8 Sustaining the supply of organic White Gold

The case of SysCom innovation platforms in India

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Setting the scene

White Gold: a primer

Why White Gold? Cotton (*Gossypium* spp.), also known as "White Gold," is not only the most important fiber plant for the production of textiles, but also one of the most intensive crops in terms of pesticide use worldwide (Bachmann, 2012). That's why the genetically modified *Bt* cotton was developed, which gives protection against the most important cotton pests: the bollworms (*Helicoverpa* spp.).

Let's go to India, the mother of history, the grandmother of legends. Madhya Pradesh State is located in the central cotton belt of dryland India. Here, *Bt* cotton occupies more than 90 percent of the cotton area (Choudhary, 2010). However, at the same time, it is also the biggest producer state of organic cotton (Truscott *et al.*, 2013).

Organic is better, isn't it?

Many of us would say yes, of course. These days, statements such as the following are springing up like mushrooms: "Increasing concerns about global food security, depleting fossil reserves and diminishing natural resources question the continuation of energy-intensive conventional agriculture, and emphasize the importance of sustainable alternatives such as organic agriculture" (IAASTD, 2009). But why would Mr. Manjit Singh Dang, an Indian small-scale farmer who produces the organic White Gold, choose organic over conventional? After all, the latter is not only less complicated, but often also more productive and thus more rewarding, right?

In Switzerland, the case is crystal clear. The Research Institute of Organic Agriculture (FiBL) has shown that organic farming leads to lower yields, but has many other benefits compared to conventional farming (Mäder *et al.*, 2002).

Today, Coop (the biggest retailer of organic products in Switzerland) makes a turnover of over one billion USD with organic products. When we go further south though, the picture becomes blurred. There is little scientific data on the comparative performance of organic vs. conventional farming systems in (sub)tropical zones. That's why FiBL launched a large program called Systems Comparisons in the Tropics (SysCom[1]). SysCom provides innovation platforms (IPs) in three countries: Bolivia, India and Kenya. It maintains a network of long-term farming systems comparison experiments (LTEs) and addresses specific challenges of small-scale organic farmers through participatory on-farm research (POR).

Besides cotton as his main cash crop, Manjit cultivates soybeans and wheat. But he had a problem: while his conventional colleagues were very flexible in terms of crop management strategies, his yields heavily relied on the limited options allowed in organic farming. Phosphorous (P) nutrition was a particular problem, because the local soils are highly alkaline; in fact, so alkaline that the usual organic P fertilizer (rock phosphate (RP)) did not work. So Manjit had no suitable phosphorous fertilizer, so both the yield and the fiber quality of his White Gold was low. This case study illustrates how Manjit and his fellow farmers overcame these limitations by being part of an IP.

How to get more organic White Gold?

Good question. We propose focusing on three central questions:

1. What can we do to increase the productivity of organic cotton systems on alkaline soils?
2. How can we spread innovations among small scale farmers efficiently?
3. How to increase the attractiveness of organic cotton systems?

Let us just sneak a peek of what is to come: through the IP in India, we developed a new kind of high quality phospho-compost that is produced from RP, butter milk and well-stored farmyard manure. Our farmers increased the yields of their White Gold and soybeans by 40 percent on average with this new technology. However, the most impactful thing we did to spread the innovation was to launch a competition among the participating farmers, arguably a more powerful tool for IPs to create impact than normal word of mouth strategies. And last but not least, we created scientific evidence that despite lower yields in organic cotton systems, the lower production costs rendered them equally rewarding as conventional systems. The less capital-intensive nature of organic cotton systems can have important implications when crops fail.

Madhya Pradesh's organic cotton problem and potential ways out

A vast problem lying in the valley of a holy river

"Narmada never runs dry you know, it is holy. A teardrop that fell from the eyes of Lord Brahma, the creator of the universe, yielded the river." Just one of the "legend has it" statements you'll hear from locals when you ask them about the many pumps and pipelines lining the shore of Narmada. Fact is that agriculture in the plains of the river heavily relies on its water for irrigation. Narmada has shaped the landscape, creating Vertisols (also known as "black cotton soils") that stretch approximately 5km to both sides of the river. These soils are mostly fertile, but also highly alkaline which poses a particular problem for crop nutrition in the production of organic White Gold.

