D7.6 - Use cases building

agricore

Deliverable Number	D7.6
Lead Beneficiary	IDE
Authors	IDENER
Work package	WP7
Delivery Date	M58
Dissemination Level	Public

www.agricore-project.eu

The Agricore project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 816078

Document Information

Project title	Agent-based support tool for the development of agriculture policies
Project acronym	AGRICORE
Project call	H2020-RUR-04-2018-2019
Grant number	816078
Project duration	1.09.2019-31.8.2023 (48 months)

Version History

Version	Description	Organisation	Date
0.1	Deliverable ToC	IDE	25-ene-2024
0.2	Initial Content	IDE	15-jun-2024
0.3	Define use cases structure	IDE	25-jun-2024
0.4	Include use cases assessment	IDE	5-ago-2024
0.5	Change document to Agricore template	IDE	10-sep-2024
1.0	Final version	IDE	11-sep-2024

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Executive Summary

This deliverable outlines the processes, stages, and considerations involved in constructing the use cases for the Agricore project. The creation of these use cases relies on developing synthetic populations that accurately represent the social, economic, and agricultural characteristics of the diverse European farming landscapes addressed by the project. A robust method utilizing Bayesian networks is employed to generate these synthetic populations.

The deliverable also covers various aspects related to the specific decisions made that determine the final outcome of the use case aspect. These are centred on crop grouping, subsidies selection and their interrelationships. An ad-hoc approach is applied and tailored to each use case, based on objective parameters observed in the data. This approach is used to make critical decisions that shape the final outcome of the synthetic population and influence its potential results in subsequent simulations.

The building of each use case begins with a foundational dataset (based in FADN) that supports the creation of the final agricultural context. Gaps identified in these datasets are addressed by supplementing with information from additional data sources.

Finally, a multidimensional evaluation of each generated synthetic population is provided, offering a comprehensive assessment of the fidelity of the constructed use cases relative to the parameters observed in real farms.

Abbreviations

Abbreviation	Full name
ABM	Agent Based Model
AGRICORE	Agent-based support tool for the development of agriculture policies
EU	European Union
DWH	Data WareHouse
I/O	Input/Output

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1 INTRODUCTION

1.1 Context of the document

The creation of this document arises in the context of the project Agricore, a simulation tool that allows stakeholders to make informed decisions by predicting potential outcomes and identifying the most effective strategies for sustainable agricultural development. The work covered and reflected in this document is within the scope the WP7 "". Within this WP, it is the only deliverable associated with task 7.5 – Building of the use cases. The goal of this task is to perform the envisaged use cases in collaboration with the involved researchers. This deliverable is closely related to task 8.5 – Coordination with policy makers. - This is because it ensures that the development of the project meets the needs of policymakers in the different scenarios, reporting all the information generated to update the tool. Also, this task will allow the identification of additional needs that might not be covered by the proposed ABM approach and would therefore require the incorporation of new functionalities.

With the aim of covering the project use cases, four different regions from four different countries are represented. These are the Andalusian use case, in which the transition from conventional to organic production regime in the olive production and its environmental and climatic effects is studied through the assessment of the impact of the M11: "Ecologic agriculture" [1], the Italian use case, in which the likelihood of dairy farmers accepting predefined policy scenarios that imply different levels of CO2 taxation on GHG emissions produced by the livestock sector in Emilia-Romagna is studied, the Greek use case, that focuses its study object on age renewal and the creation of entrepreneurial farmers through the Sub-Measure 6.1 "Start-up aid for young farmers" [2], and finally the Polish use case, focused on analysing the impacts of the national-level agricultural measure M10.1- Agri-Environmental-Climate Commitments [3].

Although each use case focuses in one country, the scope of each study focuses on a particular region rather than an entire country. This fact simplifies the overall simulation process and computational cost and allows the targeting of specific areas with specific characteristics, namely the suitability for the cultivation of some vegetable species due to their climatic, geographical, topographical and environmental conditions.

The building of such environments reflects particularities that each region owns, as well as the simplifications and assumptions made to create a coherent, trustworthy and manageable simulation environment tailored to the simulation engine capabilities. One of such simplifications is to limit the scope of the analysis by selecting a region within a country, but also selecting those features of the agricultural population useful for the simulation process and discarding those whose impact on the results evolution is negligible.

The particularities of each use case are captured in original datasets. These are the basic material from which the building of the use cases starts. Different trends in agricultural production, crop selection and rotation, farms' economic sizes, total area managed by farms, trending in subsidies according to techno-economic orientations and social profiles are the main aspects that differentiate the use cases according to data observed and that should be taken into account. As mentioned above, the building of each use case starts with different artifacts in form of empirical data and a specific frame that traces the basic information fields required to feed the generator of the use case. Basically, a use case representation is a dataset with a set of farmers with different social and agricultural characteristics

Although each use case has intrinsically some characteristics inherited from the patterns shown by the real-world farms, the building of each use case is adjusted by some rules established to simplify and accelerate both the use case building and the simulations runtime. This means that use cases building varies according to the modeler criteria, and

thus different results can be obtained given specific building rules. Specifically, customization affects to the product grouping, which is related to how crop variables are merged and simplifies to put the focus on the most representative crops.

The simulation engine used in the Agricore project is a generic model which performs short- and long-term simulations and whose performance has been validated. It has a clearly defined operational rules that convert an agricultural context into a future context through the performance of a simulation, thus allowing for assessing the evolutions, changes and impacts of various agricultural policies or practices over time. In this way, the only way to modify the simulation environment is by modifying the model initialization. This process is carried out by generating and ingesting synthetic populations that determine the evolution of the simulations and thus the obtained results and conclusions. In this way, it is possible to assume that the construction of the use cases revolves around the generation of the synthetic populations. This process is the cum of several considerations, assumptions and empirical data that finally make up an environment with a set of social, economic, demographic and behavioral features that characterize the target study population. The only requirements are that synthetic populations are adapted to the frame impose by the simulation engine, in qualitative and quantitative terms, expressing a good fidelity of the real attributes of the population analysed.

In general, the content included in this deliverable is the building of the use cases studied in Agricore, which turns around the building of the synthetic populations. Thus, it is possible to assume that the synthetic populations are the basic artifact that captures the real-world farms features and guides the evolution of a simulation thorough their application during the initialization process of the agents composing the simulation environment, allowing for the assessment of different policies scenarios. In accordance with the differentiation and diversification of each use case, different results are expected, considering that the parameters considered when characterizing the agents have enough influence on the decision-making process of the virtual agents to gain knowledge and insights about the potential impacts of policy interventions.

2 General considerations

2.1 Microdata format

The objective of this project is to create a tool capable of simulating different agricultural scenarios to draw insights and conclusions about broader trends and patterns across regions and farm types under specific agricultural policy scenarios. The representation of the agricultural systems studied is facilitated by the generation of complete and comprehensive synthetic populations for each use case that represent the features of the farming sector in a reliable way.

The building of each use case is sustained on the collection, processing and management of a different datasets containing economic, management, and agricultural information for the different use cases studied in this project. The main information source comes from FADN or related entities from each country that are in charge of collecting data trough surveys and other statistical methods aimed at capturing farm-level information across multiple agricultural sectors, thus providing comprehensive economic and operational realities of farms of the real world.

The organizations in charge of collecting data do not capture and record the mentioned information from all the farms, but they sample data from representative fractions of varied sectors of the agricultural landscaped thus reflecting heterogenous economical, agricultural and operational realities. In this way, each farm represented in the dataset is serves as a proxy for a larger sector or farm typology of the agricultural population that shares key relevant features including economic size, amount of agricultural land, crops specialization, livestock specialization and other social aspects.

The synthetic populations must represent accurately the insights of the original population, expressing similar patterns, data insights and variables interrelationships but also to obtain synthetic populations that represent the full-size of the real datasets, thus representing the total number of farms in the real use case. This later feature of the synthetic population is achieved through an extrapolation method that in a reliable way transforms the original data sample into a full-size dataset through the representativeness of each farm. Typically, this representativeness is known as weights, and data collection methodology include the information together with the microdata to facilitate and provide information about the true size of the population size that the sample is representing. Following the FADN methodology, weights are computed across three main characterization dimensions that define and characterize the farms typology: techno-economical orientation, economic size and geospatial region (NUTS3).

According the material managed in this work, two different possibilities have been found when performing data extrapolation. The first one is the easiest one and consists into use the weights facilitated by the data providers, represented by the variable A_TY_80_W. This approach was followed when building the use cases Andalusia and Italy. This option is the most reliable as it comes from the entities that carried out the surveys and data gathering campaigns, and that known the total number of farms analysed across the agricultural sectors. But this option was not always available and alternative extrapolation techniques were used for some use cases.

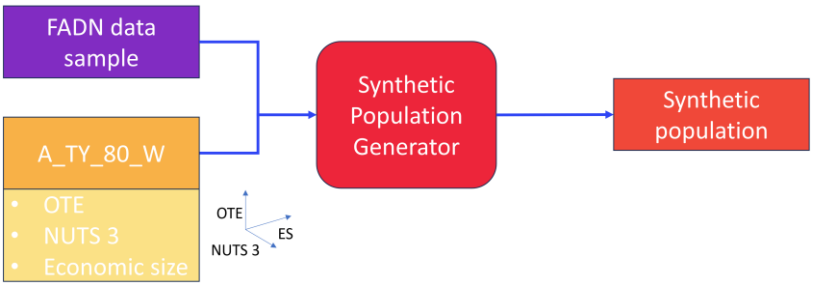

Figure 1. Sample extrapolation using FADN weights

For the cases of Grece and Poland, the most straightforward alternative method to extrapolate data consists into extrapolate data records across the three characterization dimensions utilized by the data gathering organisms. Then, using publicly available datasets containing information about the total number of farms present in the real world, the ratio between this value and the sample representation directly provides the weight of each farm. However, not all characterization variables, nor the same level of resoluti8on and detail were available as public data.

To overcome this situation and obtain a reliable weight for each farm, other public data sources were used from Eurostat. Instead of using the original mentioned characterization dimensions, just economic size was kept from the original set, and techno-economic orientation and geospatial resolution at NUTS 3 level were replaced due to inconsistencies in data. The alternative to these two variables were the agricultural land area cultivated by farms and a higher level of geospatial resolution. This approach works in three dimensions, economic size, NUTS 2 and agricultural land, and provides an acceptable resolution level to compute the number of farms represented by each farm in the sample considering the amount of land worked and the amount of money managed. In this way, it is possible to obtain the real number of farms that match a specific economic level and work a specific amount of land at NUTS 2 level in accordance with the geo spatial resolution present in available microdata.

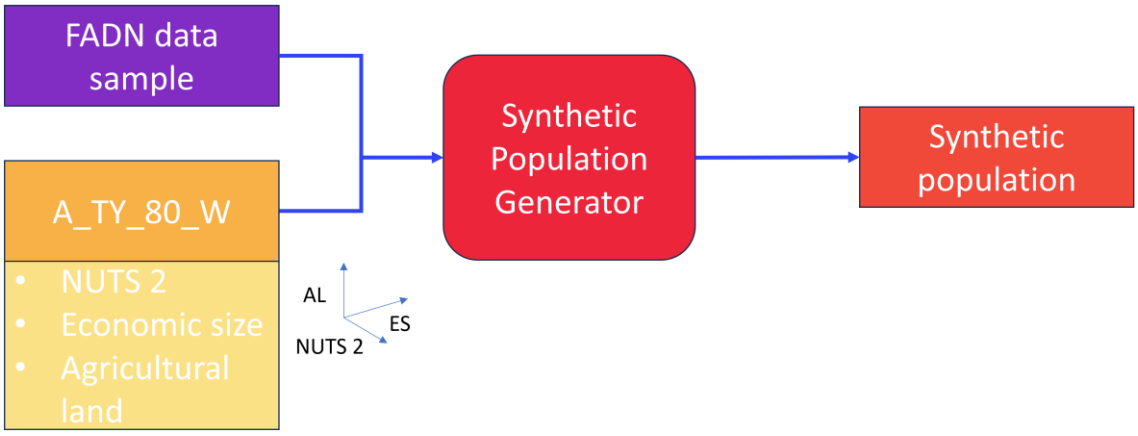

Figure 2. Sample extrapolation using agricultural land and NUTS 2

2.2 Crop grouping: justification and methodology

The purpose of the tool being developed in this project is to provide a mean of simulating and evaluating the behaviour of farmers and the evolution of the agricultural sector in response to the implementation of certain policies in the agricultural sector.

From results-oriented perspective, it is intuitive assuming that, one of the main effects that specific policies may have on the farmers behaviour is the variation in the adoption of the crops linked to the applied policy, which ultimately will be translated into a cultivated area variation for the mentioned crop, and also the same variation but in the opposite sense for the crops that farmes typically combine with the previous one. This is mentioned because crops have an enormous weight on the simulation results analysis scope. Additionally, this is very relevant aspect, as some use cases as the Andalusia use case specifically address the cultivation of olive tree in Andalusia and the conversion from conventional production methods to organic production methods.

From an operational perspective, the number of crops considered will have a direct impact on the computational effort made to run the simulations. This effect is enlarged considering that for each crop defined, there are 10 different crop-related variables defined for each agent that the simulation engine must manage.

For the case of the FADN, there is a large list of crops defined. According to the 2020 FADN guide release, there are at least 103 individual codes defined for agricultural crops. Although this high resolution in crops definition may seem beneficial from an analysis point of view, it is necessary to consider that data source is a sample, and that in most of cases crops are not representative or they have a few records.

Assuming that simulated regions contain between 40.000 and 150.000 farms depending on the use case, using the base FADN crop definition results in extremely high computational cost. Even if the simulation is successful and does not collapse, the balance between the high degree of resolution and the time required to perform such a simulation is not justified.

Considering all above exposed reasons, a contingency measure has been adopted to simultaneously address all the mentioned issues: ***crop grouping***. Crop grouping consists into create homogenous and representative crops named as *product groups* that encompass a set of individual FADN crops to reduce the number of crops utilized in the generation of the synthetic population and hence in the simulations. In this way, for each grouped crop and for each crop-related variable, the corresponding variables of the individual FADN crops are added to compose the homologous variable of the crop group. The following figure describes the process of product group building and how original individual variables concur to generate an aggregated variable of the same type:

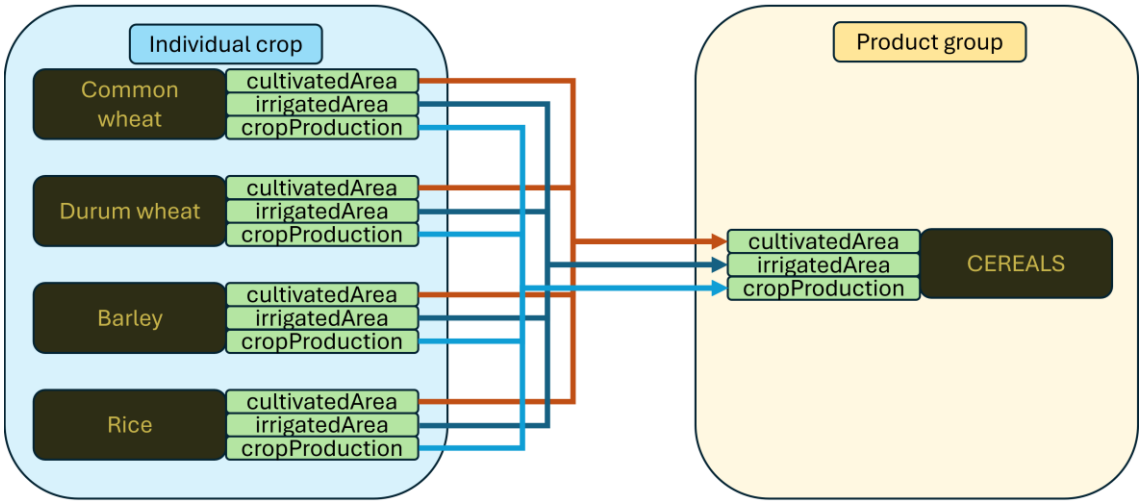

Figure 3. Crop grouping representation

The crop grouping application is a cross-cutting data transformation applied to all the use cases considered in the Agricore project, and, and inherently adds the following advantages:

- *Reduce the model complexity*: grouping low representativeness crops into a low representative group will reduce the number of variables that the simulation engine has to manage with a negligible effect on simulation results. For all the use cases a group named OTHER has been created to contain all the crops with low representativeness.
- *Reduce the computational cost*: the lower the number of variables, the lighter the simulation load and hence tengine has to manage. This aspect is directly related to the time each simulation takes.
- *Allows for specific ad-hoc crop grouping*: in use cases where the evolution of specific crops must be tracked, crops can be set aside and conform a customized group with only the crop in question. This approach also allows for maintaining crops related with specific policies, which will be highly beneficial when evaluating policies impact.
- *Allows for methodological crop grouping*: it is possible to perform the crop grouping process by analysing microdata and extracting information about crop-related variables. This analysis can be targeted to cultivated area, crop production, or total sold value, extending this analysis to economic indicators. In this way, it is possible to extract relevant information that shows the representativeness that crops show in each use case and perform a balanced crop grouping.
- *Allows for leveraging FADN crop categories*: grouping method uses crop similarities to group specific crops in a product group. According to crop representativeness grouping method, the crop categories available in the FADN guide can serve to group crops according to their affinity and similarities. These categories group crops according to cultivation methods, productions and biological specie. As example, common wheat, rye, barley, and durum wheat are categorised as cereals, so a potential product group may be cereals.

