



Modern silviculture operations,
opportunities and challenges –
Brazilian grower company
perspective.

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R&D – DEXCO, BRAZIL

DEXCO

deca portinari hydra duratex castelatto ceusa durafloor

DEXCO

We are Brazil's leading industrialized wood panel manufacturer, the Southern Hemisphere's leading sanitary ware maker, and one of the country's ceramic tiles top sellers.

DEXCO has been more than 70-years history

Since 2009, the company has been listed in B3's Novo Mercado (New Market), a testament to its high corporate governance standards. Additionally, since 2008, it has been listed in the ISE (Corporate Sustainability Index) portfolio, which goes to show our commitment to environmental and social responsibility matters.



BUSINESS AREAS

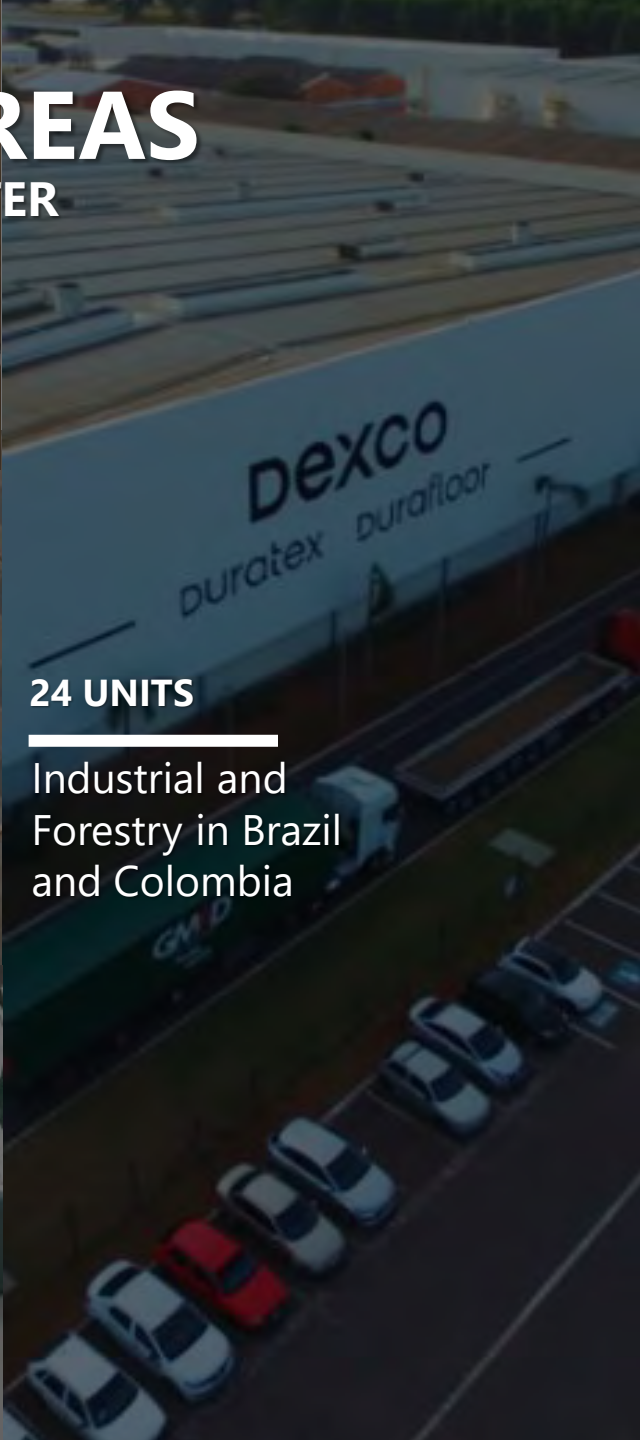
SOLUTIONS TO LIVE BETTER



3 BUSINESS DIVISION

Wood, Sanitary Ware and Ceramic Tiles

Deca portinari Hydra
duratex ceusa durafloor



24 UNITS

Industrial and Forestry in Brazil and Colombia

Caetex

Joint-Venture for eucalyptus management in northeast of Brazil

LD Celulose

Joint-venture with Austria's Lenzing to do water-soluble cellulose mill in Minas Gerais

DX VENTURES

Fund for investments in start-ups and scale-ups

WOOD BUILDING DESIGN
noah

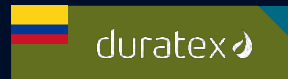
urbem

BRASIL
AO CUBO

Dexco

DEXCO | WOOD

GROUP COMPANIES



FORESTRY
EUCALYPTUS E PINES
3 INDUSTRIAL UNITS

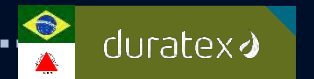


FORESTRY
EUCALYPTUS

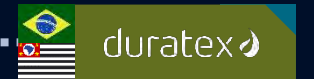


FORESTRY
EUCALYPTUS
WATER-SOLUBLE
CELLULOSE

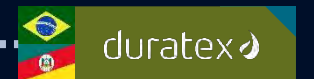
UNITS DURATEX



FORESTRY
EUCALYPTUS AND PINES
1 INDUSTRIAL UNIT



FORESTRY
EUCALYPTUS
2 INDUSTRIAL UNITS



FORESTRY
EUCALYPTUS
1 INDUSTRIAL UNIT



The forestry plantation sector in Brazil - 2023

10.2

Million ha of planted areas



4.92

Billion tons CO₂eq stored



33.7 m³/ha/year

average productivity at age 7



8,310

Species in forest areas



2.69

Million jobs



US\$ 22.6

Million invested in R&D



10.6

Million ha Certified



US\$ 12.7

Billion export revenue



6.91

Million ha of conserved areas



US\$ 7.3

Million invested in social projects



Wood demand scenario and lack of forestry labor: need for advancements in mechanization