As mentioned, Manjit had a problem with phosphorous: he used to apply RP which did not show any effect on his alkaline soils due to chemical processes (Appendix 8.1). Manjit was neither aware of that, nor did he have any other choice in terms of organic P fertilizer. Conventional farmers don't have this problem. They can use synthetic P fertilizers that work on alkaline soils. These fertilizers are produced by treating RP with strong inorganic acids.

The scope of this problem is vast: vertisols are not only the predominant soil type in Madhya Pradesh, but they cover a staggering 73 million hectares of the subtropical regions of India (Kanwar, 1988). The country counted 184,029 farmers producing 75 percent of the world's supply of organic cotton (312,131 Mt seed cotton) in 2011–12; 50 percent of this amount was produced by 90,500 small scale farmers in Madhya Pradesh (Truscott *et al.*, 2013). bioRe® India Ltd. is an organic cotton enterprise that works with some 5,000 small scale farmers (bioRe farmers). The company mainly operates in the Khargone district (area: 8,030 km^2) of Madhya Pradesh (Figure 8.1). Other major Indian states growing the White Gold include Andhra Pradesh, Gujarat, Haryana, Karnataka, Maharashtra, Odisha, Punjab, Rajasthan and Tamil Nadu (Figure 8.1).

Fighting complexity with diversity

To address this rather complex problem, FiBL set up an IP at bioRe back in 2006. The IP brings together a wide range of stakeholders in order to ensure the acceptance of our activities at different levels. Among them are bioRe® India Ltd. and its farmers, an associated non-profit organization (bioRe Association[2]), and researchers from both India and Switzerland. Furthermore, an Indian spinning mill, a Swiss yarn trader (Remei AG), and donors representing NGOs (Biovision Foundation for Ecological Development), retailers (Coop Sustainability Fund) and governmental development agencies from Switzerland (Swiss Agency for Development and Cooperation) and Liechtenstein (Liechtenstein Development Service) were involved. Details about the stakeholders are provided in Appendix 8.2.

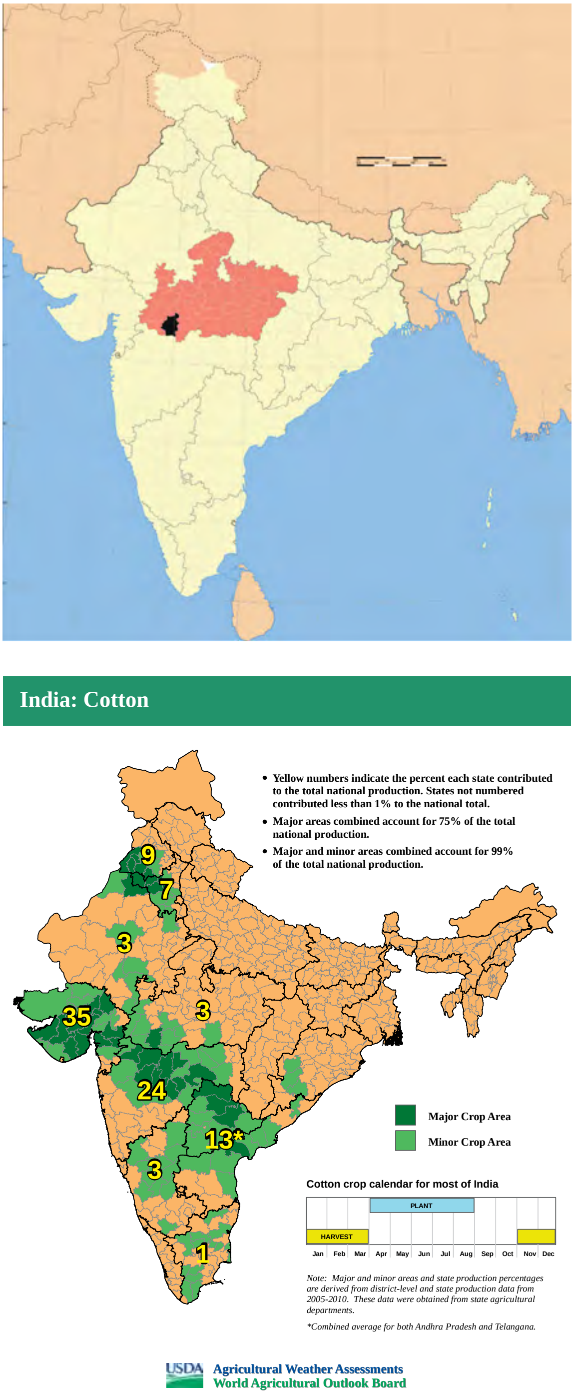

Figure 8.1 Top: location of Khargone District (black) in Madhya Pradesh State (red). Bottom: major cotton growing areas of India

