Global Juice Sustainability Report

2023

Sharing Knowledge Globally

International Fruit and Vegetable Juice Association

IFU

SCIENCE • STANDARDS • MARKETS • SUSTAINABILITY

Contents

Message from the President

Kees Cools, IFU President

After the IFU last year's first edition of the global sustainability report we are happy to present a follow up.

The global juice industry encompasses many elements that represent activities throughout the supply chain from field to fridge. At the start of the supply, is the farmer, who's way of working depends very much on the development in the geography. We have precision farming in North America and Europe existing next to large scale mechanized farming in South America and China. At the same time, we have rural family size farming with old technologies in Asia and Africa.

The carbon footprint of each of these farming methods is quite diverse but on a global scale all farms, are increasingly exposed to water scarcity and are facing decline in crop yields because of the impact of a changing climate everywhere. Agriculture accounts for 30% of global greenhouse gas emissions, 80% of deforestation and 70% of freshwater consumption, we can read in a recent PGIM report, so the impact and challenges are immense.

It therefore may not come as a surprise, that it is over there, where massive effort is put at work to reduce the negative impact and optimize and modernize ways of working. Biodiversity conservation and sustainable use of resources and land in support of improved input efficiency ensuring the output of high-quality, nutritious fruit and vegetable crops.

Further downstream, in the worldwide juice industry supply chain, initiatives are developed to deal with reduction of waste and promotion of a circular economy. Minimizing the environmental impact of Juice packing, transportation and distribution by optimizing fuel efficiency and exploring alternative transportation methods are further initiatives undertaken by the industry.

Consumer information about origin, production details and sustainability efforts are building trust. Certification and standards further help to inform juice buying consumers making their choices.

Sharing all the knowledge in our industry will assist to ensure the continuous availability of affordable, high quality nutritious processed fruit and vegetable consumer products.

The Fruit Juice Industry and sustainability – where we are today

David Berryman, SWG Chair

We live in interesting times – indeed, to borrow from Charles Dickens, the famous English author, **it is the best of times, it is the worst of times.**

The global fruit juice industry in its present form is relatively new on the world stage. For example, it is younger than the whole of the automobile industry. It has been a vibrant and exhilarating rollercoaster project.

Dramatic and fascinating modern technology has made the whole process massively more efficient. Who can't but admire the polished giant stainless-steel tanks, the military precision of filling thousands of bottles per minute with pristine health-supporting juices? And who cannot but admire the way in which juices led the whole of the beverage industry against food fraud and adulteration?

It is truly remarkable that today juice from oranges in Brazil, juice from apples in China, pomegranate juice from Turkey can all now be purchased throughout the world.

So, as Charles Dickens would say, these are the best of times.

We often talk about the changing climate as being an omen for difficult times ahead, something which will happen in the future, something which our grandchildren need to worry about. This is undoubtedly true, but we all can see that, **today,** the changing weather patterns are becoming more extreme and more commonplace. The evidence is that such extremes are because greenhouse gas emissions are simply not dropping, indeed at this very moment, they are increasing, and year after year, we are seeing more catastrophic flooding, droughts and forest fires.

Our soils for growing crops are contaminated with microplastics. Plastic waste is being dumped into the sea at the rate of 20 tonnes a minute, leaching into the marine life cycles to such an extent that we are increasingly facing the prospect of finding microplastics in the fish we eat.

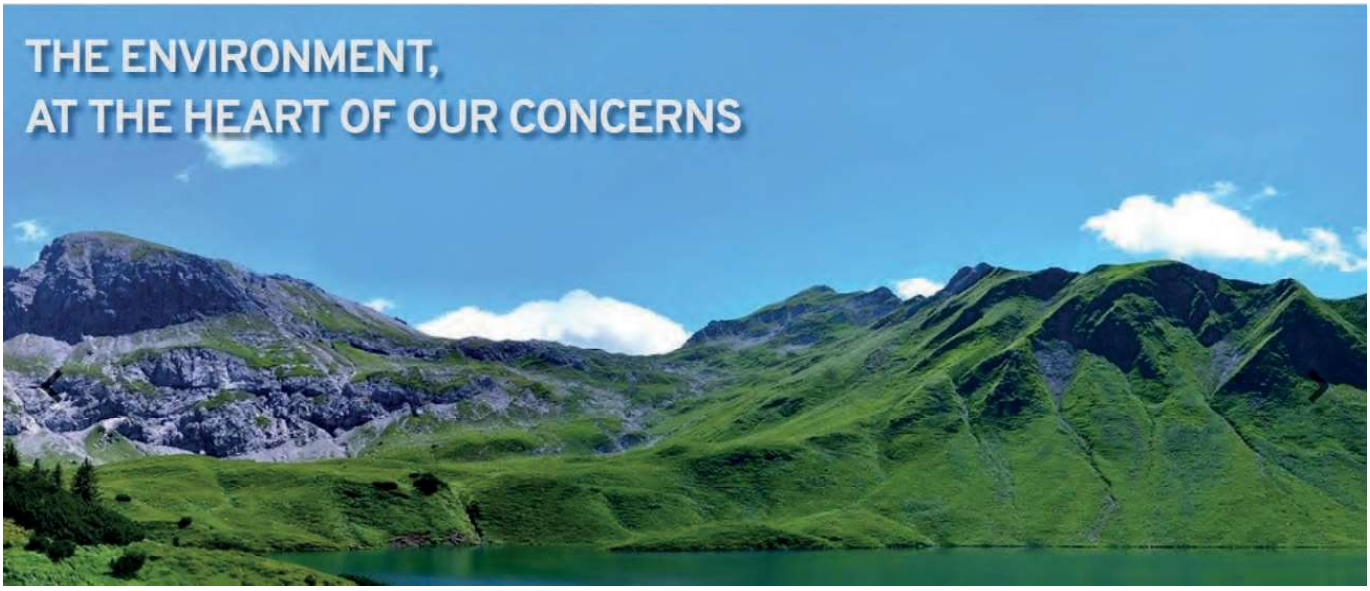
And I think we are all aware that, in the midst of these crises, corporations from every segment of commercial activity fall into that easiest of traps, greenwashing away the problems. Unsubstantiated claims and wishful thinking only make the problem worse.

So again, as Charles Dickens would say, these are the worst of times.

But there is hope for the juice industry. As Kees indicates in his foreword, there are genuinely huge steps being made to improve our sustainability credentials, for example, by using renewable energy at many stages in the supply chain, by saving and re-using water in our factories, by using efficient farming techniques, by using less plastic in production and transportation, by burning less fuel, by attending to the needs of colleagues and local society, by increasing biodiversity…….the list goes on. We can be proud that we are tackling many of the 17 United Nations sustainability goals.

In almost every case, changes in our practices have led to cost savings, although modernisation often requires investment before the savings begin. Solar panels for offices and recycling water are clear examples of this.

So ultimately, our hope for our industry is that all the improvements we are making, great and small, will help make life better for thousands and in the process will help save the planet!



ESGs in the North of Africa

Slim Othmani
IFU Africa Ambassador

My involvement in the previous year allowed us to underscore the diverse Environmental, Social and Governance factors (ESGs) and the uphill task they posed for African nations in realizing them. We also realized that these efforts cannot be solitary pursuits but rather a societal agreement incorporating all stakeholders: individuals, governments, banks, corporations, and all other civil society institutions. The reports from the International Labour Organization (ILO) and McKinsey are a valuable well of insights for our endeavours on the African continent.

- **https://www.mckinsey.com/About-Us/Social-Responsibility/ESG-report-overview?cid=Esg2023-pme-gdn-mip-mck-oth-2306-Non-Brand&gclid=CjwKCAjwwb6lBhBJEiwAbuVUShSu9U-Pz5Rby-sSzDdcC8reXtho5ZeBl_nfrxVslahOShRZP4dp8BoCoOUQAvD_BwE&gclsrc=aw.ds**

- **https://www.ilo.org/actemp/regions/africa/WCMS_848401/lang--en/index.htm**

Speaking from our standpoint as fruit processors, beverage manufacturers, and broadly a participant in the fruit processing supply chain, understandably, the step to engage all IFU member organizations operating in Africa was not undertaken. Nevertheless, the individual efforts by NCA-Rouiba (Castel Group) in Algeria, and the collective endeavor by APAB in Algeria, merit recognition.

Given the escalating relevance of post-consumption packaging waste, especially waste resulting from beverage use (PET bottles, cans, multilayer packaging, glass bottles), Algerian beverage manufacturers have signaled their readiness to accept their Corporate Social Responsibility (CSR) by initiating a voluntary Extended Producer Responsibility (EPR) program. Under APAB's aegis, they

have voluntarily established an eco-organization: "An Economic Interest Group (EIG) created by beverage manufacturers who are APAB members in collaboration with (APAB-FILREC / GIZ-DELOITTE/VALORIE and the Ministry of Environment)."

Meanwhile, NCA-Rouiba, apart from its participation in APAB, is among the most proactive entities in terms of ESG implementations, demonstrated by the establishment of CSR days since 2021, a likely role model to emulate. https://castel-algerie.com/les-journees-rse/.

I am confident that numerous initiatives are underway in the African beverage industry. Let's initiate an internal IFU survey, share these with our community, and commemorate them at our annual conference.

While internal communication is vital, it is sadly inadequate and the trickle-down effect is slow to materialize, attributed to several factors including the lack of explicit regulations, the shortage of skilled workforce, and particularly the cutthroat competition that eats into the margins of operators, thereby prohibiting the necessary investments to achieve ESG.

More practically, the question of financing ESG is a central concern within Africa's economic sphere. All IFU members are cognizant of this. By 2030, according to the United Nations Economic Commission for Africa (ECA), the continent will require $438B to adhere to ESG. This is where the government's role, as well as that of actors across all sectors, becomes crucial.

