

# **BOOSTING BIODIVERSITY AND IMPROVING FARMER LIVELIHOODS THROUGH CROP DIVERSIFICATION**

**THE PRACTICE AND IMPACT OF SCALING CROP DIVERSIFICATION  
IN INDIAN ORGANIC COTTON-BASED FARMING SYSTEMS**



A RESEARCH PROJECT FROM



IN COLLABORATION WITH



UNDER FUNDING SUPPORT FROM







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# INTRODUCTION

The Organic Cotton Accelerator (OCA) envisions a future where we have fully realised the Organic Cotton Effect - organic cotton's powerful and positive impact on people, planet and prosperity. Since our establishment with founding partners Laudes Foundation, H&M, Kering, Eileen Fisher, Textile Exchange, Tchibo, Inditex and C&A, OCA has been committed to convening the sector around a common agenda and using our platform's collective investments to act as a catalyst for change to bring integrity, supply security and measurable social and environmental impact to organic cotton.

OCA places organic cotton farmers at the heart of its mission and strategy so we understand that a clear business case is needed for farmers to switch to and stick with growing organic cotton. Our Farmer Engagement and Development (FED) Programme in India focuses on improving this business case because we believe in organic cotton's multiplier effect: with a higher income, farmers have the chance to invest in healthy cropping practices which can guarantee a prosperous future for their family and community.

Organic farmers in OCA's programmes grow more than cotton alone so we wanted to look beyond the cotton crop to explore the profitability of the entire farming system. In 2019, financed by funding support from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, OCA partnered with the Research Institute of Agriculture (FiBL) to conduct a research study on crop diversification, using participatory methods to produce recommendations for and by the Indian organic cotton sector. This Executive Summary provides the key takeaways from the original research project<sup>1</sup>, which can be downloaded at the [OCA website](#).

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***Organic agriculture has always embraced crop diversification as a key practise in its holistic approach to farming. In OCA's work with organic cotton farmers in India we have seen some excellent examples that maximise the benefits of crop diversification, yet we also appreciate the untapped potential of systematically mapping and sharing that knowledge across the organic cotton community and beyond.***

***Through this study we've been able to identify the crop diversification practices which optimise agronomic, environmental and economic benefits for organic cotton farmers across the different cotton growing regions in India, as well as the key levers to promote these practises at the farm-level. These insights will supercharge OCA's ability to support Indian farmers in earning a more diversified and resilient income while achieving greater environmental benefits. And hopefully, these findings will inspire other crop diversification efforts across the sustainable agriculture sector for even greater impact. The world needs it!***

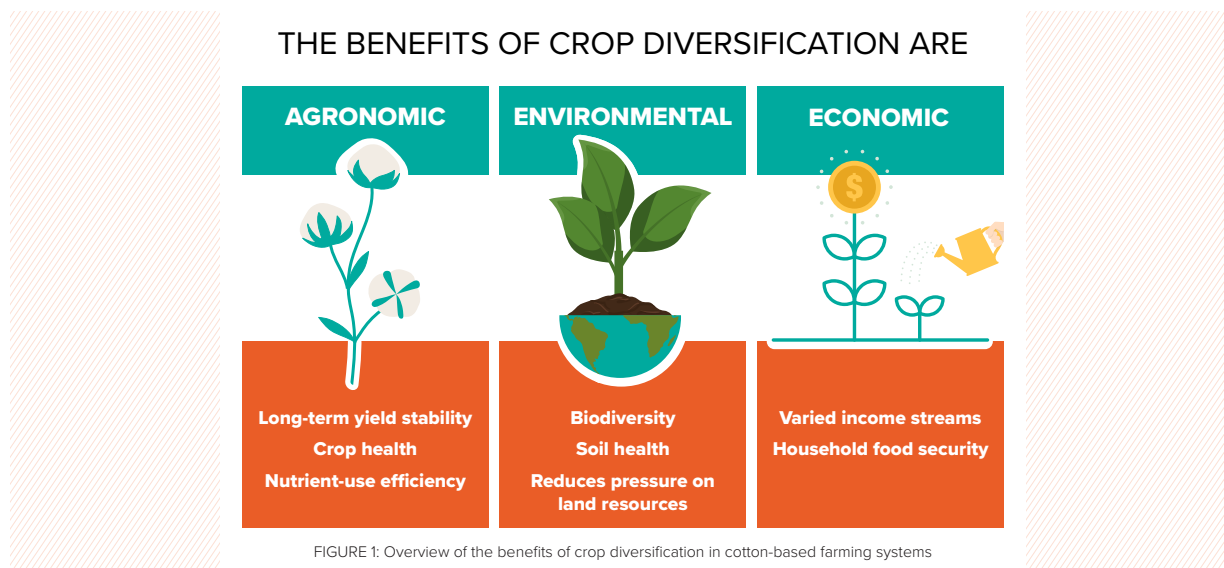
”

BART VOLLAARD, EXECUTIVE DIRECTOR, OCA

<sup>1</sup> Riar A., Joshi T., Goldmann E., Joshi S., and Tournebise M. (2020) Boosting biodiversity and improving farmer livelihoods through crop diversification: The practice and impact of scaling crop diversification in Indian organic cotton-based systems. OCA, Amsterdam, pp 48.