New investments in the forestry sector (5 years)

US\$ 19,5 Bi

Increased wood consumption

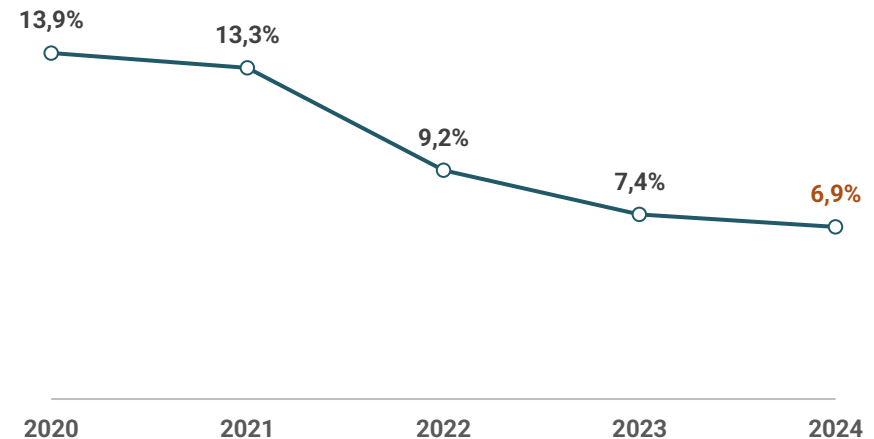
37Mi m³/year

Demand for increased planted area

1Mi ha

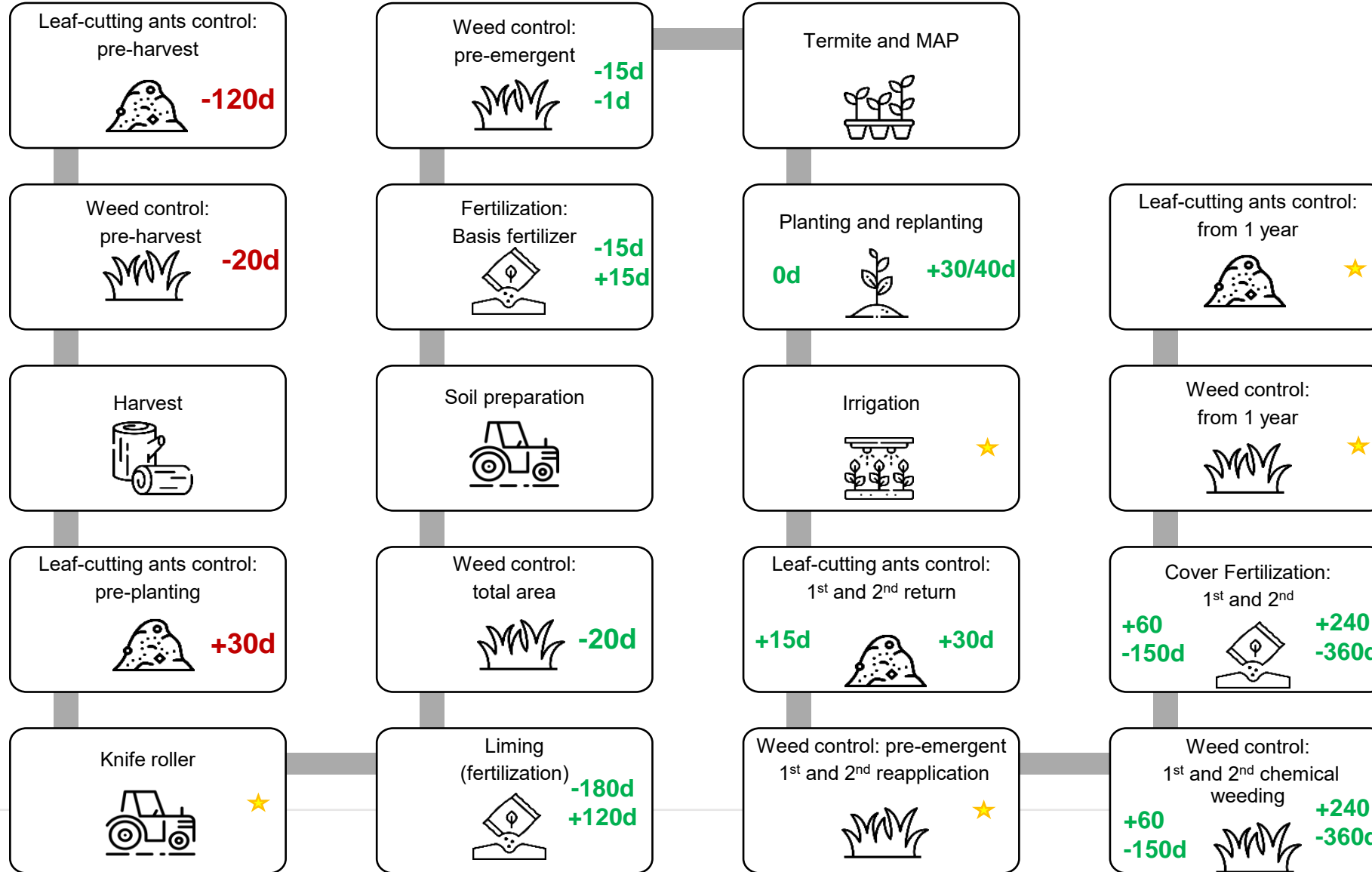


Reduction in unemployment in Brazil demonstrates lower availability of labor, especially in rural areas