Likely, the role that the IFU could assume in the execution of ESG could be to form collaborations with global institutions such as the World Bank, the European

Bank for Reconstruction and Development (EBRD), the African Development Bank (ADB), and numerous other organizations, or even the United Nations Economic Commission for Africa (ECA). The backing of these institutions, and the respective governments of African nations, will be the sole guarantee of the success of the ESG implementation within the continent.

Sustainable Development in Citrus Production in Nigeria

Patricia Obichukwu, Best Produce International UK Ltd.
CEO and IFU Country Representative Nigeria and West Africa

Nigeria Citrus fruit industry sector has steadily grown since 2014 despite all the challenges facing Agriculture in generally such as insurgence in many parts of the country, impact of Covid 19 pandemic, effects of the Ukraine / Russian war and the current global economic situation.

Citrus fruit production in Nigeria in 2021 was roughly around 4.11 million metric tonnes; thereby showing a steady increase of 1.5 million metric tonnes in 1972 and 3.98 million tonnes in 2020.

The key citrus fruit families being grown in Nigeria are **Oranges, Tangerine, Lemon, Shaddock, Limes, Grapefruit,. Citron, Calamondin, Pummelo and Tangelo.** Other fruits that are also grown in large quantities in Nigeria include mango, banana, pineapple, pawpaw and guava. Citrus fruit are majorly produced across these states in Nigeria, for example Benue, Nassarawa, Kogi, Ogun, Oyo, Osun, Ebonyi, Kaduna, Taraba, Ekiti, Imo, Abia, Enugu, Akwa-Ibom, Cross River, Ondo, Kwara, Edo, and Delta.

The major industry players are Coca Cola, Farm Pride, Rutta, Edge, 5 Alive, Chivita, Fumman, Dansa, Fan juice, Chi Exotic, Lloyd's fruit squeeze, Niyya, Dudu, Cyway natural drink, etc.

Opportunities and Population Growth

Nigeria benefits a great deal from favourable climate conditions of tropical and sub-tropical region with rich fertile soil, vital minerals and good sub-Sahara temperature that are excellent for citrus fruits production. The population growth of the country is increasing every year with current estimate of 223 million people in 2023 and also expected to rise up to 400 million in 2050. In addition, Nigeria's land for agriculture is roughly about 80% of the countries landmass and less than 58% of it are been cultivated. As a result of these favourable conditions for citrus fruits growing in Nigeria, the Federal Government began the process of empowering the farmers in this sector in 2014.

By 2022, the Federal Government encouraged the key stakeholders such as the Growers, Processors and Marketers to come together to form an Association called **NATIONAL CITRUS GROWERS, PROCESSORS AND MARKETERS' ASSOCIATION OF NIGERIA (NCIGPMAN).**

Since then, NCIGPMAN has swung into action to facilitate the process of its members achieving the following goals in the next five years;

1. **To capacity build and support their members in developing sustainable farming within citrus industry.**

2. **To empower women in developing thriving and sustainable businesses across the citrus production and supply chain sector.**

3. **To create employment opportunities and encourage young people into citrus farming and juice production.**

4. **To become one of the key players in local, regional and international market arena on citrus fruits and juice production.**

5. **To collaborate with key international industry stakeholders in addressing some of the key issues such as poverty, healthy juice production, quality education on citrus production, innovation and infrastructural development, environmental management and sustainable communities.**

NCIGPMAN has so far registered over 30,000 citrus farmers and together with processors and marketers has registered around 500,000 as Association members across 20 states out of 36 states plus State Capital in Nigeria. They have also appointed National and State leaders to ensure that the process runs smoothly in speeding up their plans. The Association is set to ensure that employment opportunities are made available to women and young people.

Sustainable Citrus Production in Nigeria:

Nigeria Juice Market Size is estimated **to reach $5.7 billion** by 2027. Furthermore, it is poised **to grow at a CAGR of 3.9%** over the forecast period of 2022-2027. The fruit and vegetable juice industry has witnessed significant growth as this is considered to be a naturally sweetened nutritious food with the ability to boost immunity.

Nigeria Juice Market based on type can be further segmented into Fruit Juice and Vegetable Juice. Fruit Juice held a dominant market share of 59% in the year 2021 and is also estimated to be the **fastest-growing, with a CAGR of 4.4%** over the forecast period of 2022-2027. (by Industry ARC forecast 2023).

With the current youth unemployment rate of over 13 million and still increasing, the NCIGPMAN has prioritised empowering youths at every level of Citrus production at each State in Nigeria. However, the major challenges facing them in actualising this are as follows:

- Lack of infrastructural development including advance Technology / Smart Farming methods:
- Financial resources for capacity and development of women and youths in this sector
- Poor research development and lack of good agricultural practices.

In order to enable NCIGPMAN address the above critical challenges and barriers to addressing youth unemployment, they are seeking the following;

1. **Financial aid to empower women and youth for seedlings / land procurement / leasing for farms (small, medium and possibly, large).**

2. **Knowledge Transfer and Technological support on modern farming and quality standards.**

3. **International collaboration with interested buyers**

In conclusion, Nigeria Citrus production has great potential for growth with appropriate infrastructural development and financial resources for training and capacity building of its members especially the youths and women.

A diverse landscape, a possible future

Paula Dip, Head of Sustainability, Vicente Trapani S.A.

Looking at global initiatives to combat climate change and GHG emissions, **forestry** is one of the most cost-effective **nature-based solutions** for sequestering carbon.

Innovate…creating positive change

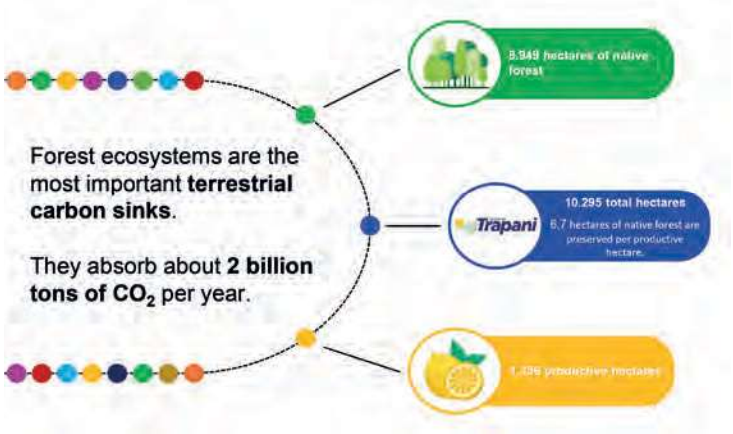
When we talk about sustainable development, climate change and global warming, it may mean going **back to basics.** *What nature already knows how to do.*

Our strategy

Latin America's productive and natural ecosystems are capable of mitigating greenhouse gas emissions, as well as capturing and storing carbon in soils and biomass, like no other region in the world.

We work together with the **ProYungas Foundation** in the implementation of the **Protected Productive Landscape** Program *(PPP)* with the purpose of interrelating productive and wild areas, valuing the synergy between both in a context of environmental sustainability and social promotion.
We are advancing in a specific work that aims to maximize GHG mitigation by considering two main strategies:

✓ Potential of citrus plantations as carbon fixers.
✓ Potential of native areas and the importance of their conservation in reference to the stock of carbon stored.



These initiatives, combined in a healthy **balance,** make it possible to increase productive yields in order to guarantee **food security** for this population that continues to grow, through a path that admits concrete actions in **GHG mitigation**, as well as the valuation of those extra benefits in the provision of goods and services generated by forests from their natural **eco-systemic functions.**

ANNUAL CARBON SEQUESTRATION

Plant formations act as C storage sinks due to their main vital function, photosynthesis.

The lemon tree is one of the crops that captures more CO2 than other citrus and representative crops (fruit trees, cereals, vegetables).[1]

Although emissions are released during cultivation, they are lower than the capture capacity of this crop.

Keys to reducing emissions. An optimal balance:

✓ Organic production
✓ Optimization of energy consumption
✓ Efficiency in irrigation systems
✓ Responsible consumption of fertilizers and phytosanitary products.
✓ Soil resource conservation mechanisms.
✓ Measurement and monitoring of carbon footprint and water footprint.

Short-term actions (1.336 hectares)

✓ Calculation of annual carbon sequestration at Esmeralda, Zuccar, Río Loro, Ruiz and Berbelux farms during 2023.
✓ Calculation of annual carbon sequestration in 100% of the properties during 2024.
✓ Determination of the crop's capacity to mitigate climate change based on its annual sequestration.

It's everyone's commitment

Starting in 2022, we will advance in reforestation processes in degraded areas and watersheds in order to prevent water erosion, and forest enrichment with native species.

2022: We reached 544 geo-referenced trees in order to monitor their growth.

2023: We have surpassed the planting of 4,000 trees, also involving our collaborators in enriching awareness and teamwork sessions.

PROTECTING THE CARBON STOCK STORED IN NATIVE FORESTS

CO2 sequestration by terrestrial plant ecosystems constitutes an important component in the **global carbon (C) balance.**

During deforestation processes, large amounts of carbon dioxide and other **greenhouse gases** are emitted into the atmosphere, contributing to **climate change.**

The carbon stock in the **Chaco** and **Yungas** eco-regions, where our wild areas are located, have an **estimated total carbon stock content of 110 and 185 tons per hectare** respectively.[2]

Knowing that we have a valuable carbon stock, we work **responsibly** to protect it.

Standing forests are instrumental in helping to address the impacts of climate change not only by absorbing greenhouse gases, but also by creating more resilient landscapes. They do this by regulating water flow, improving and maintaining the soil resource for agriculture, and protecting communities against extreme weather events and sea level rise, such as migratory corridors for flora and fauna preservation.