In counterpart to these advantages, a part of crop resolution is missing. But the methodology applied ensures that the impact is minimal, by using non-subjective grouping methods that ensure that target crops remain representative after crop grouping, thus allowing for analyzing key performance indicators derived from specific crop-related variables.

2.3 Methods and tools utilized to generate synthetic populations

The methods and algorithms utilized when building the synthetic populations started from the work performed by [4]. This approach utilized Bayesian networks to capture the interdependencies between different social, economic and agricultural variables to later generate a synthetic population that follows such data patterns.

A generic Synthetic population generation module was built by inheriting the mentioned theoretical approach in such a way that the process of generating synthetic data is automatized. The automatization capability of the module is also sustained on the software envelop created to encapsulate all the ancillary modules and code scripts that make up the synthetic population synthesis process.

A specific Python class was created to orchestrate the whole process of data generation. This class acts as a pipeline to manage the artifacts necessary to build a reliable synthetic population according to the user specifications. In this way, the module automatically loads, microdata, process and transform variables, merges datasets and builds an object ready to be used by the generation algorithms following the generation rules set by the user. The orchestration applies sequentially different steps or data transformations, ensuring that each operation is completed before moving to the next. This process structuration in a modular step-by-step manner guarantees that the synthetic population generation follows a logical and reproducible workflow to ultimately reduce the risk of errors and increasing the flexibility when managing different data sources and use cases.

The modular structure of the synthetic population generator does not only serve to obtain a consistent and ready-to-use synthetic population generation module, but also to facilitate its deployment across different devices without rely on external dependencies including modules, or python libraries or packages. This is achieved through the containerization of the module by using Docker. This containerization environment is the best way to isolate applications and avoid conflicts between different version of packages and libraries.

Among the various steps applied, the module is responsible for data standardization, handling missing data, identifying outliers, removing unnecessary variables, generating synthetic population fidelity reports and standardizing variable names so that each field in the source dataset is mapped to an agent parameter. This is a key stage in data preprocessing because the main datasets originate from different sources, each with its own set of rules. Therefore, different preprocessing rules must be applied depending on the origin of the data and the entity generating it. Another preprocessing step applied is the croup grouping step explained in the previous section. The goal is to ensure that data processing is automatic and reliable, especially given the repetitive nature of the task and the potential for future modifications, to prevent errors and avoid skipping mandatory steps.

Once data is processed the generation module fits a Bayesian network to capture the complex interdependencies present among the variables composing the dataset. This generation method is a probabilistic generation method that identifies and leverages the conditional relationships between variables to define dependency paths in form of direct acyclic graph. This graph is composed by nodes and arrows that determine such parent-son interrelationships and probabilities of each son variable of taking a specific value according to the value of its parent. The main generation algorithm linked to the Bayessian network is the Kernel Density Estimation. Additional details about this algorithm are included in Annex I. Kernel Density Estimation algorithm. The reason behind using this algorithm it that it is a high-accurate generation algorithm for non-dependent variables.

The child variables have been generated by leveraging the relationships defined by their parent variables and the structure of the Bayesian network. These relationships are represented through the conditional probability distributions that describe how the values

of the child variables depend on the parent variables. Specifically, the generation process begins by first identifying the parent variables, which are the direct influencers of each child variable in the network. The next step involves determining the possible values of the parent variables as observed in the dataset. Using these values, the corresponding conditional probability distributions captured through statistical analysis of observed data, are applied to model the probabilistic dependencies between the parent and child variables. These distributions encode how likely certain outcomes for the child variables are, given specific combinations of the values of the parent variables. Through this process, the child variables are not generated arbitrarily, but rather they emerge as a result of the probabilistic relationships captured in the network. These relationships reflect the underlying structure and dependencies of the data analysed and enable the Bayesian network to model the complex relationships showed by data, in which in most of the cases, the behavior of one variable is contingent on others. Through the iterative application of this approach, probabilistic influences are propagated through the network. Ultimately, this is translated into an accurate synthetic population whose patterns are similar to the ones showed by the original data sample.

For all the use cases, the generation algorithm performs this task in a methodical and systematic manner. Additionally, it allows the imposition of external constraints on the generation process, such as setting forbidden directions to ensure that a specific variable is not generated from other variables that are known a priori not to influence it.

The end stage of this process is the generation of a report that comprehensively describes the fit between the original and synthetic data to be able to correct errors during the generation process, missing variables, and to objectively assess the goodness of fit of the synthetic population.

Finally, the last component of the described module is a synthetic population importer, which is in charge of upload a package composed of the population generated and a specific set of associated metadata and configuration files that provides a comprehensive simulation initialization package.

2.4 Techniques to compare and assess synthetic population fidelity

When building a synthetic population, it is desired that the synthetic data follows the same patterns and interdependencies as the original data. For this reason, different statistical techniques have been applied to assess the goodness of each use case in an objective and diverse manner.

The fidelity of the synthetic population is higher when it closely resembles the original dataset from which it is constructed. The synthetic population fidelity can be defined as the degree of accuracy to which synthetic data mimic the original data in terms of statistical properties and underlying characteristics of patters.

The quality of the synthetic populations generated will strongly depend on the quality of the data source utilized and, on the models, and algorithms used to generate the synthetic data. These dependencies are recognized as challenges to be overcome during the synthetic data generation process.

The importance of data source quality lies on how the biases and representativeness of the data are transferred to the synthetic data generated. The use of unrepresentative or biased data sources can result in synthetic data that do not accurately reflect real-world scenarios, ultimately undermining the effectiveness of simulations and the reliability of simulation-based scenarios.

Models should be able capable of capturing data insights, identifying trends, and understanding the interrelationships between variables in order to translate this information into synthetic data. A model with poor performance will not be able to accurately represent the underlying patterns in the data, leading to synthetic data that lacks fidelity and fails to maintain the integrity of the original dataset.

Synthetic data quality can be assessed across three dimensions: fidelity, utility, and privacy [5]. In this work, the dimensions of utility and privacy are not considered. Utility is typically used to evaluate the effectiveness of synthetic data for training ML models, while privacy is assumed to be protected, given that the original data already contains anonymized sensitive information. Therefore, in this study, fidelity is the sole dimension used to evaluate the quality of the synthetic population.

Before going deeper in the techniques used to measure the synthetic population fidelity, it worth nothing to mention that synthetic populations do not have to be identical to real data. Instead, they should contain accurate and realistic properties extracted from the real-world datasets which mimic the underlying patterns, distributions, and relationships present in the original data.

Synthetic data fidelity is related with the similarity between the original dataset and the synthetic data generated. In this case, the empirical and synthetic distributions for all variables used in the agent initialization are compared. According to data science theory and statistics, there are different methods and techniques that can be used to compare and assess the similitude or differences between two data distributions. A set of methods have been selected to target the measure of specific properties of data according to the purpose of this work. These include visual methods, descriptive statistics, non-parametric tests, and distribution comparison methods.

The methods explained above are the scientific way applied to measure and reflect the synthetic population fidelity. For each of the synthetic populations generated, all of them have been applied, offering wide vision about what can be achieved utilizing the combination of the explained data sources and the algorithms and methods used to generate synthetic data.

Kolmogorov-Smirnov test

The Kolmogorov-Smirnov (KS) test is a non-parametric test that compares the cumulative distribution functions (CDF) of two pairs of random variables.

Essentially, the test detects the maximum absolute difference between the CDFs of two sets of random variables. For any given pair of random variables, their respective CDFs increase monotonically from zero to one. If both samples originate from the same distribution, their CDFs will nearly overlap. In the opposite, a notorious gap between both CDFs will indicate that it is likely that both samples do not come from the same distribution. In this way it is possible to measure how similar or different these random variables are in an understandable manner, as the larger the difference between both CDFs the likely both samples come from different distributions [6].

Although it is beyond the scope of this work, this test is useful for ranking generation models and algorithms, as it directly indicates how closely one random variable approximates to another. In addition, it allows to identify the weakest point in the data distribution.

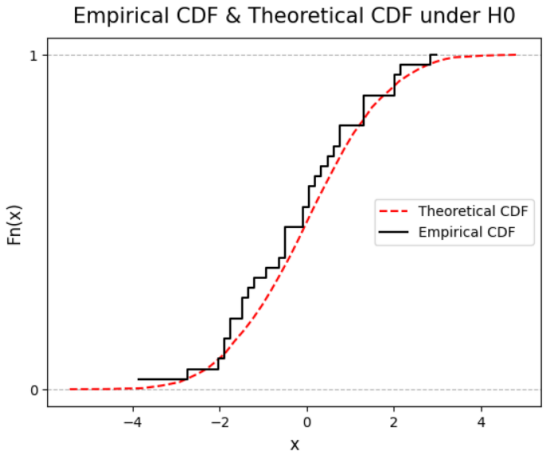

Figure 4. Kolmogorov-Smirnov test illustration

The interpretation of the results of this test is related to the p-value returned. A low p-value indicates that there is evidence that samples were not generated from the same distribution[7] .

The problem statement is as follows:

- Null-hypothesis H_0: both samples come from the same distribution.
- Alternative hypothesis H_A: at least one value does not match the specified distribution.

The critical distance between both CDFs is computed as follows:

$$D(F_0, F_{synth}) = \max_{-\infty \le x \le \infty} |F_0(X) - F_{synth}(X)|$$

Where:

- $F_0(X)$: fraction of the original sample $\le x$.
- $F_{synth}(X)$: fraction of the synthetic sample $\le x$.
- $D(F_0, F_{synth})$: distance between the distributions $F_0(X)$ and $F_{synth}(X)$ at critical x.

The KS test concludes by comparing the obtained value of D against a particular target that depends on the critical value and the samples size. This critical value is derived from statistical tables and calculated based on the significance level and sample sizes. Then, it is stated that two distributions are equal or differ at the significance level of alpha, where alpha represents the probability of rejection the null hypothesis when it is actually true.

$$D(F_0, F_{synth}) = c(\alpha)\sqrt{\frac{n_1 + n_2}{n_1 n_2}}$$

Where:

- α: significance level of the hypothesis test.
- $c(\alpha)$: maximum allowable difference between the CDFs of original sample and synthetic sample for them to be considered statistically similar at the given significance level.
- n_1: size of the original dataset.
- n_2: size of the synthetic dataset.

Cramer-von Misses criterion

Cramer-von Mises test is a powerful goodness-of-fit test that is largely utilized when comparing the good-of-fit between two random distributions. This test allows for introducing empirical data to perform the test, which in this case is the synthetic population variables[8][9].

To determine whether the differences between the original sample and the synthetic data are significant enough an hypothesis test is conducted. Here, the hypothesis is stated as follows:

- Null-hypothesis H_0: both samples come from the same distribution.
- Alternative hypothesis H_A: data samples come from different distributions.

The quantification of the evidence that both data samples come from the same distribution is given by the Cramér-von Mises distance as expressed the following formula:

$$W^2 = n\int_{-\infty}^{\infty}[F_0(x) - F_{synth}(x)]^2 dK(x)$$

Where:

- W^2: Cramér-von Mises test statistic.
- $F_0(x)$: original sample cumulative distribution function.
- $F_{synth}(x)$: synthetic sample cumulative distribution function.
- $K(x)$: combined cumulative distribution function.
- n: number of samples of the synthetic data.

In practice, this formulation is simplified by switching from an integral to a sum of values and obtaining a computationally simple formula:

$$W^2 = \frac{1}{12n}\sum_{j=1}^{n}\left(F_{synth}\left(X_{(j)}\right) - \frac{2j-1}{2n}\right)^2$$

Where:

- $F_{synth}\left(X_{(j)}\right)$: empirical CDF of the synthetic data evaluated at the j-th order statistic of the original data.
- $X_{(j)}$: the j-th sorted observation from the original data.
- n: number of observations of the original data.

The procedure to perform the Cramer-von Mises test is as follows:
Firstly, data samples are sorted and CDFs are computed for both data samples (empirical and synthetic). Then, both data samples are combined and sorted in a single sample in ascending order. With this new dataset, two new cumulative distribution functions are computed using the number of samples corresponding to the empirical dataset and the synthetic dataset. With these values, the statistic W can be obtained by applying the above formula. The value of the statistic W obtained is compared with the critical value corresponding to the desired significance level alpha, which is obtained from statistical tables or from mathematical solvers. Finally, the null hypothesis is rejected if the statistic W exceeds the critical value at the chosen significance level, and it is assumed that synthetic data has not been generated from original data. Otherwise, the null hypothesis is not rejected, suggesting that the synthetic data may have been generated from the same distribution as the empirical data.

Kullback-Liebler divergence

The Kullback-Liebler (KL) divergence is a useful tool that server to compare two distributions[10].

This a distance measure based on entropy and information theory and serves to measure the uncertainty gained or information lost when replacing distribution P with Q [11].

$$KL(P||Q) = \sum_{i=1}^{d} p_i log_2 \frac{p_i}{q_i}$$

Where:

- $KL(P||Q)$: is the KL divergence for the probability distribution functions P(x) and Q(x).

It is possible to notice from the above equation that, when distributions are the same, the KL divergence is zero, as nothing is gained or lost. Conversely, while when distributions largely differ, the value of KL divergence increases.
It should be noticed that it is not a symmetric distance measure, as $KL(P||Q) \neq KL(Q||P)$.

Jenssen-Shannon divergence

The Jenssen-Shannon (JS) divergence is a metric based on the KL divergence. In this case it is a symmetric distance measure and can be considered as a metric [11]. The formulation of the JS divergence is given by the following equation:

$$JS(P,Q) = \frac{1}{2}KL(P||M) + \frac{1}{2}KL(Q||M)$$

Where:

- $JS(P,Q)$: is the JS divergence.
- $KL(P||M)$: is the KL divergence between P and M.
- $KL(Q||M)$: is the KL divergence between Q and M.
- M: is the average of P and Q, such that $m_i = (p_i + q_i)/2$.

This new formulation of distributions distance is symmetrical and preserves the properties of the KL divergence. As [11] suggests, it is the right function to use for measuring the distance between probability distributions.

Descriptive statistics

In addition to the methods previously discussed for measuring the similarity or divergence between the original and the synthetic data, other statistics have been included in the report to provide a more comprehensive evaluation of the data generated. The descriptive statistics are minimum value, maximum value, mean value and standard deviation. In this way, by comparing these parameters for both datasets is possible to affirm if the ranges of original data and synthetic data are aligned, if the mean values are comparable, and whether the overall dispersion of the data is similar.

Visual methods

Visual methods have been included in this work as complementary tools to statistical measures for comparing distributions. The plotting of the probability distribution functions or histograms of both datasets allows for a direct visual comparison of their distributions. This is an easy way to assess the shapes, ranges and overall structures of data distributions and how closely they match. For all the continuous numerical variables pairs of probability

distribution functions (original and synthetic) have been included to easily assess how closely the synthetic data approximates the distribution of the original data.

Main indicators ratios

Finally there is a last fidelity checking method to compare the totals obtained for the synthetic population against the totals expressed in the original data samples. These totals are computed for the different crops or product groups considered in each use case. The totals are computed for three different variables namely, cultivated area, expressed in hectares, crop production, expressed in € and quantity sold expressed in tons. Once totals area computed for al crops and for all variables, the ratio between the value expressed by the synthetic population versus the value showed by the data sample is obtained. The closest the value is to 1 the better the fit of the synthetic population.

3 UC1: Environmental impact assessment in the olive farming sector in Andalusia

The first use case presented in this report corresponds to the Andalusian use case. The complete use case includes two different analyses, an Ex-ante (2014-2017) analysis and an Ex-ante analysis (2018-2020). The core of this use case is the cultivation of organic olive groves in Andalusia, although other different farming practices, factors and indicators are considered. Andalusia is not a random region chosen for this purpose, but it accounts with the regions with the highest production of olive in the world, and hence, this crop is one of the most representative in this Spanish region.

The evolution of the olive groove cultivation is assessed considering the impact of Regional Measure 11, promoted by Junta de Andalucia government and which is part of "Programa de Desarrollo Rural de Andalucía 2014-2020". This measure is focused on fostering the productive systems based on organic production methods, fostering the care of the environment, the promotion of sustainable practices and that respond to the increasing demand of products obtained through natural methods.

In this context, the use case is designed not only to evaluate the current status but also to predict the widespread adoption of organic olive farming practices. Both the short-term and long-term effects of policies that support organic practices will be assessed. Conclusions about the trends in the adoption of organic olive farming will be drawn, considering the shift of farmers toward more environmentally conscious production methods. This analysis will also serve to provide insights into how environment-friendly practices are influenced by policy interventions, and how they can transform the agricultural sector more broadly, paving the way for a more resilient and eco-friendly agriculture.