Unemployment rate in Brazil (full employment)

Timeline of silvicultural activities

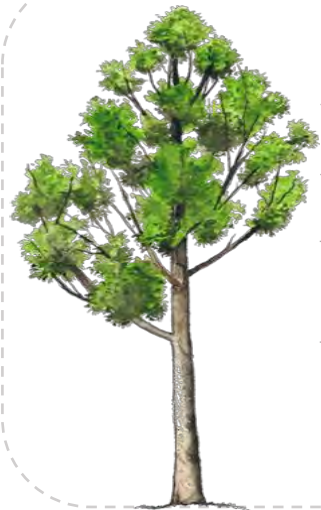


RECOMMENDATIONS' EFFECTIVENESS



Breeding

- Ensure the sustainability of the wood supply for the mill with high productivity and adaptability genetic materials.
- Improve the genetic materials diversity for different environments of the company;
- Develop new genetic materials aiming biotic and abiotic risks mitigation;
- Recommendation of a group of genetic materials that proportionate continuous gain for the mill.



Breeding program – 55 years

2024: 8 commercial genetic materials

Multiple uses of wood: Wood Sheet, soluble cellulose, engineered wood

Genetic variability – Field: 3879 Progenies / 1488 clones

Nursery: 37 Species / 2163 clones

Main species: *Eucalyptus grandis* and *Eucalyptus urophylla*

Strengthening of work with new species: *Eucalyptus longirostrata*

Selection of superior trees



Volume



Density



Water deficit and frost

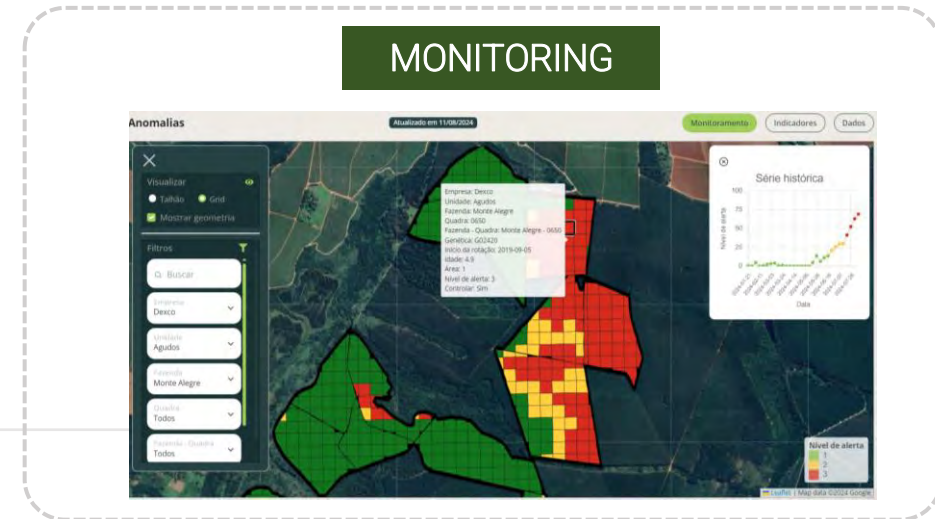
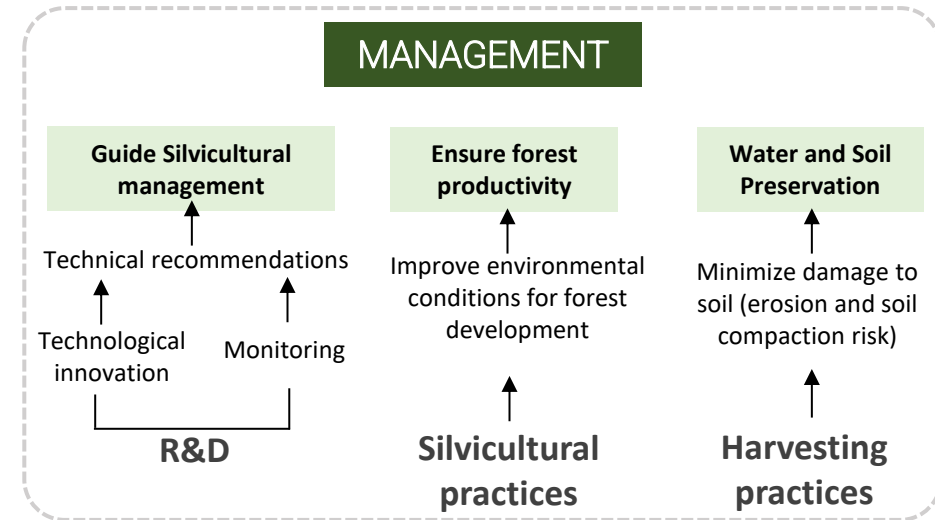


Diseases

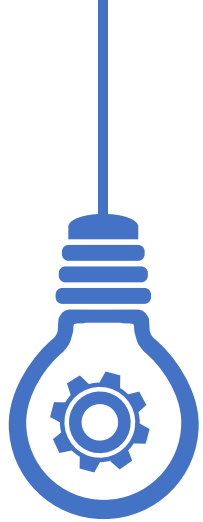
Forestry resilience to biotic and abiotic stresses

Biotic factors

Environmental factors

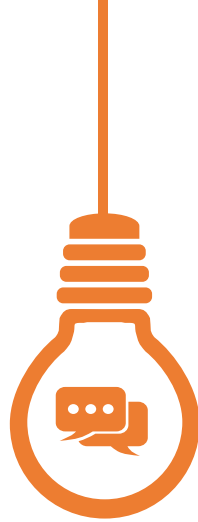


WORKFORCE TRAINING | Opportunities



Automation and Smart Machines

Opportunities for **specialization** and the **increased value of professionals** as a result of the introduction of **technological and automated machines**