# WHY THIS RESEARCH PROJECT?

In the past few decades, Indian agriculture has shifted from subsistence farming towards the monoculture of commercial crops in intensive production systems. While this trend has increased agricultural productivity in the short term, it has also led to growing environmental problems and raised concerns about today's cropping systems' capacity for adapting to climate change, regenerating soil health and creating the synergies required with biodiversity so that both the crop and its environment can thrive.



Organic farming takes a holistic cropping system approach instead of a crop-centric one, which makes it a leading alternative to intensive farming. Why? Because organic farmers build on crop diversification, meaning they aim to increase the diversity of crops grown at different times and scales on the farm. By maximising synergies between the crops grown together (e.g., through intercropping), or after each other (e.g., through crop rotation), on the same field, crop diversification practices are a proven means of providing agronomic, environmental and economic benefits at the organic farm.

Not only do crop diversification practices make it possible for organic farmers to secure their farm's productivity, regenerate soil health, and maintain a stable biodiversity at the farm for the long term; they can also contribute to diversified and more resilient income sources for farmers, which gives them the opportunity to sustain their businesses and invest in their family's future.

In the Indian organic cotton sector, many organic cotton farmers and farm groups already invest in crop diversification. However, a commonly repeated cropping sequence remains the cultivation of wheat after cotton - whilst the benefits of crop diversification are best harvested when a systemic and holistic farming approach is taken at the organic farm. For a cotton farmer, this means moving from a crop centric approach towards a cropping system approach, and from an input-based production logic towards knowledge-based farming. Knowledge is the key to unlocking the benefits of organic cotton-based farming systems. Improving the business case for organic cotton farming in India means bridging the knowledge gap on crop diversification and considering the profitability of the whole farming system.

OCA took the needs of the sector to heart and initiated this study on crop diversification to:

- Identify the crop diversification practices which optimise agronomic, environmental and economic benefits for organic cotton farmers across different cotton growing regions in India
- Understand the key levers to promote the use of crop diversification practices at the farm and maximise their potential for income generation
- Illustrate how higher levels of crop diversification for organic cotton-based farming systems can best be achieved



# PARTICIPATORY RESEARCH METHODOLOGY

This 10-month study on crop diversification in the context of Indian organic cotton farmers used participatory methods to center farm groups and local experts at the heart of this work. This ensured that local farming nuances were considered throughout the research project, thereby guaranteeing that the findings delivered would be relevant and include on-the-ground expertise.

The project teams at OCA, FiBL and GIZ would like to thank all the stakeholders involved in this participatory process for their valuable inputs and validation of the study findings.

## GEOGRAPHIC SCOPE

The research project focused on five primary cotton-growing states: Madhya Pradesh, Maharashtra, Odisha, Gujarat and Rajasthan. It zeroed into districts that are representative of the diversity of agro-climatic conditions within these states and/or that are organic cotton farming hotspots.

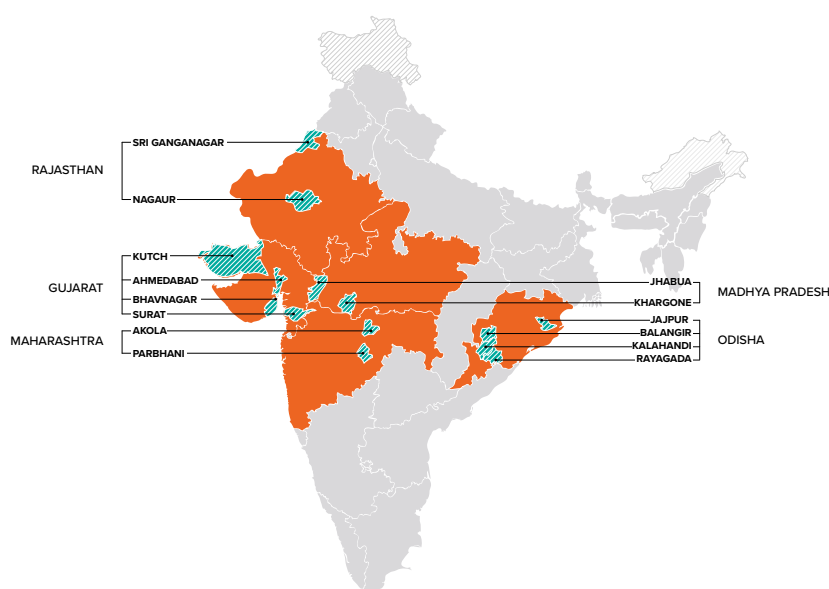


FIGURE 2. Primary organic-cotton producing states in India and representative districts chosen for each agro-climatic zone

