One Step Ahead with Sustainable Agriculture

Nossa Senhora Aparecida – Brazil

Bayer Forward Farming

Sustainable production,
generation after generation

The Fiorese family has been devoted to farming for generations. Today, Kaio and Henrique work with their father, Oli, to produce soybeans, corn, field beans and wheat at Nossa Senhora Aparecida, a farm of 2,700 hectares in Goiás, a state in the heart of the country. But the Fiorese family's passion for agriculture goes further back. Their ancestors emigrated in the last century from Italy to the fields of Southern Brazil. Later in 1995, Oli himself accompanied his father on a risky adventure to produce grains in the Brazilian Cerrado.

Prospering in this new position demanded passion from Oli, his wife Edileusa and their two children. "Everything was different. The dry climate was an obstacle for soybean production, and the soil had a high clay content, so we had to adapt to a larger cropping scale, which requires a different management," says Oli. For the Fiorese family to succeed in this mission, it was essential to adopt new agricultural technologies.

Today, the family invests in sustainability to achieve maximum productive capacity. "We want to produce on this same land for the next 300 years. Since 2016, we've been partnering with Bayer ForwardFarming on innovative solutions, technical support and cutting-edge technology," says Oli. "To address climate challenges, our strategy is to monitor the weather digitally and in real time. With the collected information. automated irrigation is implemented only in the fields when necessary."

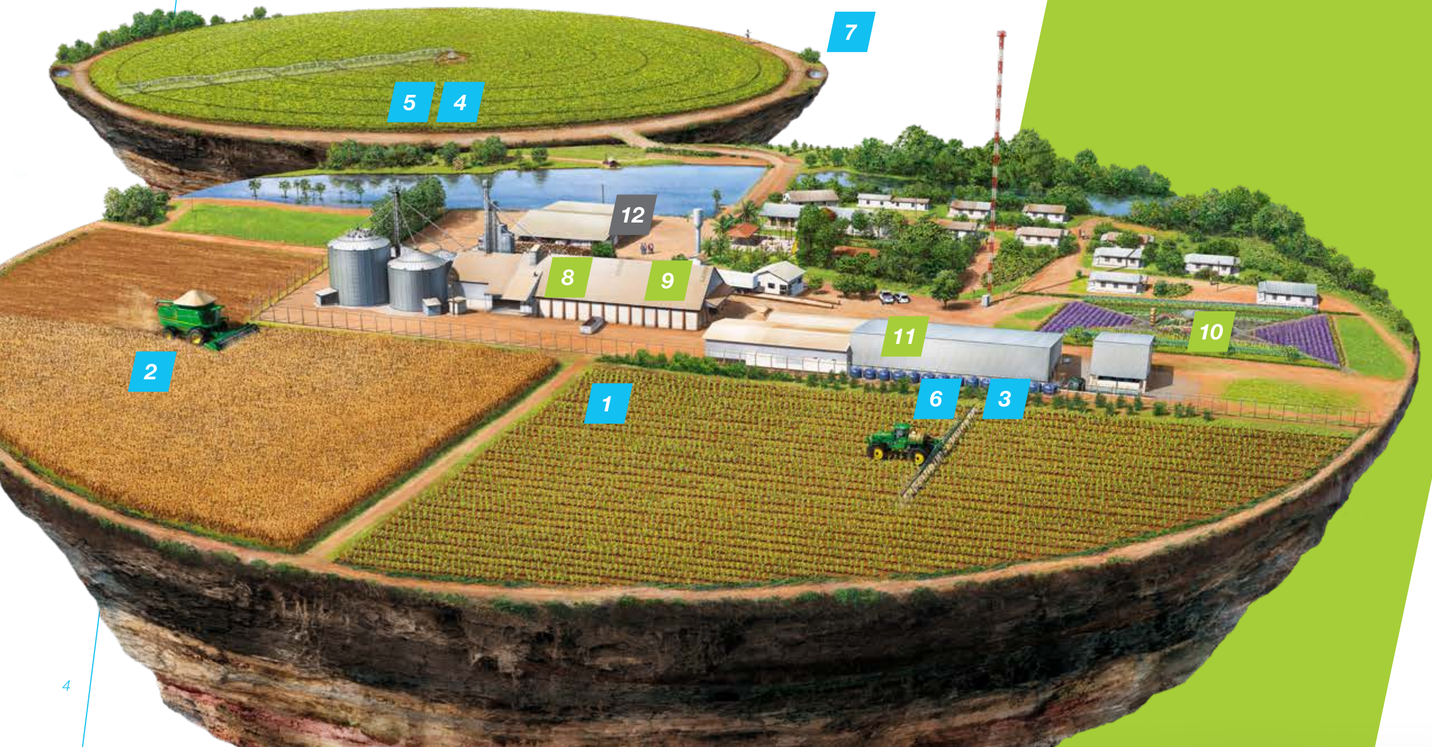
The soil is also managed very closely. We apply specific fertilizers and have adopted the practice of no-tillage on corn stubble, which leaves the earth less exposed and preserves moisture. In addition, rainwater catchment basins serve a dual function: they protect the soil from erosion and fill up the ground water table. By using genetic, chemical and biological resources, our seeds have been performing better and better. Finally, to control pests and weeds, we use the most modern and efficient crop protection products.