Keys to the conservation of our forests

✓ Sustainable management of citrus production to reduce pressure on surrounding forests.
✓ Execution of a forest management plan to restore degraded landscapes and ensure their protection.

Short- and medium-term actions (8.949 hectares)

✓ Quantification of the carbon stock stored in Yungas during 2023 and 2024.
✓ Quantification of the carbon stock stored in Chaco Serrano from 2024 to 2028.

Living forests sustain life

1 Cesar Mota, Carlos Alcaraz-López, María Iglesias, M.C. Martínez-Ballesta y Micaela Carvajal. (2011) Investigación sobre absorción de CO2 por los cultivos más representativos.
2 Gasparri I., Manghi E. (2004). Estimación de volumen, biomasa y contenido de carbono en regiones forestales argentinas.

Citrusvil and the Continuous Improvement of its Sustainable Performance

Agustina Lucci,
Sustainability Director. Grupo Lucci

From Tucumán, Argentina, Citrusvil manufactures safe products for the world, based on its customers' needs. The company is defined as a strategic partner in the supply of lemon-based industrialised products which are specially required in the food, beverages and fragrances markets.

Through its business model, it creates value for the various stakeholders, integrating the social, economic and environmental performance.

It has recently presented a new issue of its sustainability report with GRI, SASB and SDGs indicators, where it describes the progress made in its sustainability management and how this management pillar is at the centre of the business decisions, taking on commitments to preserving natural resources for future generations.

This new issue is called "We Create Sustainable Value for the World," and it highlights significant achievements in terms of environmental management.

- 23% of the electric energy consumed comes from renewable sources.

-There was a 5.4% reduction in the specific consumption of non-renewable electric energy at its industrial plants.

-As part of its commitments to caring for natural resources, there was an 8% reduction in its water footprint in comparison with 2021,

-and, in particular, it managed to reduce its water consumption by 17% per ton of processed fruit.

In addition, it managed to **reduce its carbon footprint by 24%** in comparison with the previous year due to the commitment of its teams in each production stage to obtain better results. It is worth mentioning that, due to its vertically integrated business model, **Citrusvil compensates for all the GHG emissions** generated throughout the value chain. Lemon plantations retain greenhouse gases and contribute to stopping climate change, resulting in a **positive annual net footprint of 76,000 tons of CO2 in 2022.**

In the **Protected Productive Landscape Program,** implemented together with Fundación Proyungas, **0.75 hectares of native forest are preserved per productive hectare.** In this way, the company integrates different production activities with the preservation of natural goods (biodiversity, soil and water) and services (water and climate regulation, carbon, pollination). It has 5,744 hectares of native forest under protection.

Moreover, through **Fundación Vicente Lucci, its private social investment** takes place in 40 rural schools in northwestern Argentina, benefiting over 9,000 people

with education, entrepreneurship and citizen engagement actions in its areas of influence and with 20 years of uninterrupted community work.

"We offer natural and quality-certified food products to the world. We preserve the sustainability of the planet by working to prevent climate change and preserve biodiversity. We promote a circular business model to contribute to caring for ecosystems. In addition, for 60 years, we have been fostering the development of northwestern Argentina through genuine work, innovation, and the implementation of state-of-the-art technology in our different processes in the pursuit of continuous improvement and sustainable growth," adds Agustina Lucci, Citrusvil's Sustainability Manager

For further information: https://contenidos.grupoluc-ci.com.ar/reportes/2022/es/

Green Bond for Citrusvil

In recent years, sustainable finances have been gaining importance, specially when it comes to the issuance of green, social and sustainable bonds. Investors focus on operations oriented to sustainability, and financing can be obtained for projects that have a positive impact on the environment and society. Citrusvil issued its first green bond in 2022.

By means of the issuance of Corporate Bonds classified as green bonds by the International Capital Market Association (ICMA), Citrusvil could refinance sustainable projects for an amount of USD 6,368,399 at a 0% rate for 30 months.

The funds obtained will be allocated to financing the already executed projects, related to:

- Generation of electric energy from biogas
- Systematization and control of laminar soil erosion in San Rafael Orchard
- Light conversion of the industrial site

All these projects contribute directly to UN Sustainable Development Goals 7, 12 and 13.

About Citrusvil S.A.

Citrusvil, an Argentine company established in the 1970s, is a leading company in the global market which is engaged in the production, processing and commercialization of lemons and their by-products. Its product portfolio comprises essential lemon oils, lemon concentrate juices, pulp cells, dehydrated lemon peels, and other tailor-made solutions. In addition, the company is starting to produce organic lemon juice for its customers, as well as other by-products such as certified oil and pulp.

Quality requirements in these industries are constantly increasing; that is why Citrusvil works with the highest levels of food safety, conducting regular audits of its processes and considering continuous improvement to be a pillar in its daily work. By means of its 23 productive orchards, which are certified by the Global GAP and Global GAP GRASP standards, it supplies the 100% of the fruit that is industrialized. The company produces about 260,000 tons/year, and it is one of the major private employers in the province of Tucumán, Argentina.

CITRUSVIL
LEMON GROWING & PROCESSING

How Brazilian Citrus farm Works to Make Orange Juice a Good Choice for the World

Ibiapaba Netto, Executive Director. Citrus BR

Over the years, Brazilian citrus farm has adopted a series of measures and technologies that have contributed to the sector's evolution within a sustainable model, where high-quality and efficient production is in harmony with nature. One of the main reflections of this productive principle lies in forest preservation. A study conducted by the Citrus Defense Fund (Fundecitrus), a research center maintained in partnership by producers and industries, identified approximately 159,629 hectares of preserved native forest areas within the citrus belt, the main orange-producing region in Brazil, encompassing the states of São Paulo and Minas Gerais. This means that for every 2.89 hectares planted with oranges in the region, 1 hectare is preserved native forest. To put it into perspective, the area of protected forests within citrus farms is larger than the size of the city of London.

To arrive at this survey, Fundecitrus used data from the Rural Environmental Registry (CAR) and cross-referenced information with native vegetation mapping. Areas of permanent preservation, legal reserves, and surplus native vegetation were identified, excluding rivers and lakes.

Another project aimed at the sustainability of the production chain is the quantification of the carbon stock in the citrus belt. The initiative is developed by Fundecitrus in partnership with the Brazilian Agricultural Research Corporation (Embrapa), the main public research company in Brazil. Preliminary results of this study indicated that the sum of carbon stocks in biomass and soil reaches about 36 million tons of carbon in the citrus belt. This value was converted into carbon dioxide equivalent ($CO_2eq.$) by multiplying it by 3.66, resulting in approximately 133 million tons of CO_2eq. These numbers highlight the relevance of citrus growers' participation in maintaining these carbon stocks and reducing greenhouse gas emissions.

To estimate the carbon stock on orange properties, different methodologies were used for production areas and preservation areas. In production areas, orange trees of the main varieties were considered, taking into account only those with the same age as the plot. Through a direct destructive sampling method, 80 representative orange trees from the citrus belt were evaluated, where parts such as trunk, branches, leaves, and roots were separated, weighed, and analyzed in the laboratory to determine dry biomass and carbon content.

Technology is one of the main aspects in the sustainable development of Brazilian citriculture. In this regard, Fundecitrus plays a fundamental role, conducting over 44 research projects to combat pests and diseases that affect citriculture, always focusing on orchard efficiency and the sustainability of the production chain. One example is the mass production of Tamarixia, a wasp that is a natural enemy of the psyllid, the vector of the bacteria that causes Huanglongbing (HLB), the most severe disease in citrus cultivation with no cure. When released in areas with high HLB incidence, Tamarixia parasitizes the mosquito, acting as a sustainable biological control agent for pests. Additionally, natural pesticides and pest monitoring are developed.

In this way, Brazilian citriculture relies on the synergy between science and technology to reaffirm its commitment to reconcile agricultural production with environmental conservation, contributing to people's health and the sustainability of the citrus industry.

Sustainable passion fruit

Carla Garcia, Head of CSR and **and Harry Frei,** Business Development Manager. Quicornac

In 2020, we embarked on a profound journey towards sustainable passion fruit production. This journey, which involved over 40 certified smallholder farmers from our factories in Ecuador and Peru, has been both gratifying and critical for our continuous and sustainable development. As we stride into 2023, we anticipate extending our sustainability initiatives to our third factory, recently established in Vietnam – our first venture in Southeast Asia.

Our passion fruit supply chain is vast and complex, incorporating over 12,000 smallholder farmers across all our operations. Each farmer, each family we collaborate with, enriches our understanding, and fortifies our determination to ensure the success of this journey. Implementing the SAI-FSA framework with over 60 farmers in Ecuador and Peru in 2020, we faced considerable hurdles, such as a pandemic and initial lack of trust from farmers. By the end of the first phase of this project, only 30 farmers had reached the verification process. Nonetheless, these challenges have only encouraged us to press forward on our journey towards sustainability.

Our commitment to sustainability runs deep. We have worked with diverse farmer groups in Ecuador and Peru under the SAI-FSA and Rainforest Alliance Sustainable Agriculture Standard, providing consistent training, free on-demand technical assistance, and essential protective personal equipment. We also conduct vital water and soil analyses and help farmers access resources previously beyond their reach. These actions are transforming the landscape of agriculture, reshaping perspectives, and steering the industry little by little towards sustainability.