## PROJECT MILESTONES

The research project encompassed the following activity:

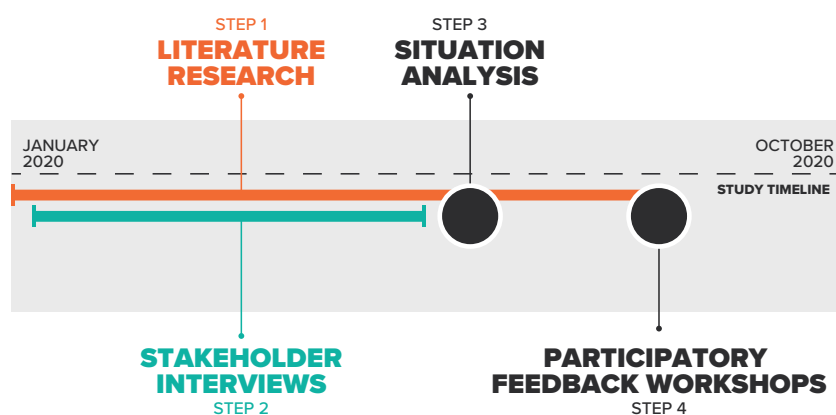


FIGURE 3. Representation of the key activities along the study timeline



## 1. LITERATURE REVIEW

The research project encompassed a literature review which included:

- Relevant scientific literature on Indian cotton production
- Data and publications from the State Agriculture Department, Ministry of Agriculture (Directorate of Economics and Statistics (DACNET), Commission for Agricultural Costs and Prices (CACP)) and the agricultural extension centre Krishi Vigyan Kendra (KVK)
- Package and practices from Agricultural Universities, the Indian Council of Agricultural Research (ICAR) and the Central Institute for Cotton Research (CICR)
- Extension service documents and literature from partner organisations and other Indian research institutes

## 2. STAKEHOLDER INTERVIEWS:

Partners from OCA's and FiBL's networks participated in the research project alongside stakeholders from the broader cotton sector in India, including farm groups and implementing partners from OCA's FED<sup>1</sup> Programme, Seeding the Green Future<sup>2</sup> programme partners, the State Agriculture Department, State Agricultural Universities, central research institutions dedicated to cotton research and other crops, agricultural extension centres Krishi Vigyan Kendra (KVKs), seed producers, NGOs, and other actors engaged directly or indirectly in the organic cotton sector.

These stakeholders provided inputs on the research questions in one-on-one interviews and focus group discussions. 40 interviews focused on the technical aspects of crop diversification while 21 zoomed into the set-up of marketing linkage and policy consideration for diversified produce.

## 3. SITUATION ANALYSIS:

An essential deliverable from this study was the situation analysis, which enabled us to map the causes and effects of the currently poor level of crop diversification in organic cotton-based farming systems, and how these elements interconnect.

The 'problem-tree approach' was used in a workshop among FiBL cotton experts, and this content was supplemented with further input collected through stakeholder interviews and relevant literature.

## 4. PARTICIPATORY FEEDBACK WORKSHOPS:

The comprehensive input collected via literature research and stakeholder interviews was validated using two online feedback workshops. Each workshop included focus group discussions to ensure high levels of stakeholder participation and in-depth validation.

The technical session focused on the agronomic, environmental, and economic benefits of the crop diversification practices identified, while the market and policy session focused on the market challenges and opportunities with regards to crop diversification.

1. Farmer Engagement and Development (FED) Programme. For more information about OCA's programmes, please visit [www.organiccottonaccelerator.org](http://www.organiccottonaccelerator.org).

2. Participatory organic cotton breeding programme led by FiBL under funding from OCA and Mercator Foundation, please visit [www.sgf-cotton.org](http://www.sgf-cotton.org)

# KEY TAKEAWAYS

## 1. CROP ROTATION AND INTERCROPPING TAKE TOP SPOT

Crop rotation and intercropping were deemed the most promising diversification practices by the stakeholders involved throughout the study, for the potential they can bring to both farmers and the planet.

