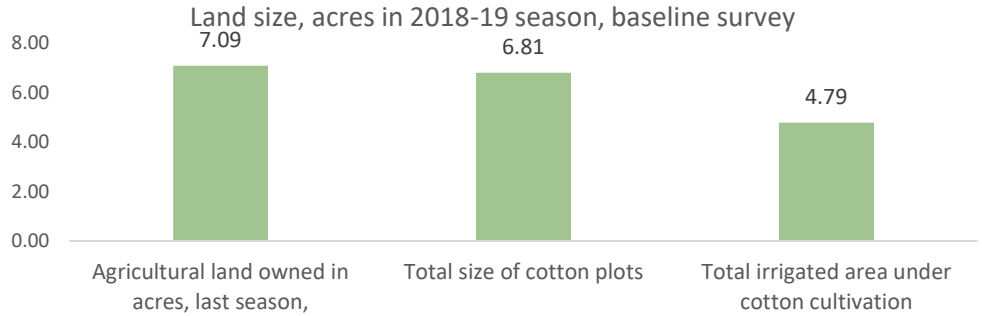
Baseline data collection & survey data description

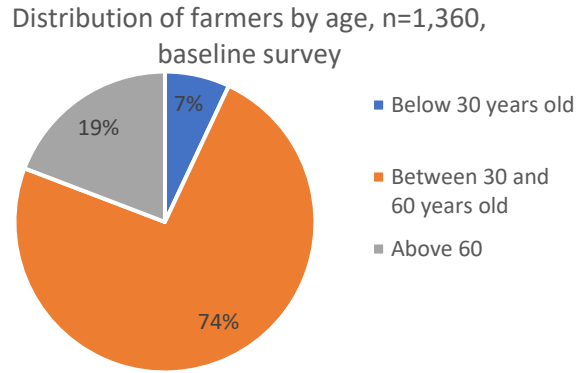
Baseline survey: 1,360 cotton farmers participated in the baseline survey administered through face-to-face interviews. These farmers were mainly smallholder farmers with literate, male and middle-aged household heads. These characteristics were established through a random sampling (ensuring unbiased population representation), and are likely to be typical of the households supported in those regions. Below, we briefly summarise the main characteristics of the baseline sample:

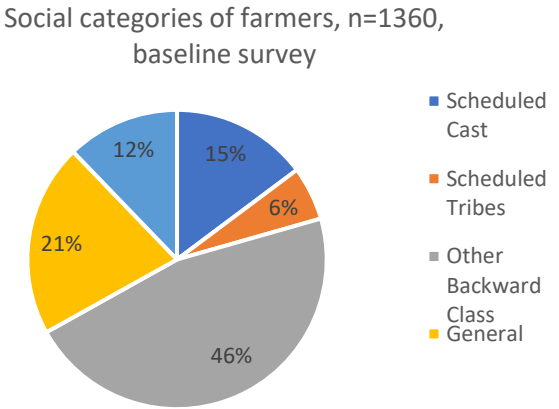
Baseline sample characteristics	**% of the baseline sample**	**Additional information reported by the farmers ~~in the survey~~**
Training participation prior to BCI activities.	9%	• "Correct and timely application of pesticides" was the most common (8%), followed by "Timely and appropriate application of fertilisers" (6%)
Experienced loss	17%	• Mainly due to fall in their cotton harvest compared to the previous season
Being aware of cover crops, trap crops, soil tests and mulching	Less than 30%	• Please see Appendix 14 for the awareness gap on agricultural practices
Organisation membership	47%	• Mainly self-help groups (41%) • A minority of farmers were members of Farmers Producer Organisations or farmers associations (3%).

Baseline survey: Small-scale farmers with literate, male and middle-aged household heads

- 95% of the households in our sample are headed by men.
- On average, farmers have received seven years of education; 83% are able to read or write.
- On average, farmers use almost all land for agricultural farming. For the cohort supported by Better Cotton, farmers use almost 80% of total land for cotton production on average, while control group farmers report the same on about 72% of their land.
- The share of irrigated area is about 68% of total agricultural land. The main sources of irrigation are open well (26%) and bore well (20%). More advanced irrigation systems are not common, as expected. The main sources of irrigation for cohort 19/20 (treatment group) are open well (31%) and bore well (23%). Similarly, the main source for control cohort are open well (22%) and bore well (17%) followed by canal (14%).







Midline data collection & survey data description (2019-20 season)

Midline survey: Among the farmers who participated in the baseline survey, 1,130 (83% of baseline farmers) also participated in the midline survey. The survey was originally planned to be completed in April-May 2020. However, due to Covid-19 restrictions, the implementation of the survey was delayed to December 2020. The midline survey was administered by phone instead of through face-to-face interviews due to restrictions related to the pandemic.

- **No significant bias due to attrition**: 230 farmers who did not participate in the midline survey were not significantly different from farmers who participated in both surveys in terms of farmer age, social class, land size, share of irrigated land, share of income from cotton and productivity levels.
- The survey included questions concerning the 2019-20 cotton season. About 62% of respondents indicated that the 2019-20 season was similar to or better than the 2018-19 season in terms of weather conditions, pest level, market conditions, prices and labour costs.
- **Long periods of rain**, indicated by 17% of farmers participating in the midline survey, and **pest attacks**, indicated by 18% of the farmers, **were the two major reasons** behind a worse season between the 2019-20 and 2018-19 seasons.
- The reported number of workers aged between 6-14 decreased from 26 to 7 observations during the midline data collection. Since the practice of hiring children is limited, we did not report further impact estimates. Both baseline and midline data for hired labour is data reported by households.

As per midline results, Better Cotton's contribution to the profitability of farmers was limited in the period between 2018-19 and 2019-20 seasons

- We found evidence for a positive impact of the Better Cotton programme on adoption of GAP, decent work practices and record keeping. Irrigation costs decreased more among farmers who reported support than those who did not report support in Better Cotton villages. But we did not detect any other effect of Better Cotton on other cotton farming costs (e.g., input and labour costs). As a result, the midline study did not find that Better Cotton intervention decreased overall costs nor improved supported farmers' productivity, production, or profitability after one year of support.
- These results were in line with PPs' expectation that the transformation process would take at least two years from the outset. We expected improved results in the endline period as the intensity of farmers' activities and trust in the programme partners would increase.
- More detailed results can be found in our midline survey results report and in Appendix 15.

Endline data collection & survey data description (2021-22 season)

Endline survey: The survey was completed in April-May 2022. Among the ACF and DF farmers who participated in the baseline survey, the survey team could reach 870 farmers (87% of initial sample). The others did not participate in the survey due to personal reasons, leasing out or selling their land, not growing or harvesting cotton, farmer mortality and other reasons. Among 870 that could be reached, 817 out of 870 grew cotton in the 2021-22 season participated in the endline survey.

- **No significant bias due to attrition**: 283 farmers who did not participate in the endline survey were not significantly different from farmers who participated in both surveys in terms of farmer age, social class, land size, share of irrigated land, share of income from cotton and productivity levels. The only difference among farmers who participated in the endline survey is that they were less likely to be part of a farmers' association than those who did not participate.
- The survey included questions concerning the 2021-22 cotton season. Around 63% of respondents indicated that the 2021-22 season was worse than the 2020-21 season in terms of weather conditions, pest level, market conditions, prices and labour costs.
- **Long periods of rain**, indicated by 50% of farmers participating in the endline survey, and **pest attacks**, indicated by 35% of the farmers, **were the two major reasons** why the 2021-22 season was more challenging than 2020-21. Our econometric methods control for these common issues and are not biased due to these.
- At endline, no respondent indicated hiring a child for any of the production activities. The number of observations therefore decreased from 14 to 0 observations. In the midline sample, we recorded 26 observations; the difference between baseline value for midline versus endline assessment is the difference in sample, i.e. absence of Jalna respondents.

Better Cotton support intensity in the 2021/22 season, farmers expectations and perceptions of the contribution made by Better Cotton

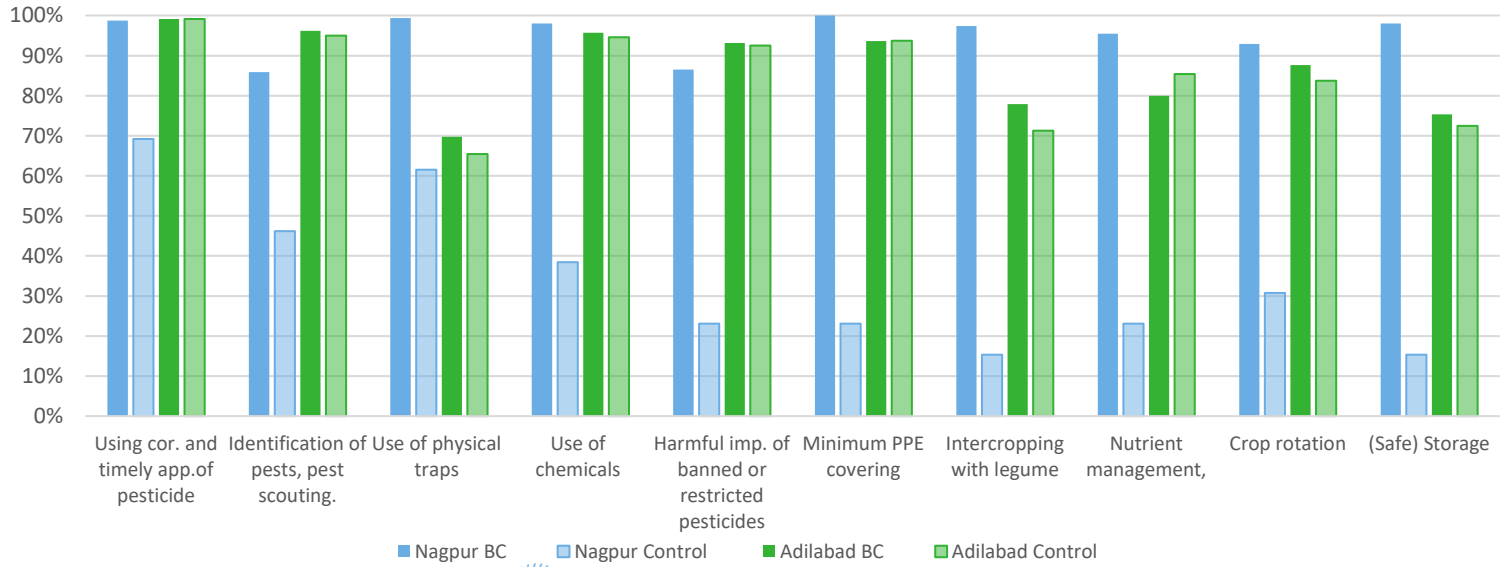
The initial discussion with the PPs suggested increased interaction with farmers in the 2021-22 season when compared to previous seasons

We organised a meeting with ACF and DF to discuss the trainings and expectations in terms of outcomes in the 2021-22 season. Our overall findings from those meetings are as follows:

- The PPs highlighted that the interaction with farmers improved in the 2021-22 season. The implementation of the project began in the 2019-20 season, Better Cotton farmers had received face-to-face training in this first season. In the 2020-21 season, capacity building was mostly remote due to Covid-19. In the 2021-22 season, PPs had more face-to-face interaction with farmers when compared to earlier seasons. Face-to-face interaction improved farmer trust in PPs and their recommendations. The PPs expected an increase in the adoption of practices on pest management, use of biopesticides and soil health. For practices where changing to an alternative would be more costly, they expected at least a significant increase in awareness in general.
- The PPs expected a reduction in outputs and yields due to infestation problems, rainfall and increase in prices of cotton (some indicated doubling of the market price of cotton).
- Among supported farmers, the PPs observed an increased share of farmers using biopesticides, implying less frequent use of synthetic spraying and synthetic pesticides and an increase in plant population. They promoted high density planting systems and encouraged intercropping, so the area under cotton would decrease as space on the field would be allocated to the intercrop.
- Farmers should be able to clearly identify the PPs as organisations providing the training (no confusion with government services or other NGOs).

The proportion of Better Cotton farmers who report having received Better Cotton support in Nagpur and Adilabad is over 75% for 14 of the 19 support topics.

Proportion of farmers who reported receiving training, booklets, information on cotton farming in 2021-22 season, graph 1



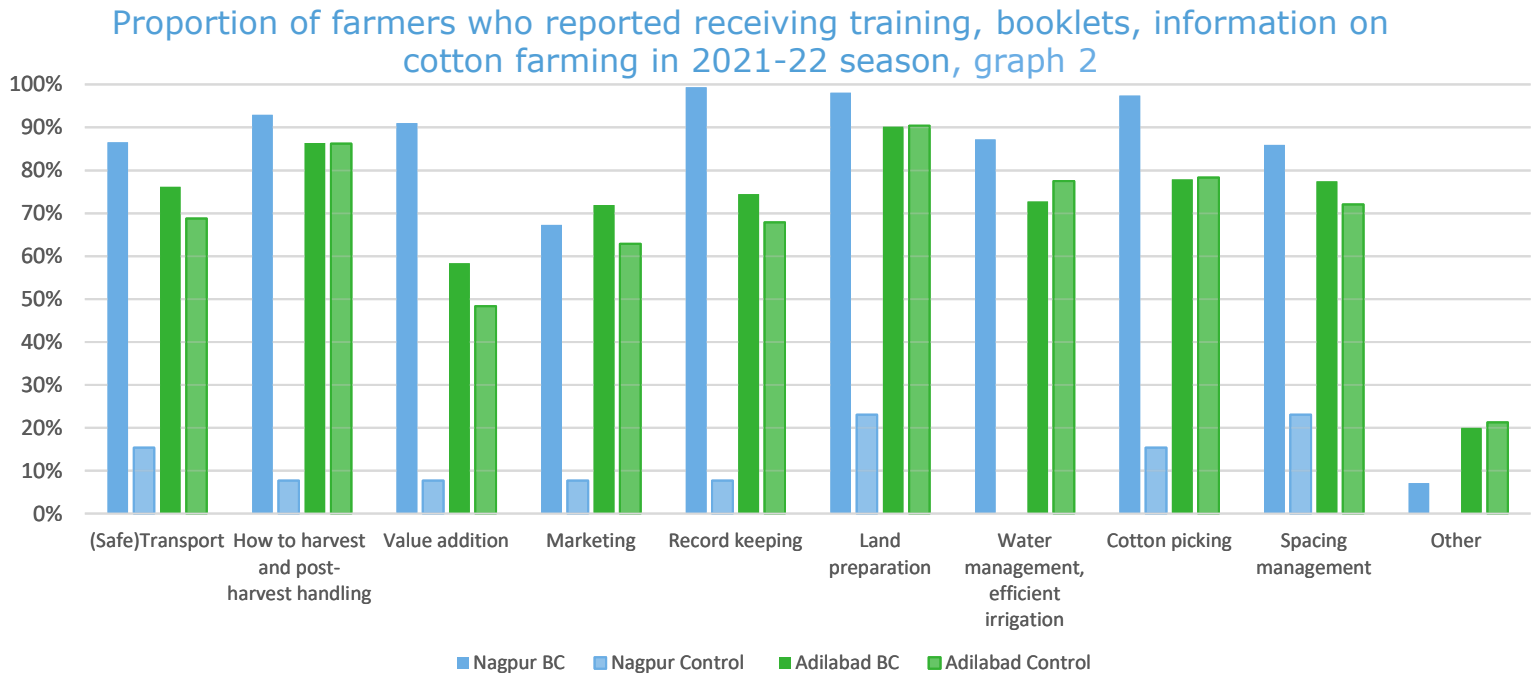
In the 2020-21 season, in Adilabad, DF supported both Better Cotton and control farmers with the same intensity. This issue was raised in the pre-analysis discussions with the PPs, and therefore this result was expected.