Source: Wikimedia (top) and Spectrum commodities (bottom)

The centerpiece of the IP is the long-term farming systems comparison experiment (LTE). The agronomic on-station experiment is carried out at the training and education center of bioRe Association, and has as its main objective to create scientific evidence about the comparative performance of organic vs. conventional cotton systems. In order to ensure that the LTE represents local farming systems, we meet twice a year with a Farmers Advisory Committee (consisting of five representatives of conventional and organic farmers each): one time to plan the season, and another time to evaluate the performance of the crops.

But creating evidence and papers is not enough, especially for farmers. After all, paper remains paper. Farmers want to see hands-on solutions for their problems from us researchers, and rather today than tomorrow. That's why we launched the participatory on-farm research (POR) component back in 2009. The goal of POR is to develop innovations that improve yields and rural livelihoods of local small-scale farmers in the mid to long term. In working with the farmers, we chose a combination of the LTE (e.g. for demonstration trials) and several POR trials (e.g. for exchange visits).

The birth of the RP-FYM technology

So how do you start such a process? First, we had to identify the needs of our beneficiaries. "So let's ask about the main challenges of our farmers," we thought. Nothing easier than that one could assume, but if you find yourself standing in front of 150 farmers it turns into a major challenge. So there we were: researchers and farmers in a ratio of 1:50, trying to reach a conclusion. We did semi-structured interviews and focus group discussions with Manjit and his colleagues (Figure 8.2). Finally, after asking countless questions and a prolonged discussion we reached consensus: together we wanted to work on the P problem described above.

It was clear: the efficiency of RP had to be improved so that the 5,000 bioRe farmers could enhance their yields, and the fiber quality of White Gold. We set off on our journey by identifying several local materials with a potential to solubilize RP (in order to make it easier for plants to absorb). Farmers and extension agents suggested compost, phosphorus solubilizing bacteria, tamarind fruits, local vinegar (LV) and buttermilk (BM). So we screened these materials in a first set of trials in 2010 and 2011.

The IP participants were eager to test the effect of the resulting fertilizers on their crop yields. When the time of harvesting came, we gathered in order to jointly evaluate the results. Everyone was convinced that the two most promising options were BM and LV, as these materials increased the availability of P the most and achieved highest crop yields. Another decisive factor was that BM and LV were locally available in ample quantities and at low or no costs for the farmers (Locher, 2011). As Manjit pointed out: "Through the participation in the rock phosphate trials, I encountered buttermilk as a simple and economical solution to increase the P supply to my crops."

Figure 8.2 Focus group discussion with farmers in 2009
Photo: Authors

Such promising first results motivated us to follow up with a second set of trials in 2012. A first study looked more closely at buttermilk and local vinegar. It tested different ratios of BM/LV to RP and experimented with different time periods of incubation. The study concluded that incubating RP with buttermilk in a ratio of BM:RP = 10:1 for a period of one week was optimal for increasing the efficiency of RP (Nyffenegger, 2012).

We also conducted a second study to look at different options available for improved farmyard manure (FYM) management. This revealed that the so-called "shaded shallow-pit system"[3] best conserved the quality of FYM. Furthermore, local farmers too preferred this system for the storage of their FYM (Gomez, 2012).

Fertilize an egg with a sperm and a baby will be born. In the same line we gave birth to the "rock phosphate-enriched-FYM" (RP-FYM) technology, by marrying the information of the two studies described above. We set up a demonstration shed for the production of RP-FYM (a high quality phospho-compost) at bioRe (Figure 8.3). It works as follows: incubate one part of RPh with ten parts of buttermilk for one week, and then spread the mixture on 40 parts of FYM (Figure 8.3). In order to reduce nutrient losses, keep the RP-FYM on a tarpaulin foil and use the foil to cover it. Shade the whole structure to protect it from the sun.