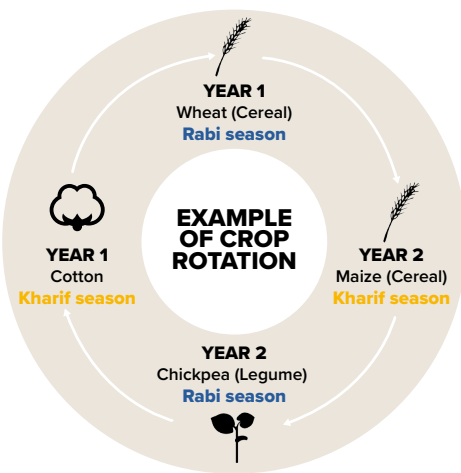

CROP ROTATION	INTERCROPPING
 <p>Crop rotation is the practice of growing different crops sequentially on a same plot of land along the years. It fosters soil fertility, helps manage pests and diseases and reduces weed pressure, leading to increased and sustainable yields of different crops produced at the farm.</p>	 <p>Intercropping is the practice of growing two or more crops on one field, at the same time. This enables farmers to increase the land's productivity per unit area, by optimising the use of land resources and farming inputs. Intercropping also offers an 'insurance' against the failure of one or more of the crops planted.</p>

TABLE 1: Definition and benefits of crop rotation and intercropping

Beyond crop rotation and intercropping, other cropping techniques such as trap crops, border crops and green manure are beneficial crop diversification practices to maintain crop and soil health at the organic production field. The integration of crop production with livestock also helps optimise soil nutrient cycles. More information on these practices can be found in the full research project [report](#).

**The question of which crops perform best when grown before, after or alongside cotton, either as a rotational crop, or as an intercrop is a key one.**

**Three crop groups were found to be especially valuable for cotton-based farming systems: legumes, oilseed and cereals, as they offer very promising combinations of agronomic and environmental benefits to farmers that are summarised hereafter.**

**We used these benefits to inform the recommended combinations for crop rotation and intercropping which can be found in Key Takeaway 2 and 3.**

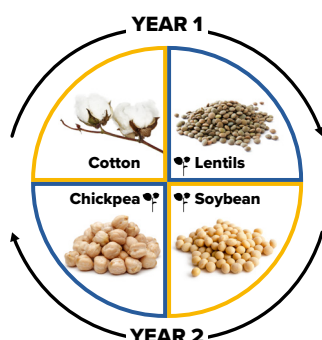
## 2. THE BEST COMBINATIONS FOR CROP ROTATION

Five crop combinations are recommended to implement two-year crop rotations combinations, as an alternative to repeating a cotton-wheat combination year after year. You can see these combinations below.

Getting the timing right when sowing and harvesting companion crops is especially essential for the success of diversified farming systems, hence the study delivered a cropping calendar for the Central, Northern, Southern and Eastern zones of India which can be found in the [full research project report](#). We highlight the calendar for the Central Zone as an example here.

### RECOMMENDED ROTATION 1 COTTON + 3 LEGUMES

Rabi / winter cropping season  
Kharif / rainy / monsoon cropping season  
Sowing  
Growth period  
Harvesting



#### Benefits of legumes / pulses in crop rotation with cotton

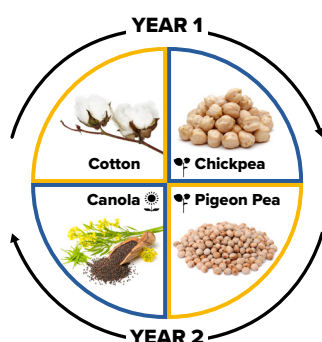
<b>Agronomic benefits</b>	<ul style="list-style-type: none"> <li>Promote Soil Organic Carbon content</li> <li>Promote available soil nitrogen</li> </ul>
<b>Environmental benefits</b>	<ul style="list-style-type: none"> <li>Carbon sequestration</li> <li>Low water footprint</li> </ul>

#### CROPPING CALENDER (CENTRAL ZONE)

Month of year	MAY				JUN				JUL				AUG				SEPT				OCT				NOV				DEC				JAN				FEB				MAR				APR			
Week of month	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4								
<div>Cotton</div>																																																
<div>Lentil</div>																																																
<div>Soybean</div>																																																
<div>Chickpea</div>																																																

### RECOMMENDED ROTATION 2 COTTON + 2 LEGUMES + OILSEED





Rabi / winter cropping season  
Kharif / rainy / monsoon cropping season  
Sowing  
Growth period  
Harvesting



#### Benefits of oilseed in crop rotation with cotton

<b>Agronomic benefits</b>	<ul style="list-style-type: none"> <li>Support biological pest control</li> </ul>
<b>Environmental benefits</b>	<ul style="list-style-type: none"> <li>Low greenhouse gases emissions</li> </ul>