Better Cotton farmers supported in Nagpur received more intensive training on all subjects compared to control farmers.

WAGENINGEN UNIVERSITY & RESEARCH

Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

Better Cotton farmers in Nagpur reported the lowest participation in marketing, while farmers in Adilabad reported the lowest additional value

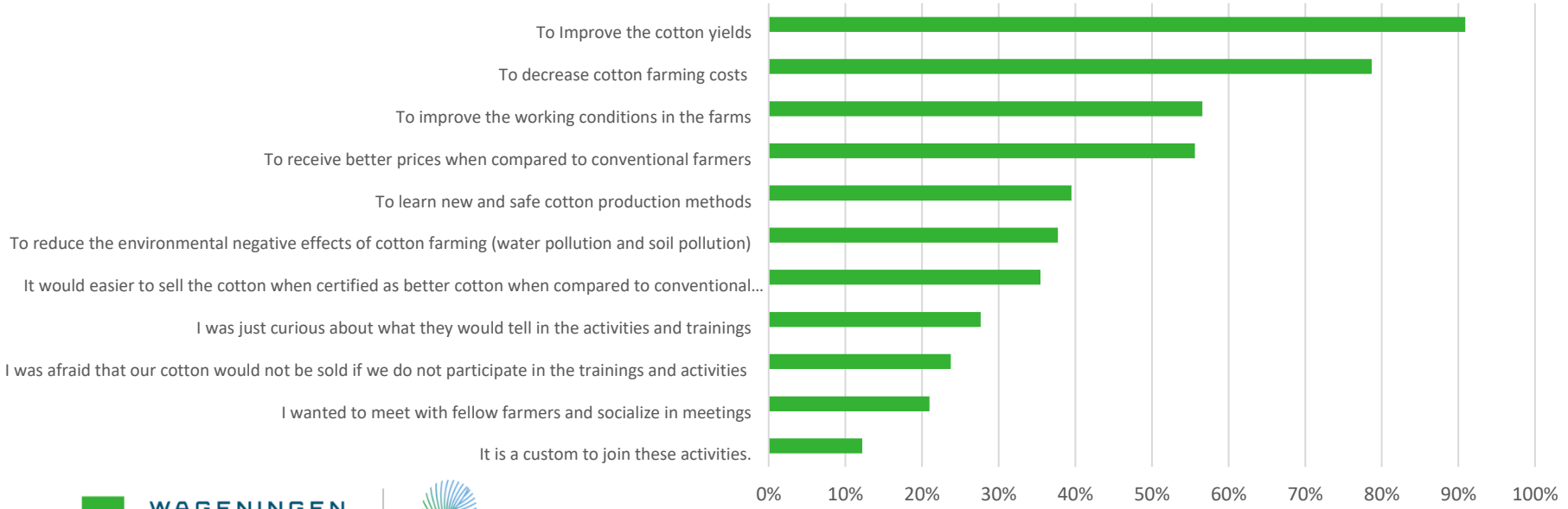


Marketing was reported as the least provided training to Better Cotton farmers in Nagpur (about 70%) and value addition was the least reported training by the farmers in Nagpur (60%). This is in line with our expectations: in our in depth interviews, PPs indicated that there had not been a high level of marketing and value addition related activities during the 2021-22 season.

Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

Improving cotton yields and decreasing cotton farming cost are among the most prevalent motivations to participate in Better Cotton training and activities

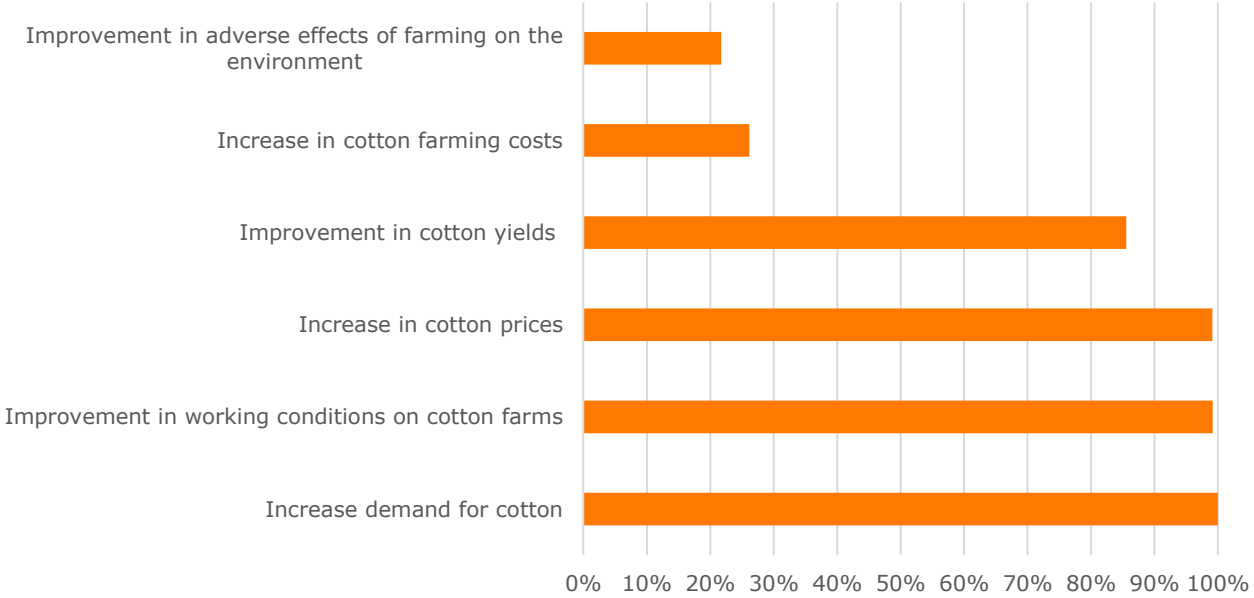
Proportion of farmers per motivation to participate in Better Cotton training and activities, endline survey results, multiple choices were allowed and an option list was provided



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

Farmers believe that participating in Better Cotton activities helped them to increase demand for cotton, improve working conditions, receive better prices and improve cotton yields.

Proportion of farmers by perceived contribution of Better Cotton activities after three seasons, endline survey



This figure depicts perceptions of farmers and does not conclude on any findings of statistical analysis; these results are therefore not related to outcomes as foreseen by the Better Cotton program but an indication of farmers subjective perceptions on potential outcomes. Each farmer were asked six question on whether participation in Better Cotton activities contributed to the livelihood farmers on the areas indicated on y-axis.

The vast majority of participating farmers perceived an improvement in working conditions on their farms, an, increased demand for cotton and higher cotton prices as a result of Better Cotton training.

Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

WAGENINGEN UNIVERSITY & RESEARCH

Better Cotton farmers believe that they receive higher prices and their cotton is considered to be of a higher quality due to their participation in the Better Cotton programme. This observation was further validated with the PPs' post-analysis of first results discussion. (Please see slides 44 and 45 for details on this)

Summary results

General note on differences in identification strategies and sample sizes between midline & endline

- In the following summary tables, we provide an overview of midline and endline summary results. There are two important aspects influencing differences in statistical significance of results:

    1) We use fewer identification strategies in endline compared to midline (more information on why more identification strategies were implemented for midline assessment can be found in Appendix 15). This implies fewer models were run and therefore there is less partial evidence.

    2) Due to smaller sample size, we sometimes find no statistically significant result per district while we obtain significant results on the total sample. For instance, even if we saw an average change higher/lower in Better Cotton farmer group than in the control group in either Nagpur and/or Adilabad, due to sample size limitations we are not able to conclude a significant difference between the two groups; and this more specifically when the effect (i.e. the extent of change), is not substantial.

The endline shows evidence of positive effect of Better Cotton on GAP awareness and adoption, decent work practices, and record keeping

Outcome variables			Midline eval. Overall conclusion All sample	Endline eval. All sample	Endline eval. Only Nagpur	Endline eval. Only Adilabad
Intermediate	Use of GAP	Implementing GAP, index (0-11)	⇧	⇧	⇧	-
	Record keeping	Farmer keep records of farming activities, (0/1)	⇧	⇧	⇧	-
	Decent work practices	Training hired workers in cotton on health & safety (0/1)	⇧	⇧	⇧	-
		Use of minimum protective and safety equipment (0/1)	⇧	*	*	*
	Correct and safe use of pesticides	Storage of pesticides Keeping pesticides separately (0/1)	⇧	-	-	-
		Keeping pesticides away from water, food and children	⇧	-	⇧	-
Immediate	Knowledge on GAP	Awareness on GAP, index (0-11)	⇧	⇧	⇧	-

⇧: Statistically significant (at 10% level) increase in Better Cotton farmers when compared to control group farmers

⇧: Some evidence on the statistically significant positive effect of Better Cotton. We use some evidence wording when the results are not statistically significant for all models.

- No statistically significant effect of Better Cotton

We use 10% statistical significance in the endline report (5% was used in the midline report), due to small sample sizes for Nagpur and Adilabad level results.

* Our statistical model does not detect a statistical effect of Better Cotton in endline on the use of minimum protective and safety equipment. This contradicts the fact that in Nagpur all Better Cotton cohort farmers reported to use protective equipment. In the same period, both Better Cotton and control cohort farmers increased their use of the equipment, therefore our models could not detect an effect.

The estimates for Better Cotton effect for midline can be found in Appendix 15 and for endline can be in Appendix 16.

Some evidence on decreased transportation costs

Outcome variables			Midline eval. overall conclusion All sample	Endline eval. All sample	Endline eval. Only Nagpur	Endline eval. Only Adilabad
Ultimate outcome variables	Cost item	Input costs (fertilizer + pesticide costs) per 100 kg of seed cotton	-	-	-	-
		Labour costs, per 100 kg of seed cotton	-	-	-	-
	Not targeted	Seed costs per 100 kg of seed cotton	**Inconclusive**	-	-	⇧
		Irrigation costs per 100 kg of seed cotton	⇩	-	-	-
	Not targeted	Transportation costs per 100 kg of seed cotton	⇩	⇩	-	-
	Not targeted	Land lease costs per 100 kg of seed cotton	⇧	-	-	-

⇧: Statistically significant increase (at 10% level) in Better Cotton farmers when compared to control group farmers. A negative direction of change was expected after Better Cotton support.
⇩: Some evidence of intended statistically significant decrease in outcome variable in Better Cotton farmers. We use some evidence wording when the results are not statistically significant for all models.
Inconclusive: We found statistically significant results but with opposite signs. Therefore the result is inconclusive.
- : No statistically significant effect of Better Cotton
We use 10% statistical significance in the endline report (5% was used in the midline report), due to small sample sizes for Nagpur and Adilabad results.

The estimates for BCI effect for midline can be found in Appendix 15 and for endline can be in Appendix 16.

The expenses for some synthetic inputs decreased while costs associated with some biologic inputs increased after Better Cotton support

Outcome variables		Endline eval. All sample	Endline eval. Only Nagpur	Endline eval. Only Adilabad
Detailed costs	Synthetic fertilizer total cost, % change	-	⇩	-
	Synthetic herbicide total costs, % change	⇩	-	-
	Synthetic insecticide total costs, % change	⇩	-	⇩
	Synthetic fungicide total costs, % change	-	-	-
	Biological fertilizer total costs, % change	-	-	-
	Biological herbicide total costs, % change	-	-	⇧
	Biological insecticide total costs, % change	⇧	⇧	-
	Biological fungicide total costs, % change	-	-	-

⇩: Statistically significant (at 10% level) decrease in Better Cotton farmers when compared to control group farmers
⇧: Statistically significant (at 10% level) increase in Better Cotton farmers when compared to control group farmers.

We use 10% statistical significance in the endline report (5 was used in the midline report), due to small sample sizes for Nagpur and Adilabad results.

Better Cotton farmers in Nagpur experienced a greater yield decrease than control group farmers. Overall, Better Cotton supported farmers receive a better price for their cotton.