"Innovative solutions are fundamental to sustainability, but there is another essential aspect when it comes to technology in the field: caring for the environment," says Oli. He is referring to the 120 hectares of native forest within the farm that is home to several species of pollinators, including the bees that are carefully monitored by the Bee Care project. "The biggest legacy of our partnership with Bayer, in addition to preserving the environment, is the transformation of all farm employees into guardians of biodiversity."

"We are committed to achieving maximum productivity in a socially and environmentally-sustainable way."

Oli Fiorese, farmer and owner of Nossa Senhora Aparecida

Sustainable Farming at
Nossa Senhora Aparecida



Farm Profile

Location:
Nossa Senhora Aparecida, Goiás.

History:
Oli Fiorese, his wife Edileusa and their two children arrived to the Brazilian Cerrados in 1995. There, they have continued the agricultural traditions of their family.

Farming Land:
Red latosol with a high clay content and medium iron content – a typical soil of the Brazilian Cerrado.

Crop:
Soybean, corn, field beans and wheat.

Partners:
M Prado, Unigeo, HP Agroconsultoria, Consultoria João Dantas, Agroexata, Icrop, Aliança da Terra, Conectere Agro e Allez.

Key Elements

1 *Seeds*
Creating value by using high-quality seeds and technologies that support the farmer to increase productivity and being more productive in a sustainable manner

2 *Soil Fertility*
Improving soil fertility by optimizing crop rotation practices to achieve high, sustainable productivity.

3 *Integrated weed management*
Identification and mapping of weeds and implementation of integrated weed management programs to limit proliferation.

4 *Integrated disease and pest management*
Implementation of techniques to monitor disease and pest outbreaks as well as making cropping recommendations to optimize a more sustainable use of crop protection products.

5 *Nematode monitoring and control*
Mapping of nematode infestation and crop damage as well as giving recommendation for integrated chemical and biological control to avoid productivity loss.

6 *Digital farming*
Use of precision farming techniques and tools like Climate FieldView™ to maximize yields and optimize farming tasks and inputs.

7 *Erosion control*
Drainage basins along the road are used to capture water runoff to fill the groundwater aquifer, preventing erosion and avoiding pollution of lakes and reservoirs with eroded soil.

8 *Stewardship*
Trainings aim to help the farmer apply agricultural products in a responsible manner, protecting people, preserving the environment and improving the crop.

9 *Valore program*
Farm certification program specifying production processes that follow legislation to ensure food safety, adding value to the value chain and competitiveness of the Brazilian farmer.

10 *Pollinator care*
Preservation of pollinators on the farm with conservation measures and harmonic coexistence between farming and beekeeping.

11 *Water protection*
Phytobac®: sustainable management of the water used to clean equipment in a process that biologically breaks down crop protection product residues.

12 *Partnerships*
Bayer ForwardFarming combines knowledge, experience, skills and new technologies with partners to grow the farming business successfully and sustainably.

Tailored Solutions | Proactive Stewardship | Partnerships

A bountiful harvest begins
with good crop cultivation

At the beginning of spring, in September in the Southern hemisphere, is when the harvest season for corn starts at Nossa Senhora Aparecida. Then, while the corn stubbles still cover the ground, soybean planting begins. This technique is called no-tillage and aims to keep the soil surface protected to preserve its moisture and nutrients. This strategy prevents the soil from being exposed to the sun and rain, which is common and continuous at this time of the year.

Between harvest and new planting of soybean, the Fiorese family's property also produces corn, field beans, and wheat. This uninterrupted production is a method of Brazilian agriculture that requires a lot of planning. To crop during the whole year and not exhaust the soil or natural resources, Oli Fiorese and his sons must be vigilant.

Planting corn, soybean and other crops in rotation is an essential strategy for preserving the soil's chemical, physical and biological characteristics. This practice also reduces the incidence and severity of pest attacks. Additionally, constant soil analysis provides the bases for better organic and mineral fertilization. "I take care of soil health as I care for the health of my family, because the land is the substrate for the whole crop. Weak soil health does not deliver productivity," says Oli.