3.1 Presentation of the data used for the generation of the synthetic population

3.1.1 Used data sources

The building of the Andalusian use case is sustained on the utilization of RECAN (Red Contable Agricola Nacional) database, from the Ministry of Agriculture, Fisheries and Food, from the Spanish Governement. RECAN represents a unique complete Spanish data-source that allows for evaluating the rent of the agricultural holdings and the impact of the agricultural policies that produce on it. As this tool is orchestrated by communitarian legislation (Reglamento (CE) 1217/2009 del Consejo, de 30 de Noviembre de 2009), the database is driven by similar accountancy principles than other EU countries. This harmonization enables for linking and comparing the information contained in RECAN with other European databases such as FADN.

The data comes from surveys made to real holdings selected following a specific Selection Plan which is reviewed and updated annually. The dataset contains structured tabular data whose records have been anonymized, so data preserves privacy and confidentiality of the personnel represented in the sample. In this way, information susceptible to be identifiable and linkable to specific individuals has been removed, allowing the data to be used for research purposes.

Originally the database was in a specific tabular data format with original data naming in Spanish and divided by the same topics as the ones used in FADN structure. This feature allows for a direct transcription through some data processing steps from RECAN structure to FADN structure, thus facilitating the homogenization of the data format.

After transforming data into FADN format, a total of 2583 variables were available. It is worth noting that from this large amount of data, a reduced number of them contained records while a large number of them were empty. This data lack is product of the high resolution and differentiation on economic profiles and activities which in turn, are a representation of the real agricultural sector.

In addition to RECAN, other data sources of public nature were utilized to build the Andalusian use case. It is the case of Eurostat database, a comprehensive source of statistical information provided by the European Union. The Eurostat database offers a wide range of data on economic, social and environmental aspects across European countries. Agriculture related datasets contained in Eurostat have been used to complement specific simulator agent parameters that were not available on RECAN.

Land value survey dataset was used to determine the value of the land in euros per hectare according to the land type (dry or irrigated, type of crops, permanent crops or arable land, etc..). This variable is used by the simulation module and its value serves to determine the land transaction operations. Although the crop resolution level found in this dataset was not very high, main crop categories were available, so it served to accurately infer the land value for the crops present in the use case.

Agrarian region is a dataset build from statistical operations performed periodically in Spain by the INE (Instituto Nacional de Estadística). It contains detailed information about structural features of agricultural holdings, including holding structure, crop and livestock distribution, technology and agricultural practices. In this way, agrarian census was used to determine specific geospatial regions below NUTS3 level according to the mentioned farm features. Hence, similar to reality geospatial distribution are achieved.

3.1.2 How the data sources were acquired

Since the RECAN dataset is of private nature, its acquisition was made following the official procedure. This procedure encompasses the fulfillment of a set of requisites and conditions that guarantee the adequate utilization of the content of the dataset. Among these, the compromise to utilize the data uniquely for research purposes in the current project, the commitment to do not distribute data to third parties, the preservation of the anonymity of holdings represented in the dataset. The data request starts by filling a commitment form, which specifies all the clauses to which the receiving entity must adhere in case it receives the microdata.

For the cases where data was publicly available (Eurostat, Land value survey and INE database), the target dataset were downloaded by setting some filtering conditions including regional and temporal selection, and data was treated accordingly to be used by the Agricore modules.

3.1.3 Data sources limitations

Although the labor of gathering data aimed to find all the information required to fill the agent attributes for the studied use case, some data limitations were found during the process. The first limitation was the content of the RECAN dataset. Using other different dataset partially mitigated the missing data issue. But even in this way, there still being agent attributes not available.

The following table summarizes the missing information and the pertinence with the agent linked variable.

Agent variable	Definition	Reason

holderSuccessors	Whether the agent has successors or not.	RECAN data did not contain this information. Additionally, other data sources did not contain specifically the holder successors distributions according farm features.
holderSuccessorsAge	Age of the successor who would continue as manager of the holding.	RECAN does not contain this information. So it is not possible to infer the age of the successors according specific farm characteristics.
holderFamilyMembers	Number of persons making up the family for the holding under anlaysis	Again, RECAN does not include this information. Possibly, this value can affect to anonymisation loss, or simply that this parameter is not considered in the scope of an economical statistical analysis.
sellingPrice	It is the price at which agricultural products are sold.	This parameter was not directly included in the RECAN dataset.
lat	Latitude of farm location coordinates	Due to anonymisation policies, specific farm location was not included in the datasets.
long	Longitude of farm location coordinates	Due to anonymisation policies, specific farm location was not included in the datasets.
variableCosts	Costs derived from the production and cultivation of a specific crop in euros per ton	The simulator engine needs this parameter to compute profitability of cultivated crops.

Table 1. Limitation of data sources and linking to agent parameters

3.2 Crop grouping analysis

Crop grouping analysis is an intermediate process applied to each use case datasets to simplify the crops managed by the simulation engine by putting attention on those crops with higher relevance in the use case. The section Crop grouping: justification and methodology contains a detailed description of the reasons, motivations and methods studied and applied to perform crop grouping. After carrying out the relevant analysis, results for Andalusian use case are shown.

3.2.1 Distribution of crops in Andalusia

The first step in crop grouping step is to perform a crop representativeness analysis. This analysis will return as result the representativeness of each individual crop according to FADN crops nomenclature. Representativeness is not an indicator itself, but it can be evaluated according to economical or agricultural factors using variables cultivated area, total production and value sales. With these indicators, a ranking has been built using the microdata from the Andalusian use case.

The list of possible crops contains 103 different FADN codes, for which in turn, conventional and organic production are defined. In this way, the representativeness analysis encompasses 206 different crop-production method pairs combinations.

The following pie chart shows the crops sorted by total area parameter:

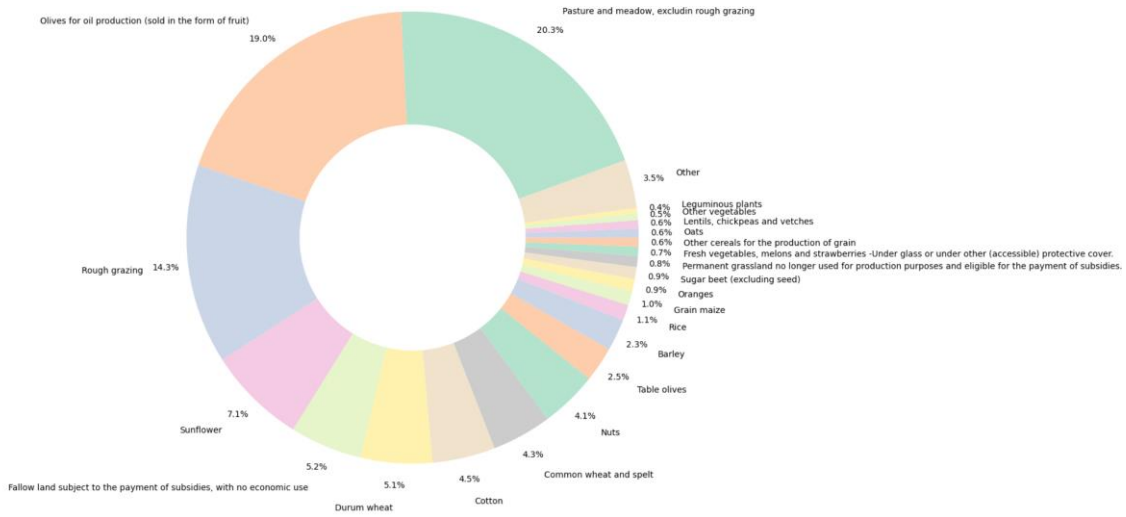

Figure 5. Andalusian crops by cultivated area

Within the top five crops by total area, pasture and meadows and rough grazing together account for 35% of the total cultivated area. The next most important crop, unrelated with grassland, is olives for oil production. This preponderance and high regional orientation of olive cultivation reflects the optimal conditions of the Andalusian region for olive growing, the production of high-quality olive oil and its important contribution to the agricultural economy of the region. After the olive tree, sunflower cultivation stands out, reflecting its importance in crop rotation and oilseed production, being the first arable land in the list by land extension. The top five crops is closed by fallow land subject to the payment of subsidies, with no economic use, highlighting the role of agricultural policy in land use decisions.

After the top five, different cereal varieties appear as the next crops on the list of representativeness. Wheat, including durum wheat and common wheat and spelt amount for a total of 9,4%, and cotton account for a 4.5% of the cultivated area, which is also a notorious quantity.

With a lower representation, other crops like sugar beet, vegetables or legumes are present in the list, with percentages of around 1% of the total land cultivated.

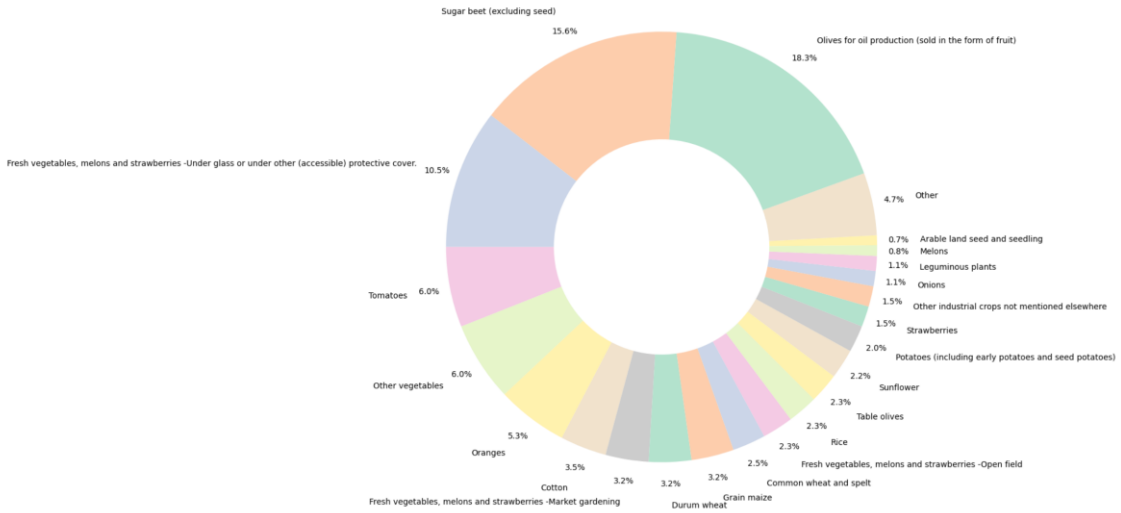

Figure 6. Andalusian crops by sales quantity

As for the quantity of sales, another distribution of crops is obtained. In this case, pasture-related crops have disappeared from the equation as their main benefit is not the production of a measurable quantity, but a reward of another kind. Now, a higher diversity in crop cultivation is obtained, indicating high adaptability of the region analysed.

Olives for oil production represent the 18.3% of the total surface capture by the microdata sample. It is followed by sugar beet, which approximately produces 460.000 Tons per year, a 21% of the total Spanish production. It is notable in this analysis that various types of vegetables occupy the highest positions, indicating high production ratios despite their absence in the cultivated area analysis.

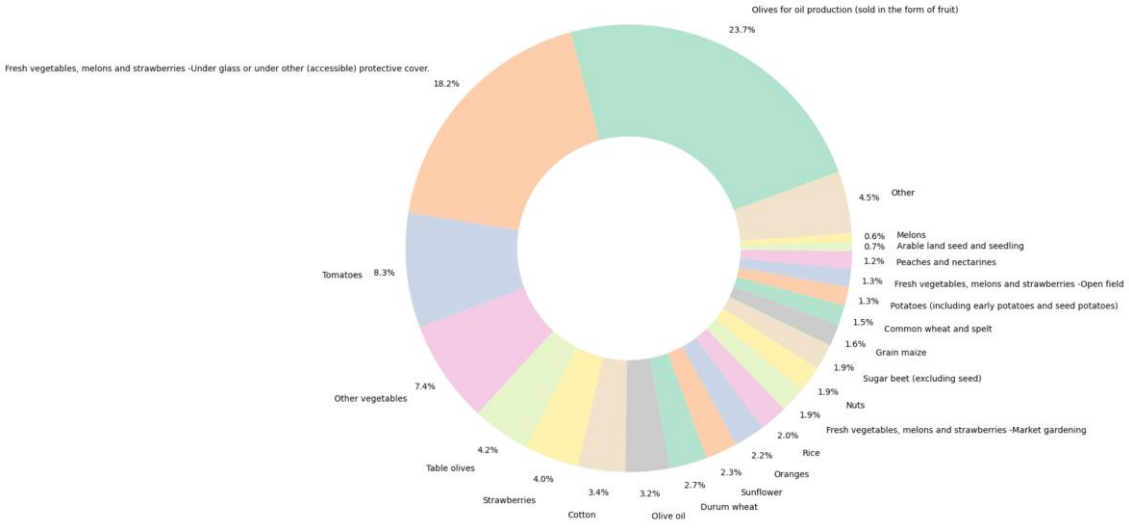

Figure 7. Andalusian crops by sales value

Finally, the economic assessment of the crops present in the list remarks the high importance in economic figures of olive cultivation. It is the crop that reports the highest economic volume considering all olive related species. 31.1% of the economic value generated in the agricultural sector comes from olive tree growth. In other words, out of every 100€ generated in the agricultural sector, 31.1€ is attributed to olive growing.

Fresh vegetables show also their weight in the agricultural sector considering their diversity and their representativeness in economic terms. Ranging from tomatoes, fresh

vegetables, other vegetables, strawberries, potatoes, and melons, it is notorious that farmers from these regions opt to cultivate these crops.

There is also a significant presence of permanent crops. With the exception of olive tree, it is represented by citrus trees, nuts and stone fruit trees. Other notable crops include cotton, representing a 3.4% of the economic agricultural output, and a variety of cereals including wheat, rice, and maize.

Overall, this crop variety is favored by optimal climatic conditions, and a fertile soil, which ensure excellent conditions for agricultural activities and the achievement of high productivity. The region, characterised by mild winters, long growing seasons and warm temperatures, offers and ideal environment for crop diversity and adaptation.

Finally, it is worth nothing that crop under conventional production regime surpass organic crops in all the indicators. This means that organic crops will not be used to take crop grouping decisions, but conclusions extracted from conventional groups will be applied to organic crops.

	FADN Code	Description	Group	Frequency	Frequency Rel	Total Area	Production Quantity	Sales Quantity	Sales Value	average_area	Share Area	# Crops Combination	Production Method
0	30100	Pasture and meadow, excludin rough grazing	GRAZ	7180	0.061613	730970.309000	0.000000e+00	0.000000e+00	0.000000e+00	1668.881984	9.435367	3.145283	CONVENTIONAL
1	40320	Olives for oil production (sold in the form of...	OLIV	41279	0.354223	685960.352650	3.007537e+07	2.982600e+07	1.252792e+09	1385.778490	56.869854	2.282233	CONVENTIONAL
2	30200	Rough grazing	GRAZ	5686	0.048793	514969.665600	0.000000e+00	0.000000e+00	0.000000e+00	1501.369287	6.941257	4.706792	CONVENTIONAL
3	10605	Sunflower	SUNFL	9226	0.079170	254826.006600	3.629158e+06	3.629158e+06	1.219343e+08	679.536018	8.978996	3.132020	CONVENTIONAL
4	11220	Fallow land subject to the payment of subsidie...	SET_ASIDE	11521	0.098864	186040.901400	0.000000e+00	0.000000e+00	0.000000e+00	907.516592	7.853170	4.978205	CONVENTIONAL
5	10120	Durum wheat	CER	7436	0.063810	184661.624000	5.137190e+06	5.186768e+06	1.427533e+08	526.101493	7.136663	3.349401	CONVENTIONAL
6	10603	Cotton	COTTON	15431	0.132416	162311.477800	5.649028e+06	5.649028e+06	1.806169e+08	331.247914	13.413310	2.691569	CONVENTIONAL
7	10110	Common wheat and spelt	CER	6082	0.052191	154097.215100	4.066408e+06	4.041994e+06	7.685932e+07	442.808089	4.972857	3.880215	CONVENTIONAL
8	40130	Nuts	NUTS	5737	0.049230	147306.923250	5.357656e+05	5.354548e+05	9.920546e+07	472.137575	8.169139	4.646761	CONVENTIONAL
9	40310	Table olives	OLIV	7566	0.064925	90618.392925	3.665183e+06	3.665183e+06	2.219223e+08	296.138539	10.832888	2.313920	CONVENTIONAL
10	10140	Barley	CER	4301	0.036908	82290.671300	7.390567e+05	5.648682e+05	1.044065e+07	268.923762	2.971201	4.944949	CONVENTIONAL
11	10170	Rice	CER	1555	0.013344	40211.588500	3.678858e+06	3.678858e+06	1.073970e+08	141.590100	4.033664	1.686571	CONVENTIONAL
12	10160	Grain maize	CER	4153	0.035638	35896.885300	5.180696e+06	5.180696e+06	8.245843e+07	110.792856	3.409193	3.354909	CONVENTIONAL
13	40210	Oranges	CITRUS	2997	0.025718	32341.416300	8.692944e+06	8.692944e+06	1.182491e+08	113.478654	5.696954	2.296842	CONVENTIONAL
14	10400	Sugar beet (excluding seed)	OTHER	3238	0.027786	30845.256700	2.542859e+07	2.542859e+07	9.910924e+07	94.617352	2.731317	3.426773	CONVENTIONAL
15	30300	Permanent grassland no longer used for product...	OTHER	2648	0.022723	28051.552000	0.000000e+00	0.000000e+00	0.000000e+00	100.543197	2.910543	2.947538	CONVENTIONAL
16	10720	Fresh vegetables, melons and strawberries -Und...	VEG	11776	0.101052	23888.138875	1.704933e+07	1.703214e+07	9.650356e+08	67.290532	24.400650	3.576849	CONVENTIONAL
17	10190	Other cereals for the production of grain	CER	1470	0.012614	23340.621300	5.307596e+05	4.041049e+05	7.620051e+06	85.811108	1.343595	4.040010	CONVENTIONAL
18	10150	Oats	CER	1885	0.016176	22623.998300	2.073072e+05	8.108105e+04	1.507989e+06	79.382450	1.049453	4.710768	CONVENTIONAL
19	10220	Lentils, chickpeas and vetches	PROT	835	0.007165	22106.467200	1.364302e+05	1.094908e+05	6.541265e+06	88.073575	0.788860	3.635791	CONVENTIONAL
20	10790	Other vegetables	VEG	8284	0.071087	18527.633325	9.729530e+06	9.724564e+06	3.940970e+08	53.859399	14.378042	4.518536	CONVENTIONAL
21	10922	Leguminous plants	OTHER	1575	0.013515	12800.615800	1.914352e+06	1.812327e+06	2.061241e+07	45.716485	1.937796	3.368115	CONVENTIONAL
22	10300	Potatoes (including early potatoes and seed po...	VEG	2556	0.021934	11452.307950	3.265917e+06	3.265917e+06	7.098285e+07	40.467519	3.360829	4.660122	CONVENTIONAL
23	10712	Fresh vegetables, melons and strawberries -Mar...	VEG	2273	0.019505	10892.254100	5.247744e+06	5.247744e+06	9.992451e+07	36.307514	2.252714	5.047583	CONVENTIONAL

Figure 8. Crop representativeness results for Andalusia

The figure displays the sorted results for the Andalusian use case according to total area represented. In addition to the mentioned indicators, other metrics included area the average area that farmers dedicate to the crop, the average percentage of area that the crop represents in the holding, and the number of crops that usually farmers combine in average.