Outcome variables				Midline eval. overall conclusion All sample	Endline eval. All sample	Endline eval. Only Nagpur	Endline eval. Only Adilabad
Impact		Income from cotton:	Total profit from cotton per acre	-	-	⇧	-
Ultimate		Costs	Total cost per 100 kg of cotton,	-	-	-	-
		Production	Total production, 100 kg	⇩	⇩	⇩	⇩
		Productivity	Total production per acre	-	⇩	⇩	⇩
	Not targeted	Price:	Price of cotton per 100 kg	-	⇧	⇧	-
		Sales:	Total sales of seed cotton, 100 kg	⇩	⇩	⇩	⇩

⇧: Statistically significant (at 10% level) increase in Better Cotton farmers when compared to control group farmers
⇩: Statistically significant (at 10% level) decrease in Better Cotton farmers when compared to control group farmers
⇩: Statistically significant decrease (at 10% level) in Better Cotton farmers when compared to control group farmers. A positive direction of change was expected after Better Cotton support
⇩: Some evidence of intended statistically significant decrease in outcome variable in Better Cotton farmers
- : No statistically significant effect of Better Cotton

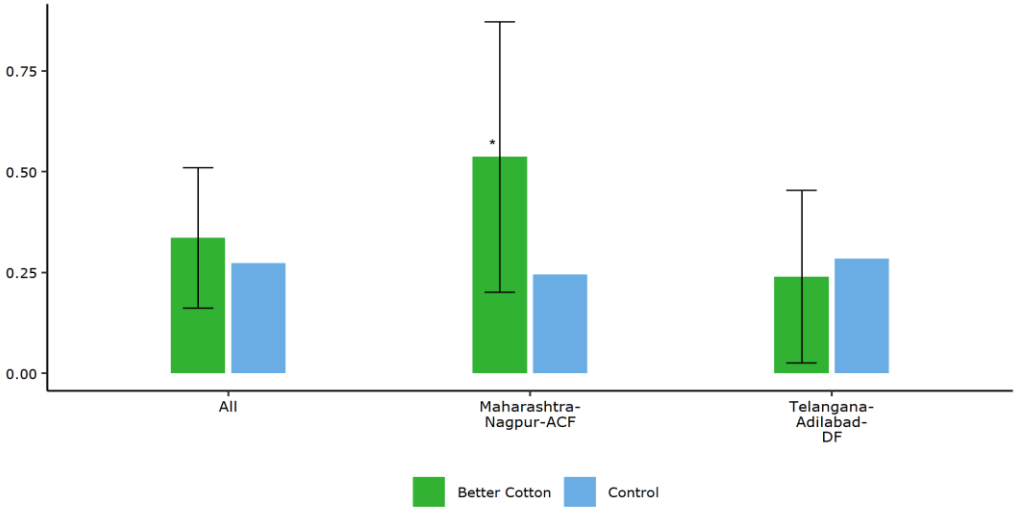
The estimates for BCI effect for midline can be found in Appendix 15 and for endline can be in Appendix 16.

WAGENINGEN UNIVERSITY & RESEARCH

Detailed results of key outcome variables at aggregate and district level

The record keeping practice of cotton farmers improved. In Nagpur, farmers improved more on average than control farmers.

Average change[1] in the proportion of farmers keeping records between baseline and endline[2]



When compared the baseline, the fraction of farmers keeping records is higher on average.

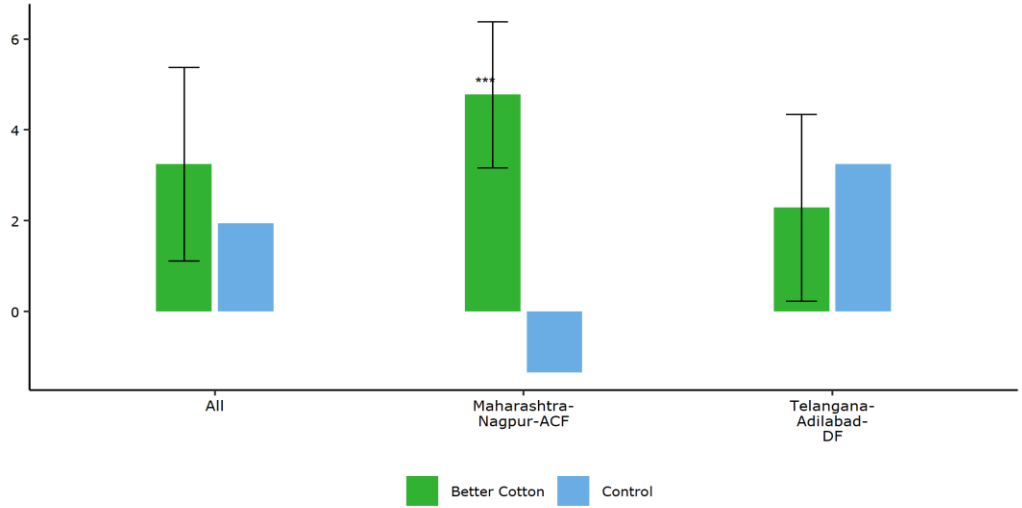
As of the 2021-22 season, the proportion of farmers keeping records of inputs used and related costs increased (from 43% to 97%) by 54 percentage points for Better Cotton and (from 39% to 64%) by 25 percentage points for control group farmers in Nagpur, implying 29 percentage points net effect of Better Cotton on record keeping.

[1]Average change is the weighted average of change in the indicator from baseline to endline survey. The weights are used farmers in Cohort 19/20 and Cohort 20/21 and estimated through our econometric analysis. They show the probability of a farmer being in the treatment cohort.
[2]All graphs are visualisations of matching DiD model of Cohort 19/20 vs Cohort 20/21 model results.
Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

Error bars shows 95% confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model. * the difference is statistically significant at 10% level , ** the difference is statistically significant at 5% level, *** the difference is statistically significant at 1% level

The average change in the adoption of practices is higher among farmers in Better Cotton villages than in control villages in Nagpur.

Average change in the number of GAP adopted between baseline and endline (0-13 score)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

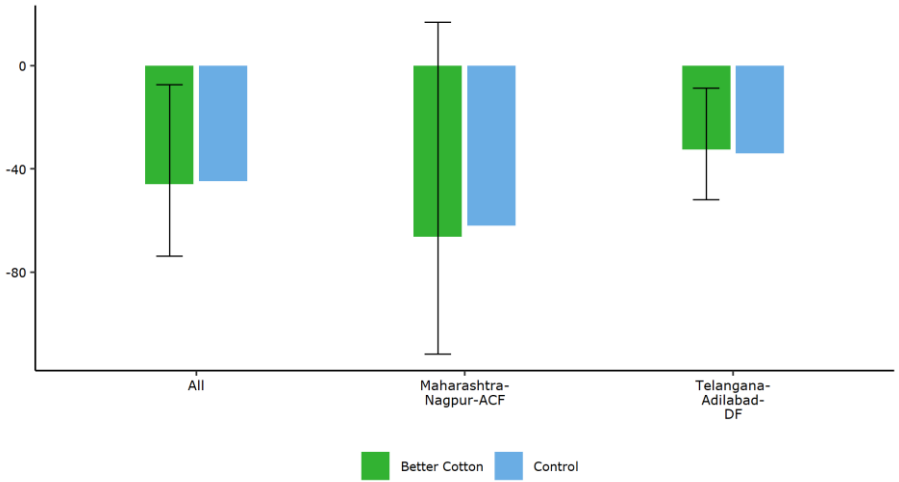
Error bars shows 95% confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level.

In Nagpur, the number of GAP practices farmers adopt improved among farmers in Better Cotton cohort villages compared to control cohort farmers. Better Cotton cohort farmers in Nagpur adopted 6 practices more than control cohort farmers.

Farmers in the Better Cotton cohort fared better in implementation of trap crops and cover crops. In control villages, we observed a negative trend between baseline and endline in Nagpur. This finding is well in line with PPs reporting on increase use of GAPs. PPs report that the possibility of in-person trainings seems to be a crucial element in increasing GAP awareness and implementation, considering the differences in programme impact between baseline and midline.

Input costs decreased for both Better Cotton and control group farmers.

Average change in input costs per 100 kg of cotton harvested between baseline and endline (% change)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana

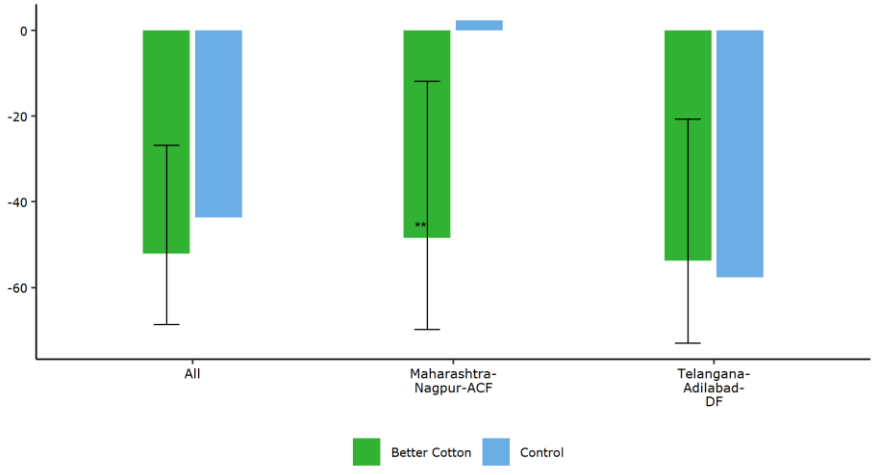
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

From baseline to endline, farming inputs costs (include all synthetic and bio fertiliser, insecticide, herbicide, fungicide costs) decreased for both Better Cotton and Control group farmers. This decrease was over 40% for Better Cotton farmer, on average, but not statistically different from the decrease for control group farmers.

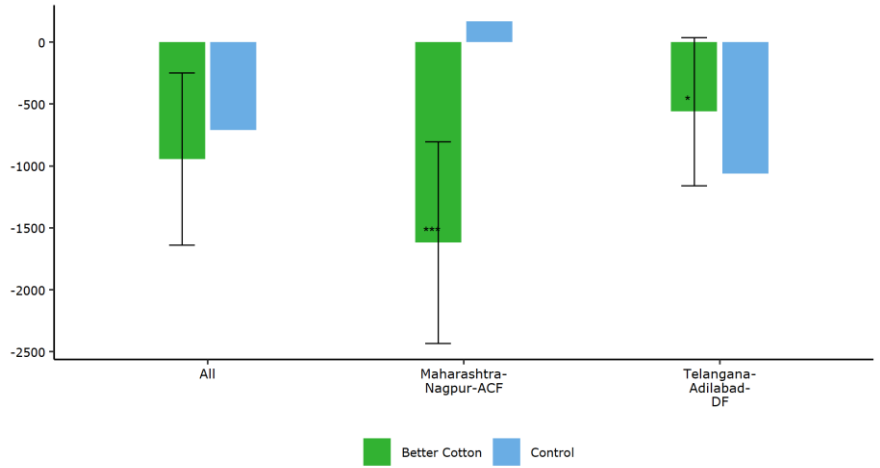
The decrease can be explained by a lower use of synthetic pesticides and fertilisers and concurrent increase in frequency of use of biopesticides. Furthermore, biopesticide costs are lower, where farmers were trained on at-home preparation. A detailed analysis of reductions in individual input costs follows in the next slides.

On average, synthetic fertiliser use costs decreased in Better Cotton villages. In Nagpur, reduction in these costs was greater among Better Cotton farmers than control group farmers.

Average change in synthetic fertiliser costs per 100 kg of cotton harvested between baseline and endline (% change)



Average change in the use of synthetic fertiliser between baseline and endline (in kg)

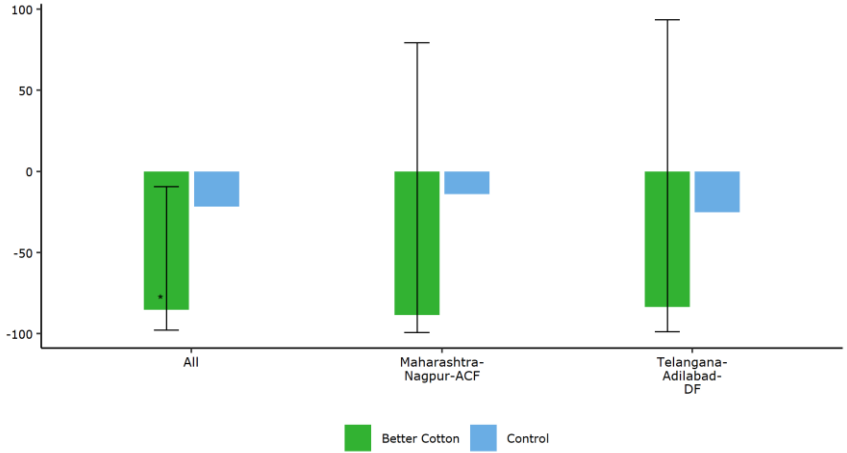


Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black line shows 95% confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

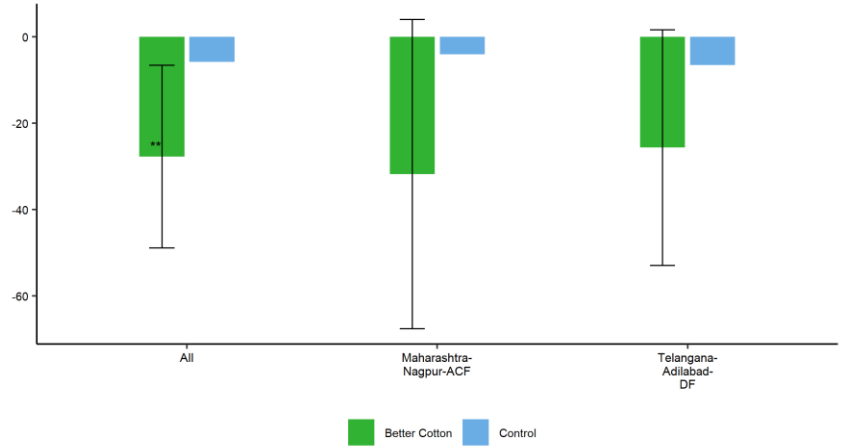
When compared to baseline costs and use for synthetic fertilizer decreased on average both Better Cotton and control group farmers. This decrease was over 50% for Better Cotton farmers, bring about 6,668 INR (85 US dollars) reduction in fertilizer costs for an average farmer in Nagpur. For Better Cotton farmers in Nagpur, the average reduction amounted to more than 1,500 kgs and this decrease was significantly greater compared to the control farmers. Similar trend was observed in Adilabad. The cost decrease is a reflection of decrease in use in synthetic fertilizer. General decrease in the use of synthetic fertilizer was also expected by the PPs as Better Cotton farmers are instructed to avoid synthetic fertilizers and pesticides as part of the program in both districts.

