D.4.1 - Report of Pilot Study Development design plan

V1.2

04/08/2023

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TECHNICAL REFERENCES

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19 September 2022	BGI	V0.1	Document started
28 September 2022	BGI	V0.5	First draft version
11 April 2023	BGI	V0.8	Added some information about Traceability
31 July 2023	BGI	V1.1	BGI send the report D.4.1 to INIAV.
04 August 2023	BGI	V1.2	Due to requested changes of the report design, it was made the second version of the report.

[Report Description:]

Title: D.4.1 - Report of Pilot Study Development

Written by: BGI

Date: 04/08/2023

Abstract: This report presents the findings of a pilot study using a blockchain approach to control the complete rice supply chain, from the farmer to the end consumer. The pilot was developed in cooperation with Ernesto Morgado, a consortium partner, covering the various steps of the chain, and enabling the build-up of a case study supported by the blockchain approach covering the whole chain. The pilot study aimed to ensure traceability, food safety, profitability, and authenticity in the chain.

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1. INTRODUCTION

The pilot study was undertaken, as part of a larger TRACE project, to develop a blockchain-based solution to the rice supply chain.

The pilot aimed to define the technical infrastructure, standards, specifications, and strategies, derived from the stakeholders' requirements, to be followed throughout the building, testing, and implementation of the system.

The study focused on monitoring the important variables at each stage of the supply chain to ensure compliance with all relevant requirements and ensure a robust and coherent system to be implemented by the end of the project.

1.1 RICE SUPPLY CHAIN

The rice supply chain is a complex network of individuals and organizations involved in the production, processing, distribution, and consumption of rice. The supply chain starts with farmers who cultivate and harvest the rice crop and ends with consumers who purchase rice products for consumption.

In between, there are numerous intermediaries such as traders, processors, distributors, and retailers who play critical roles in ensuring the efficient and timely flow of rice products from farm to table.

One of the key challenges in the rice supply chain is ensuring the quality and safety of the rice products. Rice is susceptible to contamination by pests, diseases, and chemicals used in the cultivation and processing stages. Therefore, it is important to have effective traceability systems in place that allow for the identification and tracking of rice products at every stage of the supply chain.

Another challenge is the lack of transparency and trust among supply chain participants. This can lead to fraud, contractual breaches, and insurance claims, resulting in financial losses for all parties involved.

To address these challenges, there is a growing need for innovative technologies such as blockchain that can provide a secure, transparent, and efficient way to manage the rice supply chain. By leveraging blockchain, it is possible to create a decentralized, tamper-proof ledger that allows for the sharing of information among supply chain participants while maintaining data privacy and security.

Overall, the rice supply chain is a critical component of the global food system, and ensuring its efficiency, transparency, and sustainability is essential for meeting the growing demand for rice products and achieving food security for all.

1.2 BLOCKCHAIN APPLIED TO RICE SUPPLY CHAIN

Blockchain technology has the potential to revolutionize supply chain management, and the rice industry is no exception. By using a blockchain-based application to control the rice supply chain, stakeholders can ensure traceability, food safety, profitability, and authenticity in the chain.

The app would enable real-time monitoring of the important variables at each stage of the supply chain, from the rice fields to the end consumer. The app would capture data on several variables like the genetic blueprint of the rice, the variety of rice, time and storage conditions between milling/sorting and packaging, storage conditions (temperature and relative humidity) of packed rice at the factory, during the distribution chain, and at point of sale, permeance of package material used, and pesticides and mycotoxin screening.

All this data would be stored on a distributed ledger, accessible to all relevant stakeholders in the supply chain. This would ensure transparency and accountability, as all parties can have access to the same information. The app would also enable stakeholders to track the rice as it moves through the supply chain, providing end-to-end traceability.

In addition to improving traceability and food safety, the blockchain-based app can also improve profitability in the rice supply chain. By enabling real-time monitoring of the important variables at each stage of the supply chain, stakeholders could identify inefficiencies and take corrective action. This would reduce waste and improve the overall efficiency of the supply chain.

Finally, the app would also ensure authenticity in the rice supply chain. By using a blockchain-based app to capture data on the important variables at each stage of the supply chain, stakeholders could verify the authenticity of the rice. This would help to prevent fraud and improve consumer confidence in the rice industry.

1.3 PORTUGUESE RICE SECTOR

The rice sector in Portugal is relatively small, but it is an important part of the country's agriculture industry. Rice cultivation in Portugal is mainly concentrated in the Alentejo region, particularly in the lower Alentejo area.