Photo by Valentina Eguiguren

In Ecuador, we launched our sustainable agriculture project in late 2020 with a group of 40 farmers. Despite challenges such as the COVID-19 pandemic and scarcity of auditing services in the region, our perseverance bore fruit in July 2022 when we conducted external verification for 14 dedicated producers. This success has added value for the verified farmers and instilled a sense of anticipation for future growth. In 2023, we aim to grow our FSA farm management group by at least 10% and begin Rainforest Alliance certification with a fresh group of smallholder farmers.

Peru has also witnessed significant growth in sustainable farming after overcoming initial barriers. This year, we aim to increase the number of certified farms by double digits, further expanding our sustainable footprint.

Our new Vietnam factory is preparing to embark on the path to sustainable farming. The unique agricultural practices and farming community culture in the country present exciting opportunities for the implementation of our sustainable practices. Although Vietnamese farmers are aware of the benefits of sustainable agriculture, technical training and field assistance are still required. As most farmers are smallholders, smaller even than those in Ecuador and Peru, one of our biggest challenges will be reaching and expanding available resources to a larger group of farmers. We are currently in the process of adapting our proven models from Ecuador and Peru to suit Vietnam's local conditions, with plans to conduct our first sustainable farming audit next year.

Throughout this journey, each farmer has illuminated the transformative power of sustainable farming. Consider David, a verified producer from Manabí, Ecuador. His shift to sustainable farming practices has fundamentally altered his approach for the better. His farming is now not just more humane, but also economically viable. As we continue to spotlight stories like David's, our commitment to driving change in passion fruit fields and across our supply chain remains unwavering.

As we edge closer to our 2030 goal, we are not only deeply committed to sharing these sustainable practices with our broader supply chain and our friends in the industry, but we also warmly invite you to join us in our unique journey towards a more sustainable future.

Organic Pineapple Farming: A Beacon of Sustainable Excellence in Guatemala

Alvaro Viteri, New Projects Development Manager, Popoyán/Tukan Foods

"In this farm, we will maintain and develop wild biodiversity and serve as a source of prosperity to the communities surrounding our farm." These were the visionary words of Popoyán's board when the corporation acquired its first farm in Guatemala back in 1979. This declaration remains the heart and soul of every aspect of Popoyán's operations, driven by its Shared Value strategy. Our organic farm and processing plant for MD2 pineapple juice NFC and juice concentrate in Guatemala exemplify this commitment to sustainability. Today, the farm's virgin jungle reserve is a sanctuary for over thirty-nine species of wild animals, including four on the brink of extinction.

For the past 20 years, Popoyán has taken a holistic approach to sustainability. We've shifted towards environmentally friendly and clean farming practices, including the development of organic crops, continuous adoption of agricultural technology for efficient land use and increased resilience, responsible water and resource management, wildlife conservation, and community development. We also have been generating clean energy since 2005 when we initiated our hydroelectric project in the south of Guatemala.

Tukan Foods: Quality From Harvest to Juice

Tukan Foods, our B2B brand of juice, has a global presence, reaching the United States, Europe, the Middle East, and Latin America. By controlling every aspect of production, from the farm to the processing facility, we can harvest the fruit at its peak ripeness, ensuring exceptional quality while guaranteeing reliable volumes for our customers. Three years ago, when we started our processing plant, we made a promise: "From harvest to juice in less than 8 hours." We are committed to producing the world's finest organic pineapple juice by controlling production protocols, ensuring top-tier quality, and maintaining consistent volumes for all our customers.

Jungle and plantations together.
Pineapple is only planted in the areas that were formerly savanna

Preserving Soil Health and Promoting Organic Practices

As an agricultural company, we understand the importance of preserving soil health for future generations. That's why we've developed organic production methods that are not only greener but also safer for the soil through the use of biological solutions. Moreover, our efforts have had a positive impact on reducing erosion and preserving the natural nutrients in the soil for the long term. Today, around ninety-five percent of our pineapple juice and juice concentrate volumes are 100% organic.

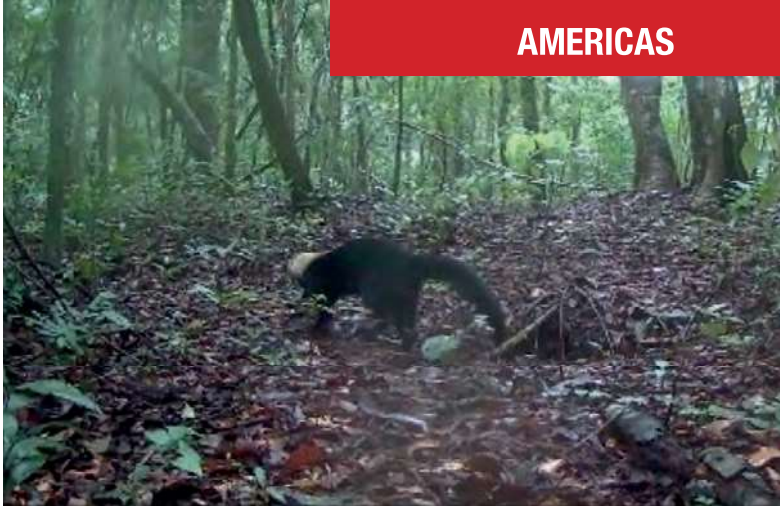
Consumer Consciousness and Commitment to Sustainability

In an era of heightened consumer consciousness, people are paying more attention to the products they consume. Based on a research study conducted by our marketing team in Central America, it's clear that 60% of our consumers read the labels on the juices they drink. They are not only interested in the ingredients but also in the brand's environmental impact and its commitment to sustainability.

Conservation of Virgin Jungle and Community Development

Popoyán has devoted 50% of its farm land to the conservation of virgin jungle, the habitat for more than 39

Ocelot pictured with the night camaras.



Tamandua pictured with our camaras

species of mammals, reptiles, amphibians, and birds. We actively maintain and develop the natural and native biodiversity to bolster the populations of wildlife. In Popoyán's reserve, you can also find local tree species, such as the oak quercus oleoides, a tree on the brink of extinction that we are cultivating to restore its population throughout our reserve.

Our organic pineapple project has been a catalyst for the local economy in the Santa Ana, Petén community. This initiative stands as an inspiring success story, demonstrating how a rural town can progress through the presence of a private sector company that invests in and creates dignified job opportunities for the local population. As a company, we run education programs and preventive healthcare facilities with a focus on reducing chronic malnutrition. The success of our community development strategy has been so profound that we've been able to scale it up through different partners, impacting more than 30,000 families throughout Guatemala.

Environmental Responsibility and a Sustainable Future

All of our farming technologies and practices are environmentally friendly. When we decided to build the processing plant, we prioritized processing equipment that is energy-efficient and fuel-conscious. Additionally, we've partnered with various suppliers to source reusable and sustainable packaging. In essence, we're not only having a positive impact worldwide but also managing costs and indicators to ensure our operation's long-term economic sustainability, allowing us to maintain a positive impact on the environment.

Popoyán's organic pineapple farming venture in Guatemala is a shining example of how a commitment to sustainability can transform not only a business but also entire ecosystems and communities. From the lush jungles teeming with wildlife to the thriving local economies, our journey has been one of dedication and resilience. As consumers increasingly seek products that align with their values, we are proud to offer a beacon of hope, a model of sustainability, and a source of prosperity that can be replicated around the world.

Animal species in danger of extinction that are inside our natural reserve:

- **Jaguar (*Panthera onca*)**
- **Ocelot (*Leopardus pardalis*)**
- **Spider Monkey (*Ateles geoffroyi*)**
- **Tamandua (*Tamandua mexicana*)**

Join Us in Creating a Sustainable Future

Join us in our mission to support sustainable farming, protect biodiversity, and uplift local communities. Choose products that make a positive impact on the environment and the people who live in the regions where they are produced. Together, we can create a sustainable future for all.

Contact us:
aviteri@popoyan.com +502 3183-1484

How Sustainability is Tackled in Middle East Region

Ahmad M. Shmoury, FnB & Water Treatment Sector - Division Manager

Due to its dry environment, scarcity of freshwater supplies, and significant reliance on fossil fuels, the Middle East area has particular sustainability difficulties. The significance of sustainability has, however, recently come to light, and there have been increased attempts to address environmental, social, and economic issues. In the Middle East, sustainability is being addressed in the following ways:

Transition to renewable energy: The Middle East is home to several nations that are heavily investing in renewable energy, especially solar and wind energy. Diversifying energy portfolios, lowering greenhouse gas emissions, and advancing sustainable development are the goals of these investments. The United Arab Emirates, for instance, has ambitious goals to produce a sizeable amount of its energy from renewable sources.

Water Resource Management: Because of the region's severe water shortage, it is crucial to manage water resources sustainably. Infrastructure for desalination plants, wastewater treatment systems, and water reuse systems is being invested in by governments. To maximize water usage, integrated water management strategies that encourage efficiency, conservation, and demand control are being developed.

Sustainable Urban Planning and Development: This is a major concern for many Middle Eastern cities. This involves combining green areas, smart city technolo-

gy, pedestrian-friendly infrastructure, and sustainable transportation alternatives into the architecture of cities. More livable, ecologically responsible cities are the goal.

Environmental Preservation and Biodiversity: The Middle East's distinctive natural ecosystems and biodiversity are being protected and conserved with growing vigor. Protected areas are being created, ecosystems are being restored, and sustainable land and marine resource management is being promoted. Development and conservation objectives are meant to coexist in harmony.

Agricultural and Food Security: A lack of arable land, and other issues with sustainable agriculture are all problems that the Middle East faces. To maximize water and land utilization, limit chemical inputs, and boost food production effectiveness, sustainable agriculture approaches are being encouraged. These practices include precision farming, hydroponics, and aquaponics.

Recycling and Waste Management: Managing waste is a crucial environmental problem. Middle Eastern governments and municipalities are putting waste manage-

ment plans into practice, including initiatives for trash reduction, recycling, and waste-to-energy. An emphasis is also placed on raising public knowledge of and participation in waste management procedures.