3.2.2 Crop grouping decisions in Andalusia

Once the distribution of individual crops was analysed, the grouping operations were performed. Representativeness has been used to determine which crops, according to their similarity and presence in the dataset, should compose a dedicated product group.

In the case of Andalusia, *olive* tree cultivation has its own product group. Although the crop's representativeness (in terms of cultivated area and economic weight) already suggests the creation of a specific product group for olive, in this use case, olive is primary object of study, and some policies linked to the conversion from conventional production methods to organic production methods for this crop are analysed.

Some product groups have been created for individual crop codes. These are *cotton*, *sunflower* and *nuts*. The idea behind the creation of such product groups is their high representativeness. Although some of them could have been included in other product groups, there is enough differentiation between them and other crops and enough crop representativeness to create a dedicated group for each, as they are typically used by

Andalusian farmers, and it will be interesting to analyse their evolution during the simulation periods.

Citrus crops and fruits trees are another case of permanent crop with significant presence in the dataset analysed. While creating a dedicated product group for permanent crops is an option, the need to have a specific product group for olive, divides the major permanent crops category into three separate groups: olive, citrus and *fruit*, although fruits is not only limited to trees.

Although with a high variety of *vegetables*, a specific product group was defined to encompass these crops. Thus, tomatoes, lettuce, potatoes, fresh vegetables (both under glass or open field), strawberries, garlic and carrots share the same product group. In fact, production methods are quite similar for all the crops mentioned, and they also share common agricultural practices such as soil preparation, irrigation, and pest management techniques. A similar case is cereals.

Cereals is another product group that encompasses several individual crops. All these crops are similar in cultivation methods and schedule, and similar production ratios. Although wheat is the most representative cereal in the dataset, several less representative crops were added to form a larger group.

Protein crops is a product group that must be created due to its particular features. According to the low representativeness of protein crops in the crops indicators, the most straightforward decision would have been to include these crops in other group. But it is necessary to create a dedicated product group to nitrogen-fixing crops.

Set aside group has been defined due to the high representativeness of fallow land observed in Figure 5. In this way, the land destined to fallow land is isolated from other crops that require regular cultivation and nutrient inputs.

Other group was created to include all remaining crops. Either by low representativeness of the crop or directly the unavailability of the crop in the use case, all crops with no interest of study were included in this group.

This is the final composition of the product groups for the Andalusian use case:

#	Product group	Abbreviation	Description
1	Olive	OLIV	Olive tree and all its varieties and derived products
2	Cereals	CER	All kind of cereals, including maize, wheat, rice, rye, barley…
3	Vegetables	VEG	All vegetables species, fresh vegetables, tomatoes, lettuce, garlic carrots, and potatoes.
4	Grazing	GRAZ	All crops that can be used as fodder or as feed for livestock, including pasture, meadows, rough grazing, green maize and plants harvested green.
5	Citrus trees	CITRUS	Fruit trees dedicated to the cultivation of citrus fruit, including oranges, lemons, tangerines…
6	Fruit	FRUIT	All types of fruit-producing crops, fruit trees, melons, peaches, nectarines, strawberries.

7	Protein crops	PROT	Agricultural plants that are cultivated for their high protein content including lentils, chickpeas, beans… Crops that serve as nitrogen-fixing.
8	Set aside	SET_ASIDE	Fallow land with or without subsidies.
9	Nuts	NUTS	Nuts cultivation
10	Sunflower	SUNFL	Sunflower cultivation
11	Cotton	COTTON	Cotton cultivation
12	Other	OTHER	Group of crops with low representativeness or without a relevant impact on the use case study. Grapes, wooded area, flowers,

Table 2. Andalusia crops grouping

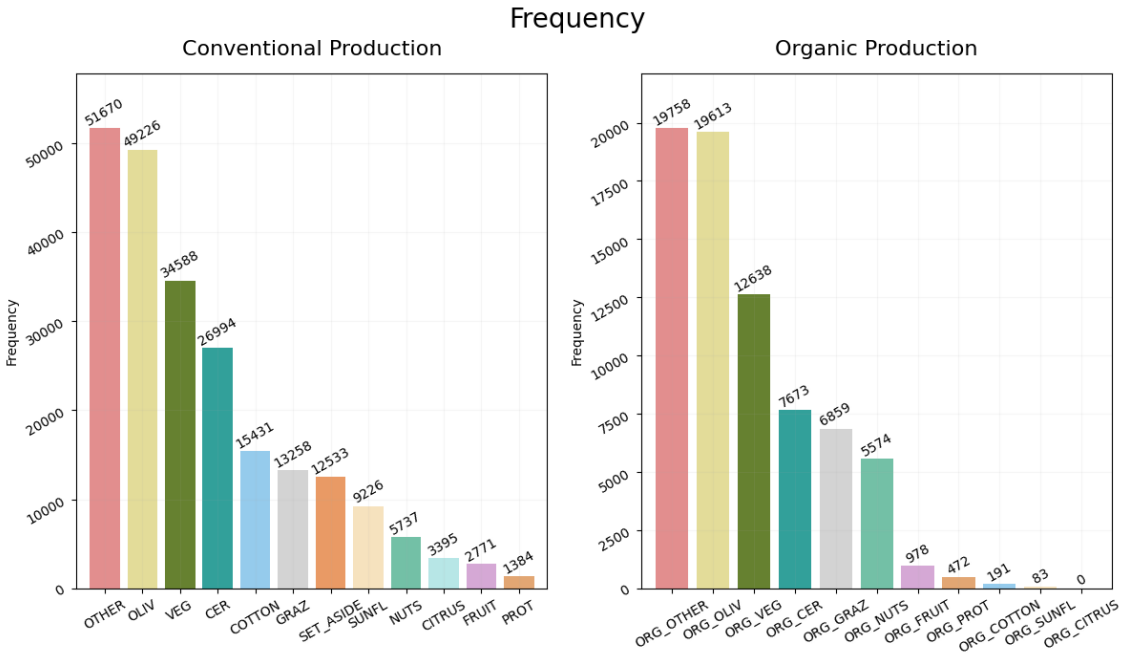

Figure 9. Andalusia crop grouping result: frequency

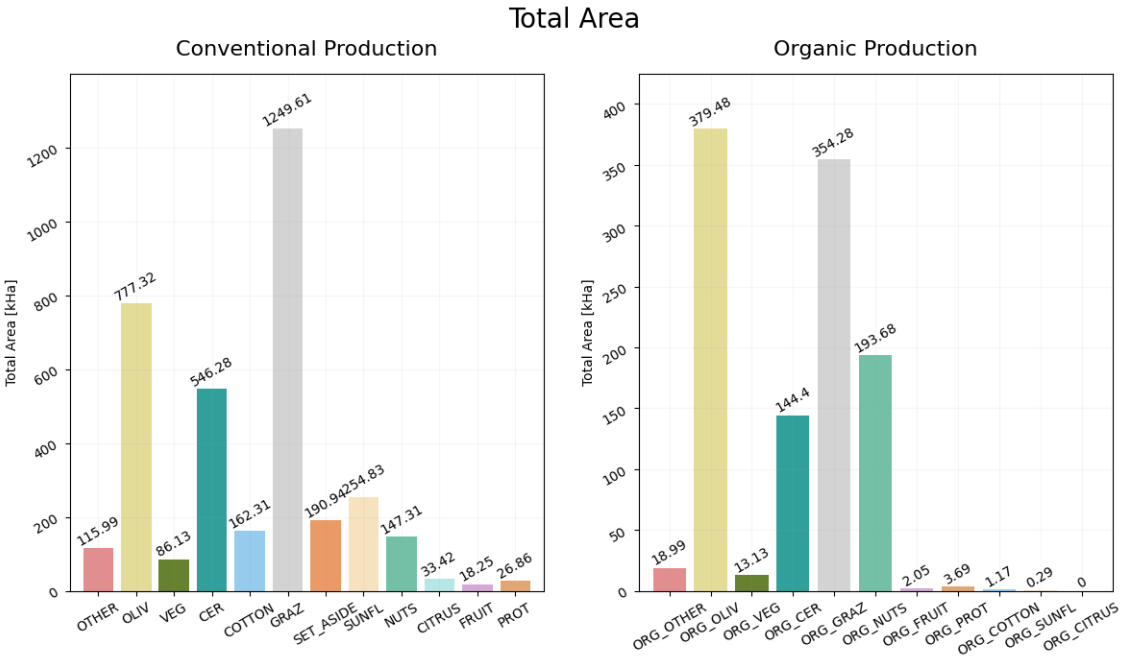

Figure 10. Andalusia crop grouping result: total area

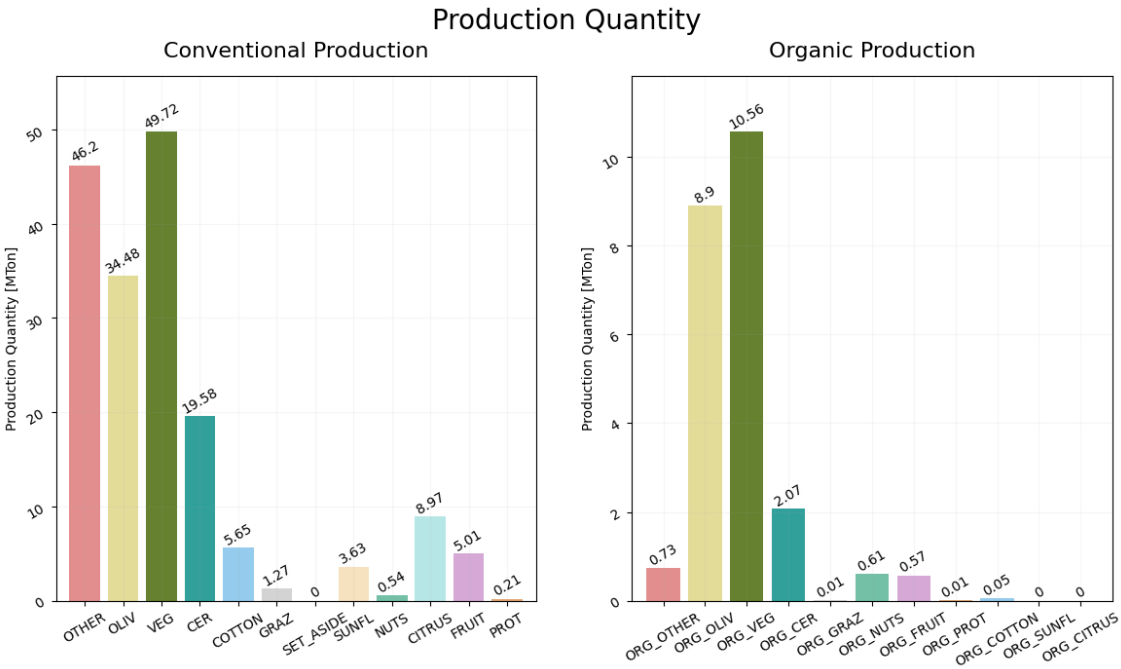

Figure 11. Andalusia crop grouping result: production quantity

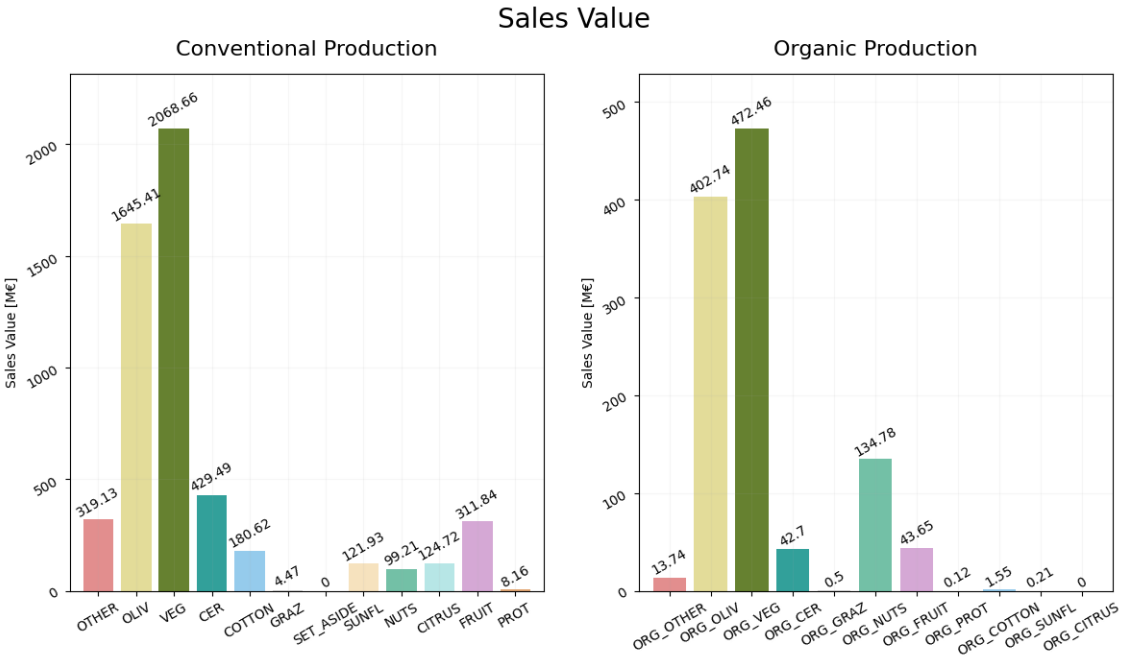

Figure 12. Andalusia crop grouping result: sales value

The above figures show the result of the product grouping operations. There are some aspects to remark. Firstly, the frequency graph shows that olive and other groups are the most frequent crops according to the current grouping. Although other is a product that a priori has not much interest in assessing the policies evolution, its high appearance frequency is due to the large number of agglutinated FADN crops, with a total of 49 crops. Organic product groups are rarely represented. With the exception of organic olive, organic vegetables, and organic nuts, other organic product groups have a close to zero representation. In terms of total area, setting aside olive and grazing product groups, all remaining product groups are balanced in terms of area. Finally, olive product group, although it only encompasses olive tree derived crops and products, is within the most representative crops across all the dimensions shown.

These results present the final grouping decisions across various indicators. The following table provides a more detailed view, illustrating how individual FADN crops, identified by their code and description, were categorized using this grouping approach.