Development of Soft Skills

For team managers, there is an opportunity to **develop leadership and people management skills**, which are essential for **operational efficiency** and team motivation



Sustainability and Innovation

Training in **sustainable techniques of forestry management** can not only improve productivity but also align operations with market demands for eco-friendly products



Distance Education

Online courses and **e-learning platforms** enable rural workers to **access quality training without needing to travel**, making training more accessible

WORKFORCE TRAINING | Challenges

01

Access to Training

Many rural areas face **connectivity and infrastructure issues**, making it difficult to access online courses

02

Resistance to Change

Professionals accustomed to traditional methods may **resist adopting new technologies and practices**. Addressing these concerns and promoting an innovative mindset is essential

03

Variety of Needs

Brazil is a **vast and diverse country** in terms of environment, culture, infrastructure, and operational reality. It is essential to **consider all these specifics** when thinking about training.

04

Talent Retention

Not only does the **migration of young people to cities** create challenges in retaining the workforce, but the **low attractiveness of rural work** is also due to technological advances and the creation of new jobs and specialization opportunities. This requires **retention strategies**, such as better working conditions and growth opportunities

05

Continuous Update

The **rapid evolution of technologies** requires professionals to not only be trained once but to be **continuously updated**. This can be challenging in terms of **resources** and time



WORKFORCE TRAINING

The importance of digital training for operational workers in the era of Industry 4.0

(Accenture, 2021) "Companies that invest in **technology** and digitalization are **3 times more likely to increase revenue and profitability.**"

"Digital world: the new scenarios for the job market."

"There are two major challenges for the transformation of work: first, a **numerical divergence between short-term job losses and long-term job creation.** Second, a **gap between the skill profiles required for the replaced tasks and those needed for newly created tasks.** This gap strongly justifies intensive training and skill development measures at all skill levels."

"Labor shortage and technology integration: challenges and opportunities for construction."

"The majority of construction companies continue to adopt **traditional building methods.** In this context, the labor shortage is even more evident. However, if you use **different technologies or innovative methods**—such as prefabricated components and light steel frame—you position yourself ahead. After all, **using an innovative technique or technology in construction makes it easier to attract and acquire specialized labor.** As long as you stay at the forefront of the market, this labor will not easily be taken from you," he analyzes.

This is very similar to what happens in forestry—hence the importance of advancements and investments in the **mechanization of forestry.**"

Eucalyptus sprout control

Technology and Mechanized silviculture activities to control eucalyptus sprouting

Total post-harvest herbicide application area



Description: Implement coupled to the tractor, has a 2,600L tank, a 10m bar, 20 tips and flow control system for land applications.

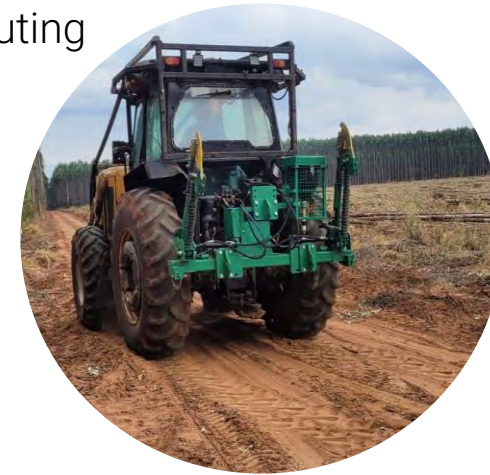
Performance: 1,09 h/ha.



Description: Self-propelled spray, has a 3,000L tank, 30m bar and flow control system for land applications.

Performance: 0,2 h/ha.

Spot application of pre-harvest herbicide



Description: Implement hitched to the tractor, has 2 knives at the ends that perform cutting and application of herbicide to standing trees. Can be combined with ant control and weed competition.

Performance: 0,6 h/ha.



Internal development



Soil preparation

Technology and mechanized silviculture activities to soil tillage

Autopilot and planting alignment



Objective: the tractor executes the planting lines autonomously using autopilot. The alignment is previously defined to optimize the effective planting area and roads.



Soil preparation on slopes areas



Description: Triple Rod Excavator for Subsoiling. Operates on slopes up to 30°.

Performance: 8 h/ha.



Description: Implement attached to the tractor for hole preparations. It has 2 rotating arms makes holes for planting. It operates on slopes up to 25°.

Performance: 4 h/ha.



We adopted the soil minimum cultivation, with the aim of avoiding the soil loss and maintaining the sustainability of forestry production.

Planters

Technology and mechanized silviculture activities to planting

Veltreeno (Novelquip Forestry + Ponsse)



Description: Buffalo forwarder with 4 heads with capacity for 960 seedlings for planting and 4 drills for preparing the pit. It works by covering 2 lines simultaneously, with autopilot technology and georeferencing of seedlings.

Operations and Performance: ✓ Pit preparation, planting and irrigation ✗ Fertilizing
Planting capacity of 640 seedlings/hour.



Equipment developed for flat areas

Description: D61 EM with 3 Bracke heads with capacity for 1164 seedlings for planting. For irrigation, a 8.000 – 10.000L rear irrigation tank is attached. It works by traveling 3 lines simultaneously, with autopilot technology and georeferencing of seedlings.

Operations and Performance: ✓ Basin preparation, planting and irrigation.
✗ Soil preparation and fertilizing.
Planting capacity of 900 seedlings/hour.