Sustainable Tourism: Since the Middle East has a thriving tourist business, efforts are being undertaken to advance sustainable tourism methods. This include creating eco-friendly resorts, promoting responsible travel, safeguarding cultural heritage, and encouraging local participation in tourism-related projects.

Corporate Sustainability: Many businesses in the Middle East are implementing sustainability practices into their daily operations. This entails using eco-friendly methods, energy-efficient technology, lowering carbon emissions, and taking social and environmental considerations into account when making decisions.

Education and Awareness: Promoting sustainability education and awareness is essential for long-lasting change. Governments, educational institutions, and non-governmental organizations (NGOs) are attempting to incorporate sustainability into curriculum, increase public awareness, and encourage sustainable lifestyles.

Due to the specific issues and goals that each country in the Middle East has, it is significant to recognize that sustainability initiatives vary among these nations. Nevertheless, there is a rising commitment to resolving the region's social and environmental problems as well as a general realization of the need for sustainable development.

"The Future of Sustainable Desalination and Water Reuse in the Middle East"

Technology improvements, environmental concerns, and the region's problems with water shortages will probably all have an impact on the future of sustainable desalination and water reuse in the Middle East. The following trends and developments might be important:

Technological Progress and Advancement: Desalination Technologies are predicted to become more advanced and ecologically benign as a result of ongoing research and development activities. Reverse osmosis (RO), membrane distillation, forward osmosis, and solar desalination improvements are a few examples of these. These technologies would work to enhance the overall cost-effectiveness of desalination operations while reducing energy consumption and environmental impact.

Renewable Energy Integration: The integration of renewable energy sources into desalination facilities is becoming more important due to the Middle East's enormous solar energy supplies. Desalination using so-

lar energy is gaining popularity as a sustainable option since it lessens the need for fossil fuels and the emissions of greenhouse gases. For desalination, photovoltaic (PV) panels and concentrated solar power (CSP) systems may be used more frequently.

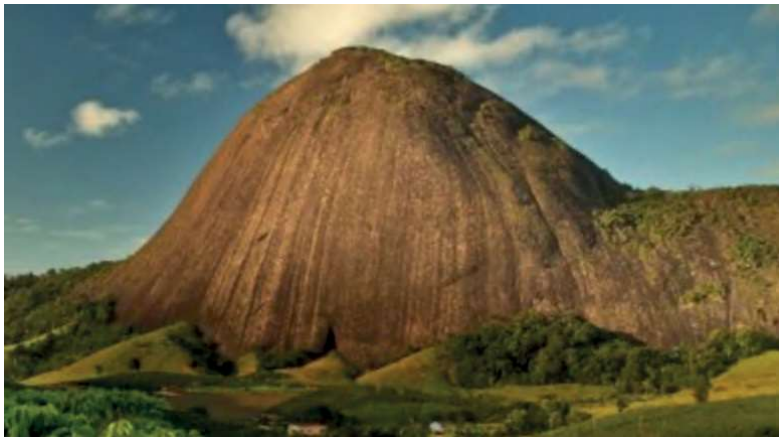
Desalination and Agriculture: Because of its dry environment, the Middle East has substantial problems with agricultural water consumption. A sustainable strategy may be to implement integrated systems that mix agriculture and desalination. Countries in the region may reduce their freshwater use, encourage water reuse, and increase agricultural production by using treated wastewater and desalinated water for irrigation.

Water reuse and Recycling: Reusing and recycling water will likely be essential in alleviating water scarcity, in addition to desalination. High-quality recovered water may be produced by advanced wastewater treatment techniques for a variety of non-potable uses, including gardening, industry, and even indirect potable reuse through aquifer recharge or surface water augmentation. In this context, expanding water reuse infrastructure and encouraging public acceptability will be crucial.

Desalination brine management: Management of concentrated brine produced by desalination processes: Improper management of this brine might have negative effects on the environment. To reduce the impact on marine ecosystems and increase the value of by-products, future efforts will probably concentrate on developing cutting-edge brine management techniques, such as brine dilution, brine crystallization, and resource recovery from brine.

Research and Collaboration: It is anticipated that governments, academic institutions, and business organizations in the Middle East would work together more on initiatives including research and development for sustainable desalination and water reusing. These partnerships may hasten the process of identifying workable solutions, enhancing productivity, and disseminating best practices throughout the area.

Policy and Regulation: Through policy and regulatory frameworks, governments will continue to play a critical role in advancing sustainable desalination and water reuse. Incentives for implementing green technology, requirements for water efficiency, the promotion of water



conservation techniques, and rules for brine disposal are a few examples of these. Support from policy makers may encourage innovation and guarantee the long-term viability of the region's water supplies.

Overall, technical improvements, the incorporation of renewable energy sources, and all-encompassing water management methods are anticipated to play a role in the future of sustainable desalination and water reuse in the Middle East. The area can address issues with water shortages, improve water security, and advance sustainable development by implementing these strategies.

Sustainability 2024 Challenges

Anat Even-Chen, Global Sustainability Manager, Prodalim

In recent years, there has been a significant change in the challenges sustainability entails for companies and in the variant implementations of companies to improve their performance. Based on the experience we gathered in Prodalim, we identified four main categories of the existing or upcoming challenges:

1. **Consumer demands –** A change in consumer behaviors reflect there is a shift to more responsible consumption hence, there is an increasing demand from consumers for sustainable products. The result is that more and more companies must answer the requests and needs arising from their consumers.

2. **Regulation demands –** In the past few years, ESG regulation has become more intensive. For example, we can see the regulation of the "Corporate Sustainability Reporting Directive" (CSRD); new standards from the "International Sustainability Standards Board" (ISSB); the EU's "Carbon Border Adjustment Mechanism" (CBAM); etc. Those are only chosen examples from the last two years alone.

3. **Company's performance –** Company measures not only on adjusting to its stakeholders requirements but also on its own sustainability performance and the different ways the company implement sustainability projects for the short and long term.

4. **Supply chain –** Because a company's supply chain is usually responsible for a meaningful part of the company's scope 3 emissions, we see it as one of the main barriers to improving a company's sustainability performance, and we wish to elaborate on this specific challenge.

Prodalim aims to drive its suppliers to become more sustainable by promoting open and transparent dialogue and engaging them with win-win projects. For example by:

- Initiating sustainability meetings with strategic suppliers to understand each side's needs and abilities to address them productively and successfully. We are also using those meetings to present our suppliers with our ESG targets and the necessary certifications and/or membership they need to join.

- Our suppliers receive a "sustainability supplier's questionnaire" once a year, which they must answer.

Based on their collaboration and answers to the two above clauses, we prioritize our suppliers and give preference to the suppliers with the highest sustainability performance.

- We see the importance of collecting and measuring our ESG data. What is not measured cannot be managed. To achieve that and to understand what we need to improve, we implemented an ESG IT system- ESGgo. With this system, we are not just collecting our ESG data, but we also started a pilot this year with chosen strategic suppliers to manage their ESG relevant data. This is a win-win collaboration because it allows our suppliers to implement an advanced ESG tool they still didn't have, which enables them to improve their performance, and we get the complete necessary ESG data and a comprehensive understanding of our supplier's emissions, for example.

- Stakeholders collaboration – By thinking outside the box, we reach potential partners to join our coalition, focusing on specific topics/products. We aim to address suppliers we have in common and, as a power coalition, discuss with them to improve their sustainability abilities and performance (adding more certifications, reducing GHG emissions, and more).

Prodalim's CEO agenda - Tsahi Berezovsky:
Sustainability is an integral part of what Prodalim does. Putting a great focus on sustainability in Prodalim is not a challenge, it is an inherent part of our DNA.

We deal with healthy products and we support a healthier way of living by using natural ingredients, promoting sugar reduction initiatives, and developing technologies to reduce Alcohol.

As the CEO of Prodalim, one of my KPIs until 2030 focuses on ESG by investing 10% of our profit in innovation projects that will help create a positive impact on sustainability.

People are our primary and most valuable asset and we treat them with great respect. It is an integral part of our core values.

We are true believers in equality and diversity, and it is reflected in any action we take.

We deal daily and dedicate many resources to be in the forefront of circular economy, assisting our supply chain partners, to utilize all possible side streams of the fruit.

Finally yet importantly, we focus on reducing our GHG emissions by setting goals for constant improvement and measuring our performance.

The journey of leading a sustainability driven organization in an uncertain environment is very fulfilling, as we know that we are doing the right thing, for our society and for the next generations

We are inviting you to contact us, learn more on our projects, and join our initiatives-

Anat Even-Chen, global sustainability manager of Prodalim: anat.even.chen@prodalim.com

Mindmap of the EU's legislative status

Justine Pradels, Sustainability and Technical Affairs Manager. AIJN

What is truly behind the EU Green Deal?
The EU Green Deal, presented by the European Commission in 2019, is in fact a communication which details a set of objectives for the future. Indeed, a non-binding document, the communication presents the Roadmap for the EU institutions to pave the way to a more sustainable and prosperous European society.

This Roadmap is composed of the eight pillars described in figure 1: climate, energy, industry, construction, environment, biodiversity, food & mobility.

On top of this, the three core values are: ensuring the transition is adequately financed, that it benefits society equally, and that it is innovative.

Figure 1: the EU Green Deal

What is then truly behind the Green Deal is the set of new rules that have been, and still will be, implemented to make it real. This includes the revision / modernisation of many existing legislation as well as the elaboration of new ones. Below an overview of the new and future rules impacting the fruit juice industry, in and outside of Europe.