Reduction in the costs of synthetic herbicide was greater among Better Cotton farmers compared to control farmer households.

Average change in costs of synthetic herbicide between baseline and endline (% change)



Average change in the percentage farmers using synthetic herbicide between baseline and endline (% change)

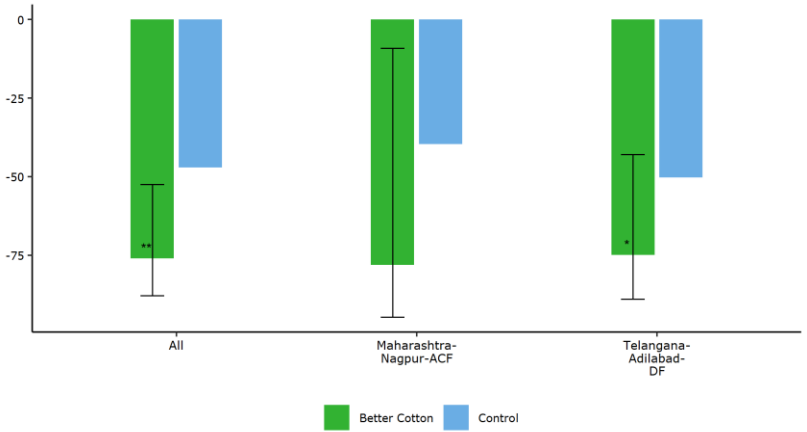


Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

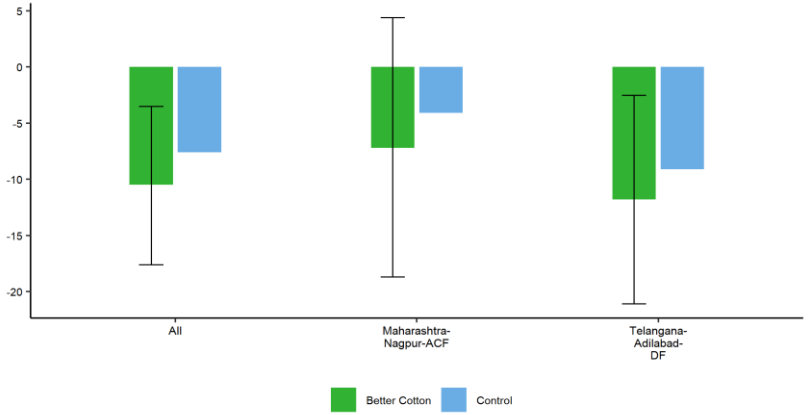
In general, synthetic herbicide expenses and use rate decreased. The costs decreased more among Better Cotton farmers compared to the control group. Overall, there is more than a 50% decrease in the synthetic herbicide costs of Better Cotton farmers, equivalent to about 1075 INR (14 US dollars) for an average farmer and a 20% decreased in the share of Better Cotton farmers using synthetic herbicide among Better Cotton farmers, with a significant difference between the two groups. At the same time, we observed an increase in the use of bioherbicides (see slide 40). This finding shows that high participation in the training on correct and timely use of pesticides in the Better Cotton group, almost 100% in both ACF and DP villages (slide 20), can result in the desired outcome of a decreased use of synthetic pesticides.

Better Cotton farmers reduced their synthetic insecticide costs by almost 75%. This decrease was greater among Better Cotton farmers compared to control farmer households.

Average change in costs of synthetic insecticide between baseline and endline (% change)



Average change[1] in the percentage of farmers using synthetic insecticide between baseline and endline (%)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

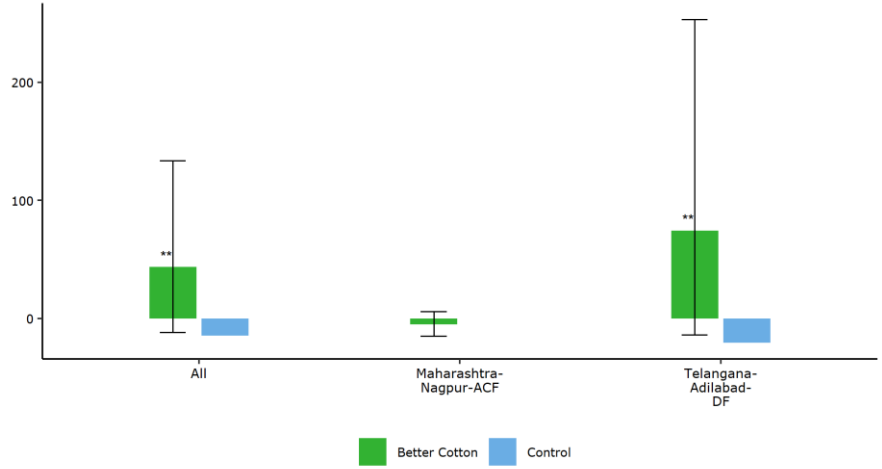
we observe similar changes in the costs of synthetic insecticides. The cost of synthetic insecticides decreased 27 percentage points more, 2361 INR (30 US dollars) per farmer more for Better Cotton farmers than control group farmers. The difference between Better Cotton and control group farmers in terms of the change in the costs was statistically significant, particularly for farmers in Adilabad. Focusing on the avoidance of synthetic pesticides within the Better Cotton program is reflected in our findings on the reduced use, volumes used and associated costs of synthetic insecticides. Instead, farmers opted for bio insecticides (slide 41) improving the sustainability of cotton produced in the studied districts.

WAGENINGEN UNIVERSITY & RESEARCH

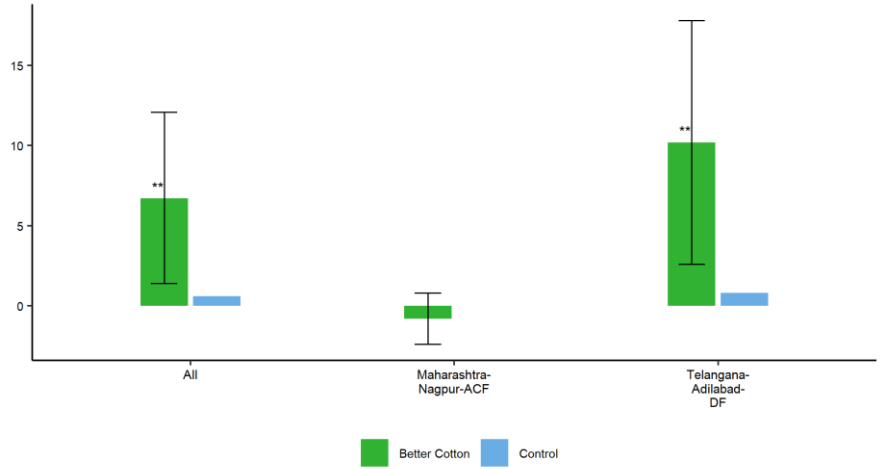
100years 1918 — 2018

The increase in the costs of bioherbicide use was greater among Better Cotton farmers than control group farmers.

Average change in costs of bioherbicide between baseline and endline (% change)



Average change in the percentage of farmers using bioherbicide between baseline and endline (%)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

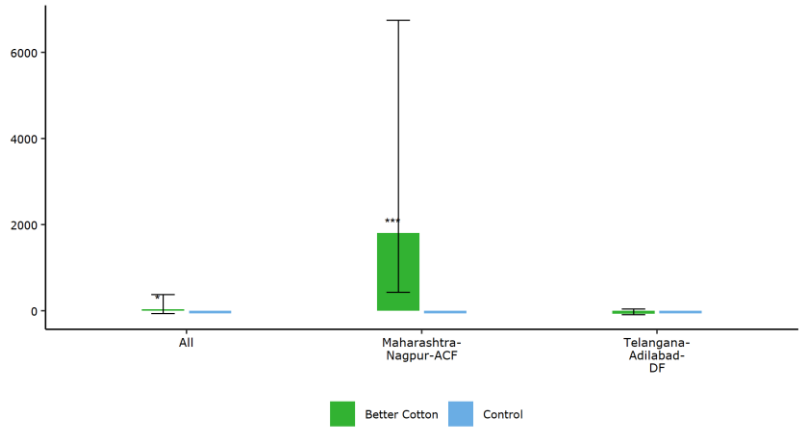
WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

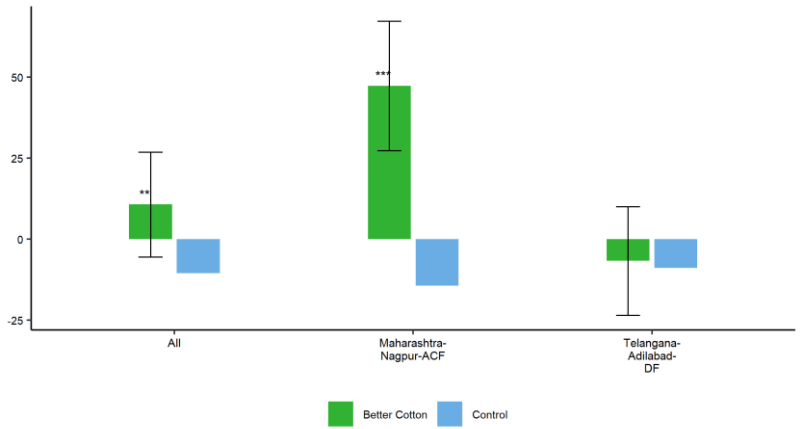
There are around 6% more Better Cotton farmers using bioherbicides compared to baseline. In Adilabad specifically, use of bioherbicide increased by 10% and the increase was greater among Better Cotton farmers than control group farmers (1%). As a result Better Cotton farmers bioherbicide costs increased by 120% more when compared to control cohort farmers, equivalent to 210 INR (2.65 US dollar) per farmer. This is because bioherbicides are commonly used in Adilabad but not in Nagpur (see slide 42). These findings confirm the focus of the PPs on decreased synthetic pesticide use among the farmers in the Better Cotton programme. The significant difference between the two groups shows that Better Cotton farmers are switching significantly more to biologic inputs from synthetic inputs. We note that the % change in the costs are high as baseline expenses for bioherbicide were minimal.

The increase in the costs of bioinsecticide and proportion of farmers using bioinsecticide was greater among Better Cotton farmers than control group farmers.

Average change in costs of bioinsecticide between baseline and endline (% change)



Average change in the percentage of farmers using bioinsecticide between baseline and endline (%)



Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

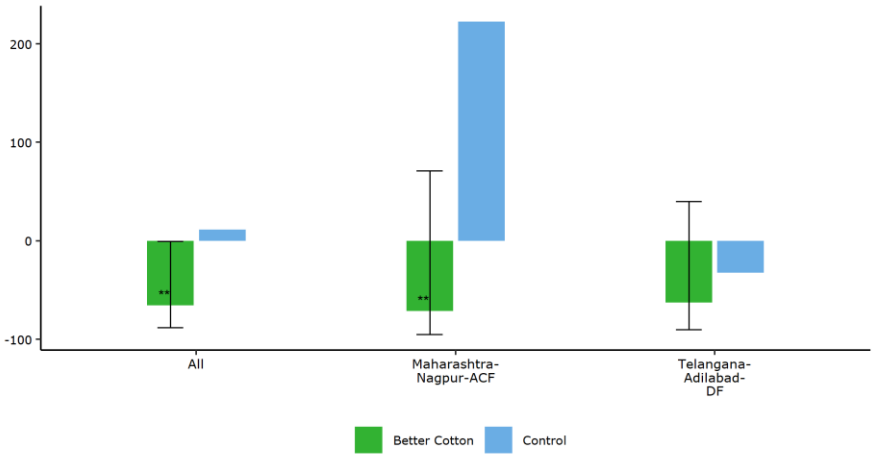
The increase in the share of farmers using bioinsecticide was higher than for bioherbicide. In Nagpur specifically, the share of farmers using bio-insecticide increased by 47% among Better Cotton farmers, significantly more than control group farmers. This is also reflected by the increase in their expenses to bioinsecticide, corresponding to 1,251 INR US$15) per farmer on average. These farmers were also found to be more frequent users of pest control techniques. On the other hand, farmers in Adilabad were specifically trained on at-home production. This might have affected their reporting on the use of bioinsecticide overall and low costs. We also note that % changes in costs are high as baseline expenses in bioinsecticide were minimal.

Post data collection interviews with the PPs and additional analysis confirm that the use of improved practices is associated with lower synthetic fertiliser costs and a higher use of biopesticides

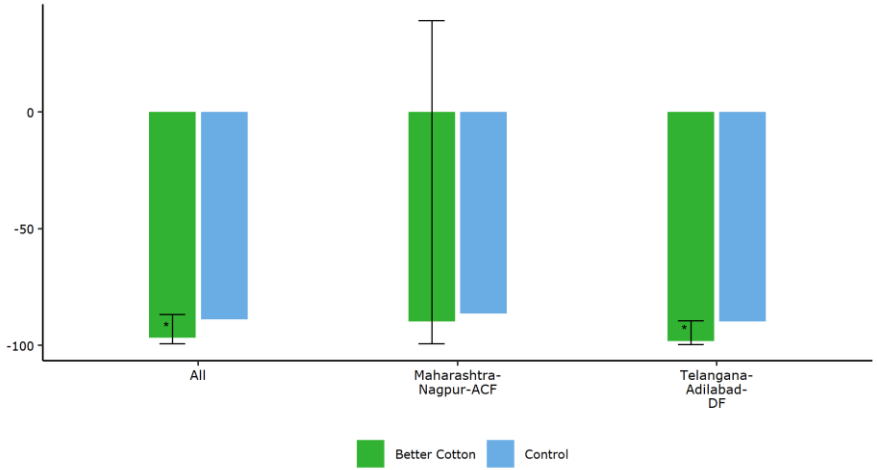
- We learnt from the interviews that Better Cotton farmers undertook training on the efficient use of fertilisers. Detailed econometric analysis also supports this and shows that Better Cotton farmers who started using the seasonal rotation of crops, leaving spaces between crops and analysing the soil prior to fertiliser application in Nagpur lowered their expenses for synthetic fertiliser.
- In-depth conversations with PPs suggest that PPs trained Better Cotton farmers in the preparation of insecticides at home in Adilabad, but not in Nagpur, explaining the decrease in bioinsecticide expenses in Adilabad and increases in costs in Nagpur. The PPs made it clear that bioherbicide use was common among Better Cotton farmers in Adilabad rather than Nagpur. We note that pheromone traps and yellow sticky cards are not included in bioinsecticide costs.
- The analysis also indicates that bioinsecticide costs increased for Better Cotton farmers in Nagpur, who started using pest control techniques such as bio-controls, pheromones, and hormones, pheromone traps, yellow sticky cards, botanical measures and neem oil sprays.
- In terms of use, besides the above decrease in use of synthetic fertilisers, insecticides and herbicides, we found a decrease in the use of synthetic fungicides and plant growth regulators, and an increase in use of biofungicides.
- We also used an econometric model to test whether there is a positive relationship between the change in cotton production per acre and synthetic and bio fertilisers, herbicides, and insecticides. This analysis provide preliminary evidence on whether replacing synthetic with bio inputs reduces cotton yields. Our model results suggest no positive and statistically significant association, implying that decreased cotton yields in our sample are not related to reduced input use.