D61 Komatsu Planter

Planters

Technology and mechanized silviculture activities to planting

PC240 Komatsu Planter P22



KOMATSU

Description: PC 240 with 2 Bracke heads with capacity for 392 seedlings for planting. For irrigation, we have an extra tank on the 6.300 L machine. For the base fertilizer, a 300 kg tank is used and application is done through a side tray. Plant 2 seedlings simultaneously, has seedling georeferencing.

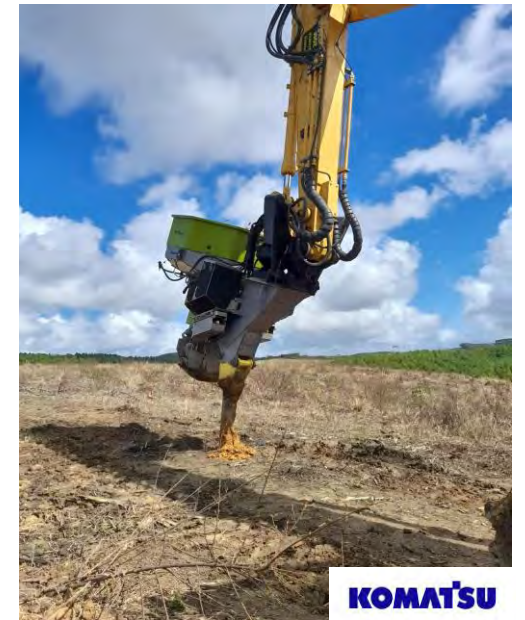
Operations and Performance: Basin preparation, fertilizing, planting, and irrigation
 Soil preparation
 Planting capacity of 690 seedlings/hour.



Equipment developed for slopes areas

Description: PC 210 with 1 Bracke head with capacity for 196 seedlings for planting. For irrigation, we have an extra tank on the 3.000 L machine. For base fertilizer, a 150 kg tank and application is done through a side tray. Performs pit by pit, has seedling georeferencing.

Operations and Performance: Pit preparation, fertilizing, planting and irrigation. Planting capacity of 180 seedlings/hour.



KOMATSU

PC210 Komatsu Planter P12b

Technology and mechanized silviculture activities to planting

Plantma X2 – Timber + Plantma

Operations:

- ✓ Soil preparation, fertilizing, basin preparation and planting
- ✗ Irrigation

Performance

With Soil preparation: capacity of 1.800 seedlings/hour.
Without soil preparation: capacity of 2.000 seedlings/hour.

Requirements

1. seedling quality
2. little residue
3. irrigation in sequence
4. microplanning
5. autopilot



Description: The base machine is a buffalo king. Planting is carried out by 2 automated arms, which are located behind a cabin. In this cabin there is an assistant who selects and places the seedlings on the 2 side spools. In addition, it has a seedling deposit with a capacity of 9,000. For soil preparation, 2 subsoiling rods and 2 fertilizer tanks with a capacity of 2,000 kg. It operates on 2 lines simultaneously, has automatic pilot and seedling georeferencing.

Irrigation

Technology and mechanized silviculture activities to irrigation



Description: Coupling equipment on the front of the tractor, which has a camera with a eucalyptus seedling identification sensor and 2 valves for water output for irrigation. It has the capacity to irrigate up to 5L per pit and is installed for one line.

Performance: 0,9h/ha. Point of attention in relation to the % of seedlings identified, volume of irrigated water, and maintenance of the operating system.

Modern silviculture operations, opportunities and challenges – Brazilian grower company perspective.

Seedling identification sensor and mechanized irrigation



Internal development



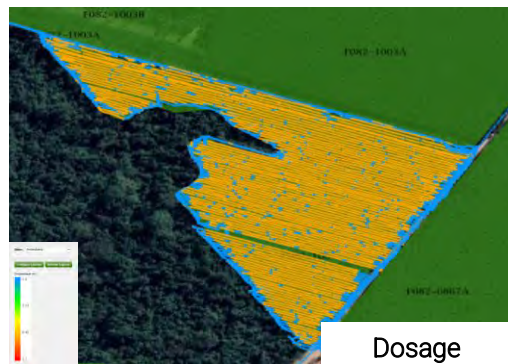
Description: Coupling equipment on the front of the tractor, has a camera with a eucalyptus seedling identification sensor and 6 valves for water output for irrigation. These valves allow irrigation to be carried out on non-centralized seedlings. Furthermore, they make a horizontal movement to follow the basin and ensure the necessary amount of water. It has the capacity to irrigate up to 5L per pit and is installed for one line.

Performance: 0,9 h/ha (testing).

Conjugation

Technology and mechanized silviculture combined

Flow control system and precision silviculture



Description: We use the system to control the flow of herbicide and fertilizer. The system allows the visualization of flow and depth information during operation on the display. Additionally, we adjust acceptable input limits, triggering alarms when not reached.



Protections and adaptations of agricultural tractors



Description: JD 190 tractor adapted with front, side and rear protections, change in the location of the diesel tank and insertion of herbicide tank.

Conjugation: Soil preparation + pre-emergent application.

Description: BM 115 tractor adapted with front, side and rear protections, change of location of the diesel tank and insertion of herbicide tank. In addition, it has 2 side bars and a front protected blanket.

Conjugation: Fertilizing + herbicide or emerging post between the lines and pre in the line.





Internal development



Air operations

Aerial silviculture technology and operations

Aerial fertilization with plane



Description: Agricultural planes carry out the fertilization operation in Planting and Coppice Plantations. It is widely used in large blocks of farms.

Performance: 70 ha / day / plane.