Figure 2: shows legislation that has been adopted, since 2019

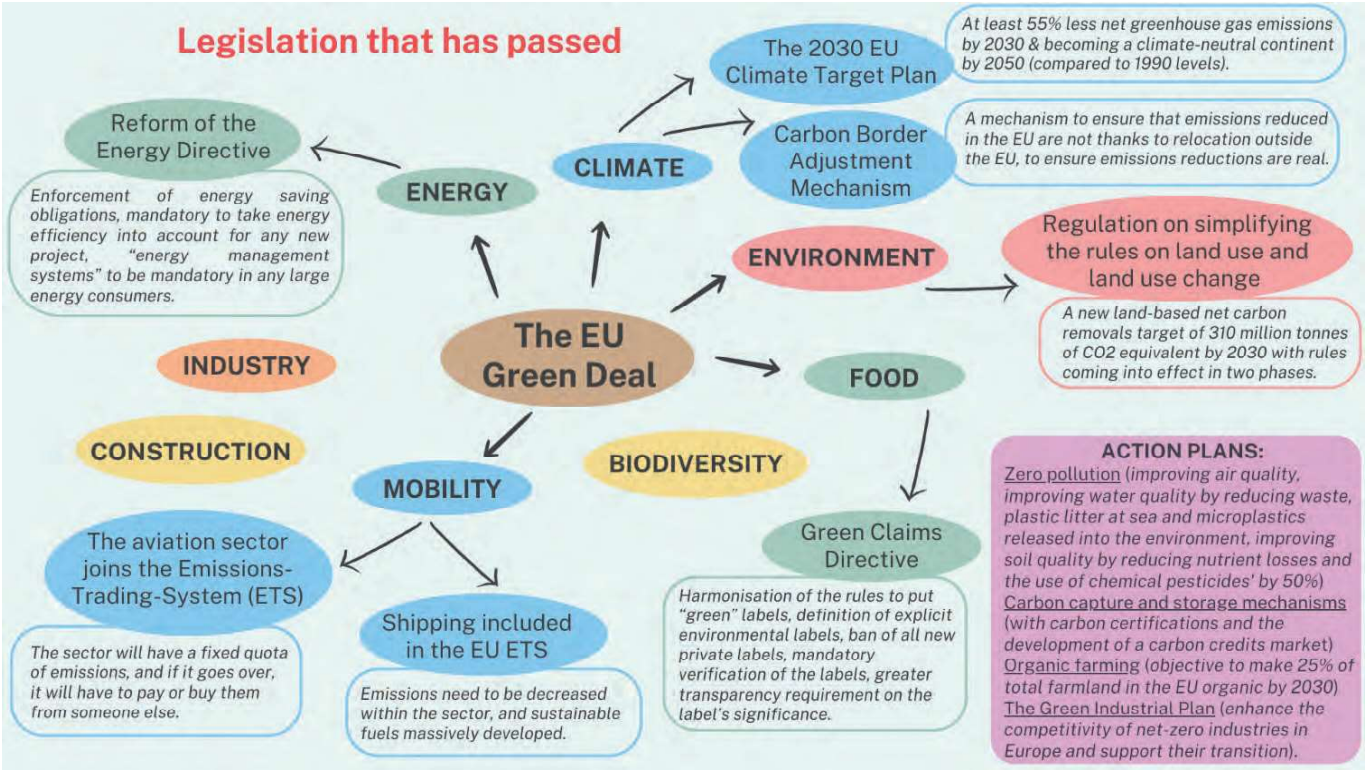
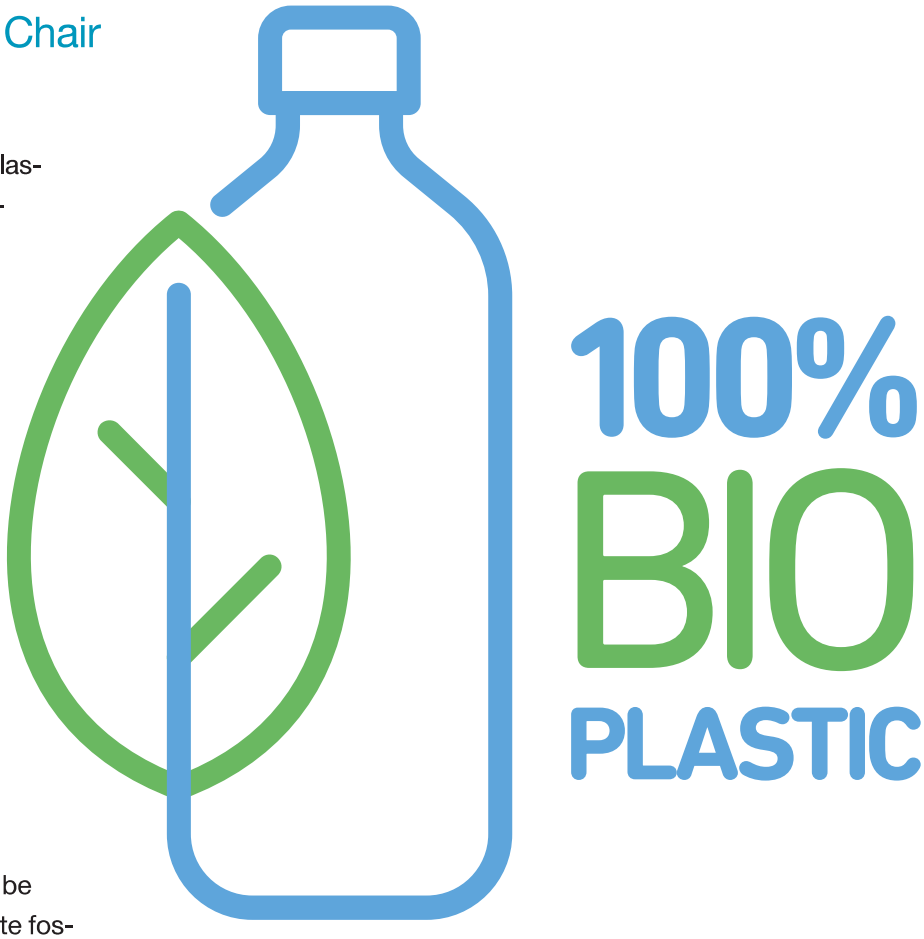


Figure 3: shows what upcoming legislation is going to have an impact on the fruit juice industry, foreseen for the next few years

Examples of alternative beverage packaging sustainability solutions

David Berryman, SWG Chair



Bioplastics

In principle, since the carbon in bioplastics does not originate from oil deposits, where the carbon had been removed from the atmosphere by plant life many millions of years ago, a bioplastic uses present day biological material as its starting point. The raw material could be seaweeds, wood, sugar cane, food waste or residues etc. The bio plastic thus becomes part of the present carbon cycle so that even at the end of its life does not add to carbon dioxide in the atmosphere.

Suntory claims to be a leader in acknowledging that this material could be an important part of the aim to eliminate fossil-based plastic by using at least 50% bioplastics in their packaging within the next six years.

The Japanese multinational which owns the drinks brands **Ribena** and **Lucozade** in the UK and **Orangina** in France, claims to be making significant progress in its sustainable packaging credentials.

In 2019, they introduced 30,000 edible capsules made from seaweed on a trial basis for the 2019 London Marathon. Since then, the capsules have become available in dispensing machines, starting in gyms throughout the UK.

Whilst the use of edible plastic from seaweed is an interesting and exciting project, it could not substitute non-edible plastics for bottles.

It's a neat example of a bio plastic which at the end of life is not contributing to environmental damage in the form of litter, land fill or marine pollution.

Perhaps most significant is that Elopak are demonstrating that cartons can be produced in an aluminium-free form, which they claim reduces the carbon footprint by 50%.

Whilst the use of edible plastic from seaweed is an interesting and exciting project, it could not substitute non-edible plastics for bottles. What would be needed is commercial scale production of bio plastics. In August this year (2023), **Suntory** and **Mitsubishi** entered into partnership with the Petrochemical giant **ENEOS** in the first steps to produce bioplastics on a commercial scale at their refinery in Okayama, Japan.

Meanwhile, **Coca Cola** continues to work with **UPM,** the wood-based biochemical company in Germany. UPM intends to produce 220.000 tonnes of BioMEG, a precursor for BioPET bottles. This is a significant contribution to Coca Cola's aim of net zero carbon by 2030.

For cartons, hugely important in the juice industry, the Swedish based **TetraPak** and Norwegian **Elopak** continue their battle of claims and counter-claims about sustainability. Perhaps most significant is that **Elopak** are demonstrating that cartons can be produced in an aluminium-free form, which they claim reduces the carbon footprint by 50% compared to cartons still using aluminium.

2024 will see the launch of a new carton. It will be launched by Zotefoams plc, which has all the appearances of a carton made from board, polymers and aluminium. However, it is made from a single type of plastic, expanded HDPE. By using a single raw material instead of the several laminations used in a standard carton, the carton is more easily recycled since it will not require specialist facilities to process. Furthermore, by using 30% recycled HDPE on a regular basis, it is expected to use 50% less water and energy than for a standard carton. For more information about this exciting launch and accreditations, go to **www.zotefoams.com**

Unlocking the Potential of Citrus Waste: Sustainable Recovery of By-Products

Carlos Fernandez, Sustainability Advisor, **Jose Biot,** Global Technical Director and **Jose Lorente,** Fruit and Vegetable Processing Technical Assistance. JBT Corporation.

With global environmental concerns at an all-time high, one sector poised to make significant contributions to sustainability is the agri-food industry. Specifically, in the citrus industry, where millions of tons of citrus fruits and juices are consumed annually worldwide, the by-products — peels, seeds and other not endocarp parts — generated during the juice extraction— represent a significant challenge for waste management. However, these by-products also present an opportunity. Inside these discarded materials are valuable elements that can be repurposed in numerous ways, from animal feed to other alternative food ingredients production like pectin, fibers, vitamins, among other applications.

