REGENERATIVE AGRICULTURE TO PROTECT PAKISTAN'S SOILS, ITS WATER, AND ITS BIO-DIVERSITY: THAL INDUSTRIES AND ITS DRAWDOWN FARM

Regenerative agriculture to protect Pakistan's soils, its water, and its bio-diversity: Thal Industries and its Drawdown Farm

As Pakistan wakes up to the degradation of its soils and the loss of bio-diversity crucial for its agriculture, Thal Industries has taken the lead in demonstrating how regenerative agricultural practices can address environmental challenges and protect our soils, our water, and bio-diversity while improving agricultural productivity. Thal's Drawdown Farm helps shatter the myth that regenerative agriculture cannot show results in the short-run and requires major financing.

Thal Industries has long been a leader in the sugarcane industry and has been working on innovative solutions in Southern Punjab in harsh climatic environments. In these tough environs, Thal Industries established Drawdown Farm at Rahimabad, a regenerative farm on more than 500 acres, exemplifying a pioneering approach to agriculture in Pakistan's Thal Desert. Initially focused on sugarcane cultivation amidst challenging environmental conditions, the farm underwent a transformative journey towards sustainability and resilience. By integrating practices like holistic planned grazing, intercropping, and transitioning to organic methods, Drawdown Farm not only improved soil health and saved water but also significantly enhanced crop yields and biodiversity. Practices such as planting hedgerows, using fungally dominant compost, and developing their own biofertilizers and bio-stimulants has resulted in massive improvements in crop yields, resulted in cost savings, and improved the overall farm ecosystem marking Drawdown Farm as a beacon of sustainable farming practices and innovation in Pakistan.

What is regenerative agriculture?

Plants require holistic nutrition in the correct forms, delivered at the right time, rates, and ratios, combined with active soil microbial communities comprising beneficial bacteria and fungi. When these conditions are met, the results can be astonishing. There are numerous examples worldwide where regenerative agricultural practices have significantly improved yields and reduced costs due to decreased reliance on synthetic inputs. In Pakistan, the situation is dire; the average organic matter content in soils is around 0.3%, with some areas having no organic matter at all. Ideally, soil organic matter should be at least 2%, with good quality soils containing 4% or more. In the wake of climate change disasters and increasing carbon emissions into the atmosphere, regenerative agriculture is also an answer to help sequester carbon. On a global level, it is estimated that if half of all global farmland adopted regenerative practices, it could help sequester excess atmospheric carbon back into the soil, where it belongs.

Contrary to popular belief, organic farming does not necessarily result in lower yields compared to conventional agriculture. Regenerative agriculture encompasses a variety of approaches, much like renewable energy includes solar, wind, hydroelectric, and tidal power (among others). However, unlike a power plant that typically utilizes a single type of energy, a regenerative farm can integrate multiple systems to enhance soil health, biodiversity, conserve water, and overall farm productivity. While one tool may be long gestating, there are many solutions that show very quick results. This case study shows examples of different tools on various crops at Drawdown Farm taken by Thal Industries and their quick yielding results.

The global context for regenerative agriculture

Over the last 60 years, agricultural output has dramatically increased worldwide, largely due to the widespread adoption of synthetic fertilizers and high-yielding seeds. However, this progress has come at a significant cost to the health of our soils, of ecosystems, and ultimately, of human health. Numerous studies indicate that the nutritional quality of staple crops like rice and wheat has declined over the past half-century, ranging between 20% to 70%. Concurrently, there has been an alarming increase in toxic elements such as heavy metals and microplastics in agricultural produce. This degradation of nutritional integrity poses a serious risk to public health and undermines the long-term sustainability of our food systems.