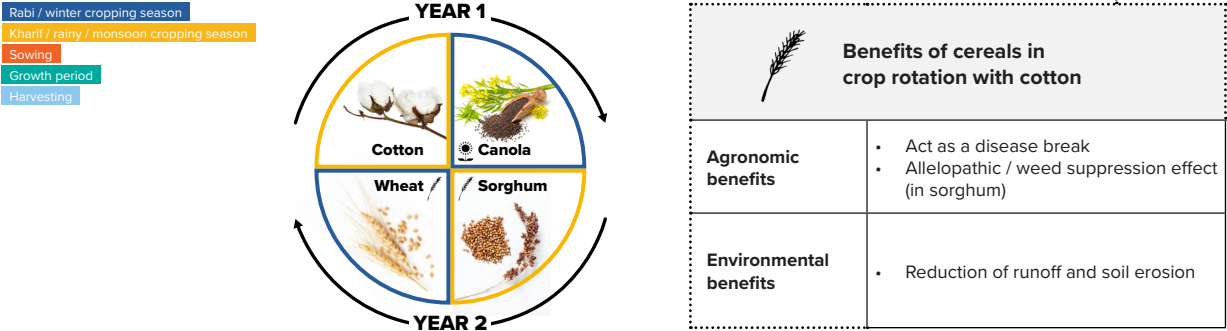
#### CROPPING CALENDER (CENTRAL ZONE)

Month of year	MAY				JUN				JUL				AUG				SEPT				OCT				NOV				DEC				JAN				FEB				MAR				APR			
Week of month	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4				
 Cotton																																																
 Chickpea																																																
 Pigeon Pea																																																
 Canola																																																

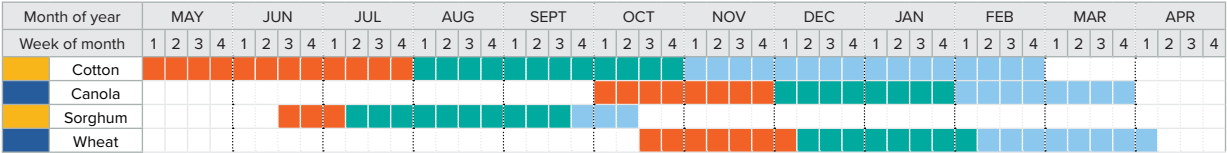


RECOMMENDED ROTATION 3

COTTON + OILSEED + 2 CEREALS

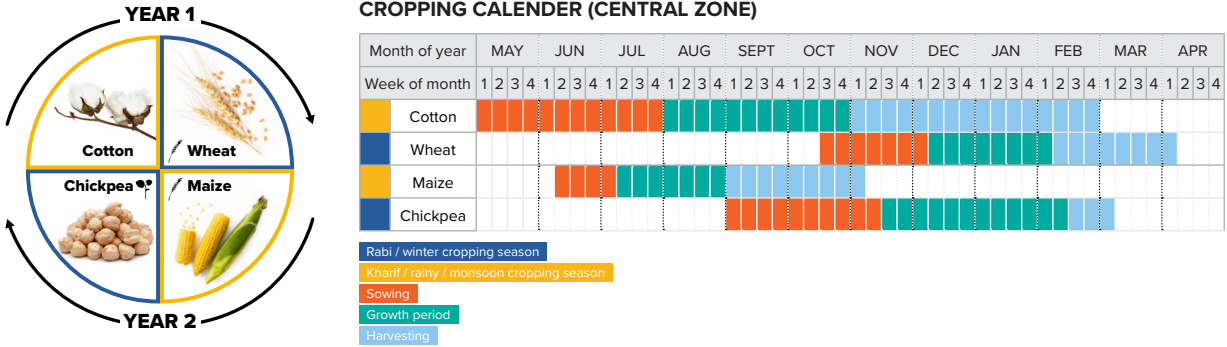


CROPPING CALENDER (CENTRAL ZONE)



RECOMMENDED ROTATION 4

COTTON + 2 CEREALS + LEGUME



RECOMMENDED ROTATION 5

COTTON + OILSEED + CEREAL + LEGUME

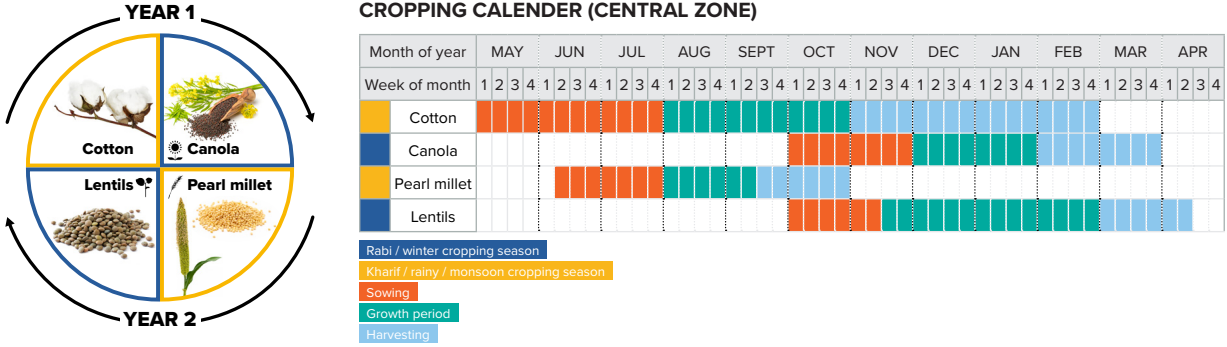


FIGURE 4. Recommended crop rotation combinations for organic cotton-based farming systems

### 3. THE BEST COMBINATIONS FOR INTERCROPPING

Eight intercrops were recommended to be grown alongside cotton on the production field in Kharif (rainy / monsoon) cropping season, as an alternative to sole cotton cropping. We have clustered them according to crop type and associated the key agronomic and environmental benefits associated with each of them.