In recent years, the rice sector in Portugal has faced some challenges due to the competition from other countries, particularly from Asian countries that can produce rice at a lower cost. However, there is still a strong demand for Portuguese rice, especially from the domestic market.

To support the rice sector, the Portuguese government has implemented various policies and initiatives to promote sustainable rice production. Overall, the rice sector in Portugal is an important part of the country's agricultural industry, providing both economic benefits and culinary traditions to the country. With continued support and innovation, the rice sector in Portugal has the potential to continue thriving and contributing to the country's economy and culture.

2. REQUIREMENTS

The implementation of the pilot phases involved several key steps. First, the value chain for rice production was mapped in a unified way that represents the processes, resources, and measurements involved. This will help to ensure that the relevant information is captured and tracked throughout the value chain.

Supply chain requirements are essential for any application aimed at improving the efficiency of the rice supply chain. The application should allow for easy tracking and tracing of rice products and all the activities that happen throughout the value chain. Key requirements include a unified map of the

value chain, simple and intuitive user interfaces, and the ability to track products from production to the end consumer.

The main features that the application should have included a transparent and traceable supply chain, with all transactions recorded and accessible to all stakeholders in real-time. The application should also be secure, easy to use, and cost-effective.

Blockchain technology can be introduced into the application to enhance transparency and traceability, as well as improve security and reduce fraud. Blockchain technology provides a secure and immutable ledger that ensures all transactions are recorded and cannot be tampered with.

The information that would be delivered by the application includes information on the origin of the rice, its quality, and the processes it has undergone. The application would also provide information on the pricing of rice products, as well as other key aspects of the supply chain, such as transport and storage.

When selecting the blockchain technology to be used in the application, key considerations include the level of security, scalability, and interoperability with existing systems.

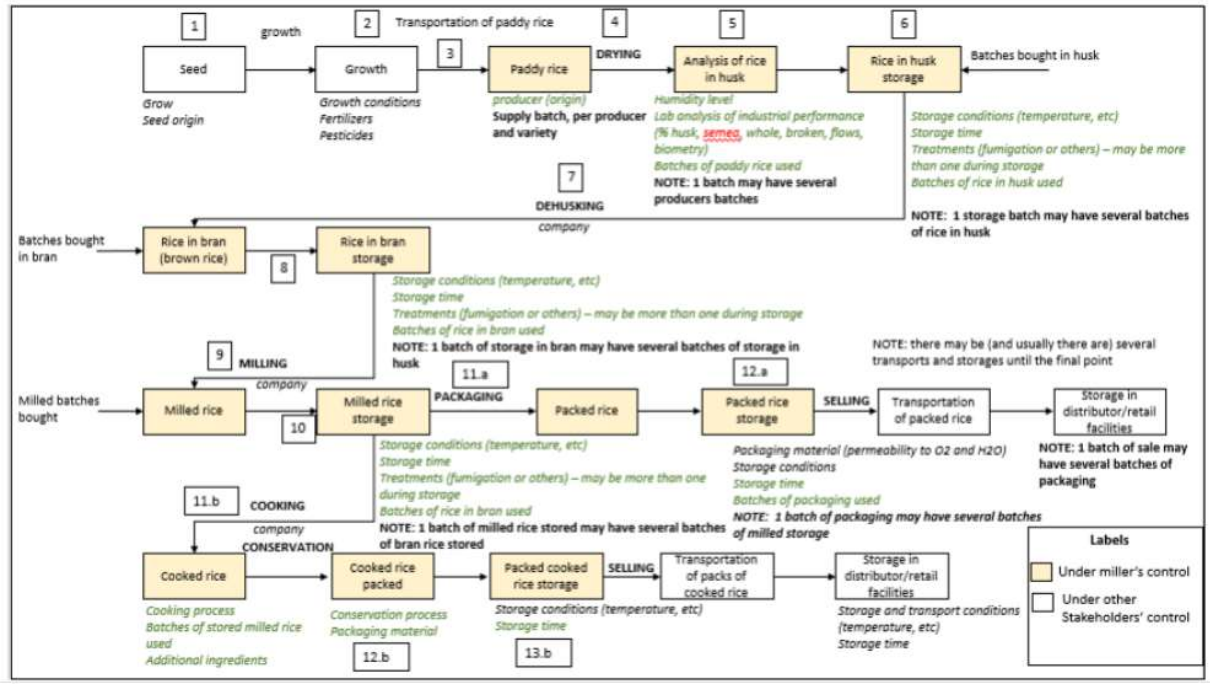


Figure 1 Rice Supply Chain Diagram

Based on these requirements a solution app - TraceAbility, was developed, supported on blockchain technology, that allows for rice products to be traced and tracked throughout the entire value chain. This solution enables the operators involved in the rice value chain, including producers, processors, and distributors, to register their activities in a simple and intuitive user interface.