	FADN Code	Description	Group
0	10712	Fresh vegetables, melons and strawberries -Market gardening	VEG
1	10711	Fresh vegetables, melons and strawberries -Open field	VEG
2	10731	Cauliflower and broccoli	VEG
3	10720	Fresh vegetables, melons and strawberries -Under glass or under other (accessible) protective cover.	VEG
4	10790	Other vegetables	VEG
5	10733	Tomatoes	VEG
6	10732	Lettuce	VEG
7	10736	Garlic	VEG
8	10737	Carrots	VEG
9	10300	Potatoes (including early potatoes and seed potatoes)	VEG
10	10605	Sunflower	SUNFL
11	11220	Fallow land subject to the payment of subsidies, with no economic use	SET_ASIDE
12	11210	Fallow land without subsidies	SET_ASIDE
13	10220	Lentils, chickpeas and vetches	PROT
14	10210	Peas, field beans and sweet lupines	PROT
15	40451	Grapes for quality wine with protected designation of origin (PDO)	OTHER
16	10922	Leguminous plants	OTHER
17	40430	Table grapes	OTHER
18	10290	Other protein crops	OTHER
19	30300	Permanent grassland no longer used for production purposes and eligible for the payment of subsidies.	OTHER
20	10400	Sugar beet (excluding seed)	OTHER
21	10840	Cut flowers and flowerbuds	OTHER
22	40500	Nurseries	OTHER
23	10735	Onions	OTHER
24	50900	Other land: occupied by buildings, farmyards, tracks, ponds quarries, infertile land, rock, etc	OTHER
25	10820	Flowers and ornamental plants -Under glass or under other protective cover	OTHER
26	10734	Sweet corn	OTHER
27	40460	Grapes for other wines	OTHER
28	10830	Flower bulbs, corms and tubers	OTHER
29	11000	Arable land seed and seedling	OTHER
30	10500	Fodder roots and brassicas (excluding seed)	OTHER
31	40700	Permanent crops under glass	OTHER
32	10690	Other industrial crops not mentioned elsewhere	OTHER
33	10910	Temporary grass	OTHER
34	50200	Wooded area	OTHER
35	10810	Flowers and ornamental plants -Outdoor or under low protective cover	OTHER
36	10601	Tobacco	OTHER
37	11300	Land ready for sowind leased to others, including land made available as a benefit in kind	OTHER
38	40452	Grapes for quality wine with protected geographical indication (PGI)	OTHER
39	40320	Olives for oil production (sold in the form of fruit)	OLIV
40	40310	Table olives	OLIV
41	40330	Olive oil	OLIV
42	40130	Nuts	NUTS
43	30100	Pasture and meadow, excludin rough grazing	GRAZ
44	10921	Green maize	GRAZ
45	10923	Other plants harvested green but not mentioned elsewhere	GRAZ
46	30200	Rough grazing	GRAZ
47	40115	Fruit of subtropical or tropical zones	FRUIT
48	40113	Peaches and nectarines	FRUIT
49	10739	Melons	FRUIT
50	40114	Other fruit of temperate zones	FRUIT
51	10738	Strawberries	FRUIT
52	10603	Cotton	COTTON
53	40210	Oranges	CITRUS
54	40290	Other citrus fruit	CITRUS
55	40220	Tangerines, mandarins, clementies and similar small fruits	CITRUS
56	40230	Lemons	CITRUS
57	10160	Grain maize	CER
58	10140	Barley	CER
59	10110	Common wheat and spelt	CER
60	10150	Oats	CER
61	10120	Durum wheat	CER
62	10170	Rice	CER
63	10190	Other cereals for the production of grain	CER
64	10130	Rye	CER

Table 3. Andalusia use case: crop grouping results

3.3 Building of the synthetic population

This section describes how the synthetic population was built for the Andalusian use case. For this use case, two different accountancy years were generated: 2014 and 2018. The synthetic population generation module generated the number of farms according to the real number of farms for each year. Not all existing farms are generated in the synthetic population. This is because there are some economic sizes that are not included in the microdata sample. Thus, the number of farms generated in the synthetic population for the Andalusian use case corresponds to the actual farms with economic sizes exceeding the threshold for professional holding, specifically excluding those with economic sizes below 4000€ which corresponds to economic sizes equal or greater than class 3 according to FADN characterization.

3.3.1 Generation of synthetic data to solve data unavailability

Data unavailability was an issue faced when generating synthetic population for Andalusia. Although the Andalusian use case was not the worst of the scenarios as most of the agent attributes were covered, some others were not available in the managed datasets. These attributes were described in Table 1. For the different attributes mentioned in the table these were the procedures applied to overcome the data unavailability:

holderSuccessors: using Eurostat data of family structure and distribution this parameter was filled.

holderSuccessorsAge: again, Eurosat data was used to obtain this information according to the age distribution of family members.

holderFamilyMembers: this parameter was estimated using demographic data on family sizes and structures from Eurostat to accurately reflect the composition of farm-holder families.

For the cases where synthetic data was generated (holderSuccessors, holderSuccessorsAge, and holderFamilyMembers), Kernel Density Estimation (KDE) was used as generation method. The generation method utilized for this set of variables follows a specific sequence as all variables are interrelated and must follow a logical sequence. This is as follows:

holderAge -> holderFamilyMembers -> holderSuccessors -> holderSuccessorsAge.

Firstly, the generator utilizes the holderAge available in the microdata from RECAN database to determine the age of the holder age. Based on this age, the generator assigns a specific value to holderFamilyMembers, representing the number of individuals in the family structure. Depending to this number, there are two scenarios: either family members value allows for successors, or they do not. If successors are possible, the last KDE module generates a random value following the patterns observed in historical data to determine the age of the holder successors.

sellingPrice: using other variables present in microdata, sellingPrice was inferred. It was assumed that all the amount produced was sold in the current accountancy year, so the selling price was the ratio between the total value of the sales and the total amount produced in euros per ton. In this way, selling price value is variable for each agent.

lat: latitude parameter was initialized to zero. The simulation engine processes this parameter according to other synthetic population variables related with the holding geo-localisation

long: same as latitude parameter.

Crops ***variableCosts***: crop variable costs were not available for the Andalusian use case. Although RECAN dataset did contain the total agricultural costs, specific break down costs were not included.

A mathematical approach has been followed to fill this agent parameter. Using the available information total crop costs and total quantity produced per crop, an optimization problem has been stated. The details of this mathematical formulation are included in the Annex B, as it is a cross-cutting approach followed for all the use cases in the Agricore project.

3.3.2 Use-case's population-specific assumptions

For the Andalusian use case, the synthetic population generated includes only regions within NUTS2 ES61 region. From a general point of view, all entries present in the dataset (especially in the RECAN dataset) with missing values are assumed to be zero.

As mentioned before, only specific economic size categories have been generated, as there is no data available for farms with economic sizes below 4000€ in the RECAN database. In this regard, it is assumed that there is a large number of farms that will not be included in the synthetic population with the subsequent impact on macro indicators. It is notorious the amount of farms within this economic range. For example, in 2016 the total number of farms in Andalusia including all economic sizes was 244.300. From this figure only 167.250 felt within economic sizes larger than 4000€. Although there is a notorious sub representation, the unavailability of data that describes the distributions, techno economical activities, crop specialization and other farms features impedes the generation and inclusion of this agricultural sector in the final synthetic population (31,53% of the holdings are missing).

milkVariable costs do not change among farmers. There is a fixed value for all agents dedicated to livestock activity with dairy animals. The reliability of the data source found facilitates this assumption as no high variations are expected for this parameter.

regionLevel3, or agrarian region, is considered the variable that expressed the highest geo-spatial resolution. It is assigned randomly considering the number of farms present in each agrarian region according to INE statistics. Although Machine Learning based techniques to infer this parameter were tested, results were not satisfactory, and models trend to overload some agrarian regions while some other still empty. For this reason, agrarian regions assignation was done using empirical statistics, so a balanced farms distribution is obtained following real trends.

With regard to greening area, some assumptions have been taken. If the holding of the synthetic population receives the greening subsidy, a variable amount of land less or equal than 5% is accounted for greening practices. Additionally, only the area used for crops with the Nitrogen fixing flag is included in the greening area.

3.4 Analysis and verification of the synthetic population

The content presented in this section depicts the results generated during the synthetic population analysis and verification. The methods and techniques utilized to objectively assess the synthetic population are described in [SECTION]. The section is organized into three main subsections. First, a graphical comparison of the categorical variables is presented, followed by a numerical and statistical validation. The section concludes with a graphical comparison of the synthetic variables against their counterparts, including

histograms of non-zero values, the probability density function, and the cumulative density function. This comprehensive presentation of results aims to provide a thorough assessment of the work performed and to establish a foundation for conducting realistic simulations.