An unexpectedly rapid evolution

So far so good, we had developed a technology, but would it really lead to higher yields? Five farmers were particularly interested in both the technology and an answer to the latter question. That is why we made them our lead

Figure 8.3 Farmers being trained in RP-FYM production (top) and demonstration shed for training (bottom)

Photos: Authors

farmers. We gave them the first batch of RP-FYM we had produced at bioRe, and they used it to set up trials in their wheat crops in 2012–13. At the same time, we built sheds on their farms, and they started to produce the phospho-compost by themselves. At the end of the season, we discussed and evaluated the results with them using a farmer field school approach (Figure 8.4).

These five farmers were our ambassadors. We built five teams of five with one lead farmer and four associated farmers per team. The lead farmers acted as team leaders, teaching their associated farmers how to produce the new fertilizer (Figure 8.4), and showing them how to put up trials in their fields.

Figure 8.4 Exchange visit with five lead farmers to evaluate the effects of different fertilizer treatments on yields of wheat grown in 2012–13 (top) and RP-FYM production on a lead farmer's farm (bottom)

Photos: Authors

Each of the lead farmers produced enough RP-FYM to supply his associated farmers with batches for them to set up trials in cotton, soybeans and wheat on their own farms in 2013–14. This way, we managed to carry out a total of 37 on-farm trials.

The results of these trials outperformed the expectations of all the IP participants: the yields of cotton, soybeans and wheat all increased significantly in the RP-FYM treatment (in some cases by more than 100 percent) as compared to farmers' practice. On average farmers harvested some 40 percent more

Table 8.1 Yield increases (mean ± s.e.m.) in on-farm trials conducted in 2013–14

Crop	*Farmers' practice (kg/ha)*	*RP-FYM treatment (kg/ha)*	*Increase (%)*	*Number of farmers/ trials (=n)*
Seed cotton	1,170 ± 205	1,646 ± 222	41	10
Soybeans	1,548 ± 118	2,163 ± 227	40	14
Wheat	2,758 ± 219	3,138 ± 242	14	13
Mean	1,825 ± 151	2,316 ± 165	31	37

s.e.m.: standard error of the mean ($\sqrt{\pi}$).

White Gold and soybeans (Table 8.1). These results were consistent across different types of soils (high/medium yield potential soils) and farms (smaller/bigger farms). We received reports that these effects are also consistent across years, as for instance Manjit told us that he continues to harvest around 33 percent more cotton with RP-FYM to date. But this success did not come about by chance. Between 2009 and 2014 we had set up a total of 159 RP-FYM trials with 118 farmers from 31 different villages. A man reaps what he sows.

The participating farmers were very pleased with the results they had achieved, and promptly engaged in more creative thinking, brainstorming how the technology could be further developed. bioRe India Ltd. also reacted positively to the results:

> The rock phosphate trials are one of the best examples we have from our participatory research activities. It improved the knowledge of both our extension teams and our farmers, while it also allowed for the conservation of traditional farmers' knowledge.
>
> (Mr. Vivek Rawal, CEO and director of bioRe India Ltd)

Does switching to organic pay off?

Besides the phospho-compost success story, the LTE also led to valuable results: as expected, organic cotton systems showed lower yields, by 10–15 percent. But the production costs were also lower, by 40–65 percent (Forster *et al.*, 2013). So at the end of the day, the organic and the conventional farmer have the same amount of money in their pockets. Why does organic pay off then? Because the organic farmer took less risk; he invested less money to grow his crop which can have important implications in cases of crop failure.

Sitaram Thakur, president of bioRe Association, stressed the importance of this information: "The involvement of farmers in the LTE helped to clarify many open questions about organic farming, and provided us with an opportunity to make an unbiased choice about the type of production system we wanted to engage in." And the farmer Rajendra Singh Mandloi underlined:

Table 8.2 Results of validation trials conducted from 2009 to 2013

Year	*Number of trials*[a]	*Number of farmers with trial(s)*[b]	*Number of farmers involved*[c]	*Number of farmers who joined bioRe*[d]	*Percentage of involved farmers who joined bioRe*	*Number of farmers who joined bioRe per farmer with a trial*
2009	18	10	45	0	0	0.00
2010	30	21	90	0	0	0.00
2011	59	49	178	55	29	1.12
2012	53	53	208	150	72	2.83
2013	55	55	210	53	25	0.96
Average 2011–2013	56	52	203	86	42	1.64

[a] Trials were carried out in cotton, soybeans, wheat and chickpeas.
[b] Number of farmers with trial(s) may be lower than Number of trials due to several trials of a single farmer.
[c] Number of farmers involved includes farmers with trial(s) and visiting farmers (exposure visits).
[d] Number of farmers who joined bioRe includes farmers with trial(s) and visiting farmers (exposure visits).