The use of mobile apps has greatly facilitated the process of collecting and managing data in various industries. In the agricultural sector, farmers can use mobile apps to keep track of their field records and activities. With the help of a mobile app, farmers can easily navigate their field records and view activities, events, and attributes associated with those activities. For instance, Uniarroz used the ESRI ArcGIS Survey123 mobile app provided by INIAV to capture operational data in the rice field.

Overall, the implementation of the pilot phase helped to address several key issues in the rice value chain, including a lack of transparency and traceability, manual document checking (e.g., field records), and higher costs for traceability and control. By providing a robust, secure, and efficient solution for tracing and tracking rice products, this approach will help to improve the efficiency, profitability, and authenticity of the rice supply chain.

3. TRACEABILITY APP

TraceAbility is a blockchain-based solution designed for all stakeholders involved in the rice value chain, including producers, processors, and distributors. The key features of TraceAbility include the ability to map the value chain in a unified way that represents how operators see all processes, resources, and measurements involved. This allows for a clear and transparent view of the entire value chain, which is crucial for effective supply chain management.

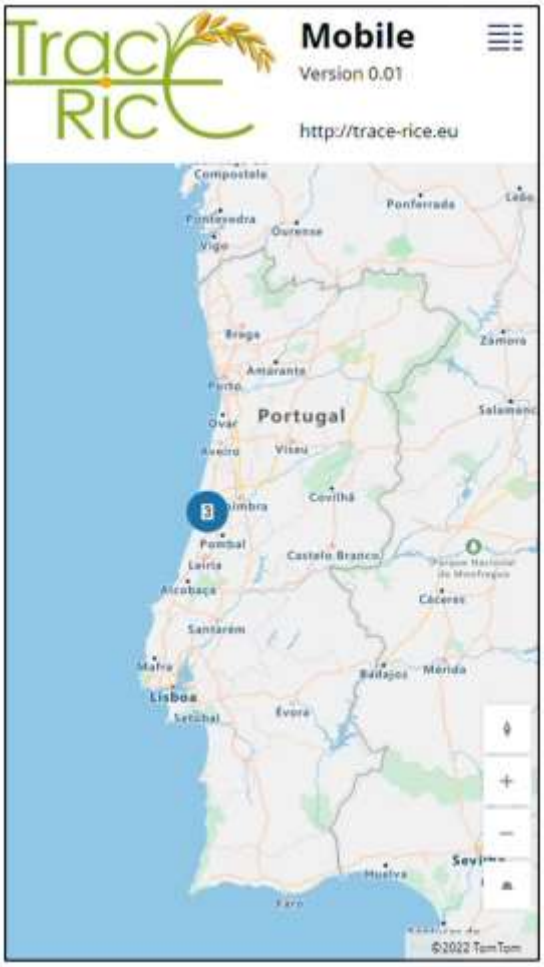


Figure 2- App Interface

Data about rice production, processing, and distribution, held in multiple and heterogeneous systems is consolidated according to the rice value chain unified model. Operators can visualize their activities in a simple and intuitive user interface, enabling them to easily track batches throughout the supply chain. This data is stored securely on a blockchain, ensuring that all parties involved have access to the same information.

One of the most important features of TraceAbility is its ability to allow operators and final consumers to trace and track products up- and downstream. This means that every participant in the supply chain can see where the product has come from and where it is going. This not only improves transparency and accountability but also helps to improve food safety and quality.

Operators can also use the recorded data for monitoring and control, serving as the basis for quality management systems and other certifications. This enables operators to identify inefficiencies in the supply chain and take corrective action, ultimately leading to greater profitability and efficiency.

TraceAbility is a powerful blockchain-based solution that provides all operators involved in the rice value chain with a comprehensive, easy-to-use tool for supply chain management. Its key features, including unified value chain mapping, simple and intuitive user interface, and product traceability, make it an essential tool for anyone involved in the rice industry.