We highlight the cropping calendar for the Central Zone as an example here to emphasise the importance of getting the timing right when sowing and harvesting companion crops. You can see a cropping calendar for the Central, Northern, Southern and Eastern zones of India in the [full research project report](#).

#### RECOMMENDED LEGUME INTERCROPS



Intercrop type to be associated with cotton	Black gram	Pigeon Pea	Green Gram
Intercrop duration	Short	Short-Medium	Short

Benefits of legumes / pulses in intercropping with cotton	
<b>Agronomic benefits</b>	<ul style="list-style-type: none"> <li>Low incidence of sucking pests</li> <li>Low nitrogen requirements</li> </ul>
<b>Environmental benefits</b>	<ul style="list-style-type: none"> <li>Water conservation</li> </ul>

#### CROPPING CALENDER (CENTRAL ZONE)

Month of year	MAY				JUN				JUL				AUG				SEPT				OCT				NOV				DEC				JAN				FEB				MAR				APR			
Week of month	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4								
Cotton																																																
Black gram																																																
Pigeon Pea																																																
Green Gram																																																

#### RECOMMENDED OILSEED INTERCROPS



Intercrop type to be associated with cotton	Sesame	Groundnut
Intercrop duration	Short- Medium	Short

Benefits of oilseed in intercropping with cotton	
<b>Agronomic benefits</b>	<ul style="list-style-type: none"> <li>Act as trap crops that attract pests away from cotton</li> <li>Biological pest control</li> </ul>
<b>Environmental benefits</b>	<ul style="list-style-type: none"> <li>Efficient utilisation of scarce natural resources</li> </ul>

#### CROPPING CALENDER (CENTRAL ZONE)

Month of year	MAY				JUN				JUL				AUG				SEPT				OCT				NOV				DEC				JAN				FEB				MAR				APR			
Week of month	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4								
Cotton																																																
Sesame																																																
Groundnut																																																

#### RECOMMENDED CEREAL INTERCROPS



Intercrop type to be associated with cotton	Maize	Sorghum	Pearl Millet
Intercrop duration	Short	Short	Short

Benefits of cereals in intercropping with cotton	
<b>Agronomic benefits</b>	<ul style="list-style-type: none"> <li>Some cereals act as trap crop and attract American bollworm away from cotton</li> </ul>
<b>Environmental benefits</b>	<ul style="list-style-type: none"> <li>Resilient to climate change</li> </ul>

#### CROPPING CALENDER (CENTRAL ZONE)

Month of year	MAY				JUN				JUL				AUG				SEPT				OCT				NOV				DEC				JAN				FEB				MAR				APR			
Week of month	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4								
Cotton																																																
Maize																																																
Sorghum																																																
Pearl Millet																																																

FIGURE 5. Recommended intercropping combinations for organic cotton-based farming systems

Sowing Growth period Harvesting



## 4. A LOCALISED APPROACH IS KEY TO SUCCESS

While very little geographic variation was observed when screening crop diversification practices across the different agroclimatic zones of Madhya Pradesh, Maharashtra, Odisha, Gujarat and Rajasthan in this study, the recommended practices should be finetuned for the local farming conditions of farmers and farm groups. Why?

Because in organic agriculture it is essential to find the optimal combination of crops that can be grown along with cotton to maximise their benefits. Hence, crop diversification decisions should be based on a thorough observation and understanding of the local land resources, soil health and pest and disease patterns as those conditions are different across the various cotton-growing regions of India.

## 5. DOES IT PAY TO DIVERSIFY?

While crop diversification practices definitely have the potential to create diversified and resilient income sources for farmers, how profitable would it be for farmers to grow the crop combinations recommended by our research project? In our cost-benefit analysis,<sup>1</sup> the potential economic benefits of the crop rotations and intercropping combinations were found to be relatively comparable across each other and in comparison with the reference monoculture system. By diversifying their cropping practices, organic cotton farmers can maintain similar earnings, while mitigating the risks of agronomic failure, managing price volatility of the cotton crop and harvesting the environmental benefits of these practices.

Looking beyond this economic analysis, the economic benefits of crop diversification can be boosted by maximising the farm's agronomic performance, as well as the prices that can be achieved for the produced goods through the established market linkage, especially when a price premium could be granted to organic farmers on all crops produced. These aspects constitute challenges that should be tackled if we want to see increased uptake of crop diversification practices.