Globally, pesticide use has surged by 60% over the last 30 years. Paradoxically, pest attacks have also risen sharply during this period. Pesticides, which are often non-selective in their impact, have devastating effects on local biodiversity. In the past 25 years, Europe has experienced a 75% decline in its insect population, a phenomenon that scientists largely attribute to the pervasive use of pesticides. This excessive reliance on synthetic chemicals has also disrupted soil biology, decimating the micro and macro-organisms that are crucial for nutrient cycling and soil health. Without these organisms, the soil food web collapses, leading to further declines in soil fertility and crop productivity.

Regenerative agriculture encompasses a variety of practices aimed at restoring and enhancing the health of the soil. Some core practices include the use of cover crops (to protect the soil from erosion, increase organic matter, and provide a habitat for beneficial insects), crop rotation (to break pest and disease cycles, improve soil fertility), integration of livestock (to naturally fertilize the soil with their manure), minimal tillage or no-till farming (to reduce soil disturbance and to preserve soil structure), intercropping, composting, integrating trees and shrubs, and many other such practices, all geared towards enhancing the health of the farming ecosystem.

Why did Thal Industries pursue regenerative agriculture?

Thal Industries has long been a leader in the sugarcane industry, working closely with farmers to provide extension services and help them improve their agricultural practices. Thal has a history of innovation, having introduced sugar beet farming in Pakistan and installed a sugar beet processing facility, which has

resulted in better sucrose recovery and is a model for others to follow. Sugar beets also require less time on the land and consume less water than sugarcane, offering significant benefits for farmers and the environment alike.

In response to increasing climate challenges, Thal Industries began experimenting with regenerative agriculture in 2016. Thal established Drawdown Farm at Rahimabad Estate in District Muzaffargarh, near Head Lanju, within the Thal Desert. The name Drawdown Farm hints towards regenerative agriculture's potential for carbon sequestration. The farm is currently on more than 500 acres. Before adopting regenerative practices, the farm primarily grew sugarcane and had some mango and citrus orchards, along with small areas dedicated to fodder crops and wheat. Some portions of the farm were left barren due to harsh climate conditions and unproductive soils. Since 2016, Thal Industries has been transforming this landscape through regenerative practices into a more productive and sustainable agricultural system.

The philosophy at Drawdown Farm emphasizes the integration of modern technologies, such as center pivots, drip irrigation systems, and drones, with regenerative practices. For example, Center pivots use 50-60% less water for sugarcane compared to the conventional flood irrigation method. And drones can apply bio-stimulants and biological inoculants, which not only increase crop yields and resilience to pests but also enhance the plants' photosynthetic capacity, leading to larger leaves, longer roots, and a more robust soil food web. The denser the soil food web is in terms of bacteria, fungi, and nematodes, the better as all of it becomes carbon (poops and dead matter) and builds the soil.

The Drawdown Farm journey

Adopting regenerative agriculture practices as a holistic approach to farming was a learning curve for Thal Industries as they were drawing on the experiences of experts from other countries who have practiced regenerative agriculture for years. The farm staff had to unlearn traditional farming methods and embrace new techniques. The initial steps included installing center pivots on previously barren parts of the land. The farm now has three center pivots growing sugarcane and has also added drip lines to the orchards. Additionally, the farm began producing its own fermented biologicals, such as fish hydrolysate and compost extracts, which can be fertigated (i.e., liquid fertilizer delivered through the irrigation lines) and sprayed on crops. The main purpose of adding these products is to fulfill the micronutrient requirements of the plant for healthy growth.

A key focus has been building soil carbon to further reduce water requirements. Studies show that for every 1% increase in organic matter in the top six inches of soil, the soil can hold an additional 27,000 gallons of water per acre. This approach could create natural reservoirs of water in soils across Pakistan, maintaining soil performance during droughts and preventing farm flooding during heavy rains. Thal also started adding mulch to improve moisture retention and prevent soil degradation. Evidence from a study in Peru showed that mulched sections of an orchard on drip irrigation consumed 40% less water compared to un-mulched sections. Mulch also suppresses weeds and increases soil organic matter as it ultimately degrades and becomes part of the soil.