Crop care continues after the seedlings have emerged. Anticipating weather patterns is critical in order to plan irrigation and optimize pest control and other operations. Pest monitoring is essential to ensure that plants achieve maximum productivity. This is a particularly challenging aspect of tropical agriculture. However, the Fiorese family has Bayer's support to make the best decisions, such as the right time to carry out chemical, biological and cultural controls.

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Oli Fiorese, farmer and owner of Nossa Senhora Aparecida

High quality seeds are the foundation *of an abundant harvest*

The Fiorese family harvests soybeans, corn, field beans and wheat in large quantities. “To achieve this performance, our work begins with the right choice of certified seeds to ensure high-quality crops,” says Oli. Buying quality seeds assure growers stable characteristics to maximize yield.

For field beans and wheat Oli uses seeds improved by scientists through numerous rounds of cross-breeding that have resulted in obtaining varieties adapted to the specific conditions of the region.

Farmers and scientists have long been using traditional plant breeding to create plants that have beneficial characteristics, like drought tolerance. In the 1980s, scientists began using biotechnology, a method of transferring genes directly into a plant without the long process of trial and error. This technology enables plant scientists to identify a potentially beneficial gene, make a copy of the desired gene, and insert it into another plant. These plants are called genetically modified organisms (GMOs) and undergo years of testing to ensure that they bring value to farmers and are as safe as their non-GMO counterparts.

This technology has helped plant scientists develop very specific seed products that are insect resistant and tolerant to crop protection products used to control weeds.

Among the crops planted at Nossa Senhora Aparecida, soybeans and corn have transgenic seeds available in the market. The Fiorese family’s search for excellence in farming has made science the ideal partner for an abundant harvest. In soybeans, INTACTA RR2 PRO™ technology combines three solutions into a single seed: productivity at an unprecedented level; glyphosate herbicide tolerance and protection against the main caterpillars that attack the crop.

And the benefits of this technology are not restricted to the farm. This is because the INTACTA RR2 PRO™ enables an optimized use of herbicides and insecticides and the adoption of sustainable farming practices such as no-tillage. Without the need for as many inputs, Oli and his family are able to reduce the amount of fuel and water used. “Genetically modified soybeans improve our productive potential and help us to farm sustainably,” says Oli.

The Fiorese family uses the corn hybrid VT PRO™ 3. VT PRO™ 3 is the first transgenic seed technology that protects the root against pinworm larvae and the leaves against major pests. Hybrids with VT PRO™ 3 technology are also tolerant to glyphosate.

The use of transgenic, herbicide-tolerant seeds fits well with no-till practices, bringing benefits to the farmer and the environment. Since herbicides for weed control can be applied after the crop has emerged, it is possible to sow into the stubble of the previous crop. This conservation technique allows the soil to be less worked, preventing erosion and compacting, preserving the natural soil moisture and reducing the release of carbon dioxide.

“At our farm, we plant the INTACTA RR2 PRO™ soybean because, besides having a great productive potential, it is a technology that helps us to farm sustainably.”

Oli Fiorese, farmer and owner of Nossa Senhora Aparecida

“Combined solutions such as the adoption of transgenic seeds and the responsible use of chemical, biological and cultural crop protection methods, together with the constant monitoring of pests and diseases are our tools for achieving productivity above the national average.”

Kaio Fiorese, agronomist and the youngest son of the Fiorese family

Weed, disease and pest control:
challenging in many ways!

“Those who see our performance cannot imagine the difficulties we have to overcome to produce in a tropical climate!” says the agronomist Kaio Fiorese, the youngest of Oli’s sons. Kaio is referring to the complex management of pests, weeds and crop diseases at the farm. With successively producing crops such as soybeans and corn, there is always a crop in the field. While beneficial, this also creates an ideal environment for pests to develop. “In temperate countries, winter works as a natural method of controlling insect pests and invasive plants. Here, the seasons of the year are not so extreme and we need to rely on science and technology to control the pests,” says Kaio.

To prevent insect attacks from compromising crop yields, the strategy begins even before sowing. The Fiorese family treats their seeds with chemical products that protect the plant even before it sprouts. But, as Kaio highlights, this is only the start. After the crops germinate, various insects feed on the leaves especially *Anticarsia gemmatalis, Chrysodeixis includens* (soybean looper) and the *Helicoverpa armigera* (cotton bollworm). The latter also attacks corn, along with the *Spodoptera frugiperda* (fall armyworm). An advantage in common for all these pests is that the family can rely on the protection offered by the transgenic, insect resistant (Bt) seeds.