## 6. STEPS TO SCALE UP CROP DIVERSIFICATION

1. **Support organic farmers:** Raise farmer awareness of the benefits of crop diversification to foster more long-term thinking in their decisions of which crops to grow. This can be done by investing in capacity building so they are supported in the selection and management of companion crops. Provide support to cushion them from the risks taken when introducing a new crop in their farming system and facilitate farmer access to adapted seed cultivars and technical tools.
2. **Harness public research and extension services:** Beyond the efforts made by farm groups and the private sector, Indian cotton research and extension services can also help raise awareness among farmers about the benefits of diversified cropping systems. They can spread the technical expertise and transfer the technology required to manage these farming practices. It's also key that learnings and recommendations from the collaboration between farmers, farm groups, and public research and extension services reach the state and central government to influence their policies and strategies.
3. **Engage seed suppliers in the mission:** Seed suppliers are essential if crop diversification is to be an agronomic success at the farm. As organic farming conditions are not artificially buffered by using synthetic inputs, farmers must be able to access the right quality and type of seed for their local environment and farming practices, and for the range of crops that they are growing. Hence, the engagement of the seed sector is strongly needed to scale up crop diversification.
4. **Offer long-term market linkages and economic stability:** Economic stability is essential for farmers to make long-term investments in diversified cropping patterns and secure their livelihood.
  - To achieve this stability, farmers need to be able to sell their diversified produce range, and both public sector and industry stakeholders can participate in the successful establishment of market linkages for diversified produce. The public sector can invest in market research on the supply and demand gaps of suitable crops for cotton-based farming system. Farm groups can make diversified cropping systems profitable by creating both backward and forward linkages across the entire agricultural value chain and integrating farmers with diversified produce to obtain maximum benefits and economies of scale.

1. The study evaluated the benefit-cost ratios for each recommended crop combination for rotations and intercropping, versus the reference monoculture cropping system, to evaluate their potential economic benefits. This was done using crop production and pricing data from the Commission for Agricultural Costs and Prices (CACP), under the Ministry of Agriculture and Farmers Welfare, Government of India, that was adapted to reflect the performance capacity of organic farming in a conservative manner (e.g. no premium price was included in our model).



- Key to this strategy is providing a fair and stable price environment to farmers so they can invest in crop diversification practices, afford to tolerate risks and benefit from crop diversification in the long run. The extension of a minimum guaranteed Market Support Price by the Indian government to a diversified range of produce would be a great milestone to promote diversified cropping systems. Organic farming also constitutes an opportunity for farmers to differentiate with quality-based produce and to be rewarded through premiums for a wider range of organic certified produce.
5. **Leverage existing policy:** Policies that support market development are crucial factors to encouraging the adoption of more diverse cropping systems by organic farmers. Further policy development in the following areas would deliver impactful results: economic policies such as quality produce support prices, public procurement schemes and policies specially designed for the organic sector in India, as well as policies on farm and (women) farmer development. By ensuring communication and collaborative action between policymakers and organic cotton stakeholders, advocacy organisations could create a dynamic environment that can help leverage crop diversification practices in organic cotton-based farming systems.
6. **Focus on female farmers:** Crop diversification can significantly scale up female empowerment by providing women with employment opportunities, generating additional income and ensuring and diversifying household food security with nutritional food. Reciprocally, the role of women has been identified as a critical success factor for the practice of crop diversification techniques at farm level. Therefore, interventions implemented to promote crop diversification should also be female-focused.