3.4.1 Report on the generated population probability distribution vs the sample one

Year 2014

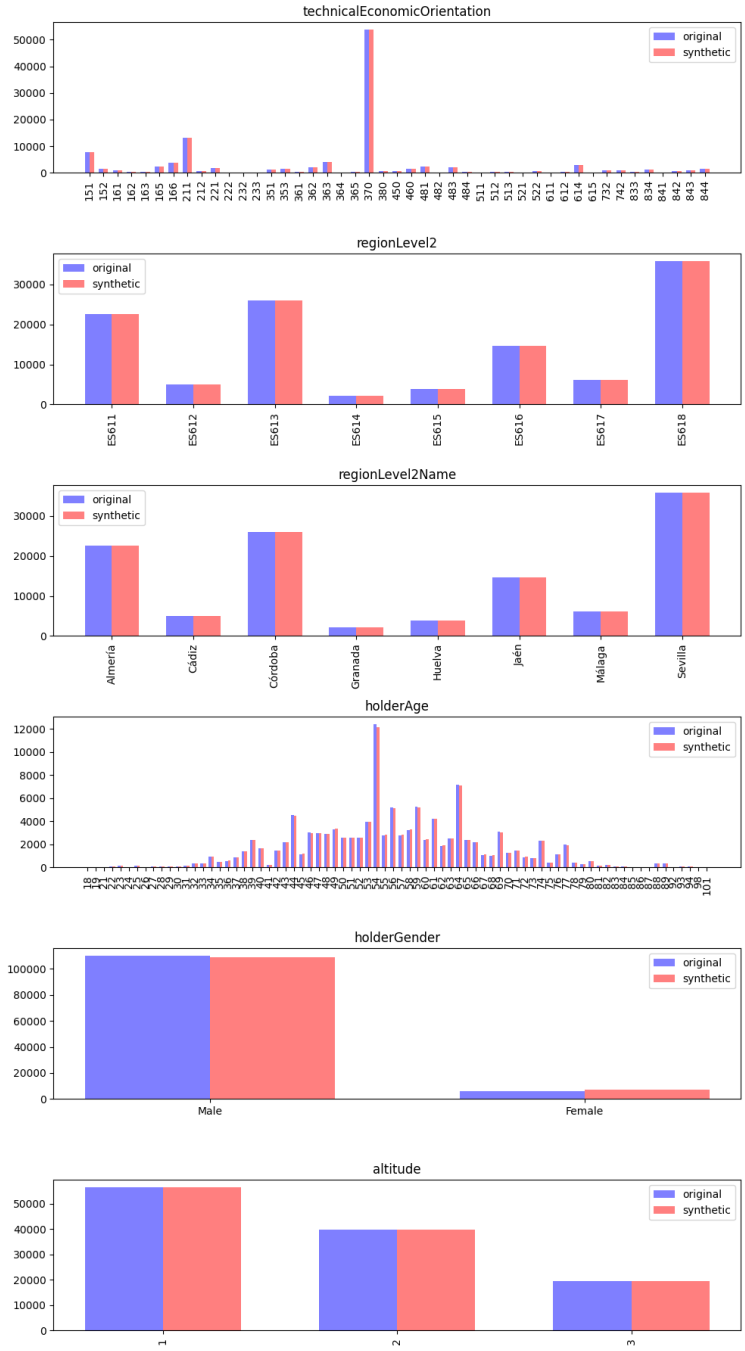

Figure 13. Comparison of Categorical Variables for the Andalusia Use Case 2014

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
1150.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
1400.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
1600.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
1700.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
23113.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2313.value	0	0	95.608	94.812	32817	32817.585	1042.17	1046.896	0.98	0.98	1	Similar	1	Similar	0	0.002
2315.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2317.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2318.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2322.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2323.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
23312.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2333.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2334.value	0	0	0.23	0.23	208	208	6.909	6.909	0.999	0.999	1	Similar	1	Similar	0	0
2335.value	0	0	0.997	0.997	4445	4445	66.573	66.573	1	1	1	Similar	1	Similar	0	0
9900.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
9901.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
CER.cropProduction	0	0	37242.77	40131.531	7125400	7125400	193370.96	185287.79	0.822	0.824	0	Different	0.002	Different	0.001	0.008
CER.cultivatedArea	0	0	4.651	4.574	250.69	251.43	17.38	17.05	0.811	0.811	0	Different	0.733	Similar	0.001	0.007
CER.irrigatedArea	0	0	0.437	0.514	250.69	250.69	5.619	5.285	0.973	0.963	0	Different	0	Different	0.001	0.008
CER.quantitySold	0	0	16.304	17.647	2375	2375	78.402	75.889	0.834	0.835	0	Different	0.001	Different	0.002	0.012
CER.quantityUsed	0	0	0.291	0.203	113.974	113.974	3.806	2.638	0.984	0.987	0.689	Similar	0.186	Similar	0.003	0.014
CER.sellingPrice	0	0	35.486	35.601	397.769	397.769	82.407	83.236	0.834	0.835	0	Different	0.203	Similar	0.015	0.03
CER.valueSales	0	0	3650.922	3973.972	712540	712540	19350.08	18580.562	0.834	0.835	0	Different	0.002	Different	0.001	0.009
CITRUS.cropProduction	0	0	10624.481	10585.528	1295640	1295640	85216.131	86209.471	0.974	0.975	0.996	Similar	1	Similar	0.002	0.01
CITRUS.cultivatedArea	0	0	0.285	0.288	35	36.244	2.36	2.391	0.974	0.974	1	Similar	1	Similar	0.007	0.023
CITRUS.irrigatedArea	0	0	0.283	0.283	35	35	2.36	2.372	0.975	0.976	1	Similar	1	Similar	0.001	0.008
CITRUS.quantitySold	0	0	7.65	7.616	860.1	860.1	63.785	64.207	0.974	0.975	0.999	Similar	1	Similar	0.002	0.011
CITRUS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
CITRUS.sellingPrice	0	0	3.999	3.982	355.769	355.769	26.247	26.278	0.974	0.975	0.995	Similar	1	Similar	0.002	0.01
CITRUS.valueSales	0	0	1062.448	1058.553	129564	129564	8521.613	8620.947	0.974	0.975	0.996	Similar	1	Similar	0.002	0.01
DAIRY.dairyCows	0	0	0.494	0.391	295	295	8.314	7.188	0.995	0.996	1	Similar	0.89	Similar	0.002	0.011
DAIRY.eggsProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.eggsTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.eggsTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.manureTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.milkProductionSold	0	0	3.576	2.788	2212.5	2212.5	61.295	52.096	0.995	0.996	1	Similar	0.89	Similar	0.002	0.009
DAIRY.milkTotalProduction	0	0	3.572	2.786	2212.5	2212.5	61.243	52.059	0.995	0.996	1	Similar	0.89	Similar	0.001	0.009
DAIRY.milkTotalSales	0	0	1280.184	1007.911	747130	747130	21496.219	18471.033	0.995	0.996	1	Similar	0.89	Similar	0.001	0.009
DAIRY.numberAnimalsForSlaughtering	0	0	0.088	0.072	55	55	1.508	1.402	0.993	0.991	0.95	Similar	0.441	Similar	0.002	0.01
DAIRY.numberAnimalsRearingBreading	0	0	0.007	0.003	50	5	0.364	0.113	0.999	0.999	1	Similar	1	Similar	0.017	0.012
DAIRY.numberOfAnimals	0	0	0.116	0.115	60	61.363	1.515	1.517	0.973	0.973	0.116	Similar	1	Similar	0.003	0.013
DAIRY.numberOfAnimalsSold	0	0	0.108	0.087	73	55	1.606	1.394	0.99	0.988	0.926	Similar	0.392	Similar	0.017	0.024
DAIRY.valueAnimalsRearingBreading	0	0	7.483	2.325	67500	4566	466.26	103	0.999	0.999	1	Similar	1	Similar	0.01	0.012
DAIRY.valueSlaughteredAnimals	0	0	80.04	71.684	63000	63000	1683.58	1638.352	0.993	0.991	0.95	Similar	0.441	Similar	0.001	0.007
DAIRY.valueSoldAnimals	0	0	124.555	104.606	79920	63000	1941.282	1776.687	0.99	0.988	0.926	Similar	0.394	Similar	0.027	0.026
DAIRY.variableCostsAnimals	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.woolProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.woolTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
FRUIT.cropProduction	0	0	26744.736	25940.305	4261520	4261520	266221.30	253660.60	0.977	0.977	0.999	Similar	1	Similar	0.002	0.011
FRUIT.cultivatedArea	0	0	0.156	0.16	22.36	23.426	1.435	1.45	0.977	0.977	0.917	Similar	1	Similar	0.008	0.024
FRUIT.irrigatedArea	0	0	0.074	0.065	22.36	22.36	1.03	0.961	0.988	0.988	1	Similar	1	Similar	0.001	0.009
FRUIT.quantitySold	0	0	4.292	4.378	597.8	597.8	37.969	38.332	0.977	0.977	1	Similar	1	Similar	0.001	0.01
FRUIT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
FRUIT.sellingPrice	0	0	14.766	13.13	1700.476	1700.476	118.207	102.815	0.977	0.977	1	Similar	1	Similar	0.002	0.011
FRUIT.valueSales	0	0	2674.474	2594.16	426152	426152	26622.13	25366.143	0.977	0.977	0.999	Similar	1	Similar	0.002	0.011
GRAZ.cropProduction	0	0	399.909	591.276	316800	316800	9122.667	10690.589	0.997	0.995	0.953	Similar	0.448	Similar	0.001	0.009
GRAZ.cultivatedArea	0	0	10.676	10.442	1460	1461.614	71.193	69.506	0.901	0.901	0.609	Similar	1	Similar	0	0.002
GRAZ.irrigatedArea	0	0	0.02	0.027	17.45	17.45	0.47	0.515	0.997	0.995	0.986	Similar	0.657	Similar	0.001	0.01
GRAZ.quantitySold	0	0	1.028	1.414	990	990	24.927	27.863	0.998	0.996	0.996	Similar	0.672	Similar	0.001	0.009
GRAZ.quantityUsed	0	0	0.084	0.188	232.537	232.537	4.036	6.361	0.999	0.999	1	Similar	1	Similar	0	0.004
GRAZ.sellingPrice	0	0	0.09	0.159	56.93	56.93	1.876	2.517	0.998	0.996	0.969	Similar	0.67	Similar	0.001	0.008
GRAZ.valueSales	0	0	37.884	54.744	31680	31680	907.382	1059.53	0.998	0.996	0.996	Similar	0.672	Similar	0.001	0.009
HOPS.cropProduction	0	0	15385.984	16037.874	1078000	1078000	63789.07	65670.356	0.868	0.872	0	Different	0.064	Similar	0.003	0.014
HOPS.cultivatedArea	0	0	1.383	1.403	110.19	111.505	5.594	5.709	0.868	0.868	0.001	Different	0.581	Similar	0.001	0.01
HOPS.irrigatedArea	0	0	0.795	0.905	66	66	4.161	4.247	0.942	0.924	0	Different	0	Different	0.007	0.022
HOPS.quantitySold	0	0	4.813	4.991	350	350	19.881	20.455	0.868	0.872	0.005	Different	0.068	Similar	0.002	0.012
HOPS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
HOPS.sellingPrice	0	0	41.863	41.052	500.885	500.885	108.314	107.68	0.868	0.872	0	Different	0.014	Different	0.01	0.023
HOPS.valueSales	0	0	1538.598	1603.807	107800	107800	6378.907	6567.351	0.868	0.872	0	Different	0.066	Similar	0.003	0.014
NUTS.cropProduction	0	0	8522.343	8835.183	805352.75	805352.75	46019.044	47568.825	0.951	0.952	0.422	Similar	1	Similar	0.002	0.012
NUTS.cultivatedArea	0	0	1.267	1.287	85.91	87.058	6.989	7.093	0.951	0.951	0.986	Similar	1	Similar	0.003	0.015
NUTS.irrigatedArea	0	0	0.012	0.017	14.77	14.77	0.295	0.361	0.997	0.996	1	Similar	0.999	Similar	0.001	0.008
NUTS.quantitySold	0	0	0.46	0.459	40	40	2.479	2.463	0.951	0.952	0.513	Similar	1	Similar	0.002	0.011
NUTS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
NUTS.sellingPrice	0	0	94.274	98.225	6581.25	6581.25	445.695	475.48	0.951	0.952	0.946	Similar	1	Similar	0.001	0.007
NUTS.valueSales	0	0	851.709	884.388	78571	78571	4592.909	4746.062	0.951	0.952	0.398	Similar	1	Similar	0.001	0.008
OLIV.cropProduction	0	0	142332.96	129065.94	6404500	6404500	377787.33	352107.13	0.606	0.607	0	Different	0.001	Different	0.007	0.019
OLIV.cultivatedArea	0	0	6.683	6.658	190	190.958	15.957	15.94	0.605	0.605	0	Different	0.011	Different	0.001	0.01
OLIV.irrigatedArea	0	0	2.917	2.522	190	190	11.317	10.969	0.806	0.83	0	Different	0	Different	0.005	0.017
OLIV.quantitySold	0	0	29.446	26.923	1601.1	1601.1	77.244	72.68	0.615	0.617	0	Different	0	Different	0.012	0.025
OLIV.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OLIV.sellingPrice	0	0	192.109	191.339	3960	3960	310.6	311.308	0.614	0.617	0	Different	0	Different	0.005	0.017
OLIV.valueSales	0	0	14154.414	12767.464	640450	640450	37748.801	35193.456	0.614	0.617	0	Different	0	Different	0.006	0.018
ORG_CER.cropProduction	0	0	4214.043	4291.133	3755360	3755360	93285.291	90526.16	0.978	0.977	0.992	Similar	0.824	Similar	0	0.003
ORG_CER.cultivatedArea	0	0	1.233	1.265	230.3	231.216	8.852	9.122	0.959	0.959	0.992	Similar	1	Similar	0.001	0.01
ORG_CER.irrigatedArea	0	0	0.078	0.059	33.2	33.2	1.556	1.354	0.998	0.998	1	Similar	1	Similar	0.001	0.01
ORG_CER.quantitySold	0	0	1.456	1.465	1341.2	1341.2	32.829	31.672	0.983	0.982	0.999	Similar	0.996	Similar	0	0.003
ORG_CER.quantityUsed	0	0	0.155	0.18	161	161	3.338	3.685	0.993	0.991	1	Similar	0.909	Similar	0	0.003
ORG_CER.sellingPrice	0	0	3.473	3.634	313.659	313.659	26.667	27.449	0.983	0.982	1	Similar	1	Similar	0.001	0.007
ORG_CER.valueSales	0	0	363.893	363.061	375536	375536	9042.666	8689.356	0.983	0.982	1	Similar	1	Similar	0	0.003
ORG_CITRUS.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.cultivatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.valueSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_FRUIT.cropProduction	0	0	3742.028	3705.145	1116582.5	1116582.5	55666.406	55909.291	0.992	0.992	1	Similar	1	Similar	0	0.002
ORG_FRUIT.cultivatedArea	0	0	0.018	0.018	7.05	8.492	0.238	0.243	0.992	0.992	1	Similar	1	Similar	0.011	0.028
ORG_FRUIT.irrigatedArea	0	0	0.004	0.004	3.8	3.8	0.085	0.085	0.997	0.997	1	Similar	1	Similar	0.001	0.01
ORG_FRUIT.quantitySold	0	0	0.487	0.481	149.8	149.8	6.99	7.027	0.993	0.993	1	Similar	1	Similar	0	0.002
ORG_FRUIT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_FRUIT.sellingPrice	0	0	4.662	4.487	1055.414	1055.414	58.045	57.176	0.993	0.993	1	Similar	1	Similar	0	0.002
ORG_FRUIT.valueSales	0	0	374.11	370.42	111658.25	111658.25	5566.646	5590.935	0.993	0.993	1	Similar	1	Similar	0	0.002
ORG_GRAZ.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.cultivatedArea	0	0	3.028	3.067	793.7	794.617	25.307	25.582	0.948	0.948	0.819	Similar	1	Similar	0	0.002
ORG_GRAZ.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.valueSales	0	0	4.28	4.28	16000	16000	261.655	261.655	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.cropProduction	0	0	130.204	136.476	225800	225800	4207.057	4423.894	0.998	0.998	1	Similar	1	Similar	0	0.002
ORG_HOPS.cultivatedArea	0	0	0.01	0.01	17.7	18.384	0.323	0.34	0.998	0.998	1	Similar	1	Similar	0.001	0.009
ORG_HOPS.irrigatedArea	0	0	0.002	0.002	5	5	0.077	0.097	0.999	0.999	1	Similar	1	Similar	0	0.005
ORG_HOPS.quantitySold	0	0	0.042	0.044	80.1	80.1	1.423	1.509	0.998	0.998	1	Similar	1	Similar	0	0.001

Figure 14. Statistical results: Andalusia 2014 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_HOPS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.sellingPrice	0	0	0.534	0.509	360.552	360.552	13.33	12.949	0.998	0.998	1	Similar	1	Similar	0	0.001
ORG_HOPS.valueSales	0	0	13.02	13.648	22580	22580	420.706	442.389	0.998	0.998	1	Similar	1	Similar	0	0.002
ORG_NUTS.cropProduction	0	0	11611.861	11579.771	3512300	3512300	98264.711	92235.268	0.952	0.952	0.899	Similar	1	Similar	0	0.003
ORG_NUTS.cultivatedArea	0	0	1.665	1.663	82.87	84.145	8.859	8.814	0.952	0.952	0.995	Similar	1	Similar	0.006	0.022
ORG_NUTS.irrigatedArea	0	0	0.029	0.023	52.4	52.384	1.231	1.102	0.999	1	1	Similar	1	Similar	0	0.001
ORG_NUTS.quantitySold	0	0	0.524	0.535	48.8	48.8	2.959	2.966	0.952	0.952	0.999	Similar	1	Similar	0.001	0.009
ORG_NUTS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_NUTS.sellingPrice	0	0	93.467	94.365	7197.336	7197.336	443.783	443.216	0.952	0.952	0.999	Similar	1	Similar	0.001	0.007
ORG_NUTS.valueSales	0	0	1159.285	1155.407	351230	351230	9816.415	9209.048	0.952	0.952	0.976	Similar	1	Similar	0	0.003
ORG_OLIV.cropProduction	0	0	37051.447	36119.655	3771700	3771700	152095.09	142310.51	0.833	0.835	0.165	Similar	0.658	Similar	0	0.004
ORG_OLIV.cultivatedArea	0	0	3.266	3.295	128.85	130.078	11.072	11.156	0.833	0.833	0	Different	0.849	Similar	0.001	0.01
ORG_OLIV.irrigatedArea	0	0	0.174	0.181	31	31	1.715	1.711	0.981	0.981	0.969	Similar	1	Similar	0.005	0.016
ORG_OLIV.quantitySold	0	0	7.123	7.12	411.2	411.2	23.274	23.036	0.846	0.847	0.084	Similar	0.669	Similar	0	0.005
ORG_OLIV.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_OLIV.sellingPrice	0	0	74.36	74.786	1065.535	1065.535	181.688	182.423	0.846	0.847	0.001	Different	0.227	Similar	0.004	0.015
ORG_OLIV.valueSales	0	0	3465.26	3420.153	377170	377170	14508.1	13763.103	0.846	0.847	0.279	Similar	0.876	Similar	0	0.003
ORG_OTHER.cropProduction	0	0	1237.746	3874.715	1482336.5	1482336.5	30233.491	68712.944	0.985	0.962	0	Different	0	Different	0.005	0.015
ORG_OTHER.cultivatedArea	0	0	0.163	0.205	28.3	29.905	1.216	1.241	0.85	0.85	0	Different	0	Different	0.011	0.028
ORG_OTHER.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_OTHER.quantitySold	0	0	0.367	1.067	367.5	367.5	7.314	14.435	0.99	0.985	0.013	Different	0.021	Different	0.004	0.018
ORG_OTHER.quantityUsed	0	0	0.041	0.151	71.492	71.492	1.423	3.277	0.998	0.998	0.994	Similar	1	Similar	0.018	0.015
ORG_OTHER.sellingPrice	0	0	3.932	2.642	2797.662	2797.662	54.583	49.916	0.985	0.985	0.034	Different	0.999	Similar	0.004	0.015
ORG_OTHER.valueSales	0	0	119.219	87.235	120000	120000	2748.63	1573.21	0.985	0.985	0.857	Similar	1	Similar	0.003	0.012
ORG_PROT.cropProduction	0	0	15.46	15.902	13834.515	13834.515	384.587	400.431	0.998	0.998	1	Similar	1	Similar	0	0.002
ORG_PROT.cultivatedArea	0	0	0.031	0.032	15.96	16.983	0.558	0.56	0.996	0.996	1	Similar	1	Similar	0.003	0.016
ORG_PROT.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_PROT.quantitySold	0	0	0.004	0.004	4.3	4.3	0.118	0.112	0.998	0.999	1	Similar	1	Similar	0	0.002
ORG_PROT.quantityUsed	0	0	0.003	0.004	8.587	8.587	0.161	0.187	1	1	1	Similar	1	Similar	0	0.001
ORG_PROT.sellingPrice	0	0	0.371	0.333	272.273	272.273	9.558	8.916	0.998	0.999	1	Similar	1	Similar	0	0.002
ORG_PROT.valueSales	0	0	1.057	0.934	890	890	28.341	26.396	0.998	0.999	1	Similar	1	Similar	0	0.001
ORG_SUNFL.cropProduction	0	0	17.938	14.966	46150	46150	840.311	748.967	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_SUNFL.cultivatedArea	0	0	0.002	0.002	6.02	6.657	0.111	0.1	0.999	0.999	1	Similar	1	Similar	0.002	0.01
ORG_SUNFL.irrigatedArea	0	0	0.002	0.001	6.02	6.02	0.108	0.092	1	1	1	Similar	1	Similar	0	0.004
ORG_SUNFL.quantitySold	0	0	0.004	0.003	9.6	9.6	0.178	0.16	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_SUNFL.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.sellingPrice	0	0	0.282	0.257	480.729	480.729	10.77	10.143	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_SUNFL.valueSales	0	0	1.794	1.497	4615	4615	84.031	74.897	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_VEG.cropProduction	0	0	40777.517	36475.561	4310738.2	4310738.2	267715.57	251506.11	0.952	0.953	0.018	Different	0.673	Similar	0.003	0.013
ORG_VEG.cultivatedArea	0	0	0.113	0.116	13.4	14.614	0.761	0.78	0.952	0.952	0.088	Similar	1	Similar	0.012	0.029
ORG_VEG.irrigatedArea	0	0	0.1	0.093	13.4	13.4	0.734	0.707	0.956	0.959	0.02	Different	0.259	Similar	0.004	0.017
ORG_VEG.quantitySold	0	0	9.086	8.227	1490	1490	70.281	68.207	0.952	0.956	0.018	Different	0.047	Different	0.002	0.011
ORG_VEG.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_VEG.sellingPrice	0	0	27.408	25.534	2500.182	2500.182	141.57	145.238	0.952	0.956	0.008	Different	0.043	Different	0.006	0.017
ORG_VEG.valueSales	0	0	4071.467	3644.534	428200	428200	26698.48	25073.753	0.952	0.956	0.018	Different	0.049	Different	0.003	0.014
OTHER.cropProduction	0	0	23863.187	20125.399	17516960	5814290	246916.97	126804.76	0.896	0.893	0	Different	0.068	Similar	0.019	0.041
OTHER.cultivatedArea	0	0	0.99	1.058	100.06	100.982	4.354	4.404	0.633	0.633	0	Different	0	Different	0.001	0.009
OTHER.irrigatedArea	0	0	0.298	0.366	89	89	2.56	2.688	0.957	0.938	0	Different	0	Different	0.001	0.009
OTHER.quantitySold	0	0	39.005	41.625	16580.5	16580.5	436.284	450.179	0.91	0.917	0	Different	0	Different	0.001	0.006
OTHER.quantityUsed	0	0	0.172	0.036	370.236	93.69	4.864	0.952	0.992	0.993	0.238	Similar	0.998	Similar	0.025	0.014
OTHER.sellingPrice	0	0	28.155	24.568	10718.182	10718.182	283.097	333.076	0.899	0.914	0	Different	0	Different	0.005	0.016
OTHER.valueSales	0	0	2740.346	2091.212	1751696	581429	25129.073	12906.144	0.899	0.914	0	Different	0	Different	0.017	0.038
OTHER_LIVESTOCK.dairyCows	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.eggsProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.eggsTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.eggsTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.manureTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.milkProductionSold	0	0	2.319	2.324	369.9	369.9	18.58	18.516	0.962	0.962	1	Similar	1	Similar	0	0.002
OTHER_LIVESTOCK.milkTotalProduction	0	0	2.32	2.325	369.9	371.016	18.58	18.514	0.962	0.962	0.997	Similar	1	Similar	0	0.005
OTHER_LIVESTOCK.milkTotalSales	0	0	1767.223	1776.553	290606	290606	13538.606	13543.421	0.962	0.962	1	Similar	1	Similar	0	0.003
R_LIVESTOCK.numberAnimalsForSlaughtering	0	0	360	462.886	509027	509027	10098.391	11635.323	0.879	0.875	0.028	Different	0.031	Different	0	0.002
LIVESTOCK.numberAnimalsRearingBreading	0	0	1.319	1.27	800	800	17.964	17.913	0.982	0.983	0.999	Similar	0.999	Similar	0	0.004
OTHER_LIVESTOCK.numberOfAnimals	0	0	169.706	171.911	89650	89651.041	2146.331	2159.926	0.856	0.856	0.997	Similar	1	Similar	0	0.002
OTHER_LIVESTOCK.numberOfAnimalsSold	0	0	362.411	465.425	509027	509027	10098.36	11635.271	0.872	0.868	0.003	Different	0.042	Different	0	0.002
ER_LIVESTOCK.valueAnimalsRearingBreading	0	0	119.706	117.691	38009	38009	1301.162	1306.921	0.982	0.983	1	Similar	0.999	Similar	0.001	0.007
THER_LIVESTOCK.valueSlaughteredAnimals	0	0	6286.302	6647.877	1028236	1028236	41525.793	42581.351	0.879	0.875	0.008	Different	0.025	Different	0	0.004
OTHER_LIVESTOCK.valueSoldAnimals	0	0	6592.655	6983.685	1028236	1028236	41792.263	42855.953	0.872	0.868	0.003	Different	0.032	Different	0	0.005
OTHER_LIVESTOCK.variableCostsAnimals	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.woolProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.woolTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
PROT.cropProduction	0	0	920.028	935.706	323926.84	323926.84	13211.18	13615.721	0.992	0.992	1	Similar	1	Similar	0	0.002
PROT.cultivatedArea	0	0	0.23	0.251	126	127.003	3.655	4.013	0.988	0.988	1	Similar	1	Similar	0	0.003
PROT.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
PROT.quantitySold	0	0	0.137	0.139	52.5	52.5	1.948	2.03	0.994	0.994	1	Similar	1	Similar	0	0.002
PROT.quantityUsed	0	0	0.019	0.019	21.532	21.532	0.567	0.565	0.998	0.998	1	Similar	1	Similar	0	0.001
PROT.sellingPrice	0	0	2.876	2.753	1100.727	1100.727	40.452	38.917	0.994	0.994	1	Similar	1	Similar	0	0.002
PROT.valueSales	0	0	69.868	70.73	32103	32103	1135.029	1171.553	0.994	0.994	1	Similar	1	Similar	0	0.002
SET_ASIDE.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.cultivatedArea	0	0	1.627	1.655	140	141.109	7.699	7.781	0.893	0.893	0.348	Similar	1	Similar	0.002	0.01
SET_ASIDE.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.valueSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SUNFL.cropProduction	0	0	10403.167	10416.638	827720	827720	55645.076	55131.37	0.921	0.921	0	Different	0.698	Similar	0.009	0.024
SUNFL.cultivatedArea	0	0	2.174	2.131	190	191.088	12.736	12.467	0.921	0.921	0.507	Similar	1	Similar	0.002	0.012
SUNFL.irrigatedArea	0	0	0.05	0.084	35.12	35.12	0.92	1.095	0.993	0.988	0.032	Different	0.007	Different	0.002	0.012
SUNFL.quantitySold	0	0	3.096	3.138	250.8	250.8	16.878	16.815	0.921	0.921	0	Different	0.807	Similar	0.004	0.016
SUNFL.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SUNFL.sellingPrice	0	0	27.029	26.982	621.389	621.389	93.844	93.769	0.921	0.921	0.249	Similar	1	Similar	0.004	0.015
SUNFL.valueSales	0	0	1040.317	1042.738	82772	82772	5564.508	5512.187	0.921	0.921	0	Different	0.705	Similar	0.009	0.024
VEG.cropProduction	0	0	177990.89	157756.56	14700440	14700440	638266.60	565909.90	0.867	0.868	0	Different	0.199	Similar	0.003	0.013
VEG.cultivatedArea	0	0	0.736	0.743	149	149.268	3.624	3.66	0.867	0.867	0.001	Different	0.926	Similar	0	0.003
VEG.irrigatedArea	0	0	0.487	0.488	149	149	2.753	2.698	0.894	0.892	0.085	Similar	0.334	Similar	0	0.002
VEG.quantitySold	0	0	42.581	43.084	3557.8	3557.8	176.902	181.143	0.867	0.868	0.322	Similar	0.876	Similar	0.003	0.014
VEG.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
VEG.sellingPrice	0	0	70.456	64.669	3750	3750	239.169	231.883	0.867	0.868	0	Different	0.078	Similar	0.005	0.017
VEG.valueSales	0	0	17780.454	15712.463	1470044	1470044	63781.957	56096.524	0.867	0.868	0	Different	0.206	Similar	0.003	0.013
agriculturalLandArea	0	0	39.745	39.562	1500	1500.751	84.787	84.776	0.021	0.021	0	Different	0	Different	0.001	0.007
agriculturalLandHectaresAdquisition	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
agriculturalLandValue	0	0	215208.95	227906.28	8653647	8653647	430446.24	432349.2	0.144	0.163	0	Different	0	Different	0.002	0.012
depreciation	0	0	4648.505	4651.82	357482.59	357482.59	8891.277	9522.782	0.012	0.032	0	Different	0	Different	0.002	0.011
farmBuildingsValue	0	0	17894.708	18154.389	916503	916503	53309.069	55524.185	0.316	0.348	0	Different	0	Different	0.008	0.023
farmNetIncome	-313436.59	-313436.59	24564.991	27667.109	588749	588749	39817.928	39845.178	0	0	0	Different	0	Different	0.014	0.03
fixedAssets	0	0	283580.50	301500.97	8972965	8972965	459088.00	460067.26	0.001	0.001	0	Different	0	Different	0.008	0.022
forestLandArea	0	0	0.034	0.012	100	100	1.641	0.977	0.996	0.998	0.982	Similar	0.718	Similar	0	0.002
forestLandValue	0	0	73.458	26.288	206571	206571	3397.257	2022.052	0.997	0.998	0.989	Similar	0.856	Similar	0.001	0.009
grossFarmIncome	-35320	-35320	40102.769	41451.684	857925	857925	49420.923	47130.362	0	0	0	Different	0	Different	0.021	0.036
intangibleAssetsNonTradable	0	0	2.039	0.616	1700	1700	58.841	32.358	0.999	1	1	Similar	0.997	Similar	0.001	0.005
intangibleAssetsTradable	0	0	12436.191	17468.532	656804	656804	25022.467	41544.83	0.17	0.151	0	Different	0	Different	0.015	0.036
landImprovements	0	0	7271.63	7171.764	383247	383247	22097.947	17569.124	0.364	0.351	0	Different	0	Different	0.006	0.02
longAndMediumTermLoans	0	0	2640.549	2954.142	360000	360000	19411.89	21620.512	0.958	0.952	0.022	Different	0.002	Different	0.006	0.018
machinery	0	0	17703.657	16787.154	3163835	3163835	71085.644	74361.03	0.04	0.028	0	Different	0	Different	0	0.002
machineryAndEquipment	0	0	17703.657	16787.154	3163835	3163835	71085.644	74361.03	0.04	0.028	0	Different	0	Different	0	0.002
otherNonCurrentAssets	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
otherOutputs	0	0	148.637	207.866	66500	66500	2020.544	2419.712	0.989	0.985	0.161	Similar	0.04	Different	0.005	0.019