Labour costs related to gap filling and intercultural operation decreased more among Better Cotton farmers than control group farmers.

Average change in gap filling costs between baseline and endline (% change)



Average change in intercultural operation costs between baseline and endline (% change)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

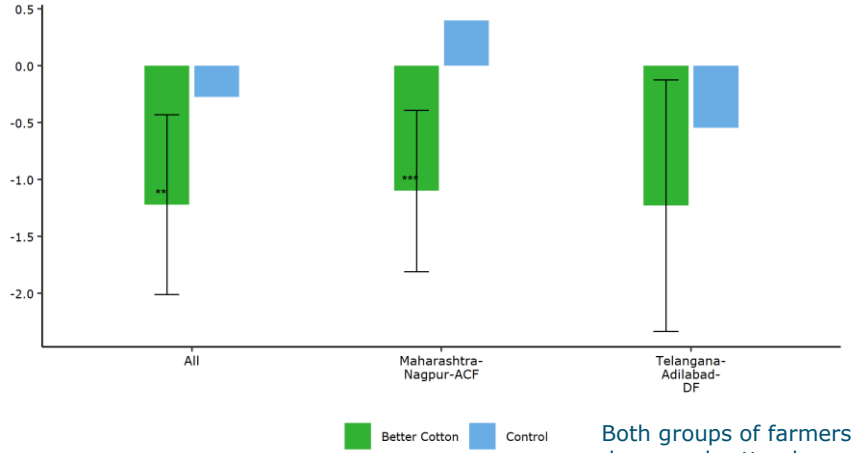
Gap filling refers to the activity whereby a seedling does not germinate and another is sown in the same spot. Intercultural operations is used for lighter activities conducted in the soil - weeding, mulching etc. From baseline to endline survey, costs related to gap filling decreased by 67% and intercultural operation decreased by 97% among Better Cotton farmers. This decrease was statistically different to control group farmers.

WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

The overall cotton yields of farmers decreased, particularly for Better Cotton farmers in Nagpur

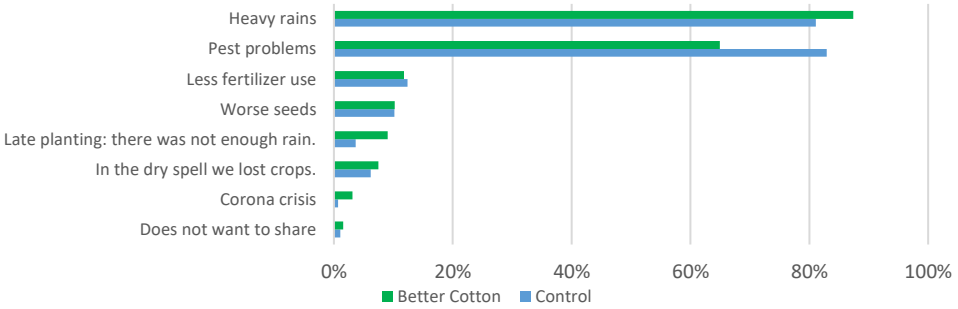
Average change in yields of seed cotton between baseline and endline (y axis is measured in 100 kg cotton per acre)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.

* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

The reported reasons of the decrease in yields from 2020-21 to 2021-22 season, endline survey results, the percentage of farmers who reported a decrease, multiple choices possible.

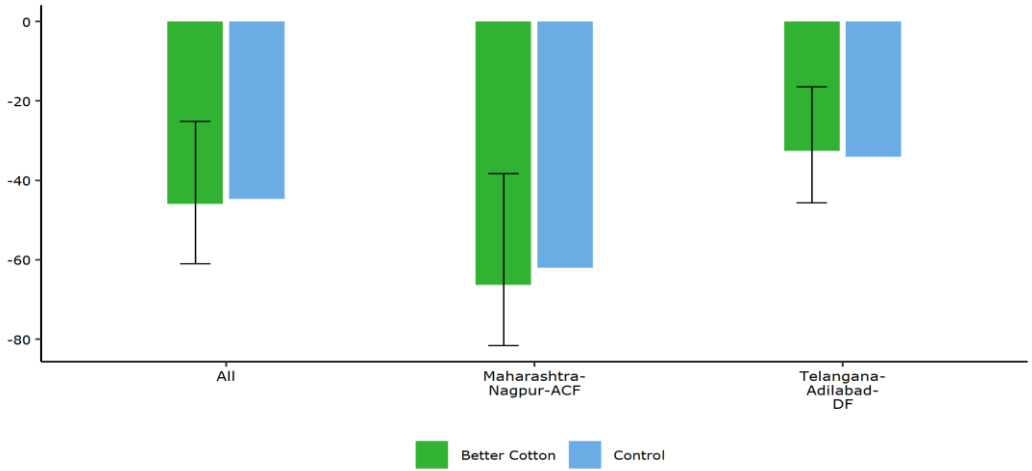


Both groups of farmers experience a decrease in yields. In endline, 58% of the surveyed farmers indicated a decreased cotton harvest. The main reasons related to yield reduction were heavy rainfall and pest disease. This finding is in line with PP observations raised during validation sessions. The decrease in the yields was 87 kg per acre (215 kg per hectare) greater among Better Cotton farmers than control group farmers, equivalent to a 14% decrease when compared to baseline. Using the market prices received by Better Cotton cohort farmers, we find that this implies a $US 96 per acre loss in cotton sales. This result is not in line with Better Cotton's Theory of Change, and we therefore conducted some further descriptive and econometrics analysis to understand the reasons behind this. For example, more Better Cotton cohort farmers who reported a decrease in yields had planted cotton late as there was not enough rain. This can explain the greater decrease in yields among Better Cotton cohort farmers compared to control farmers. The PPs also suggested that this could better due to the increased use of intercropping among farmers. However, our econometric analysis did not support this argument. Further research is needed to explain the mechanism behind this decrease in yields.

WAGENINGEN UNIVERSITY & RESEARCH

The average costs of cotton farming of both Better Cotton and control group farmers decreased

Average change in cotton farming costs per 100 kg of seed cotton harvest between baseline and endline (% change)

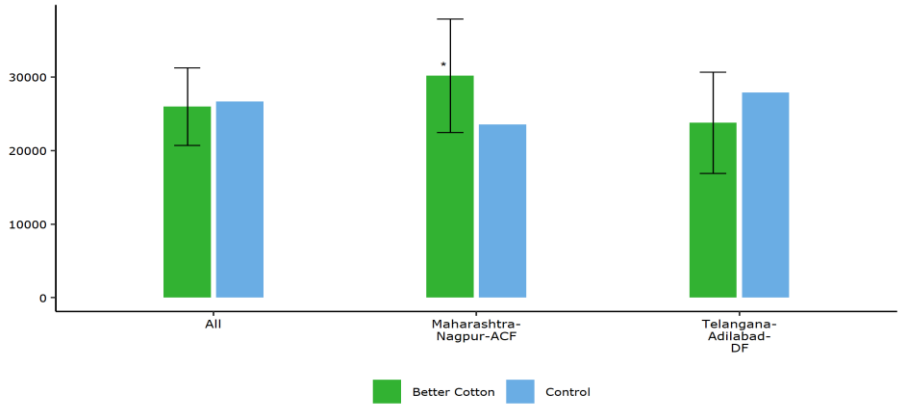


From the baseline to endline survey, total cotton costs decreased by over 50%. We see this through decreased costs of input (slide 36) and decrease in costs related to some agricultural practices (slide 39). This may be partially explained by a decrease in the use of synthetic pesticides (slide 37), reducing input costs. Conversely, less labour was required due to lower yields (slide 40). However, the decrease in the costs of Better Cotton farmers is not statistically different to control group farmers.

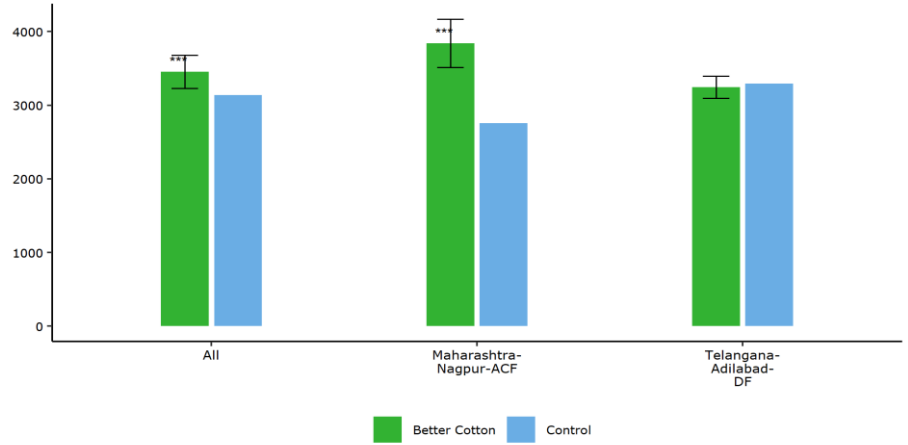
Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.
* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

The profitability of and prices achieved by Better Cotton farmers increased in Nagpur and these increases were greater, when compared to control group farmers in Nagpur

Average change in the profits per acre from baseline to endline (INR/per acre)



Average change price from baseline to endline (INR)



Source: Survey conducted among 1,360 cotton farmers for the baseline and 817 for the endline, in Maharashtra and Telangana
Error bars indicated by black lines show 95% statistical confidence levels for the differences between Better Cotton and control cohort farmers, which is estimated by the Matching DiD model.* the difference is statistically significant at 10% level
** the difference is statistically significant at 5% level
*** the difference is statistically significant at 1% level

Profitability increased in both Nagpur and Adilabad despite a decrease in yields (slide 40). This can be explained by price rises driven by market changes (supply shortages due to heavy rainfalls and pest disease) and decrease in costs. PPs expected that prices of seed cotton would increase for both groups of farmers in both Adilabad and Nagpur. The Better Cotton contribution to the improved profitability of cotton farmers in Nagpur is about 6,600 INR (US$ 82), equivalent to a $US 500 income increase for an average farmer, cultivating cotton on around 5.8 acres of land. The price increase was higher among Better Cotton farmers, particularly in Nagpur. The prices increased 1,082 INR (US$ 13.5) per quintal. This might imply that in the cotton value chain, Better Cotton is differentiated from conventional cotton and offers a higher price, in line with the findings of Ghori et al. (2022) on Better Cotton farmers in India and Pakistan.

Qualitative evidence from interviews with PPs and additional data analysis provide some explanation behind high cotton prices achieved by Better Cotton farmers in Nagpur

In-depth conversations with PPs revealed that Better Cotton farmers in Nagpur could receive a better price than control group farmers because:

- Ginners in Nagpur perceived that cotton produced by Better Cotton was of a higher quality than cotton produced by conventional producers. They therefore waived weighing charges, middleman and unloading costs for Better Cotton farmers.
- Through Better Cotton capacity-building activities, farmers in Nagpur learnt that they should not sell their crops early in the harvest when the cotton market prices were low. They instead stored (some) cotton and sold it in the late season when the cotton prices were high.
- In both Adilabad and Nagpur, Better Cotton farmers have better access to market information and information on cotton prices in general.

The first two factors were not present in Adilabad as Better Cotton had only been introduced in the area recently. Hence, ginners do differentiate quality price for Better Cotton farmers in Adilabad .

Our additional regression analysis shows that there is a statistical relationship between the adoption of good agricultural practices and the profitability of Better Cotton farmers in Nagpur, following capacity-building activities. Our in-depth quantitative analysis shows that trap crops, rotating crops seasonally, leaving space between the crops and testing soil prior to fertiliser application increased their profitability more than Better Cotton farmers who did not receive support.

Conclusions

Conclusions

- The Better Cotton programme led to a higher uptake of GAP practices among Better Cotton farmers in Nagpur. This is reflected in a greater use of record keeping in this group of farmers (from 43% to 97%), in reported improvement in decent work practices and the correct use of pesticides. The programme participation in turn encouraged farmers to decrease synthetic pesticide and fertiliser use and concurrently increase biopesticide use. This is reflected in the increase in bioinsecticide and bioherbicide costs among Better Cotton farmers, compared to control group farmers. Better Cotton farmers in Nagpur decreased herbicide, pesticide and fertiliser costs when compared to control group farmers.

- We have also detected that labour cost expenses for gap filling and intercultural activities decreased after Better Cotton support in Nagpur and this decrease is statistically significant. Beyond this, we found an increase in use of biofungicides, suggesting that farmers who follow the advice from Better Cotton to replace synthetic with biological inputs. Farmers themselves perceived that programme participation allowed them to decrease cotton farming costs, reduce adverse the environmental impacts of cotton production and improve working conditions.

- Our calculations for synthetic and bioinsecticides and herbicides expenses show that Better Cotton contributed to a reduction in synthetic insecticides and herbicides expenses by $US 44 per farmer and to an increase in bioinsecticides and herbicides expenses by $US 18 dollars per farmer.