In this article, we will delve into the innovative technologies developed by JBT, a leader in food processing solutions, to recover these by-products, transforming citrus waste into an array of valuable and sustainable materials. These technologies not only bring benefits to the citrus processing industry by creating new revenue streams, but also contribute to global sustainability goals, facilitating a circular economy and reducing environmental impact.

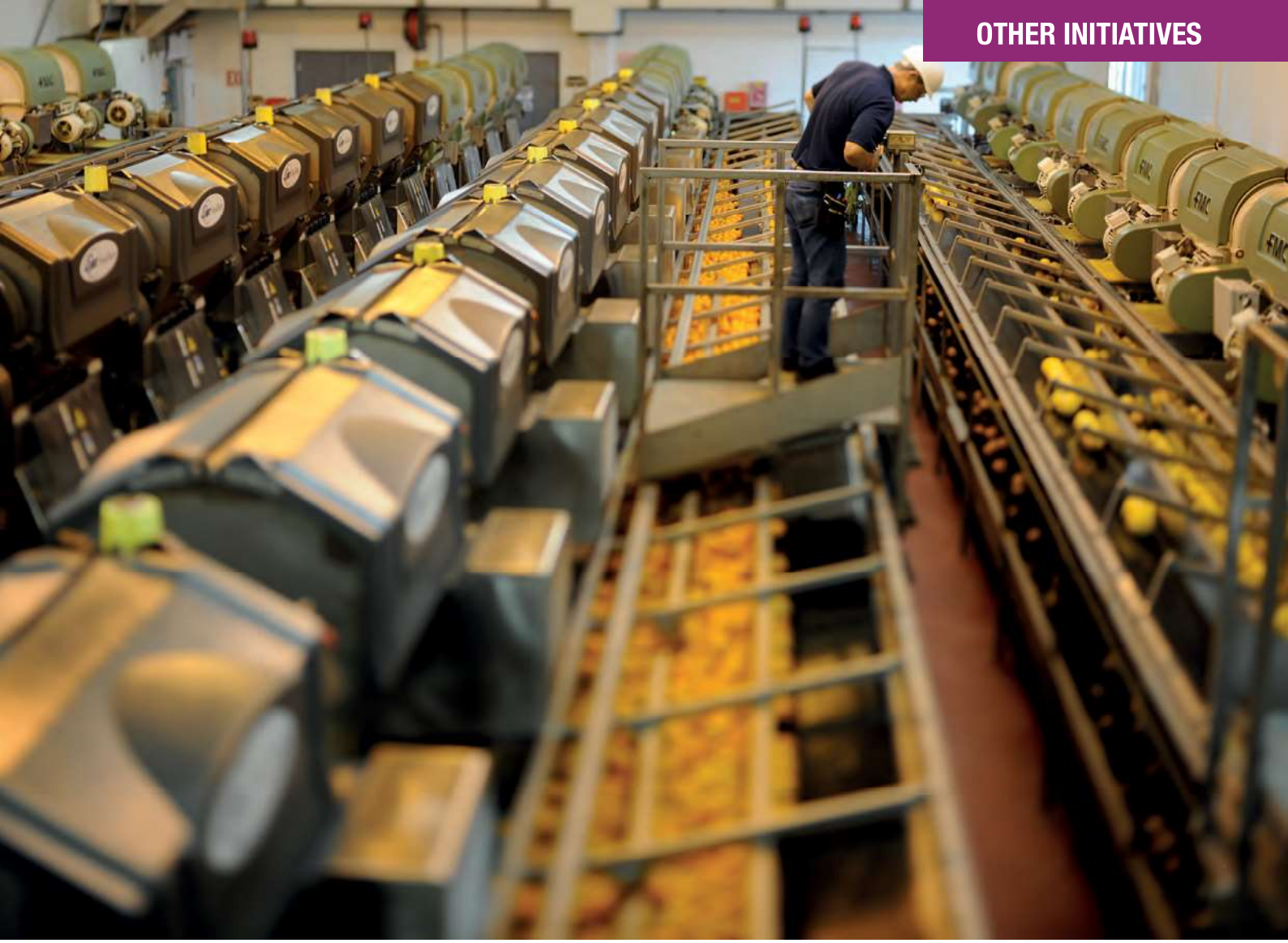
Citrus Anatomy and Structure

A citrus fruit, while simple in appearance, is a complex structure rich with nutrients and valuable compounds. A closer look at its anatomy reveals a multi-layered structure, each with its unique characteristics and potential uses. The outermost layer, known as the flavedo, is full of colorful pigments and aromatic essential oils. The layer underneath, the albedo, or white pith is loaded with pectin, dietary fiber with properties highly sought after in food production. Lastly, the seeds, while often discarded, hold potential for use in pharmaceutical industry to recover bio functional compounds.

Understanding these distinct components and their location within the citrus fruit is fundamental for the development of technologies aimed at effectively recovering and utilizing these components. Each layer of waste peel presents a unique opportunity for recovery and reuse.
JBT, recognizing the potential in citrus waste, has developed a range of solutions to extract the valuable elements hidden within. Each technology is designed to target specific components of citrus waste efficiently and sustainably. In the following sections, we will explore these technologies in detail.

Feed Mill (Peel Drying)

Among the most significant challenges with citrus waste is its high moisture content, which increases weight, making transportation costly and complicates further



processing. JBT's Feed Mill solution addresses this issue head-on, using an efficient drying and pelletizing process that turns wet peel waste into a valuable product — a rich source of nutrition for animal feed or a base for pectin extraction.

The process begins with the addition of lime (calcium hydroxide) to the peel in a screw conveyor, which prepares the peel for further processing. The mixed limed peel is crushed to keep a homogenous particle size which benefits the drying step. The limed crushed peel is then pressed to reduce its initial high moisture content, turning it into what is referred to as 'peel with lower water content' or press cake.

After pressing, the liquid fraction, referred to as liquor, can be directed into one of two options based on the desired product:

1. **In the first option, the liquor can be used directly in the production of cloudy products, an ingredient often found in fruit soft drinks. This process requires the peel to be pressed without adding lime, but on the contrary often requires specific enzyme addition.**

2. **In the second option, the liquor is concentrated in a Waste Heat Evaporator (WHE), a crucial step where energy in the form of water vapor is removed from the peel. The resulting concentrated molasses is added back to the press cake before final drying, enhancing the energy efficiency of the dryer and further reducing the moisture content of the peel. The molasses also provides additional soluble solids (sugars) content to the final dried peel, which cattle find very tasty.**

The press cake, the solid fraction from pressing, mixed with the concentrated molasses, is introduced into a rotating drum dryer. A stream of heated air evaporates the remaining water content, reducing the peel's volume and leaving behind a dry pulp. This dried pulp then moves to a pellet mill, where it is compressed into pellets, making it easier to handle and transport.

The resulting dried, pelletized citrus waste not only holds high nutritional value as an animal feed but also significantly reduces waste disposal's cost and impact. This product, because of an alternative similar process, can also be used as a base for pectin extraction, opening further opportunities for revenue. Dried Pectin Peel produced from the peel wash and drying.

Pectin Recovery

Pectin is a key component in the food industry, serving as a gelling, cloudy stabilizer, and thickening agent in jams, jellies, baby foods, juices, beverages, yogurt, and many other products. Recognizing the value of pectin and its abundance in citrus peels, JBT developed a dedicated technology to extract it — the Dried Pectin Peel solution.

The process starts with washing the citrus peels in a counter-current flow to remove the sugars (diffusion of soluble solids from the peel into controlled temperature water). This process is achieved by using washing tanks, static mixers and presses or finisher separators. After the washing steps, the peels are dried in a rotatory dryer at a lower temperature to preserve the pectin quality. Right after the dryer, there is a cooling reel and a baling machine to produce dried pectin peel flake bags.

These pectin-rich flakes can be further processed into commercial-grade pectin, a product in high demand in the food industry. This innovative and sustainable solution reduces disposal costs, contributes to a circular economy in the citrus industry, and opens a lucrative revenue stream for processors.

The water that was used to wash the peels is also enriched with natural fruit sugars, which can be extracted to create another recovery stream. This water is sent to JBT's TASTE Evaporator to obtain these sugars as a concentrated product—fruit natural sugars.

d-Limonene from Press Liquor

d-Limonene is a fragrant compound found in the essence oil of the citrus peels, particularly in the flavedo (peel) layer, where the oil sacs are located. d-Limonene is the major constituent of the citrus peel essential oils. Its pleasant citrusy scent has found applications in cleaning products, perfumes, and as a flavoring in food and beverages. To recover d-limonene, JBT uses a flash distillation system, READYGo d-Limonene, designed specifically for this purpose.

In the READYGo d-Limonene system, the emulsion liquor from citrus peels, an oil-bearing stream obtained when processing the citrus peel by using JBT Technology, together with other streams from citrus processing like press liquor, is utilized to separate the d-Limonene. The different streams are then heated with live steam, which breaks the oil stream into oil droplets and water droplets. The oil droplets, containing d-limonene, are then distilled from the water using a flash distillation process. This vapor is condensed and collected as pure d-limonene, ready for use in multiple applications.

Peel Cloudy & Comminuted

JBT also develops technologies to produce peel cloudy extract and comminuted citrus base from waste peel or whole fruit, respectively. These are popular ingredients in the beverage industry, as they add cloud stability, texture, and enhance the taste of drinks. The process begins with crushing and milling the peels or whole fruit:

• **Cloudy products:** The pulp that results from this process is washed in a counter-current manner with an added enzyme mix. This leads to a liquid extraction process that requires ample time for enzymatic reactions to occur. The pulp is then centrifuged to separate and remove the heavier solid residues. At times, a de-bittering step may be applied, and finally, is concentrated to yield a superior quality citrus base or extract known as 'peel cloudy.'