Among the several regenerative practices adopted at the farm includes the planting of hedgerows and trees around fields to increase biodiversity and foster beneficial insects. Although there are no studies on this topic in Pakistan yet, a UK study showed that every dollar invested in hedgerows yields a fourfold return. These hedgerows also provide leaves for composting and attract pollinators and beneficial insects. Recently, Thal Industries planted chilies on the farm, a crop that conventionally requires pesticide applications every 7 to 10 days. However, due to the presence of beneficial insects and healthier soils, no pesticides were needed for the entire seven-month crop cycle, saving approximately thirty-five to forty thousand rupees per acre compared to conventional farms growing chillies.

A product used commonly enough in regenerative farming is bio-organic phosphate (BOP) for which there is a regulated standard by the government as well. However, there is a huge range of quality of BOP available in the market. To address variability in the quality of BOP available in the market, Thal Industries developed its own biologically enhanced BOP. It is made from rock phosphate and nitrogenous organic materials and includes other materials like microbial inoculants and pH regulators.

A trial of this proprietary BOP was conducted on a silage maize crop, utilizing three trial plots on the same center pivot at Drawdown Farm. One-third of the plot received only the recommended dosage of DAP, another third was treated with only BOP, and the final third received a mix of half-dose DAP and BOP. All other fertilization practices remained consistent across the plots, with the only variation being the phosphate treatments. The results were remarkable: the plot that received the mixed dosage of DAP and BOP achieved a 21% higher yield compared to the DAP-only plot, and at 33% lower cost!

Encouraged by these results, Thal Industries selected a similar product from Australia and conducted trials on a sugarcane farm managed by a progressive farmer who supplies cane to their sugar mills. This farmer, already achieving high yields of around 1100 maunds per acre, saw his yields increase to approximately 1350 maunds per acre with the introduction of the new product. This significant improvement underscores the potential of integrating innovative regenerative products into conventional farming practices.

Intercropping

Another common regenerative practice is intercropping, which reduces competition for soil nutrients, increases soil cover, and enhances microbial diversity. However, the choice of crops for intercropping must be made wisely so that the crops do not compete with each other. At Drawdown Farm, sunflowers were intercropped with sugarcane, and the results showed a significant improvement in the sugarcane crop. Sunflowers were also grown as a monocrop in a trial, and the intercropped sunflowers were found to perform significantly better. A rough calculation indicates that if 50% of Pakistan's sugarcane crop were intercropped with sunflowers, yielding an average of 25 maunds per acre, the country could produce an incremental 525,000 tons of sunflower oil. This would be a substantial benefit, considering Pakistan imported $3.6 billion worth of edible oil last year.

All of the orchards at Drawdown Farm are now completely organic and regenerative, with no synthetic inputs. The farm manages pest pressure by improving plant health, supporting French scientist Francis Chaboussou's theory that healthy plants can be immune to pests. This approach has been particularly successful in the sweet lime orchard, where the quality and taste of the limes has improved significantly and the production has increased by 50%.

To integrate livestock into regenerative agriculture, Drawdown Farm implemented a trial on a ten-acre plot with a sprinkler irrigation system, growing multi-species perennial and annual grasses like Rhodes grass and Mombasa grass, mixed with herbs. The sandy soil, initially with almost no organic matter, was transformed through holistic planned grazing. In this method, animals are clustered together in one area and allowed to graze only that specific part. Once the animals have grazed the land, they are moved to another paddock. This rotation allows the initial paddock to regenerate before the animals return. By grazing in this manner, the grass is not eaten down to the roots and is given enough time to recover, enabling rapid regeneration. The animals also contribute to soil fertility through their manure and urine. Adding compost or other soil additives can further accelerate this process. As a result, the ten-acre plot's desert sand turned into deep, chocolate-colored brown soil.