> Before the existence of this innovation platform, there was a lack of information. I was doing organic farming on my own, and I was desperately looking for any authentic source of information. This platform has filled this gap and served as a milestone for organic farmers in the region.

The LTE and bioRe concepts also attracted the attention of conventional farmers. They wanted to see the performance of organic cotton on their own farms. "OK" we thought, and, taking advantage of our IP, launched another subproject: the validation trials. Did the LTE findings reflect the real situation of farmers on the ground? Yes they did. During the first two years (2009 and 2010), conventional farmers were not convinced, because commonly observed yield depression during the conversion period to organic farming (Panneerselvam *et al.*, 2012) also became manifest on their fields. However, they started recognizing the benefits of organic farming from 2011 onwards, and many of them joined bioRe: per farmer with a trial, an average of 1.64 farmers joined bioRe from 2011 to 2013. In 2012, the number reached almost three farmers per farmer with a trial (Table 8.2), which clearly underlines the potential of validation trials and exposure visits with neighboring farmers.

Creating impact through IPs

Competitions to stimulate excellent performances

How to increase the yields of 5,000 farmers by 30 percent? Good question, especially because that's the stipulated target impact of our IP. We needed knowledge transfer. Knowing that the building materials for each RP-FYM shed cost about 100 USD, we quickly realized that building many more sheds would have been too expensive. We were in desperate need of a smart idea in order to reach the farmers who had not been involved in our activities.

Many great men made it into the books of history because they had a deeper understanding of only two words: spontaneity and intuition. They listened to their guts, and this is rarely the wrong thing to do. The director of FiBL advises his employees to take their coffee breaks, as they are at the root of most innovations. In our case, the flash of inspiration struck in a meeting at bioRe: an IP member came up with the brilliant idea to launch a competition among the participating farmers. We asked them to initiate the production of their own RP-FYM; whether it was in a shed similar to the ones we had built or underneath a tree and covered with palm leaves didn't matter.

Just like the CGIAR Research Program on Integrated Systems for the Humid Tropics launched its IPs Case Study Competition which lies at the root of the text you are just reading, we announced a valuable award in order to stimulate creativity and superb outputs of our farmers: a cow with its calf for the most innovative idea or the best quality phospho-compost. The word about the competition spread like wildfire, reaching many more farmers than the project could have ever informed. Rajesh Shobharam, for instance, built a low-cost shed from scrap materials he found lying around his yard.

The air vibrated with excitement during the period leading to the award. Many farmers must have had thought "is my idea good enough to beat my neighbor?" during these weeks and months. In the meantime, the project team was busy preparing for the award ceremony: we prepared illustrated leaflets in English and Hindi, printed posters and drafted a laudation for the winner. In order to avoid controversy, we needed to make a fair judgment based on objective assessment criteria. To identify the winner, we decided to rate the nutrient contents analysis of the RP-FYM the participants had produced. The farmers agreed with this procedure, so nothing stood in the way for an enjoyable award ceremony.

Finally, the day of the ceremony came. Farmers screened their wardrobes for the nicest set of clothes, everyone was excited and the event attracted considerable attention. In total, 96 farmers and 12 bioRe and FiBL staff participated. Rajesh Shobharam was announced as the winner, and he humbly accepted his prize (Figure 8.5). After the laudation, we gave the floor to him:

> When I collected the manure, I was not doing it with the intention to win the competition. But shortly before the ceremony I felt I had done a good job, as I had strictly followed the instructions my lead farmer Manjit gave me. My manure was very good, and I achieved a high crop yield, so I had a good feeling.

We also gave consolation prizes to all the other participants in order to acknowledge their commitment and good results. They sincerely thanked us

Figure 8.5 Competition award ceremony with participating farmers, researchers and extension agents. The best quality phospho-compost (RP-FYM) won a cow and calf. Competition winner Rajesh Shobharam (front middle with flower neck garland) and project leader Dr Gurbir Singh Bhullar (front middle, wearing turban)

Photo: Authors

for organizing "one of the best activities the project has ever carried out," and encouraged us to launch more such competitions.