- ✓ **Advantages** Higher yield
Application quality
Increased mechanization

- ✗ **Disadvantage:** Operation cost
Need to construction of landing strips
Supplier availability

Herbicide application with drone



Description: Drone for aerial application, with 40 L tank, rotating tips, obstacle detection sensors, remote control with display that allows adjustment of height, flow, application range. All application maps are uploaded to an online platform.

Performance: 0,33 h/ha.
Pay attention to weather conditions.

- ✓ **Advantages** Higher yield
Better application quality
Lower investment

- ✗ **Disadvantage:** Qualified labor
Sensitive to weather conditions
Specialized maintenance

Forestry tractor

Forestry tractors for silviculture operations

Skidder for silviculture JD 640 L-II



Potency: 218 CV
Drag capacity: 17 Ton
Torque: 979 Nm

Description: Protections developed for forestry activities. The skidder has a durable powertrain with low fuel consumption, axles and tires designed for work on uneven terrain, durable and easy-maintenance components, high stability and ergonomic cabin.

Operations: Subsoiling, Herbicide application, Fertilizer application
Pit marking

Description: 4x4 forestry tractor, Power Shift transmission. Skidder winch machine, without front blade, with winch stop plate.

Operations: Maintenance operations



IRUM 690 S5

Potency: 136 CV
Drag capacity: 2x7 Ton
Torque: 550 Nm



Maintenance Engineering

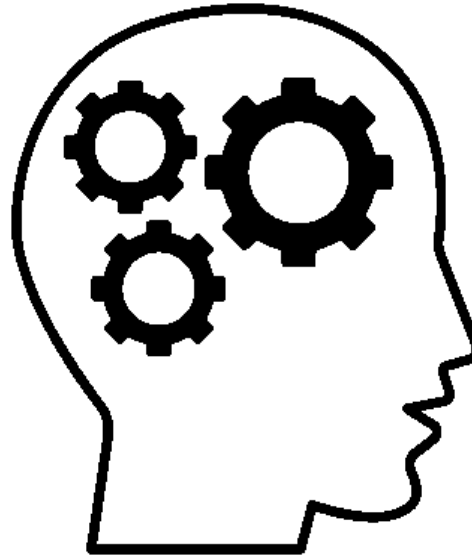
Functions

MAINTAINABILITY

- ✓ Specialized support and maintenance diagnostics;
- ✓ Testing new processes and tools;
- ✓ Support for the technical development of maintenance teams;
- ✓ Indicate necessary technical training;
- ✓ Assist in sizing necessary spares;
- ✓ Support in supplier development;
- ✓ Specify structure required for maintenance;

RELIABILITY

- ✓ Failure analysis;
- ✓ Creation and updating of maintenance/inspection plans;
- ✓ Development and application of new techniques and process to improve maintenance;



CORPORATIVE MAINTAINANCE CONTROL

- ✓ Improvement of maintenance Planning and control;
- ✓ Standardization/training of Planner Maintenance team activities;
- ✓ Analysis of predictive maintenance reports;
- ✓ Control of general Maintenance Registrations.

PROCESS STANDARDIZATION

- ✓ Creation of procedures related to Maintenance;
- ✓ Creation of technical instructions and single-point lessons;
- ✓ Define appropriate KPIs;
- ✓ Synergistic action between forestry units to disseminate best maintenance practices.
- ✓ Standardize materials – Alternative x Genuine.

Control Tower

HARVESTING

Telemetry and online monitoring of equipment and digitization of forestry harvesting processes



Fatigue & Distraction Management

The driver behavior camera system can monitor phone and seatbelt use, reckless driving, fatigue, distraction, and smoking.



SILVICULTURE

Telemetry and online monitoring of tractors and digitization of mechanized forestry processes + electronic controllers



VEHICLES

GPS speed tracking detect quick increases in speed and generate reports that indicate the occurrence of dangerous driving.





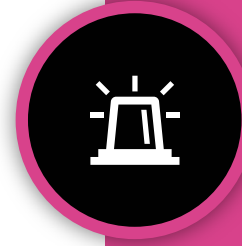
HOUSTON PROJECT



Silviculture and Harvest Monitoring



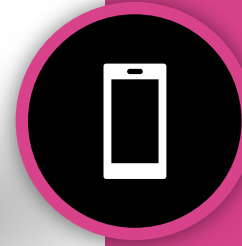
Message handling via onboard computer over satellite and 3G signal