• **Comminuted:** Obtained from the whole fruit crushed, refined and filtering by using different JBT technologies (crushers, cyclones, finishers, pasteurizers).

These extracts provide a cloud stability to other drinks and beverages and improves the flavor and mouthfeel of beverages and increase their fiber content, adding to their nutritional value. With this technology, what would have been waste is transformed into a valuable product contributing to the taste and nutrition of beverages enjoyed worldwide.

Dietary Fiber from Citrus Fruits

Dietary fiber, otherwise known as food fiber, is a broad term that covers all plant components that are not broken down by human digestive enzymes and thus, cannot be absorbed. It consists of non-digestible carbohydrates, including cellulose, hemicellulose, pectin, and gums, as well as non-carbohydrate constituents like lignin (LLOYD et al., 1982).

To harvest this component, various stages of the citrus processing are employed through the JBT citrus extraction line:

• Cyclone discharge in pulp recovery.
• Juice Extractor Orifice Tube discharge once the peel plugs have been eliminated.

The fractions obtained are washed with water at a temperature less than 15°C, then dried and milled.
This extracted fiber finds various uses in food products such as bread, pastries, functional drinks, and more. This process not only adds another useful product from citrus waste, but also promotes a healthier and more fiber-rich diet.

Contributing to a Sustainable Economy: Citrus Waste Management

The sustainable recovery of by-products from citrus waste is no longer just a theory; it is an increasingly viable and integral part of the citrus industry. JBT's innovative technologies have paved the way for citrus processors to turn what was once considered waste into a variety of valuable products. This not only adds new revenue streams to their business, but also significantly contributes to the larger goal of a sustainable and circular economy.

As we move forward, the industry can expect to see continued development in this field. More research and technological advancements will likely uncover even more potential uses for these valuable by-products. This movement towards a sustainable future show that with innovative processing methods and an understanding of the value within what we often discard, the potential for citrus waste is indeed bright.

Overview of the Sustainable Juice Platform

Atha Mandis, Director at De la Tierra Ltd
and Chair of the Sustainable Juice Platform

History
The SJP was founded as a sustainability initiative for the fruit juice industry (2013). It was co-initiated by the European Fruit Juice Association (AIJN), Sociability (Denmark), UTZ (Netherlands), and AZTI (Spain). The Platform was supported and co-funded by the European Commission for the first 18 months of operation. Today, the Platform is entirely funded by its 50 international members. The Platform and its members represent over 90% of fruit juice traded in Europe.

Objectives
The objective of the Juice CSR Platform is to:
Inspire, guide and **support** fruit juice actors to integrate corporate social responsibility (CSR) in their business operations and core strategy.

The roles of the Platform include:
1. Facilitate and support collaboration,
2. Ensure quality and sector-wide participation, and
3. Communicate and harmonise efforts.

Governance and Structure
Membership fees go towards platform management, projects and running working groups.

Plenary. Members are responsible for approving annual budgets and the strategic direction of the Platform. Members from each of the eight membership categories elect representatives to Steering Committee.
Steering Committee. Responsibilities include selecting and reviewing the performance of platform management service providers, project reviews, evaluating performance of the Platform and its activities, approval of new member application and communication.
The Platform has identified three pathways to address sustainability within the sector. These include:

Mitigation. Characterised by interventions in hot spots. Mitigation projects can originate either from working group activities or via the Spotlight process.
Initiation. Identification and collaboration on projects and improvement opportunities.
Education. Raising the level of awareness for and on behalf of members and their supply chains.

2022 – 2023 Activities

Mitigation
The Platform had recently undertaken a desk-top research project into the main socioenvironmental risks in strategic supply chains. The next step is to explore the reality on the ground, i.e., do the identified medium and high risks exist in the supply chain? Supply chain and civic actors shall be invited to share their knowledge and experience on supply chain risks with the ultimate of objective of determining where to invest time and resources to mitigate the worst socioenvironmental risks.

Initiation
The Platform is co-funding two initiation projects:

Upscaling sustainable apple sourcing in Poland

The objective is to train and assist 100 apple producers implement FSA verification Other activities include
1) increase awareness of Good Agricultural Practice (GAP),
2) assess Greenhouse Gas (GHG) emissions,
3) perform soil analysis,
4) develop farm level Biodiversity Action Plans (BAPs), and
5) improve knowledge-sharing concerning pesticide management.

PROJECT LIFECYCLE: January 2021 to December 2023

PROJECT LEAD: Döhler

PROJECT PARTNERS: Eckes-Granini, Riedel, Keurig Dr Pepper, Sustainable Juice. Covenant (SJC), Sustainable Juice Platform (SJP)

COLLABORATION: Agroekoton, Rolinctwo Zrównoważone, Otop

Photo: Döhler. Examples of initiatives under the farm-based Biodiversity Action Plans.

Contribution of ecosystem services provided by wild pollinators and natural enemies in the Atlantic Forest and Cerrado, Brazil.

The Brazilian citrus belt is found in the Atlantic Forest and Cerrado biomes. The objective of this unprecedented project is to verify the hypothesis that the abundance of wild pollinators and natural enemies found in natural conservation areas decays over distance into production areas. The aim is to quantify the economic deficit caused by this decay to argue the case for promoting ecosystem services provided by beneficial insects.

Project life cycle: January 2022 to June 2023

Project lead: FUNDACAO DE APOIO A PESQUISA, ENSINO E EXTENSAO

Project partners: Innocent Drinks, Sustainable Juice Platform, Federal University of São Carlos, University of São Paulo, University of Reading, CREAF.

Collaboration: Fundecitrus.

Education

The SJP, SJC, IFU and AIJN co-initiated JEDD Talks, a series of environmental lecturers to promote some of the case studies from our juice supply chains. The first lecture in March this year focused on biodiversity. This will be followed by lectures on waste (October) and water (November).

Towards sustainability in the fruit juice industry: opportunities of organic waste reduction through circular economy

Aintzane Esturo, IFU Technical Director

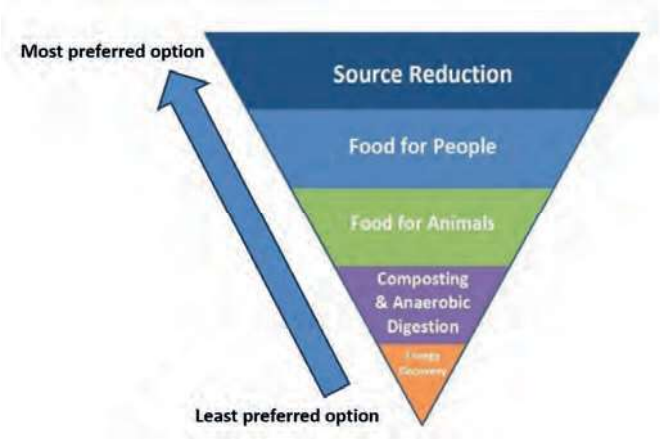
As consumers become more demanding and discerning when it comes to products that have minimal environmental impact, companies are working to reduce their environmental footprint by using sustainable ingredients and practices. This includes regenerative agriculture, sustainable sourcing, reducing carbon footprint, using eco-friendly packaging, and promoting the circular economy.

The fruit juice industry has a great opportunity to apply circular economy models, where products and packaging are designed for reuse, recycling or upcycling. This approach intends to minimize the waste generation and to extend the lifespan of products.

Focusing on the organic waste generation, most of it occurs in the agriculture and fruit processing steps. According to Rabobank (2018) data, only about 10% of the fruit production goes for processing from which 75% goes for juice production.

Obviously, the organic wastes generated by different types of fruits are different and can range from the 60% to 5% of the total fruit weight. Likewise, the upcycling opportunities for the generated wastes are also different. For edible parts, the re-introduction into the food chain is desirable while non-edible parts can be upcycled for energy valorisation for example. The recovery hierarchy from the waste should focus on reducing the waste gen-

eration and increasing the yield. The second option is to upcycle from the generated organic by-products to produce feed. Composting (for soil remediation) and energy valorisation (biogas production) come as next option, being the energy recovery the least preferred option. This is summarised in the graphic:



Source: CityMarket Coop

However, in certain processes there will be always a waste generation, specially in the first steps of the food value chain: agriculture and fruit/vegetable processing. The strategy of the company should be to try to get the best value of those by-products, trying first to introduce them in the human food chain. The more value the product has the more interest a company will have in exploiting them, for example fermented products based on by-product, extraction of high value molecules, obtention of ingredients, etc. The raw materials for animal feed, production of compost or energy, require less investments but also generates less revenues.

The strategy to apply the circular economy is to think of the fruit/vegetable processing plant as a biorefinery, where all the organic material is valorised. It consists of the pproduction of innovative products from existing process streams which avoids expansion of the crop area, and improves fruit utilization.

There are many interesting examples in the industry where those side streams are being recovered to produce a unique product with important market demands. Citrus oils (not only from lemon), limonene, fruit fibres, pectin, bioactive compounds (antioxidants), etc.. have interesting expanding markets.

Certainly, the juice producing sector is strongly committed to improve the sustainability of its activity and there are great exploitation opportunities. In this sense technologies play a key role because they allow to extract in an efficient and affordable manner interesting compounds from side streams. But even if the technically those proposals are feasible, it is important to have a close look to the economic feasibility, where the volumes of side streams and the logistics involved in the transportation of side streams for upgrading are key.

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