Going viral: the power of simplicity

Was this ceremony not the perfect opportunity for further dissemination? Yes it was. We just had to take advantage of having so many ambassadors in one place at the same time. Together, they could cover all the 5,000 fellow farmers of Manjit. Especially the extension agents responsible for each extension center in the area surrounding the IP had the potential to make our interventions go viral. We provided them with leaflets and posters, and encouraged everyone to further spread the information by word of mouth. After a proper feast they departed, eager to go back to their districts in order to build demonstration sheds and train farmers. We have received oral reports that these facilities have been used for training farmers and sharing knowledge and experiences ever since. However, at the end of the day the most powerful tool that led to the adoption of the technology was also the simplest one: farmer to farmer extension. In other words: word of mouth.

Why was this award such a success, such an impactful event? Because we did not have to start from scratch; flashback: we had performed 39 meetings, 27 exchange visits on participating farmers' fields and 27 workshops around this topic between 2009 and 2014. And of course, we had our LTE next to which we also installed RP-FYM trials for exposure visit; 437 men and 339 women participated in these events in 2013 and 2014 alone, figures that emphasize the potential of exposure visits with neighboring farmers. We repeat: "a man reaps what he sows."

The future of organic White Gold

We don't rest on our laurels. Just like a company who launches a product, you constantly have to adapt in order to keep up with the changes around you. There is potential for improvement of the RP-FYM technology. One farmer, for instance, came up with the suggestion to simultaneously mix in wood ash in order to enhance the potassium content. Moreover, the socio-economic sustainability has to be further investigated: how much buttermilk is available for the farmers, and at what time periods? What if there is a market to sell the buttermilk? How about the availability of RP in the villages, and the sustainability of RP in general? After all, RP from phosphate mines is a finite resource that cannot be manufactured (Neset and Cordell, 2012). And last but not least, what do the market characteristics and dynamics of both FYM and buttermilk look like?

What's next for our IP? Besides the fact that we need to assess the impact of our interventions on the livelihoods of our farmers (after all, raising agricultural productivity is just one of the five pillars to improve the income and food security of poor people in low-income countries (GAFSP, 2014), we are going to address the big challenges for the production of organic White Gold; Organic pest control, for example, is still one of the major constraints. But beyond that, arguably the most daunting issue is the lack of suitable seeds. As breeding companies focus almost exclusively on *Bt* cotton hybrids, organic producers are increasingly cut off from the progress in breeding. We had to do something about that, so we used the IP as a stepping stone to launch yet another project about breeding: since 2013, "Green Cotton"[4] has been pursuing the objective of training farmers on how they can sustainably cover their seed demand by themselves. Will we be able to contribute to sustaining the supply of organic White Gold from India? We strongly believe so.

It is not about best practice, but best fit

This case illustrates the advantage of combining applied science with participatory action research. Agricultural systems are complex and unpredictable. Accordingly, we cannot hope to simplify the development processes of such agricultural systems. Instead, as our case demonstrates, we can harness this complexity to our advantage. How? You teach a number of people the underlying principles of your innovation, and ask them to implement it by themselves. You'll be surprised by the many different ways they take and

WHITE GOLD (INDIA)

all these different ways can together lead to a better end result. Our point of reference was a long-term farming systems comparison trial (LTE), an agronomic on-station experiment. As we did not have any limitations in financial or human resources in this trial, we were able to ensure optimal management conditions for the crops we grew. The resulting crop yields were higher than the average yield of the farmers we worked with in our IP. Since the productivity increase due to our innovation in the LTE was consistent with the results our ambassador farmers had obtained in their own field trials, we did not have to try hard to "sell them" on our innovation to other farmers. They readily embraced and adopted the technology on their own.

The diversity of our approach made the farmers confident: they could test out new technologies on their farms and exchange their experiences with us at the central LTE, as well as on their farms. As the bioRe extension agent Randhir Chohan pointed out: "The combination of participatory research and long-term experiment provided a scientific basis which helped us to provide authentic knowledge to our farmers." The greatest lesson of our experiment was: if we teach farmers to carry out research on their own farms, they are more eager to own their innovation, adopt it in practice and spread the innovation by word of mouth. All these processes can eventually lead to a snowball effect and thus considerable impact.