Emergency button



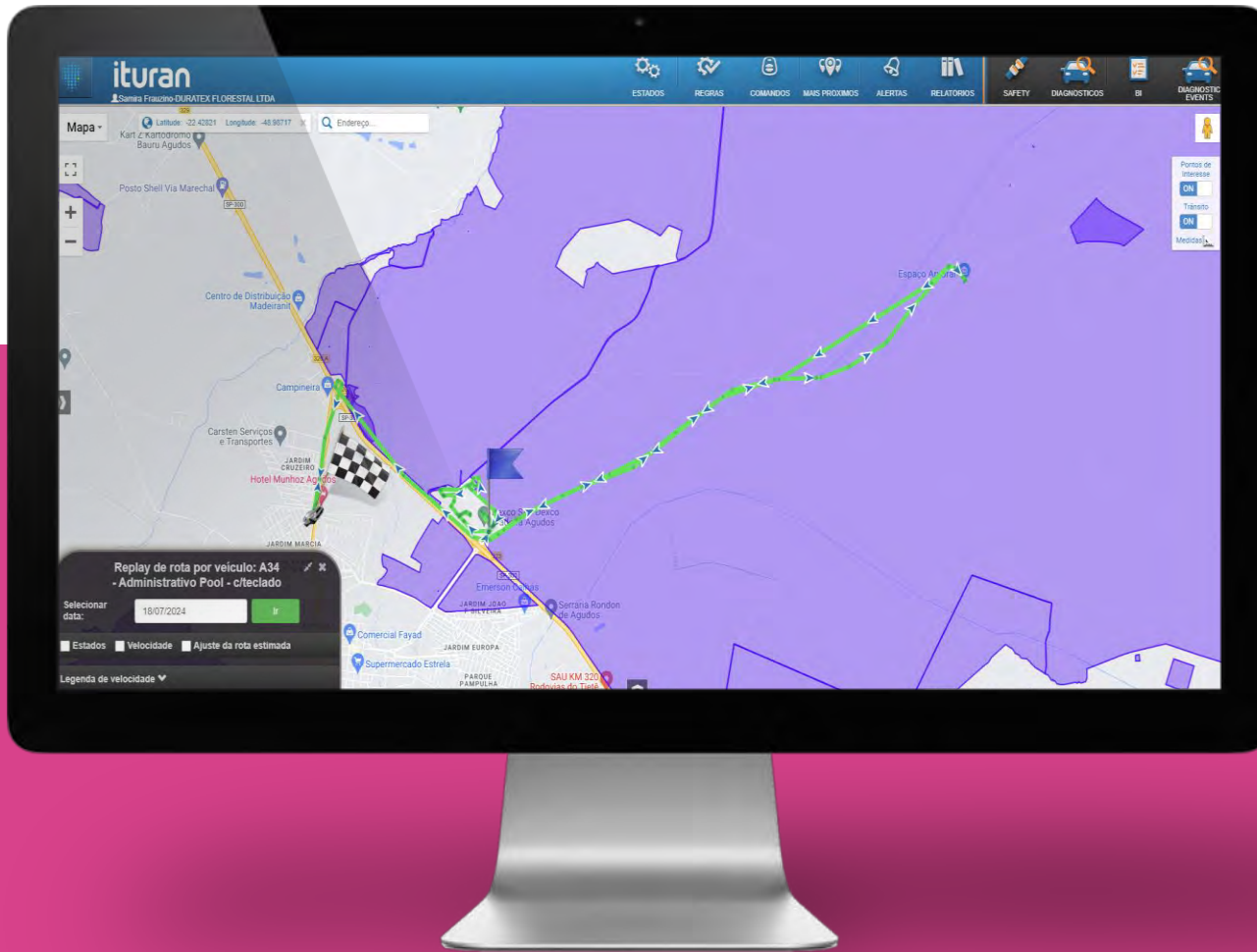
Micro-planning onboard



24-hour service via WhatsApp

Fatigue & Speed Management

Ituran



- **Features:** Vehicle tracking, vehicle security, telematics, satellite monitoring
- **Reports:** Generated for analyzing vehicle locations, machine traces, speeds, and others KPIs.
- **Responsible Parties:** Daily reports sent to managers for strategic decision-making in equipments management.



Fatigue & Distraction Management

Phone alert
Speed: 41 km/h



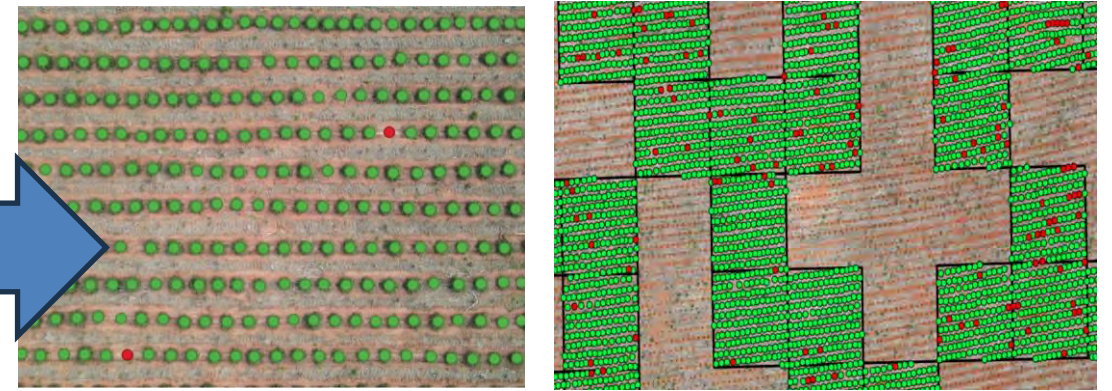
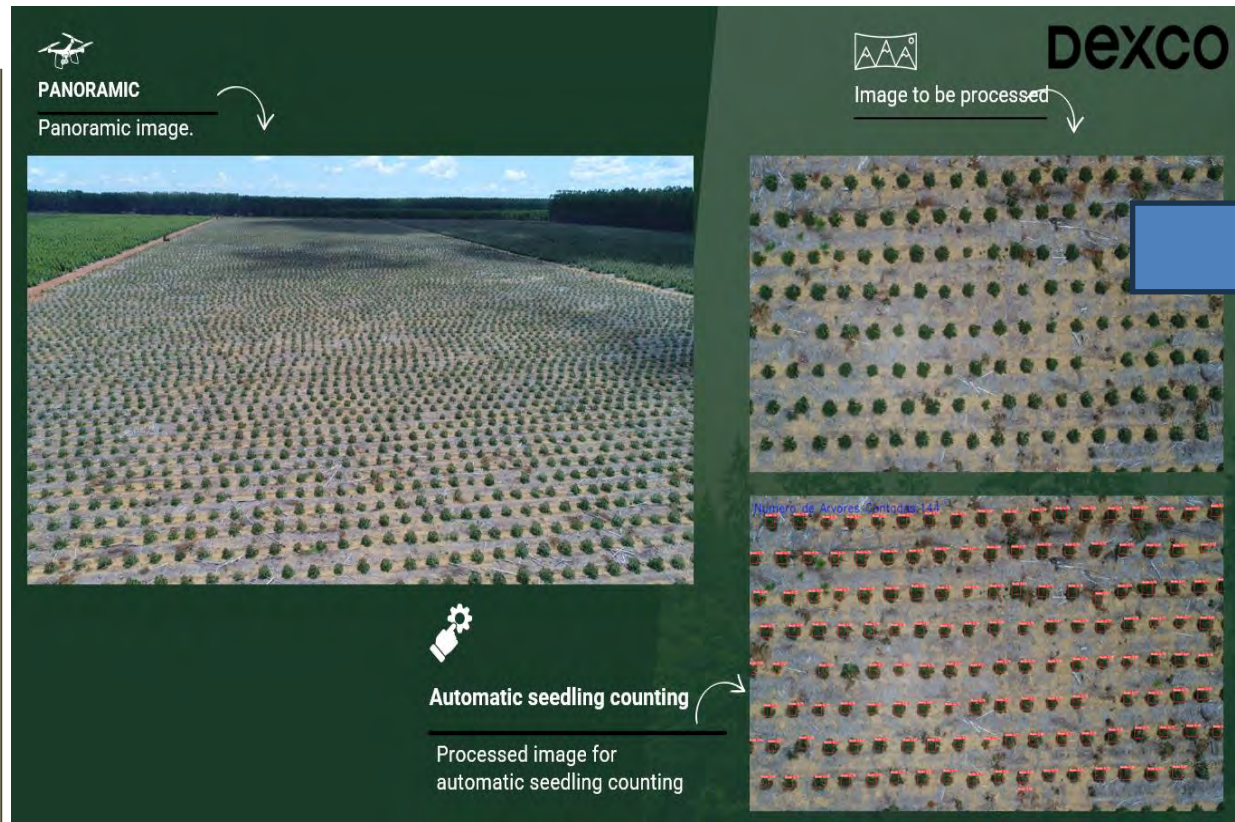