## LEGEND

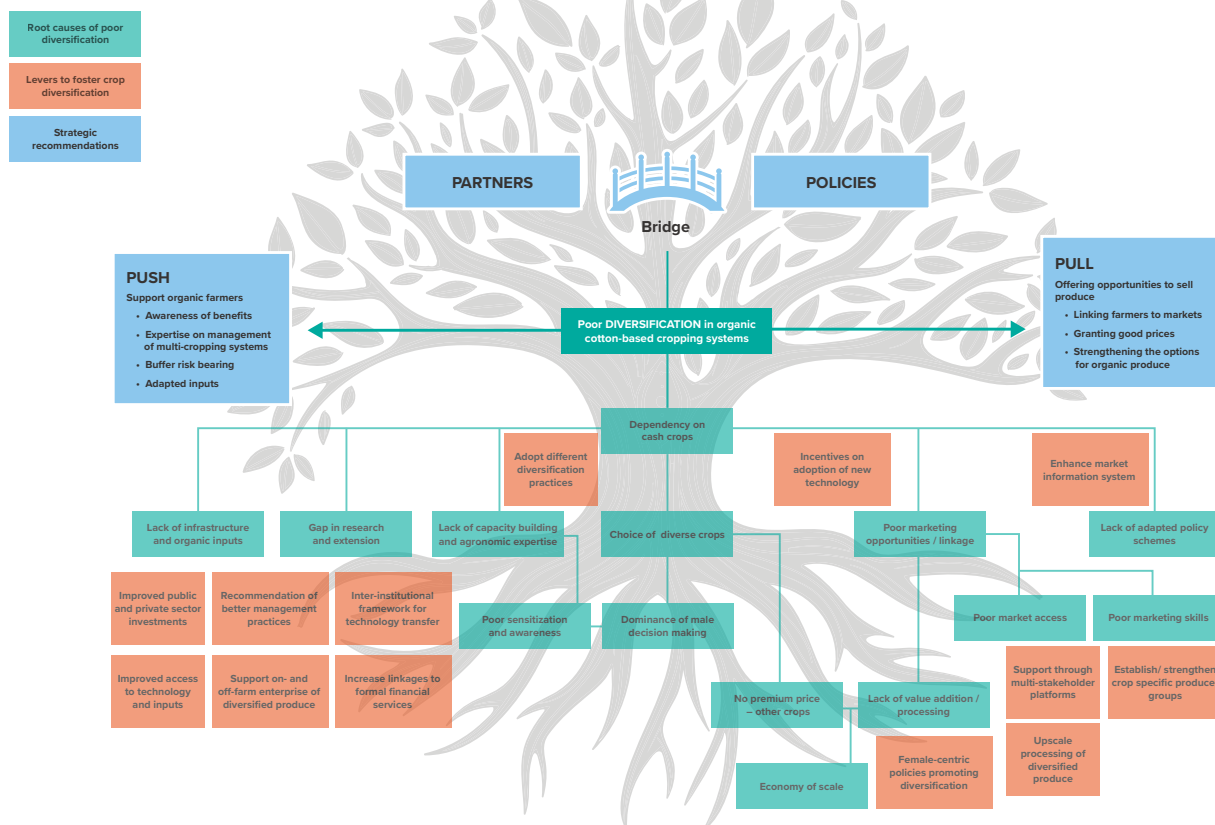


FIGURE 6. Strategic recommendations to foster crop diversification in organic cotton-based farming systems

This figure provides an overview of levers identified throughout the study and summarises the strategic recommendations to foster crop diversification in organic cotton-based farming systems, for the benefit of Indian organic cotton farmers and the planet.

## WHAT COMES NEXT?

Communication and collaborative action is needed to establish the logistics, market linkages and economical support required to provide farmers with stability, as well as optimise storage and transportation infrastructures. At OCA, we are already wondering what comes next and are ready to do our bit.

Now more than ever, the diversification of cropping systems is needed at a large scale, to boost the resilience of our farming systems to pests and diseases, climate change and other environmental stresses, regenerate our soils, as well as sustainably support farmers' livelihoods. However, the recommendations from this research project indicate that a lot has to be done to get there.

As the Organic Cotton Accelerator, we are willing to champion and facilitate crop diversification within our programmes. The agronomic recommendations from this research project will inform the Organic Cotton Training Curriculum, that is aimed to leverage capacity building for organic cotton farming in India. Through OCA's FED<sup>1</sup> Programme, an increasing number of Indian farmers will benefit from these recommendations. OCA will also connect with Indian advocacy bodies in order to discuss the entry points that could help supercharge crop diversification efforts through policies. We will also pilot data-based feedback loops to monitor the use and performance of different crop diversification practices at farm level, which should also help finetune these best practices, whilst nuancing these study recommendations at local level.



But we also know that we can't do this alone. Long-term partnership is essential to accelerate the shift towards more diversified organic farming systems. Hence, we warmly welcome partners to join our movement. The Organic Cotton Accelerator focuses on leveraging the business case for farmers to grow organic cotton. We do this by getting brands to commit on premium paid to organic farmers and offering a purchase guarantee early in season. As a next step to this study, we are especially looking forward to connecting with organisations (cooperatives, sustainability initiatives etc...) who are specialised in other crops than cotton and could collaborate with us to successfully link farmers to markets and open up the opportunities to market different crops, ideally as organic certified produce.

Beyond the organic cotton sector, we are sharing the study findings openly with a broader public, in the hope we inspire others to take action, leverage existing advocacy initiatives, identify synergies across organisations and create collaborations across crops and sustainability initiatives i.e. agroecology and regenerative agriculture. Ultimately, we all chase similar goals and should all partner together.

**If you are interested in partnering with us** to take the support for the income resilience of Indian organic cotton farmers to the next level, please contact us at [secretariat@organiccottonaccelerator.org](mailto:secretariat@organiccottonaccelerator.org)

To access the full version of the research project report, please contact the OCA Team to request it: Riar A., Joshi T., Goldmann E., Joshi S., and Tournebize M. (2020) Boosting biodiversity and improving farmer livelihoods through crop diversification: The practice and impact of scaling crop diversification in Indian organic cotton-based systems.

1. For more information about OCA's programmes, please visit [www.organiccottonaccelerator.org](http://www.organiccottonaccelerator.org).