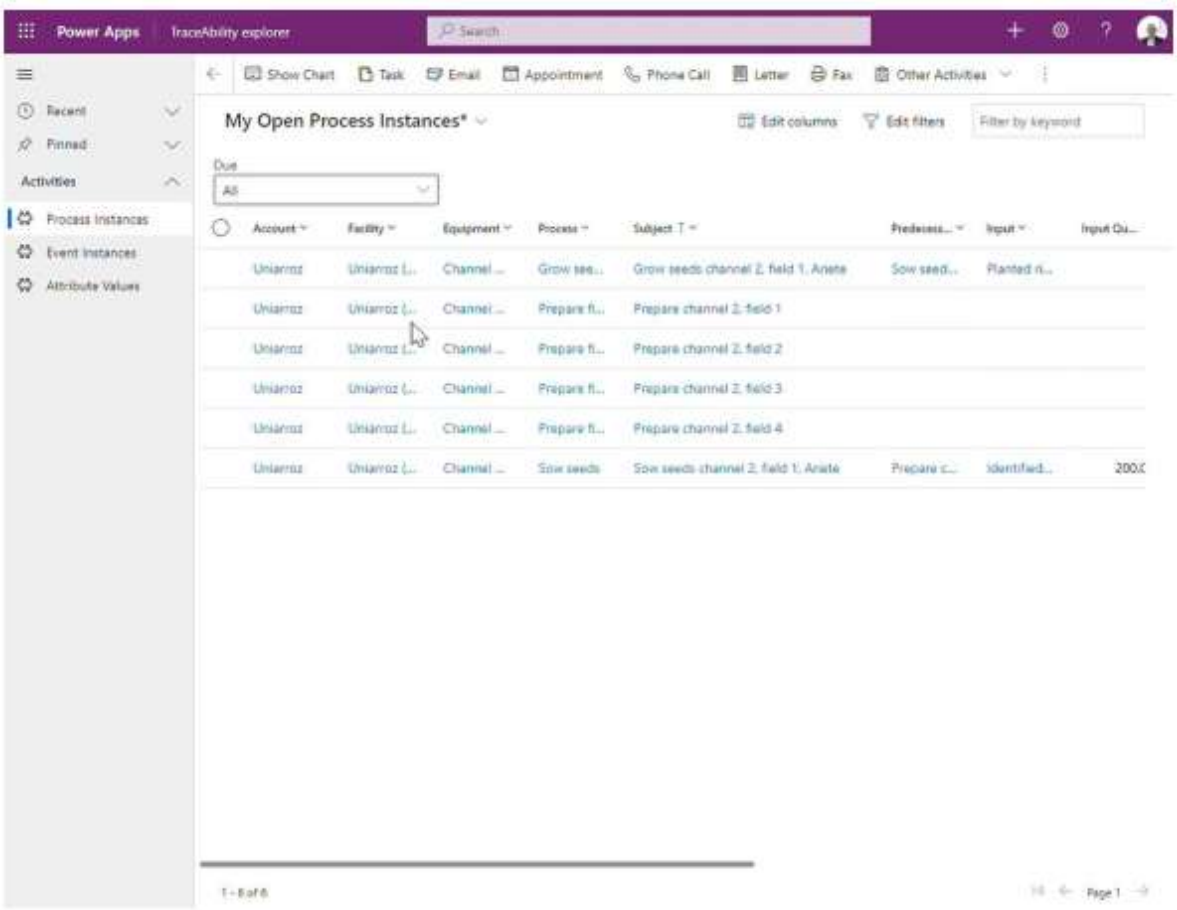


Figure 3 - TraceAbillity Screenshot

3. CONCLUSIONS

The pilot study demonstrated that the blockchain approach was an effective way to control the rice supply chain. The use of blockchain technology enabled real-time monitoring of the important variables at each stage of the supply chain, ensuring compliance with all relevant requirements and

ensuring a robust and coherent system. The pilot study also showed that the blockchain approach could improve traceability, food safety, profitability, and authenticity in the chain.

Building a unified representation of the rice value chain in a flexible data model was successfully achieved. This includes critical tracking events (CTE), key data elements (KDE) and CTE-KTE matrices.

Moving field data capture from paper to digital was done only in a pilot plot. Two versions of the data form were developed by INIAV, but pilot data was captured using the simplest one (free text fields), requiring additional data quality checks and corrections. A new version of the data form (structured fields) is available for the upcoming pilots (Spain and Egypt).

Rice processing data (primary and secondary) is currently stored by Ernesto Morgado in a central database system. A data flow from this system into TraceAbility can be easily implemented using a SOAP web service. Data about the pilot processing activities is available and will be provided (limited detail).