How can we bring the successes described in this case study to scale and help those who want to start a similar IP for another crop? Our best practices of including farmers in research and allowing divergent methods of experimentation definitely are a good starting point. Of course, we recognize that each new replication of our model must be customized to local conditions. Yet some of the general principles we have touched upon in this case stand no matter what the local context. For instance, it is only when you have the general picture (such as results from meta-analyses), that you can break it down to the local level again.

Thus, it is our suggestion that International Agricultural Research for Development (IAR4D) needs to reinvent itself. If we are to bring our interventions to scale in order to create impact, we need a paradigm shift: IAR4D has to become IAR-*IN*-D, that is, International Agricultural Research-*IN*-Development. What is IAR-IN-D? It is a process of embedding scientific research in economic development by shortening the feedback loops that are inherent parts of innovation cycles, and involving farmers in real-time research and impact analysis. We need to honour the complexity of the systems we are dealing with through the research design of our projects. Social and natural sciences need to be integrated not only in our activities, but also in new forms of educational institutions. This direction is not only appealing to donors, but also to farmers, who can, at last, discover, enjoy and benefit from the process of IAR4D.

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Appendices

Appendix 8.1 Precipitation of phosphorous ions under alkaline soil conditions

The form in which free P ions in the soil solution occur depends on the pH. At pH levels below X you find PO_4H_3, at pH levels between X and X you find $PO_3H_2^-$, at pH levels between X and X you find PO_3H^{2-} and at pH levels above X you find PO_3^{3-}. Under the soil conditions described in this case study, you mostly find PO_3H^{2-}. These ions can be bound to free Ca^{2+} ions which are also found in the soil solution under alkaline conditions. If this happens, $CaPO_3H$ is precipitated, a process called "precipitation" (Hopkins and Ellsworth, 2005; Dick, 2007). For further information on P dynamics in the soils consult Marschner (2012).

Appendix 8.2 Details about case study stakeholders

In 1991, the Swiss yarn trader Remei AG and the Indian spinning mill Maikaal Fibres (India) Ltd. initiated the Maikaal bioRe® organic cotton project. What had started as a non-commercial experiment to help cotton producers find a way out of debt and secure a sustainable livelihood has meanwhile developed into an enterprise that joins social responsibility and ecology with economic profit. Maikaal bioRe, these days known as bioRe® India Ltd., has grown to become one of the largest and most well-known organic cotton projects worldwide, with more than 5,000 smallholders (figures year 2012–13) producing organic cotton and other organic commodities. bioRe distributes the needed inputs (e.g. seeds, organic fertilizers, pesticides, biodynamic preparations, etc.) to its farmers and purchases their cotton which is subsequently processed in bioRe's own modern ginnery.

Besides the commercial body of bioRe, the non-profit organization bioRe Association is an NGO that runs several social projects. These include a center for training and education that provides extension to local farmers and carries out research. The association also provides credit to farmers in order to promote infrastructure development (e.g. drip irrigation, biogas facilities, etc.).

Manjit Singh Dang represents the small-scale farmers associated with bioRe. bioRe assures market access for its farmers by a five-year purchase guarantee with a premium price of 15 percent for organic quality. In addition, Manjit and his fellow farmers regularly receive training in organic and biodynamic farming and participate in the ongoing research activities of bioRe Association.

In its early days, bioRe did not engage much in research due to the non-commercial nature of the initial project, and the subsequent direction towards sourcing of organic cotton aiming at the buildup of a steady supply chain. However, the need to engage in research became increasingly evident when the impacts of *Bt* cotton introduction started to become manifest. Subsequently, a close collaboration between bioRe and the Research Institute of Organic Agriculture (FiBL) was established. FiBL is the world's leading research institute on organic agriculture.

Following the chain of the White Gold, the Swiss yarn trader Remei AG exports and processes it into trendy clothing and other cotton products, many of which are sold by upmarket brands including "Naturaline" of Coop, the biggest retailer of organic products in Switzerland.

Notes

1 www.systems-comparison.fibl.org/
2 www.bioreassociation.org
3 FYM is stored in a shallow pit whose interior is covered with a thick foil. The pit is covered with a polythene sheet and the ground is slightly sloped in order to collect the effluent.
4 Funded by the Mercator Foundation Switzerland: www.greencotton.org/?lang=en

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