Figure 15. Statistical results: Andalusia 2014 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
plantationsValue	0	0	2756.781	3609.752	631244	631244	12270.892	29322.682	0.507	0.535	0	Different	0	Different	0.005	0.017
rentPaid	0	0	193.302	193.037	13000	13001.344	970.208	968.057	0.705	0.705	0	Different	0.472	Similar	0	0.001
specificCropCosts	0	0	2084.698	2057.214	194524.25	194524.25	6105.788	9808.247	0.062	0.12	0	Different	0	Different	0.008	0.021
subsidiesOnInvestments	0	0	0.115	0.161	2668	2668	17.525	20.735	1	1	1	Similar	1	Similar	0	0
taxes	0	0	591.49	683.747	10900	10900	964.483	1101.451	0.064	0.082	0	Different	0	Different	0.026	0.041
totalCurrentAssets	787	787	90692.087	99258.858	2523763	2523763	189995.35	192632.25	0	0	0	Different	0	Different	0.013	0.029
totalExternalFactors	0	0	10522.331	8771.75	286580	286580	20933.612	18085.015	0.229	0.31	0	Different	0	Different	0.007	0.02
totalIntermediateConsumption	2515	2515	28102.84	32324.177	979051	979051	46228.461	49154.582	0	0	0	Different	0	Different	0.005	0.017
totalOutputCropsAndCropProduction	0	0	43171.028	41520.126	1847876	1847876	65096.682	59239.082	0.065	0.09	0	Different	0	Different	0.005	0.018
totalOutputLivestockAndLivestockProduction	-15462.96	-15462.96	9742.786	16645.439	876623	876623	48058.897	60368.362	0.856	0.814	0	Different	0	Different	0.015	0.033
vatBalanceExcludingInvestments	-3091	-3091	1744.522	1839.543	51965	51965	3654.73	3687.191	0.356	0.312	0	Different	0	Different	0.014	0.03
vatBalanceOnInvestments	-28636	-28636	-367.058	-353.531	49076	49076	1747.23	1852.177	0.87	0.871	0	Different	0.189	Similar	0.005	0.016

Figure 16. Statistical results: Andalusia 2014 (sheet 3)

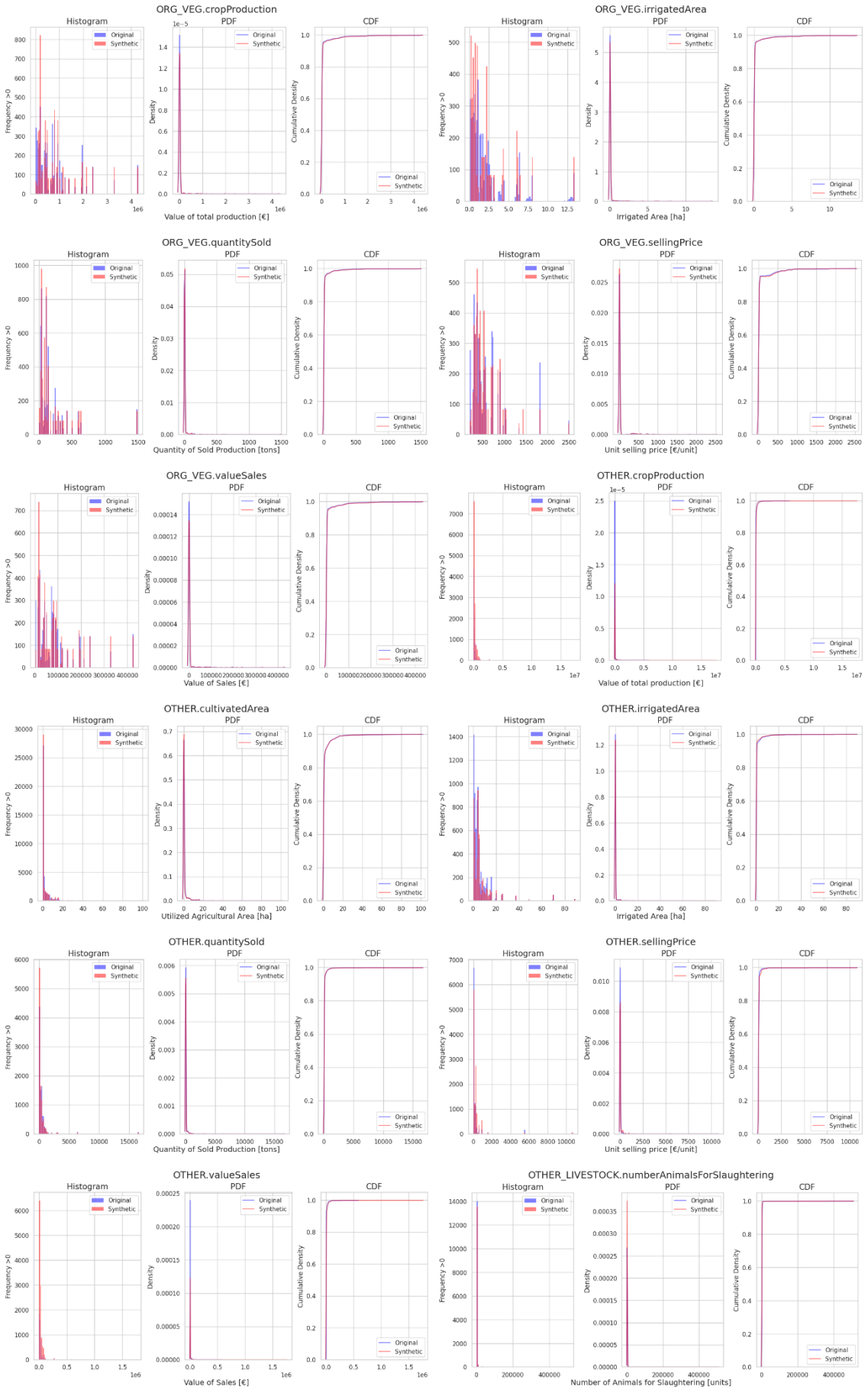

Figure 17. Comparison of Continuous Variables: Andalusia Use Case 2014 (sheet 1)

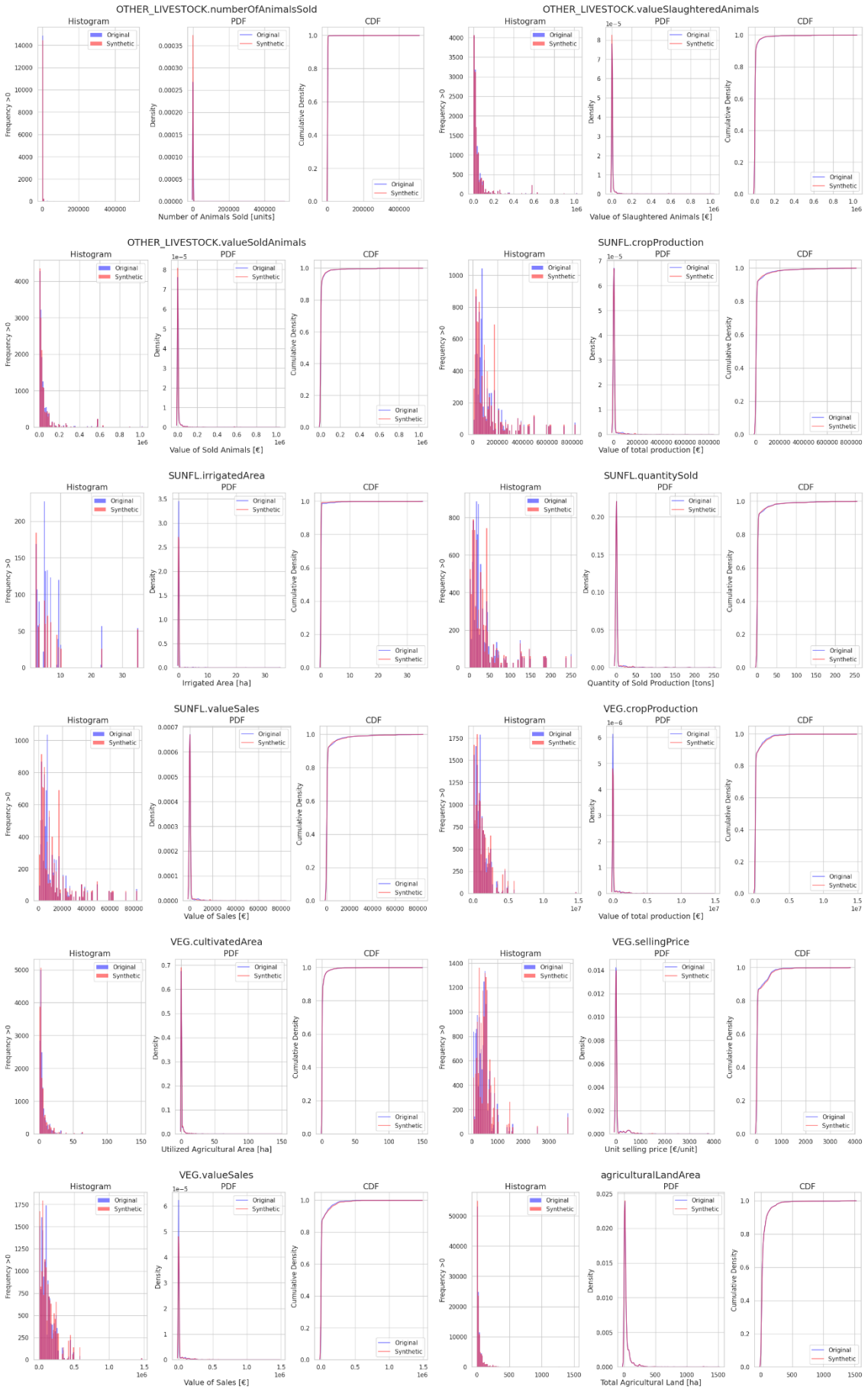

Figure 18. Comparison of Continuous Variables: Andalusia Use Case 2014 (Sheet 2)