For pests that are not controlled by Bt technology, Kaio uses chemical and biological agents. “Bayer offers a broad portfolio of products for plant defense, and we apply them only when pest monitoring indicates the need, strictly following product instructions and field worker protection procedures,” says Kaio. This same practice is also used to treat or prevent crop diseases such as soybean rust, which is caused by a fungus.

The challenges do not stop there. Invasive plants also need to be controlled, as they compete with crops for natural resources and can cause serious damage to productivity. That’s when herbicides come in. The use of these products, combined with the adoption of herbicide tolerant transgenic seeds, gives the farmer more flexibility and contributes to the high productivity of Nossa Senhora Aparecida.

Rational water use

Water:
a precious resource

With climate change, variations in the rainy season are expected in different regions. As a result, access to water may be compromised in many places. The availability of this natural resource is of such importance that the United Nations (UN) has established a specific Sustainable Development Goal (SDG) to address the issue: SDG 6, "Clean Water and Sanitation". The Brazilian Cerrado, where Nossa Senhora Aparecida is located, is called the cradle of the waters. This biome occupies about a quarter of the Brazilian territory, and despite not having any large rivers, the area has a concentration of springs that feed 8 of the 12 major Brazilian hydrographic regions. This is why the Fiorese family strives to be extremely efficient with water use.

Irrigation – rational water use

Technology enables water use in agriculture to be optimized. On his farm, Oli closely monitors climate, soil and plant condition data to irrigate only when necessary. Decision-making happens field by field and takes all of this data into consideration. Thus, while one part of the farm might require irrigation, another part might not due to being in a lowland region. In this manner, the family re-affirms its commitment to preserving water resources.

Rain water management

Preserving water implies using it efficiently, but also making the most out of rain. "To do this, we use a simple but very efficient tool for storing water: the catchment basin," says Oli. The basins are distributed along the roads of the farm and function as reservoirs that accumulate rainwater. The positive effects are diverse. First, the basins avoid water runoff and soil and nutrient loss in areas with steep slopes. In addition, they allow water to gradually penetrate the ground to fill up the region's groundwater reservoirs.

Preserving biodiversity: *a matter of care*

"The bees are back!" celebrates Edileusa, Oli's wife. One of the bees' favorite places is an area of 120 hectares of native, preserved vegetation. Since agriculture can repel these insects, Edileusa knows that the presence of bees indicates that Nossa Senhora Aparecida was successful in preserving their habitat.

Bees and birds are important pollinators and are an important cornerstone to biodiversity. Besides contributing to the reproduction of several species of plants, bees collect pollen to produce honey. Bees function as an indicator to know if good practices are being implemented well, and therefore their appearance is a source of joy for the Fiorese family.

"Before partnering with Bayer ForwardFarming, we didn't know exactly how to apply the concepts of sustainability in practice. Today, we are guardians of biodiversity in the Cerrado and we promote the ideas and procedures that preserve the local fauna and flora," reveals Henrique Fiorese, the family lawyer and eldest of Edileusa and Oli's sons.

One of the practices that Henrique refers to is the proper use of crop protection in order to protect bees and other beneficial insects. In addition, with the help of the Bayer Bee Care Center, there are proactive actions aimed at attracting and settling pollinators in the area. For example, one year after establishing bee hotels and beehives for *Apis mellifera*, it was verified that beehive bees remained, and the hotels were occupied by different bee species. Monitoring conducted by project partner specialists confirms the diversity of pollinator species at the farm.

Today, we know that several factors can harm the health of these pollinators. Finding solutions will not be an easy task, but Nossa Senhora Aparecida is committed to contributing. The measures adopted preserve not only the health of bees and the harmonious coexistence between beekeeping and agriculture, but also enable the conservation of plants and animals of the Cerrado.


Bee hotel


Preservation areas

"Before we started the Bayer ForwardFarming project here at the farm, we didn't know exactly how to apply the concepts of sustainability in practice. Today, we are guardians of biodiversity in the Cerrado and we promote ideas and procedures that preserve the local fauna and flora."

Henrique Fiorese, the family lawyer and eldest of Edileusa and Oli's sons

Safety *first*


Safety

As with many activities, the use of equipment and the management of crop protection products must be done with worker safety in mind. Therefore, Oli makes sure that all employees strictly follow safety rules. “In the past, some employees thought the safety measures were unnecessary. Today, however, safety is a top priority and custom at the farm.”

This means that every worker who prepares crop protection products for use, performs applications or is involved in any activity in which he may be exposed to these products needs to be properly protected with Personal Protective Equipment (PPE). After use, the PPE is also properly decontaminated.