- Better Cotton farmers receive better prices for their cotton, which has implications for their livelihoods improvement. We observed this as an outcome of statistical analysis, as well as from qualitative input. In Nagpur, between 2018-19 and 2021-22 seasons, the price per 100 kg of seed cotton received by Better Cotton cohort farmers increased $US 13.5 more when compared to control cohort farmers, and this result was statistically significant. Better Cotton farmers also perceived that the participation in the Better Cotton program allows them to receive better prices. This was confirmed during a validation session, whereby the PP from Nagpur confirmed that Better Cotton sales are associated with higher prices. PPs indicated that the ginners's demand for Better Cotton was high and they may consider the quality of the cotton superior. This effect is yet to be observed in Adilabad, compared to Nagpur, where it is more established. Better Cotton contributed to the increase in the profitability of farmers by $US 82 per acre, which is around $US 500 for an average cotton farmer in Nagpur, as shown by the statistically significant difference between the change in profitability of Better Cotton and control cohort farmers from the 2018-19 to 2021-22 seasons. Such results are vital to improve cotton farmers' livelihoods,

- For all farmers, yields decreased between the 2018-19 and 2020-21 seasons. The decrease from the 2020-21 to 2021-22 seasons was attributed to heavy rains and pest disease. In Nagpur, between the 2018-2019 and 2020-21 seasons, the average yield of Better Cotton farmers decreased more than the yields of control group farmers. We econometrically tested whether this decrease in yields is related to a reduced use of synthetic fertiliser, insecticide, herbicides, and/or the increased used of intercropping. However, we did not identify any correlation. Further detailed research should investigate the reasons behind the yield decrease.

Remarks on the findings and future use of pipeline evaluation method by Better Cotton

At the beginning of this evaluation, Better Cotton and WUR discussed whether the pipeline approach could be integrated into the Better Cotton M&E system at a larger scale. The approach will rely on PPs gradually rolling out their programmes in different regions. The pipeline approach requires baseline data collection from all Better Cotton farmers participating in the programme at the same time before they receive support. This study provide important lessons on the strengths and weaknesses of the approach.

- Better Cotton farmers and comparison farmers have important baseline differences. Without controlling for those differences, it is not possible to attribute impact to the Better Cotton programme. In this respect, the pipeline approach is superior to other ex-post evaluation methods not controlling for baseline differences.

- The spill-over of the Better Cotton activities to the control group villages in Adilabad created a challenge in detecting the effect of Better Cotton on practices, costs and profitability, as the farming outcomes of control group farmers may have improved thanks to Better Cotton support. For the future use of the pipeline approach, this potential spill-over effects to the late cohorts (control groups) should be considered and pros and cons of scaling up the support to other villages should be communicated well with the PPs.

Specifically related to this report:

- This evaluation was not designed to conduct the analysis at the evaluation at the district level. The sample sizes at district levels are small. Therefore, it is only possible to detect large Better Cotton effects at district level.

- The endline evaluation observes high decreases in the farming costs (Slides 34-37). However, those observations are estimated with high standard deviations – shown by the black lines on the graphs –, indicating that the precisions of the estimates are low. One should be cautious when using the actual effects estimated (e.g., 50% increase to predict the expected change in costs after a Better Cotton programme).

More information

Haki Pamuk, PhD.

Senior Researcher and Project Manager

Wageningen Economic Research

haki.pamuk@wur.nl

Nina Motovska.

Junior Impact Evaluation Researcher

Wageningen Economic Research

nina.motovska@wur.nl

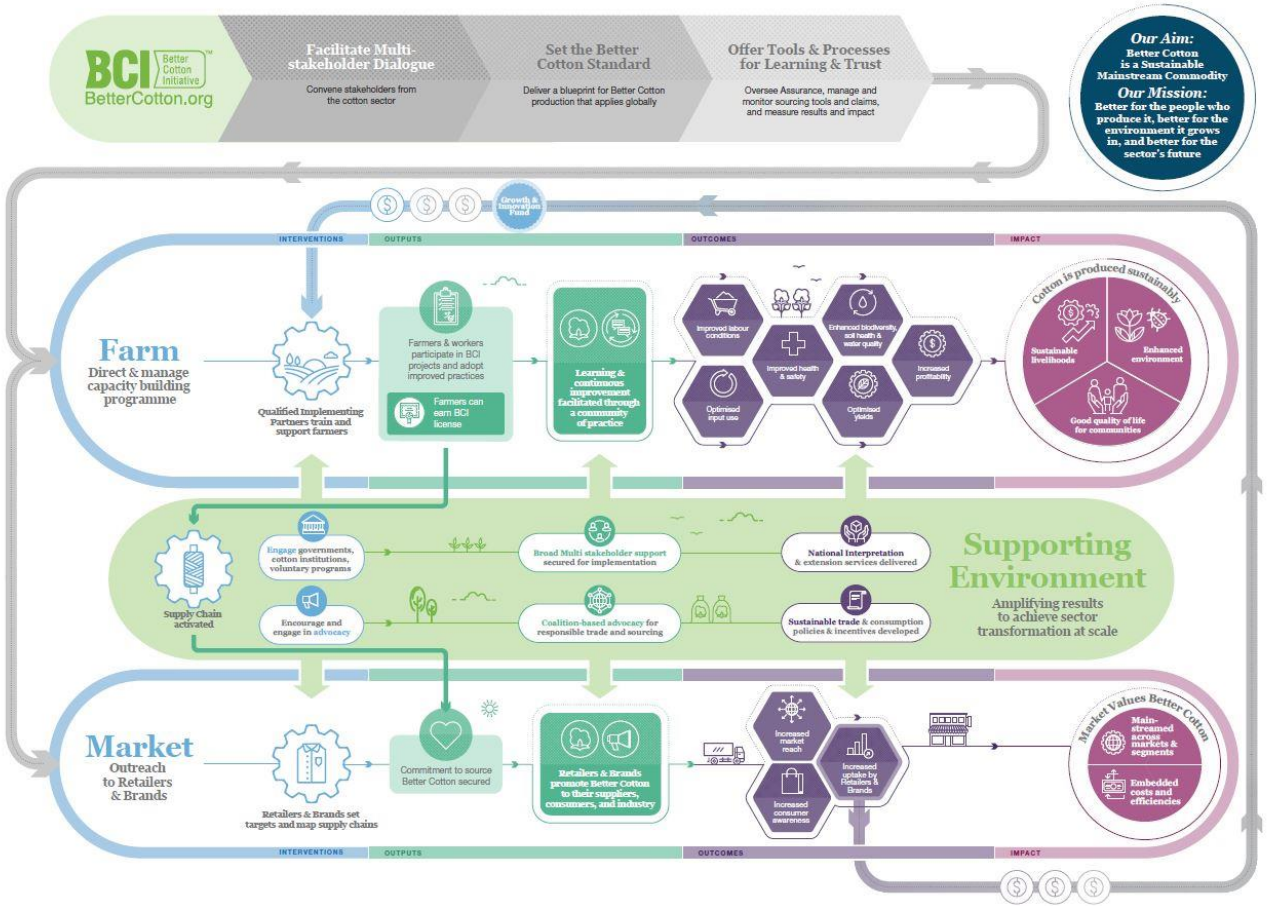
This study was carried out by Wageningen Economic Research, and commissioned and financed by IDH and Better Cotton.

WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

Appendices

Appendix 1: Better Cotton Theory of Change.



Back to the main slide

Appendix 2: Detailed list of activities conducted by Deshpande Foundation from 2019-20 to 2021-22 season

- Awareness on Bio fungicides, Basal dose and covid19 Precautions
- Deep Summer Ploughing and related advantages
- Soil Sample collection and testing training
- Seed selection - Awareness on Intercropping, border cropping, refugia, differentiation between fake seeds and original seeds, precautions to be followed while buying seeds and minimum wages.
- INM (Integrated Nutrient Management)- Increasing the usage of micro nutrients, encouraging split application and fertilizer management as per crop stage.
- IPM1 (Integrated Pest Management) - Avoiding synthetic spray until 60DAS. Awareness of physical measures (Pheromone traps, yellow sticky cards) botanical. measures, ETL.
- Minimum wages
- Child labour

Continued...

- IPM2 - Awareness on recommended dosage, Avoidance of cocktails and broad spectrum pesticides. Minimum PPE while preparing and spraying, random spraying, Safe storage and disposal of pesticide bottles
- Awareness on water management (furrow irrigation, judicial irrigation), biodiversity mapping biodiversity medal approach, soil and water mapping.
- Awareness on Minimum PPE and avoidance of pesticide cocktails, decent work
- Fibre quality - Best practices to maximise fibre quality while harvest, storage, avoiding polythene bags, labour profiling
- Decent Work- Awareness on child labour and child labour policy, minimum wages, equal wages, facilities to be provided to workers, labour profiling, disadvantaged groups.
- Crop termination, crop rotation
- Community event/field days/exposure visit
- Crop residue management
- Intercropping

Appendix 2 cont'd: Detailed list of activities conducted by ACF in from 2019-20 to 2021-22 season

- Variety selection, soil health, planting distance, intercropping ,
- Fertiliser management, water stewardship, integrated pest management, minimum PPE, importance of biodiversity
- Water and nutrient management, cotton pests (pink bollworm) management, importance of September activities
- Fibre quality, importance of September activities, pink bollworm management (early uprooting of cotton stalk), alternate furrow irrigation
- Safe storage of cotton, pink bollworm management (early uprooting of cotton stalk), early termination and crop rotation, self-protection and cotton protection during cotton picking
- Water stewardship as Water Budgeting, well monitoring, drainage analysis.

Appendix 3: List of good agricultural practices

1	Do you use of pest control techniques such as bio-controls, pheromones, and hormones, pheromone traps, yellow sticky cards) botanical measures etc?
2	Do you regularly monitor the crop pests, beneficial insects and crop damage?
3	Do you use the same pesticide/pesticide group without rotating with other pesticide/pesticide group?
4	Do you use trap crops?
5	Do you use of neem oil spray/neem extract?
6	Do you sow cotton randomly and fill the gaps with other crops (e.g. castor, sunflower etc)?
7	Do you use border crops (e.g. maize, sorghum, pearl, millet, non bt cotton) around cotton field?
8	Do you use cover crops?
9	Do you apply manure compost in your field?
10	Do you use mulching?
11	Do you seasonally rotate cotton with another crop?
12	Do you leave spaces between the rows of cotton?
13	Do you test the soil before fertilizer applications?

Appendix 4: Impact and ultimate indicators that will reported

Outcome variables	Definition of the variables
Awareness about good agricultural practices	Total of (i3_1_a+...i3_11_a)
Implementing good Agricultural practices	Total of (i3_1_b+...i3_11_b)
Training hired workers in cotton on health & safety	d3_16
Use of minimum protective and safety equipment	d3_17
Keeping pesticide in special boxes only used for this	d6_3=4
Keeping pesticide away from water, food, and children	d6_4=4
Record keeping	b1_3
Use of child labour (hired)	
COST: Fertilisers and pesticide costs	(d4_biofert_tcos+d4_chemfert_tcost+d4_bioinsect_tcos+d4_cheminsect_tcost+d4_bioherb_tcost+d4_chemherb_tcost+d4_biofung_tcost+d4_chemfung_tcost+d4_plant_tcost)/e1_1
COST: Seed costs	(d2_3*d2_5)/e1_1
COST: Labor	(D3_3_14 (summation for all categories))/e1_1
COST: Irrigation	(d7_2a+d7_3a+d7_4b)/e1_1
COST: Transportation costs	d1_2/e1_1
COST: Land leasing cost	d1_4/e1_1
COST: Total costs	(d4_biofert_tcos+d4_chemfert_tcost+d4_bioinsect_tcos+d4_cheminsect_tcost+d4_bioherb_tcost+d4_chemherb_tcost+d2_3*d2_5 +D3_3_14 (summation for all categories)+ d4_biofung_tcost+d4_chemfung_tcost+d4_plant_tcost+d7_2a+d7_3a+d7_4b+d1_2+d1_4)/e1_1
Production of seed cotton per acre	e1_1/c1_5b
Total production	e1_1
Sale of seed cotton	e1_3
PRICE of seed cotton per quintal	e1_3a
INCOME from Cotton: Total Sales-Total Cost	(e1_3*e1_3a-Total costs)/e1_1

Appendix 5: Details on support levels in cohort 2021-22

1. Three programme partners (PPs) involved in this evaluation to implement the Better Cotton programme. According to the initial design, no PP is expected to train farmers from the control cohort. However, in June 2020, one PP, Deshpande Foundation, reported that it organised shared information on good farming practices with control cohort (control group) farmers. This training was mostly completed remotely due to the Covid-19 pandemic. Other PPs reported that they had not conducted any training or support activities with the control cohort as of January 2022.

2. The research team's expectation was that that ACF would not train in the 2021-22 season and Deshpande Foundation would keep the training limited. Deshpande Foundation continued its support to cohort 2021-2022 farmers in the 2020-21 season more intensively. According to the Foundation's records, control cohort farmers received the same trainings with Better Cotton cohort.

Back to the main slide

Appendix 6: Sampling strategy

We used 2016/2017 season data from the Better Cotton monitoring system for sampling. Better Cotton support was implemented in 8 states by 22 PPs in India. Implementing the pipeline approach requires focusing on a number of states and a clean baseline - farmers that have not yet been supported but will eventually join the Better Cotton programme.

According to our preliminary analysis, in Maharashtra, Telangana, Punjab, and Andhra Pradesh, we identified that farmers who received Better Cotton support have higher profitability than farmers who did not report support. This suggests that these states had a high potential to create positive impact. Therefore, we decided to focus on those five states for sampling.

Ensuring the baseline requirement was only possible in the Maharashtra, Telangana, and Punjab states, where the Better Cotton programme was to be expanded further in 2019-20 and 2020-21 seasons. The clean baseline was not possible in Andhra Pradesh.