Fatigue & Distraction Management

Seatbelt alert
Speed: 30 km/h



Global Assessment of Forest Quality through Drone Mosaics



Advantages:

- Automatic plant survey through optimized algorithm;
- Larger forest sampling (50% compared to 2,5% previously).
- Possibility of further analysis (e.g. weed competition).
- Anyone can run the mosaic (logistics gain on farms | easy operation).

Forest Quality

- Earlier and more accurate ways to assess forests and detect deviations for correction.
- Use of remote sensing tools for monitoring and early detection of anomalies in old plantations and adoption of quickly corrective actions.

Forest Management

- Development of bio stimulant products to increase the plantations tolerance to climatic stresses.
- Development of microbial consortia to increase the use efficiency of soil nutrient by forest plantations.
- Improve formulations technology of raw material (fertilizers, herbicides, ...).



Breeding

- Selection of materials more resilient to abiotic stress.
- Expand the genetic base (conservation)
- Clonal composites uses as a resilience strategy

Forest Protection

- Promote the environmental equilibrium: through Increase biological control with specific natural enemies.
- Use of remote sensing as a tool for monitoring pests, diseases and weeds.

Workforce Training

- Advancements in machinery technologies, data management solutions, **connectivity, and integration possibilities open doors for more efficient management of company resources and assets.** However, this will only be possible if continuous skills development is a standard practice—technical and behavioral training at all hierarchical levels must be part of the companies' strategy.
- **There is a strong trend in using artificial intelligence for training and development,** which, combined with **customized platforms and investments in connectivity,** can facilitate and broaden access to various content within companies. Additionally, it is important for companies and strategic leaders to consider new training models that differ from traditional standardized ones. To maximize the potential of resources involved in operations, training must be tailored to the specific needs of individuals or workgroups.



TRENDS

SILVICULTURE MECHANIZATION

- Balance between labor availability x planting and irrigation mechanization.
- Insertion of forestry tractors and the advantages of using them in operations.
- Technology in operations, with less decision-making dependence on the part of operators, such as precision forestry, autonomous equipment, etc.

MAINTENANCE ENGINEERING & SILVICULTURE MECHANIZATION

- Technological advances in mechanization in Silviculture tend to generate a great need for increased technical training of mechanics and operators, as well as increased use of control and failure analysis tools.



TRENDS

Telemetry and real-time operations monitoring

- Automatic detection of operation and movements in forestry processes.
- Precision agriculture (PA) on the silviculture process involves applying the right input, at the right rate, to the right place, and at the right time, following the principles of the 4 R's.

Data use and KPIs

- Systems that guarantees the traceability of operations and strong control in the administration of outsourced services and inputs used.
- SAP platform integrated with other satellite systems in a unified data lake to ensure accuracy in decision-making.

Artificial Intelligence on Forestry

- Artificial neural networks, machine learning and computer vision in forestry processes aim to ensure effective cost management and improvements in productivity, such as pest identification or characterization of productive areas via satellite.



GENERAL TRENDS

For this to make sense...

- People security and respect must be in the first time.
- Environmental and productivity sustainability, and consequently economic sustainability, must guide any decision.
- Many technologies will be available and must be adopted if they make sense.
- The diversity and coexistence between different generations must be improved in the job market.
- Communication must occur assertively; the language must be appropriate for the person who receiving the message.

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Thank You!

José Eduardo Petrilli Mendes

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