The safety of the employees goes far beyond the PPE and the guidelines of how to work safely. Periodic medical monitoring of all workers is another good practice adopted by the Fiorese family.

Safety is also a word associated with the environment at Nossa Senhora Aparecida. Crop protection products are stored in an appropriate place built according to the strictest technical recommendations. After use, product packaging is appropriately washed and returned to the traders. In this reverse logistics system, the Fiorese family manages to dispose 100 % of packages appropriately, more than the already high Brazilian index of 94 %.

Agriculture and science *together for the planet*

At Nossa Senhora Aparecida, there is a constant need to increase productivity, manage large-scale production and manage climate change while preserving the environment. The variables are many, and partnerships are essential in ensuring that they are all being taken into consideration. “Our experience in the field and the cutting-edge technology brought by Bayer ForwardFarming, together, make it possible to advance sustainable farming,” says Oli.

This successful partnership brought with it even more partners. M. Prado helps to ensure that the farm is set-up as an enterprise that will continue to generate economic, environmental and social value. The Union of Independent Agronomists (UAI) provides specialized consultancy for soybean cultivation, providing fundamental analyses on nutritional balance, fertility and soil profile to ensure efficient pest and disease management.

Other alliances have also been formed. The farm is working with Agroexacta to treat smaller field areas of 3 hectares more precisely and with Patrulha Percevejo to monitor pests and make decisions about control techniques. Alianca da Terra helps to identify improvement opportunities for certification enhancements, while Icrop helps save energy and water. Finally, HP Consultoria helps the family in the area of pollinator and biodiversity maintenance.

“Collaborating with Bayer ForwardFarming has helped us farm even more sustainably. Our experience in the field, together with Bayer’s cutting-edge technology bring together the characteristics needed to achieve this goal.”

Oli Fiorese, farmer and owner of Nossa Senhora Aparecida

Innovation and sustainability

go hand in hand

Any farmer who wants to be competitive and sustainable must make use of innovative tools. It is this spirit that drives the Fiorese family. “Sometimes people come to talk to me or to my brother to congratulate us for the changes we’re bringing to the farm. They hardly know that the greatest enthusiast for technology is our father.” The statement is given by the eldest son of Oli, Henrique, and is accompanied by the approval looks of his younger brother Kaio.

Digital farming for a sustainable future

Nowadays, to increase productivity, preserve natural resources and ensure environmental protection, each small piece of arable land is analyzed individually. Digital tools, such as Climate FieldView™, collect information on different variables and help the Fiorese family assess their current situation. This contributes even further to a reduction in the impact of farming on the environment. Digital technology is the new revolution that is already changing the way we farm for the better.

New and improved ways to protect water

Water is essential for life and agriculture. Therefore, it is critical that this precious resourced is used responsibly. The Fiorese family takes this commitment very seriously and relies on Phytobac®, an innovative system that was developed to prevent water contamination by crop protection products. This tool biologically degrades residues of chemical pesticides present in the water used to clean agricultural machinery, personal protective equipment (PPE) and even product containers. The waste water is brought out over a special basin filled with a soil-straw mixture where the residues are degraded by bacteria. The process is the same as in nature, but Phytobac® allows it to happen in a more efficient and safe way.

Sustainable Agriculture

in practice

At Bayer ForwardFarms, farmers and Bayer experts demonstrate innovative solutions for sustainable agriculture that comprise three components:

// ***Tailored Solutions –*** Innovative products and services tailored to customer needs, including high quality seeds and traits, biological and chemical crop protection products and digital solutions. These solutions are backed by tailored services ranging from agronomic support, field demonstrations, diagnostics, and prediction tools to documentation.

// ***Proactive Stewardship*** to ensure product integrity (for seeds and crop protection products), protect human health, and preserve the environment. We offer training to raise standards of handling and usage, as well as to minimize any possible risks to human health and the environment.

// ***Partnerships*** to enhance the quality of life for farmers, communities, and society. Mutually beneficial partnerships that include all players in the value chain and help to leverage the potential for collaboration in modern agriculture.

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www.forwardfarming.com

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Contact

Bayer CropScience S.A.
Rua Domingos Jorge, 1100
04779-900 São Paulo – SP
Brazil

Claudia Quaglierini
Phone: +55 (11) 5694-4472
E-mail: claudia.quaglierini@bayer.com

www.agro.bayer.com.br

Farm

Fazenda Nossa Senhora Aparecida Oli Fiorese

Rodovia GO 118
km 68 à esquerda + 22 km.
Água Fria de Goiás – GO
Zona Rural
Brazil

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