We excluded Punjab from our sample for the following three reasons:

- *Costs*: It was not possible to cover the costs of data collection in more than two states.
- *Differences in irrigation systems*: Better Cotton plans to upscale its activities among the rainfed cotton farmers, similar to the farmers in Maharashtra and Telangana. In Punjab, irrigation cotton farming systems are common.
- *Timing*: Baseline data collection could be done in June 2019 at the earliest. In Punjab, the farming activities and Better Cotton training had already started in May.

Continued in the next slide

Appendix 6 con't: Sampling

In the 2016-17 season, 41% of producer units supported by Better Cotton were in Maharashtra and Telangana. Maharashtra included the highest and Telangana included the fourth highest number of producer units. It was expected that Better Cotton would scale up its operations in those two states, hence the focus of this study.

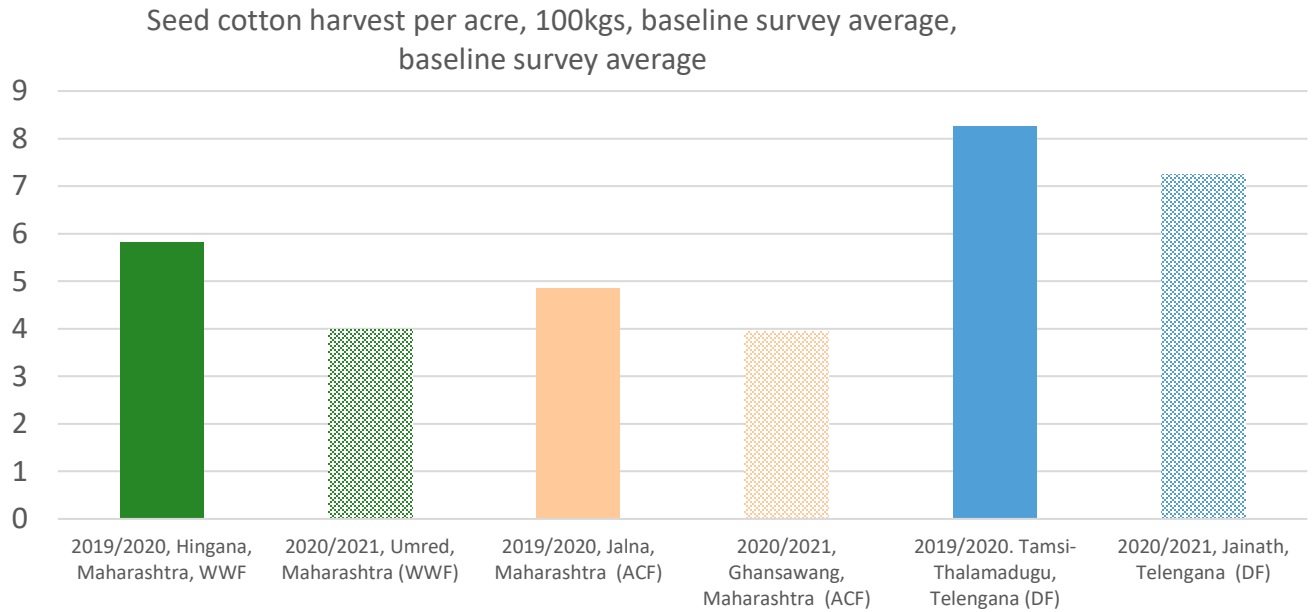
In the 2016-17 season, Better Cotton worked with ten PPs in Maharashtra and five PPs in Telangana. Among those, we focused on the scale partners. We identified ACF and WWF in Maharashtra and Deshpande Foundation in Telangana to be the scale partners of Better Cotton to expand in 2020 and 2021 in selected states.

The PPs have different organisational structures, implementation strategies and potential outcomes:

- ACF and Deshpande Foundation: Innovative approaches of support, bottom-up approach and decision-making strategy.
- WWF: Decentralised implementation strategy, working with local partners to implement the programme.

Appendix 7: Yields differ significantly between cohorts and states in the baseline.

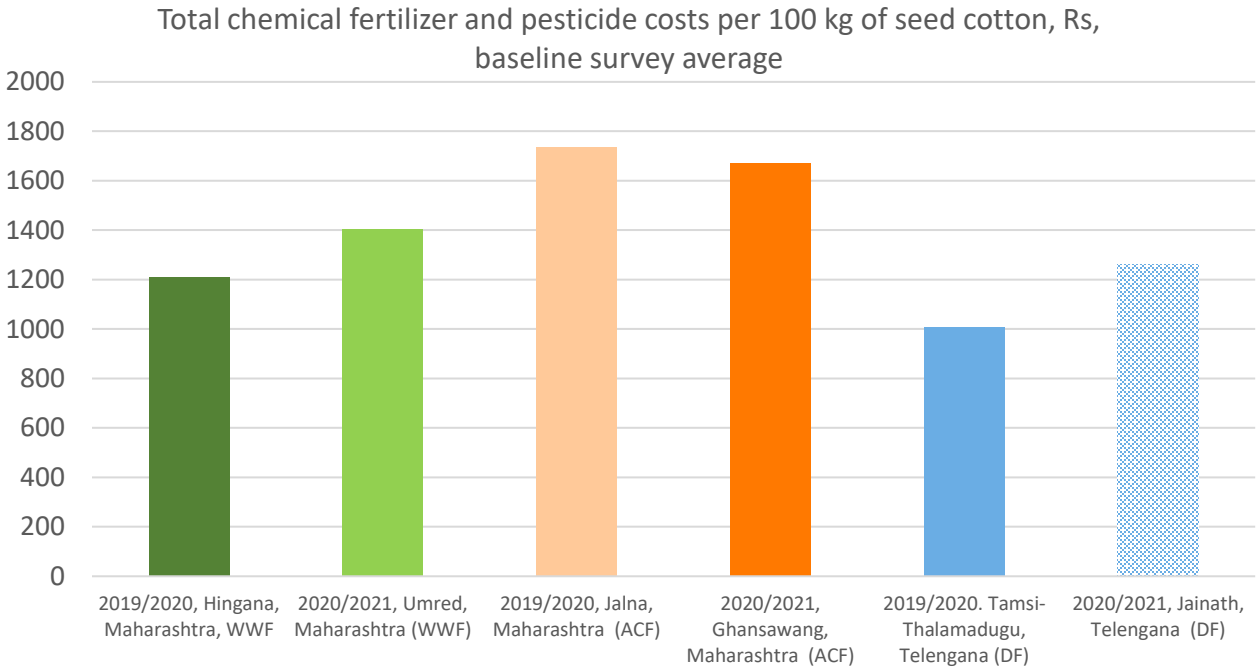
Back to the main slide



The differences between cohorts 2019-20 and 2020-21 farmers are statistically significant for Maharashtra and Telangana.

Appendix 8: Input costs differ significantly between districts, less between cohorts in the baseline survey.

Back to the main slide



Between Thalamdugu-Tamsi and Jainath is statistically different; We do not detect a consistent difference between other 2019-20 and 2020-21 cohorts.

Appendix 9: DiD econometric model specification

To estimate the impact of Better Cotton, we will estimate the following difference in differences model, using the full dataset of farmers for which the data on profits is available for,

$$Y_{ivt} = \alpha_v + \beta_0 Midline_t + \beta_1 Treatment_{vt} \times Midline_t + X'_{iv}\omega + \alpha_v + \epsilon_{ivt}$$

where i indicates cotton farmer, v shows village, and t is the data collection period (baseline or midline). Y_{ivt} is the outcome variable. $Treatment_{vt}$ equals 1 when farmers are in Better Cotton cohort villages that have already been supported by Better Cotton since 2019. It equals 0 when farmers are in cohort-2 villages that have not received support yet. $Midline_t$ equals 1 when the data is from the midline survey (0 otherwise). X'_{iv} is a vector of household characteristics that control for the baseline differences between households, including the share of cotton in total income, the share of irrigated land in total, social class, age of the household. α_v is the village level fixed effects controlled by using a dummy variable for the villages. The estimate for β_1 shows the average treatment effect of Better Cotton on the outcomes, comparing the change in the project outcomes from baseline to midline for Better Cotton cohort and cohort-2 farmers.

We estimate the model using the data from farmers that participated in both survey and data of cotton profit per acre, control variables are not missing for. This is because profits per acre is our key variable of interest (impact level) and we will try to explain the changes in it throughout the evaluation. Opting for a different variable might lead to a different sample for the analysis (missing data on selected variable would lead to exclusion from the sample). Nevertheless, we report on results for all intermediate, immediate, outcome and impact indicators.

We are going to estimate the model using the Ordinary Least Squares (OLS) method, and report the estimates for β_1 and heteroscedasticity robust standard errors clustered at the village level. According to the theory of change for Better Cotton, we expect that for the immediate and intermediate outcome variables, we hypothesize that the estimates should be positive, $(\beta_1 > 0)$. Better Cotton support is expected to reduce the cost of cotton farming; therefore we expect that $\beta_1 < 0$. We expect that this will increase the profitability given that sales improve or do not change.

Appendix 10: Baseline characteristics are balanced after matching

Baseline characteristics	Better Cotton	Control	Difference	p-value for equality
Social category is SC	0.13	0.11	0.02	0.27
Household head is under 30 years old	0.06	0.07	-0.01	0.46
Household head is between 30 and 60 years old	0.75	0.72	0.03	0.29
Cotton farming land size, acre	7.41	6.94	0.47	0.14
Square of cotton farming land size	93.28	76.54	16.74	0.14
Fraction of irrigated land	0.58	0.57	0.01	0.67
% of income from cotton	63.60	63.69	-0.08	0.94
Years of education	6.94	6.84	0.10	0.67
Square of years of education	68.20	66.08	2.12	0.49
Fraction of membership to an association	0.49	0.50	-0.01	0.68

Appendix 11: Matching DiD econometric model specification

We only use data of the farmers that participate in both baseline and midline survey. For those farmers, we will match the farmers from cohorts 1 and 2 using the propensity score matching method and baseline characteristics (yield per acre, profits per acre, share of cotton in total income, the share of irrigated land in total, social class, and age of the household).

Using only the sample of matched households, we will estimate the following model of for the outcome variables:

$$\Delta Y_{iv} = \beta_0 + \beta_1 Treatment_v + \epsilon_{iv}$$

$\Delta Y_{iv} = Y_{ivt} - Y_{ivt-1}$ is the change in the outcome variable from baseline to midline for farmer i. Here the use ΔY_{iv} eliminates any household level unobserved factors and their influence on the estimate for β_1.Again estimates for β_1 show the effect of Better Cotton on the project outcomes, and we will estimate this model with the OLS method where the standard errors are clustered at the village level.

Please note that we estimate Matching DiD with lower number of observations than we estimate DiD. This is because there are fewer number of farmers from two cohorts that match in terms of selected characteristics. Fewer observation might reduce the chance of detecting impact estimates statistically. However, if we observe similar estimates to model (1), this will show the robustness of our estimates.

Back to the main slide

Appendix 12: Pros and cons. of DiD and Matching DiD models

Time for data collection	Pros	Cons
Difference in difference model	Large sample size, allowing us to detect smaller Better Cotton effect statistically.	Increased risk of comparing very different Better Cotton cohort and control cohort households that have potentially different trends before 2019.
Matching difference in differences model	Small sample size (only matched household), risk of not being able to detect Better Cotton effect statistically, although there is an effect.	Higher precision in impact estimates comparing similar Better Cotton cohort and control cohort households that have potentially similar trends before 2019.

Back to the main slide

Appendix 13: In the midline four identification strategies were used to test and explore the ToC.

	Treatment group farmers	Control
1. Better Cotton vs control villages	All farmers from the villages that are included in Better Cotton program in 2019-20 season.	All farmers from the villages that are **not** included in Better Cotton program in 2019-20 season.
2. Reported support vs not reported support	Farmers from Better Cotton cohort villages who reported they received any type of training or information on cotton farming over 2019-20 season	Farmer from Better cotton cohort villages who reported they have not received any type of training or information.
3. Reported Better Cotton support vs not reported Better Cotton support	Farmers from Better Cotton cohort villages who reported they received training or information on cotton farming from Better Cotton, IDH, WWF, ACF, and/or DF over the 2019-20 season.	Farmers from Better Cotton cohort villages and did not report they received training or information on cotton farming from Better Cotton, IDH, WWF, ACF, and/or DF over the 2019-20 season.
4. Reported Better Cotton support vs control villages with no Better Cotton support	Farmers from Better Cotton cohort villages who reported they received training or information on cotton farming from Better Cotton, IDH, WWF, ACF, and/or DF over the 2019-20 season.	Farmers from control cohort villages and did not report they received training or information on cotton farming from Better Cotton, IDH, WWF, ACF, and/or DF over the 2019-20 season.

Continued…

Back to the main slide

Appendix 13 cont'd: Identification strategy 2 and 3: using information on the training and information shared with farmers.

Our analysis of midline data on the Better Cotton training intensity revealed that less than half of farmers in Better Cotton cohort reported having received a training or information about cotton farming between baseline and midline. Identification approach 1 might have thus underestimated the Better Cotton impact on supported farmers.

We used three alternative approaches to test the simplified Better Cotton's Theory of Change: all alternative models used matching DiD model to reach robust results.

- Identification strategy 2: We compared changes in outcomes of farmers who reported to receive any type of training or information on cotton farming over 2019-20 season with the farmers who do not report.
- Identification strategy 3: We compared changes in outcomes of farmers who reported to receive a training or information on cotton farming from Better Cotton, IDH, WWF, ACF, and/or DF over 2019-20 season with the farmers who did not report this.

Strategy 2 and 3 used the sample of farmers from Better Cotton cohort villages planned to be supported by Better Cotton in 2019-20 season. This is because farmers in Better Cotton cohort are more comparable to each other and primarily targeted by Better Cotton.

- Identification strategy 4: We looked into changes in outcomes of farmers who reported to receive a training or information on cotton farming from Better Cotton, IDH, WWF, ACF, and/or DF over 2019-20 season and were from Better Cotton cohort villages. We compared these farmers to farmers who did not report any support and were from control cohort villages. Here, farmers from control cohort villages served as a clean control with minimal Better Cotton support.