Another fundamental principle of regenerative agriculture is increasing biodiversity by integrating multiple crops. Drawdown Farm aimed to grow bananas in certain zones to enhance biodiversity, despite skepticism about their success in the harsh Thal Desert environment. Contrary to expectations, the banana plants thrived and grew healthily. Similarly, a ginger trial was conducted this year. Ginger requires soil rich in organic matter, so it was grown under black shade tunnels in soil enriched with fungally-dominant compost. This attracted native earthworms, whose castings further enriched the soil. Earthworms also naturally till the soil, creating tunnels that allow air and water to reach plant roots. Since ginger is mostly imported in Pakistan, this successful trial demonstrates the potential for local cultivation, contributing to import substitution.

Cost-saving

Thal Industries is also exploring other cost-saving measures. One such trial involves growing sugarcane from seedlings instead of cane sets. Trials have shown that growing sugarcane from seedlings can reduce costs by 60%. This method is advantageous for both mills and farmers, as the land typically used for growing cane seeds can be utilized for more sugarcane production.

A recent study by the Boston Consulting Group on regenerative agriculture globally highlights the need for processor companies to support farmers initially, as it takes a few years for the results to materialize. However, the study does not consider the diverse regenerative tools available, each with different gestation periods. The transition strategy of each farm determines the outcomes. Many regenerative tools provide higher yields and cost savings from the outset. An analogy can be made to a chronically deprived human being who sleeps 4 to 5 hours a day, and consumes unhealthy food, and who suddenly starts consuming healthier food, sleeps better, and starts exercising. A massive change can be observed

in the physical and mental health of the person in just a few days even as some of the strategies employed for improving this person's health take their time to show results.

Future outlook

Implementing regenerative agriculture at Drawdown Farm is a constant learning exercise, requiring continuous adjustments to find the right fit for the farm's unique conditions. For instance, the compost used so far has been predominantly bacterially dominant, which is not the ideal option for the farm. A fungally-dominant compost is preferred and the farm is working to produce it. This illustrates a key challenge for regenerative agriculture in Pakistan: while the products underpinning what is now considered conventional agriculture (e.g., chemical fertilizers, pesticides, weedicides, etc.) are readily available from reputable manufacturers and agents, the products that can underpin regenerative agriculture in Pakistan are generally not available.

To address this challenge, Thal Bio Ag Corporation, a subsidiary of Thal Industries, is set to bring its products to the wider market, aiming to assist all kinds of farmers in improving their yields. The company will offer three main categories of products: bio-fertilizers, bio-stimulants, and microbial inoculants. These products are designed to enhance soil and plant health, leading to better yields while promoting sustainable farming practices.

The farm team members are constantly expanding their knowledge about the type of nutrition to give to plants and the best methods for delivering it. In addition to improving soil and plant nutrition, the farm is focused on increasing tree cover by planting more and more trees. Several studies indicate that increased tree cover can influence rainfall patterns, and in line with this, a two-acre Miyawaki forest is being planted on the farm. This initiative aims to create a dense, native forest that can contribute to the local ecosystem and climate resilience.

Drawdown Farm by Thal Industries represents a transformative example of how regenerative agriculture can mitigate environmental challenges and protect our soils, water, and bio-diversity while improving agricultural productivity. Through innovative practices and continuous learning, the farm has not only revitalized soil health but also diversified crop production and enhanced sustainability. By introducing methods like holistic grazing, intercropping, and biological inputs, Drawdown Farm sets a precedent for sustainable land management in Pakistan. The biggest myth that this example shatters is that regenerative agriculture cannot be successful from the onset and that it needs to be financed. Some of the low hanging fruits like the use of bio-fertilizers and other such inputs can provide immediate returns. Thal Industries and Drawdown Farm made a major national advance for regenerative agriculture by seeding the launch of the Pakistan Alliance for Regenerative Agriculture at Pakistan Agricultural Coalition's Agri-Connections 2024 event at Lahore Expo Center in April 2024. As they prepare to introduce their agricultural products to wider markets, Thal Industries is poised to further advance sustainable farming practices nationwide, contributing to a more resilient and productive agricultural sector.