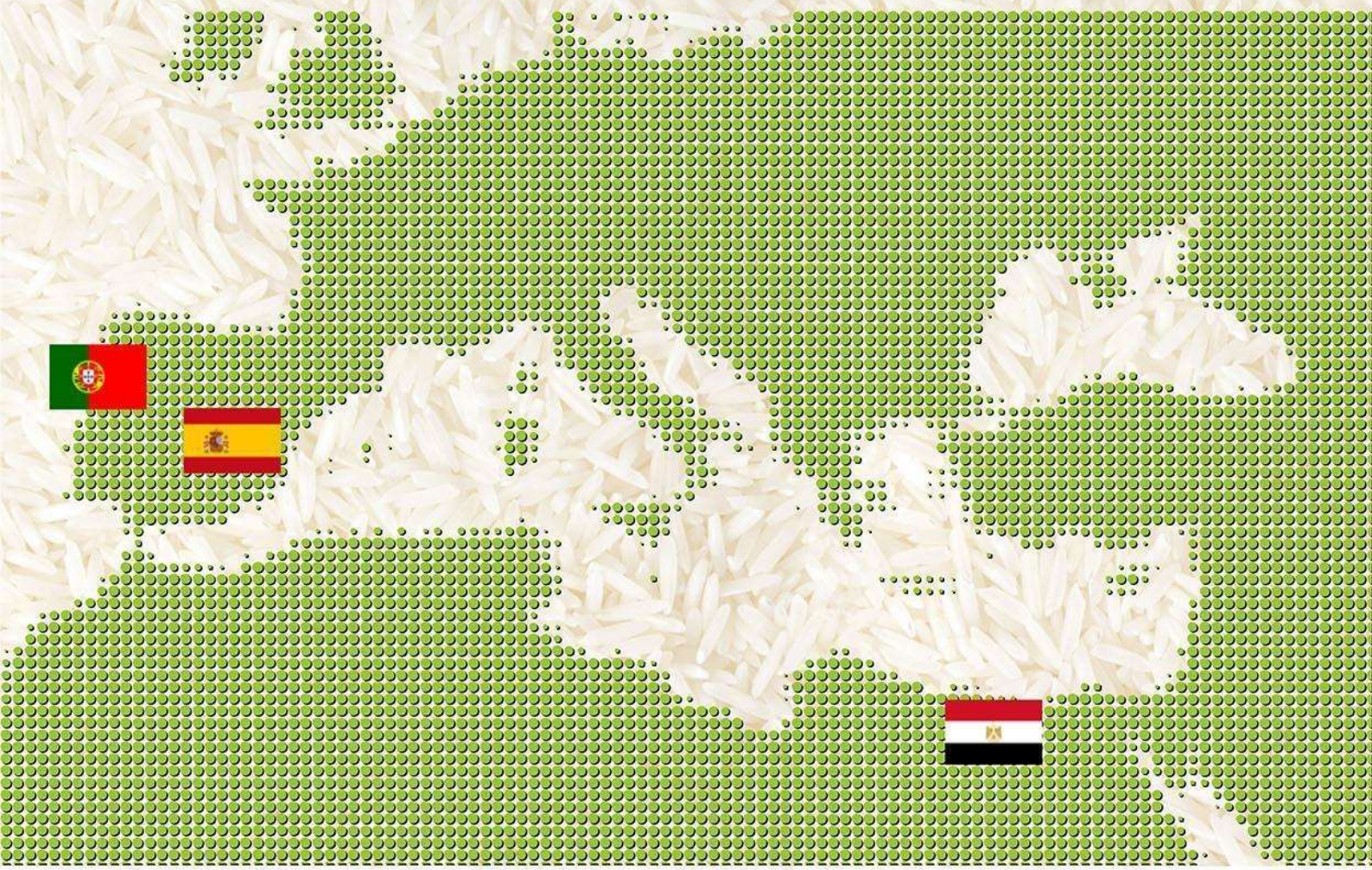
The consumer-facing app (to be developed by Mater Dynamics) will use the blockchain to obtain key data elements for consumers, like variety, origin, and a time-based indicator (to be defined).

The findings of this study can promote the new pilots in Spain and Egypt (WP5), testing the versatility and adaptability of TraceAbility as a software solution, as it can be tailored to the specific needs and requirements of different regions and supply chains.

In particular, the unified representation of the rice value chain will be validated with the new partners and pilot data will be consolidated and fed to the blockchain.

The project team will also evaluate a potential new venture based on the findings of this pilot study, using business modelling analysis based on state-of-the-art tools such as strategizer, canvas, value proposition, and perceived value.

Trace Rice



TRACE-RICE Consortium

Instituto Nacional de Investigação Agrária e Veterinária, I.P.

iBET Instituto de Biologia Experimental e Tecnológica

ITQB Universidade Nova de Lisboa

Casa do Arroz

ernesto morgad desde 1920

MATER DYNAMICS

BGI www.bgi.pt

Grupo Desarrollo

iata Instituto de Agroquímica y Tecnología de Alimentos

Alexandria University