Continued…

WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

Back to the main slide

Appendix 13 cont'd: Pros and cons of identification approaches

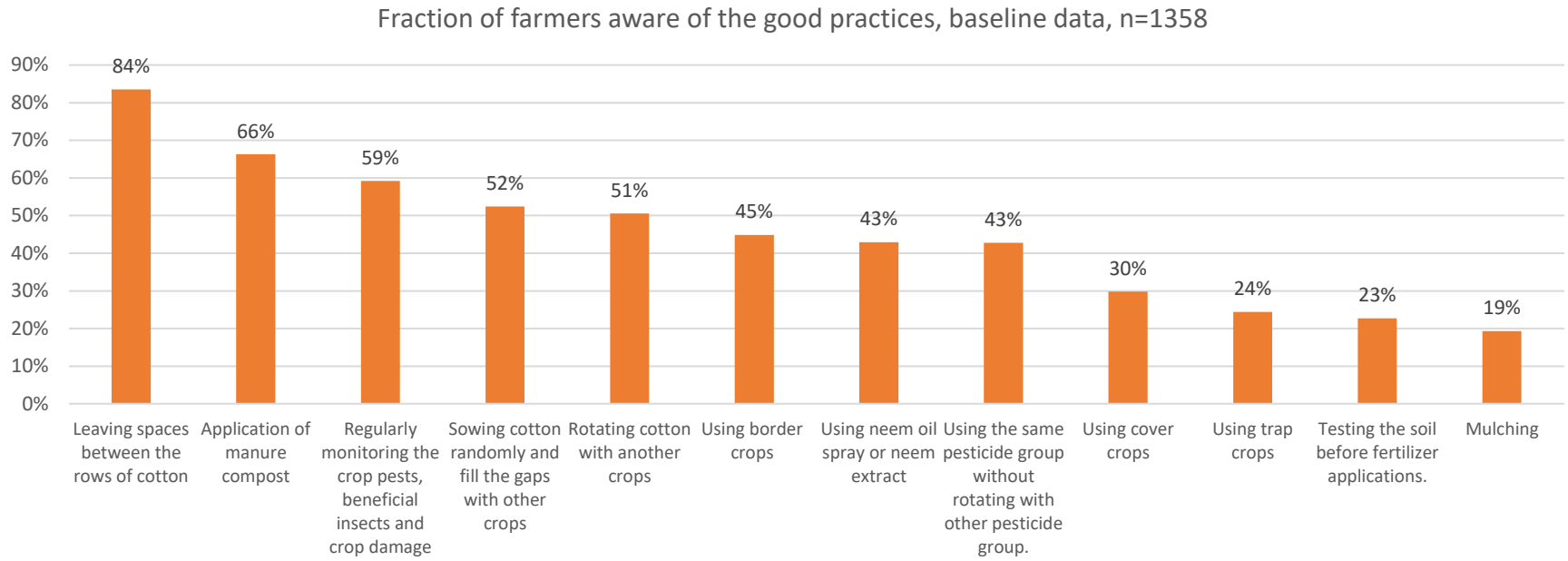
Identification strategy	Pros	Cons
1. Better Cotton vs control villages	Easy to attribute the impact to the Better Cotton program: The selection to the Better Cotton program is external to the farmers. Farmers cannot determine to be in the program village or not.	Risk of underestimating the effect on the treated farmers: Many farmers who are in Better Cotton cohort and were supposed to receive training did not report that they received any training.
2. Reported support vs not reported support in Better Cotton villages. 3. Reported Better Cotton support vs non-reported Better Cotton support in Better Cotton villages.	Low risk of underestimating the effect on the treated farmers: It shows the effect of training and information about cotton farming on the treated farmers. However, they are comparable since they are from the same villages.	Difficult to attribute the impact to the program: Some farmers can self select into the training at a village or the PPs can select them (e.g. large land size farmers who are members of a farming organisation). In identification strategy 2, farmers might have received training from other organisations. Risk of overestimating the effect of the programme: Farmers who recall receiving a training might be the ones who benefited from the training the most and adopted the practices, while other farmers who did not recall the training might be the ones who did not benefit from the training/benefitted much less. We also few number of observations and risk of not being able detect the impact consistently.
4. Reported Better Cotton support in Better Cotton villages vs control villages with no Better Cotton support	Neither easy nor difficult to attribute the impact to the program: Farmer in control village with no Better Cotton support did not receive Better Cotton support and it is a clean control group. Farmers that report Better Cotton support can still self select themselves in the training at a village.	Risk of overestimating the effect of the programme: Farmers who recall receiving a training might be the ones who benefited from the training the most and adopted the practices, while other farmers who did not recall the training might be the ones who did not benefit from the training/benefitted far less.

Continued in the Next slide

WAGENINGEN UNIVERSITY & RESEARCH

Back to the main slide

Appendix 14: Less than 30% of farmers are aware of cover crops, trap crops, soil tests, and mulching in the baseline. Back to the main slide



On average, about 9/10 of farmers use the practices that they know.

Appendix 15: Midline Results of statistical models

Outcome variables			Better Cotton vs. control villages		Reported support vs. not reported support	Reported Better Cotton support vs. not reported Better Cotton support	Reported Better Cotton support vs. control villages with no Better Cotton	Overall conclusion
			DiD Model	Matching DiD	Matching DiD	Matching DiD	Matching DiD	Matching DiD
Intermediate	Use of GAP	Implementing GAP, index (0-11)	-0.7	-0.45	⇧ **2.55**	1.43	-0.86	⇧
	Record keeping	Farmer keep records of farming activities, (0/1)	⇧ **0.13**	⇧ **0.19**	⇧ **0.24**	⇧ **0.42**	⇧ **0.42**	⇧
	Decent work practices	Training hired workers in cotton on health & safety (0/1)	-0.05	0.08	⇧ **0.52**	⇧ **0.89**	⇧ **0.72**	⇧
		Training use of minimum protective and safety equipment (0/1)	-0.12	0.02	⇧ **0.53**	⇧ **0.79**	⇧ **0.59**	⇧
	Correct and safe use of pesticides	Keeping pesticides in special boxes only used for this (0/1)	-0.04	0.06	0.53	⇧ **0.21**	-0.13	⇧
		Use of minimum protective and safety equipment (0/1)	-0.7	0.03	⇧ **0.19**	0.19	0.15	⇧
Immediate	Knowledge on GAP	Awareness on GAP, index (0-11)	-1.49	-1.02	⇧ **3.34**	⇧ **1.67**	-0.33	⇧

Continued…

⇧: Statistically significant (at 5% level) increase in Better Cotton farmers when compared to control group farmers

⇧: Some evidence on the statistically significant positive effect of Better Cotton; - : No statistically significant effect of Better Cotton

Back to the main slide

Appendix 15 cont'd: Midline results

Outcome variables			Better Cotton vs. control villages		Reported support vs. not reported support	Reported Better Cotton support vs. not reported Better Cotton support	Reported Better Cotton support vs. control villages with no Better Cotton	Overall conclusion
			DiD Model	Matching DiD	Matching DiD	Matching DiD	Matching DiD	Matching DiD
Ultimate outcome variables	Cost item	Input costs (Fertiliser+pesticide costs) per 100 kg of seed cotton	23	145	51.8	17.73	-165.37	-
		Labor costs, per 100 kg of seed cotton	-399.5	-26	186.85	197.4	-610.25	-
	Not targeted	Seed costs per 100 kg of seed cotton	⇧**32**	⇧**52**	-9.12	⇩**-24**	0.36	**Inconclusive**
		Irrigation costs per 100 kg of seed cotton	-0.64	7.5	⇩**-36.85**	-4.46	11.02	⇩
		Transportation per 100 kg of seed cotton	-21	-23	⇩**-57.8**	-16.38	1.89	⇩
	Not targeted	Land lease costs per 100 kg of seed cotton	⇧**166**	⇧**156**	24.7	119	⇧**651.19**	⇧

Continued in the Next slide

⇩: Statistically significant (at 5% level) decrease in Better Cotton farmers when compared to control group farmers
⇧: Statistically significant increase (at 5% level) in Better Cotton farmers when compared to control group farmers. A negative direction of change was expected after Better Cotton support
⇩: Some evidence on the statistically significant negative effect of Better Cotton
⇧: Some evidence on the statistically significant positive effect of Better Cotton
\- : No statistically significant effect of Better Cotton

Back to the main slide

Appendix 15 cont'd: Midline Results

Outcome variables				Better Cotton vs. control villages		Reported support vs. not reported support	Reported Better Cotton support vs. not reported Better Cotton support	Reported Better Cotton support vs. control villages with no Better Cotton	Overall Conclusion
				DiD Model	Matching DiD	Matching DiD	Matching DiD	Matching DiD	Matching DiD
Impact		Income from cotton:	Total profit from cotton per acre	-583.8	-627	2261	-552	-4384	-
Ultimate		Costs	Total cost per 100 kg of cotton	-232	269	223.38	374	-106	-
		Production	Total production, 100 kg	⇩**-9.8**	⇩**-12.45**	4.33	3.6	-12.21	⇩
		Productivity	Total production per acre	-0.66	-0.42	0.47	0.26	-1.31	-
	Not targeted	Price:	Price of cotton per 100 kg	48	-9	13.9	-48	-63	-
		Sales:	Total sales of seed cotton, 100 kg	⇩**-8.7**	⇩**-11.18**	6.2	-1.91	-11.44	⇩

⇩: Statistically significant decrease in Better Cotton farmers when compared to control group farmers. A positive direction of change was expected after Better Cotton support
- : No statistically significant effect of Better Cotton

WAGENINGEN UNIVERSITY & RESEARCH

100years 1918 — 2018

Back to the main slide

Appendix 16: Endline Results of statistical models

Outcome variables			Better Cotton vs. control villages All sample		Better Cotton vs. control villages Adilabad	Better Cotton vs. control villages Nagpur
			DiD Model	Matching DiD	Matching DiD	Matching DiD
Intermediate	Use of GAP	Implementing GAP, index (0-11)	⇧**1.53**	1.3	-0.963	⇧**6.123**
	Record keeping	Farmer keep records of farming activities, (0/1)	⇧**0.16**	0.06	-0.045	⇧**0.537**
	Decent work practices	Training hired workers in cotton on health & safety (0/1)	⇧**0.3**	⇧**0.46**	0.248	⇧**0.9**
		Training use of minimum protective and safety equipment (0/1)	0.04	0.2	*	*
	Correct and safe use of pesticides	Keeping pesticides in special boxes only used for this (0/1)	-0.0006	-0.12	0.129	-0.049
		Use of minimum protective and safety equipment (0/1)	-0.05	0.05	0.015	0.064
Immediate	Knowledge on GAP	Awareness on GAP, index (0-11)	⇧**1.6**	1.35	-0.945	⇧**6.238**

Continued…

⇧: Statistically significant (at 5% level) increase in Better Cotton farmers when compared to control group farmers
* Our statistical model does not detect a statistical effect of Better Cotton in endline on the use of minimum protective and safety equipment. This contradicts the fact that in Nagpur all Better Cotton cohort farmers reported to use protective equipment. In the same period, both Better Cotton and control cohort farmers increased their use of the equipment, therefore our models could not detect an effect.

Back to the main slide

Appendix 16 cont'd: Endline results

Outcome variables			Better Cotton vs. control villages All sample		Better Cotton vs. control villages Aidlabad	Better Cotton vs. control villages Nagpur
			DiD Model	Matching DiD	Matching DiD	Matching DiD
Ultimate outcome variables	Cost item	Input costs (Fertiliser+pesticide costs) per 100 kg of seed cotton (log)	0.07	-0.09	-0.11	-0.05
		Labor costs, per 100 kg of seed cotton (log)	-0.18	-0.05	0.04	-0.24
	Not targeted	Seed costs per 100 kg of seed cotton (log)	0.02	⇧**0.18**	0.14	⇧**0.26**
		Irrigation costs per 100 kg of seed cotton (log)	-0.2	⇧**0.74**	0.56	⇧**1.26**
		Transportation per 100 kg of seed cotton (log)	⇩**-0.36**	-0.07	-0.19	0.17
	Not targeted	Land lease costs per 100 kg of seed cotton (log)	-0.56	0.07	0.69	-1.24

Continued…

⇩: Statistically significant (at 5% level) decrease in Better Cotton farmers when compared to control group farmers
⇧: Statistically significant increase (at 5% level) in Better Cotton farmers when compared to control group farmers. A negative direction of change was expected after Better Cotton support
⇩: Some evidence on the statistically significant negative effect of Better Cotton
\- : No statistically significant effect of Better Cotton

Appendix 16 cont'd: Endline Results

Outcome variables				Better Cotton vs. control villages All sample		Better Cotton vs. control villages Adilabad	Better Cotton vs. control villages Nagpur
				DiD Model	Matching DiD	Matching DiD	Matching DiD
Impact		Income from cotton:	Total profit from cotton per acre	-3457.7	-684	-4113.7	⇧6617.6
Ultimate		Costs	Total cost per 100 kg of cotton	218.2	270	403.12	-20.45
		Production	Total production, 100 kg	**⇩-13.8**	-2.8	6.57	**⇩-22.7**
		Productivity	Total production per acre	**⇩-1.35**	**⇩-0.87**	-0.62	**⇩-1.39**
	Not targeted	Price:	Price of cotton per 100 kg	**⇧246.5**	**⇧313.6**	-47.8	⇧1082.4
		Sales:	Total sales of seed cotton, 100 kg	**⇩-13.7**	-2.29	6.4	**⇩-20.9**

⇩: Statistically significant decrease in Better Cotton farmers when compared to control group farmers. A positive direction of change was expected after Better Cotton support
⇧: Statistically significant (at 5% level) increase in Better Cotton farmers when compared to control group farmers

WAGENINGEN UNIVERSITY & RESEARCH

Back to the main slide

Appendix 17: Detailed information of programme partners

Programme Partner	ACF	DF	WWF
First Year of Implementation in India	2010	2015	2010
No. of States in which the PP had their presence during the period of the study	4	1	3
No. of farmers participating per PP in India in 2019-20	169,117	85,314	119,176
No. of farmers participating per PP in India in 2021-22	172,987	86,471	115,025

Back to the main slide