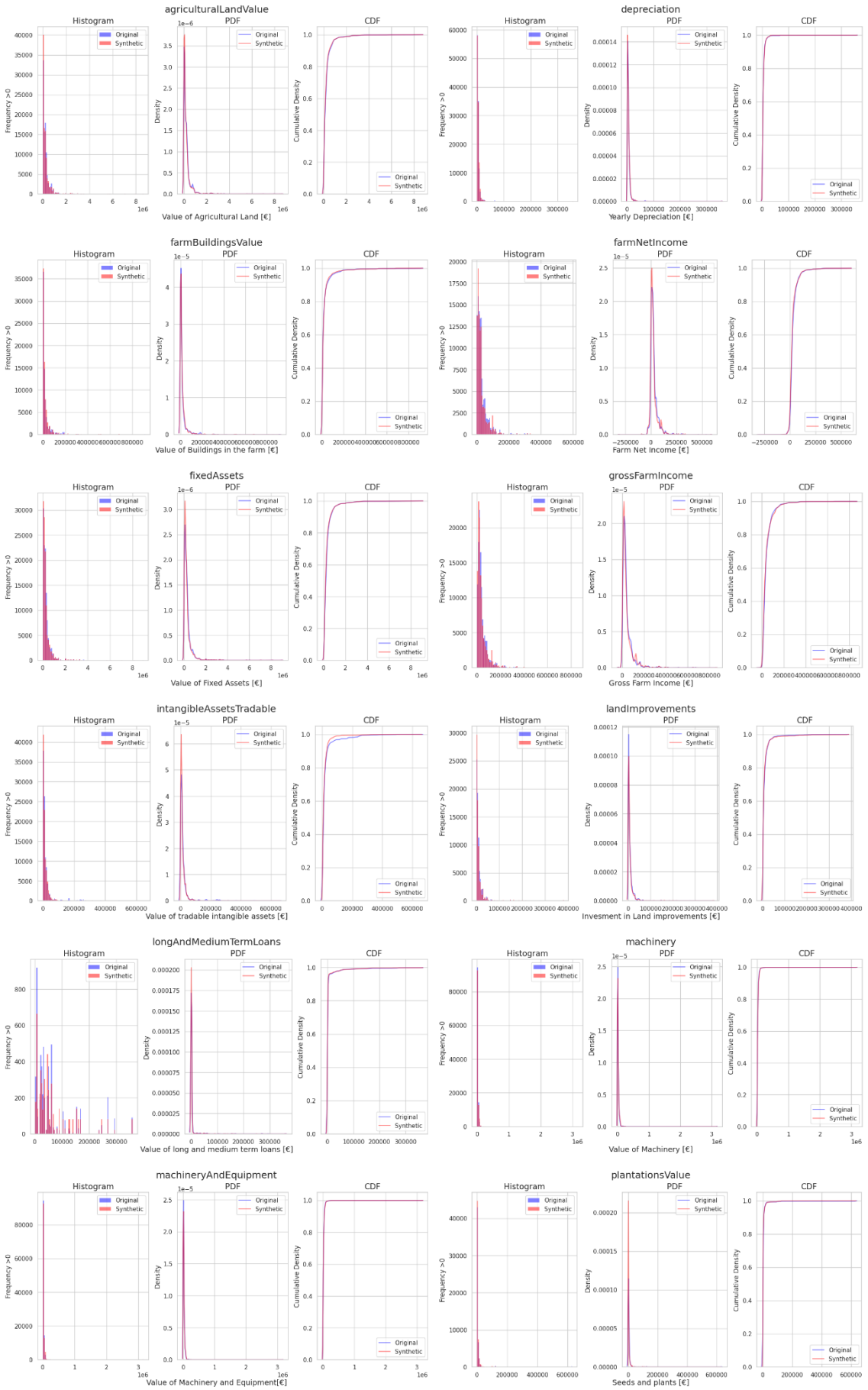

Figure 19. Comparison of Continuous Variables: Andalusia Use Case 2014 (Sheet 3)

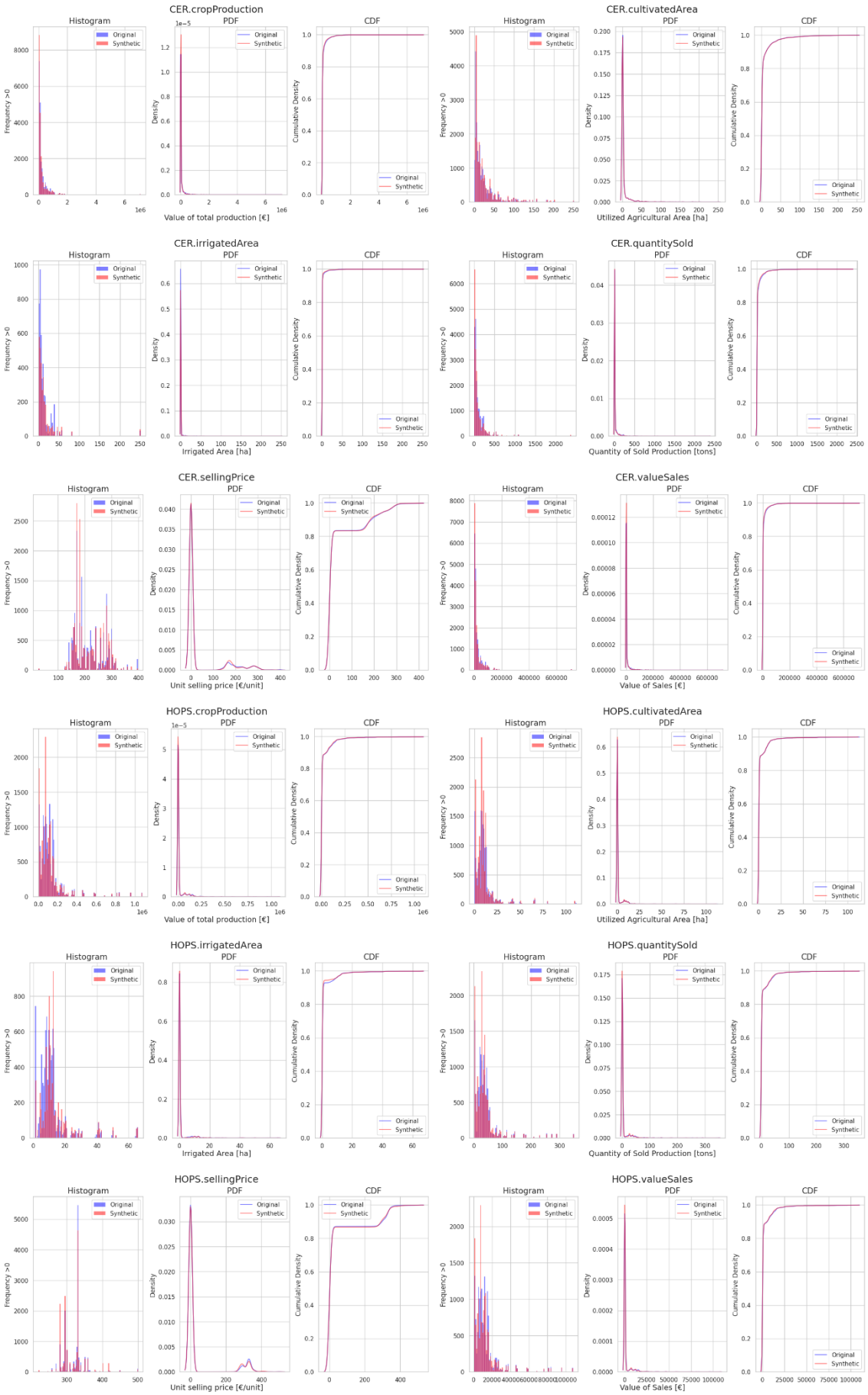

Figure 20. Comparison of Continuous Variables: Andalusia Use Case 2014 (Sheet 4)

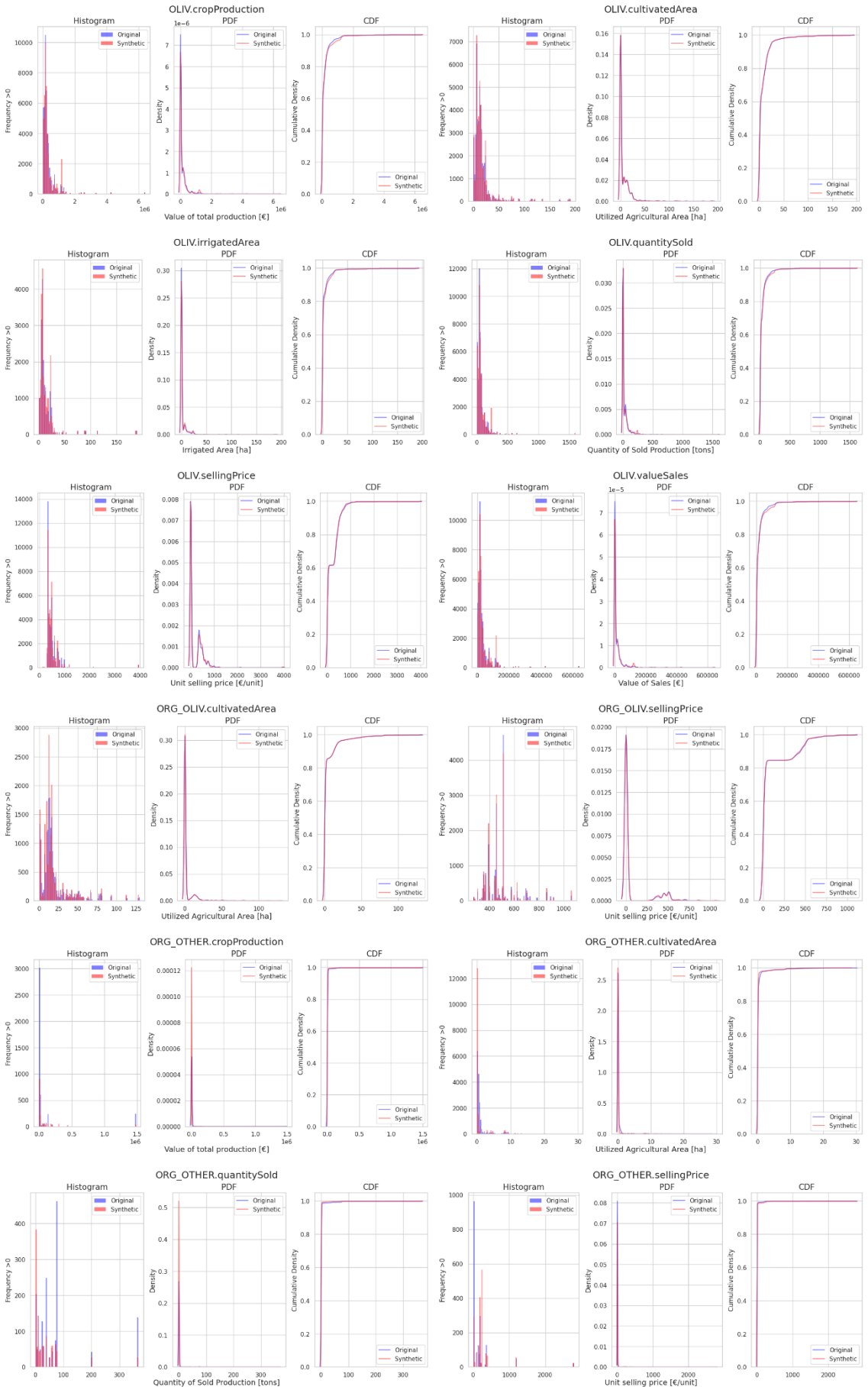

Figure 21. Comparison of Continuous Variables: Andalusia Use Case 2014 (Sheet 5)

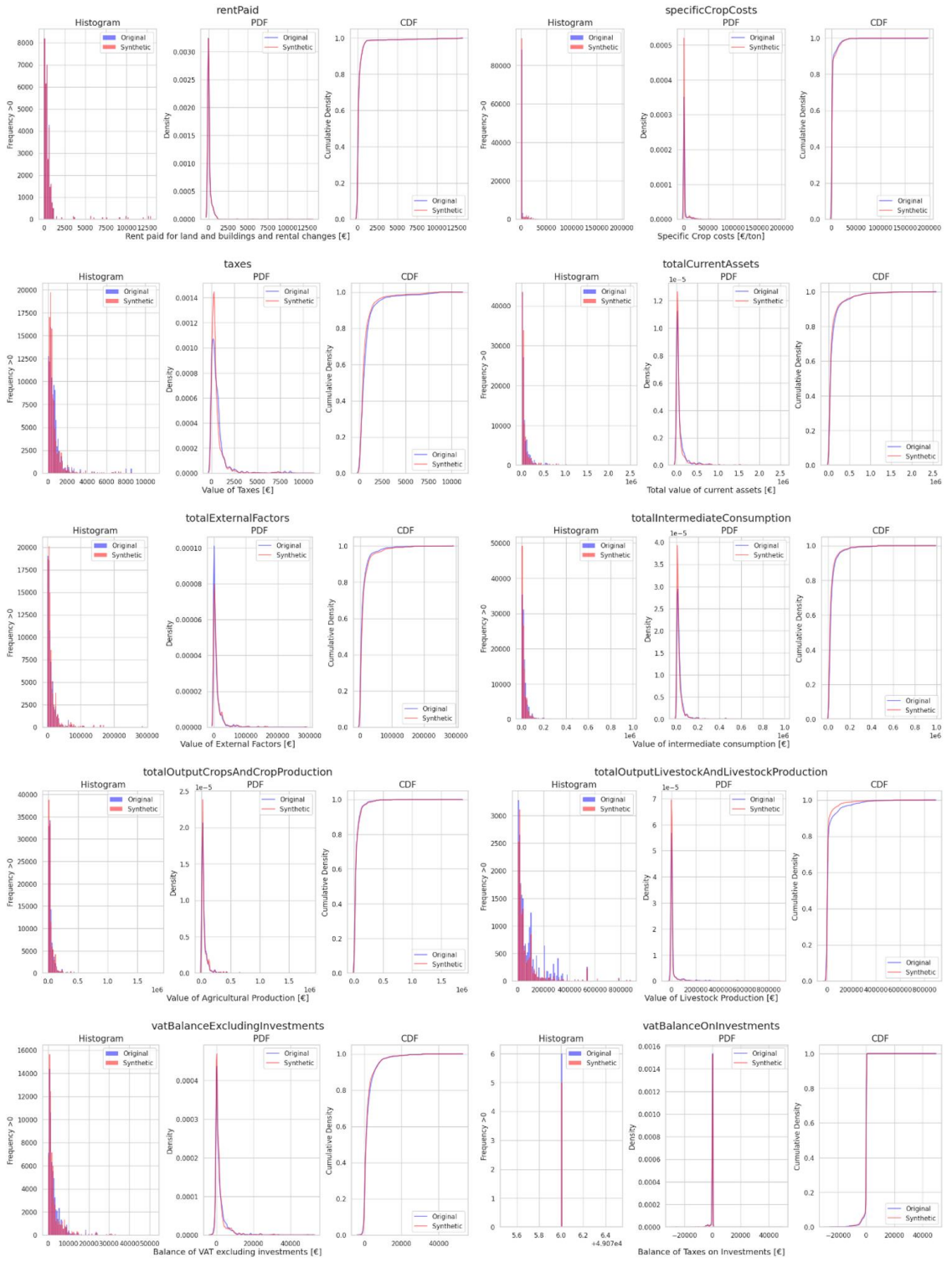

Figure 22. Comparison of Continuous Variables: Andalusia Use Case 2014 (Sheet 6)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
GRAZ	1237245	1210081	0.978
OLIV	774419	771534	0.996
CER	538940	530064	0.984
ORG_OLIV	378440	381897	1.009
ORG_GRAZ	350898	355402	1.013
SUNFL	251954	247008	0.98
ORG_NUTS	192971	192762	0.999
SET_ASIDE	188542	191746	1.017
HOPS	160294	162630	1.015
NUTS	146866	149096	1.015
ORG_CER	142882	146627	1.026
OTHER	114705	122565	1.069
VEG	85347	86153	1.009
CITRUS	33017	33358	1.01
PROT	26683	29062	1.089
ORG_OTHER	18856	23784	1.261
FRUIT	18115	18556	1.024
ORG_VEG	13106	13401	1.023
ORG_PROT	3643	3670	1.007
ORG_FRUIT	2036	2053	1.008
ORG_HOPS	1140	1212	1.063
ORG_SUNFL	289	251	0.869
ORG_CITRUS	0	0	1.0

Table 4. Andalusia use case, 2014: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
VEG	20626474809	18281619728	0.886
OLIV	16494255516	14956807498	0.907
ORG_VEG	4725502499	4226970394	0.895
CER	4315878406	4650642469	1.078
ORG_OLIV	4293706978	4185726271	0.975
FRUIT	3099313710	3006092240	0.97
OTHER	2765385482	2332231840	0.843
HOPS	1783004757	1858549037	1.042
ORG_NUTS	1345640517	1341921814	0.997
CITRUS	1231217980	1226703880	0.996
SUNFL	1205571030	1207132060	1.001
NUTS	987611767	1023865143	1.037
ORG_CER	488344367	497277948	1.018
ORG_FRUIT	433644938	429370718	0.99
ORG_OTHER	143436197	449021294	3.13
PROT	106617466	108434244	1.017
GRAZ	46343424	68519965	1.479
ORG_HOPS	15088662	15815570	1.048
ORG_SUNFL	2078799	1734350	0.834
ORG_PROT	1791605	1842828	1.029
SET_ASIDE	0	0	1.0
ORG_GRAZ	0	0	1.0
ORG_CITRUS	0	0	1.0

Table 5. Andalusia use case, 2014: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
VEG	4934518	4992779	1.012
OTHER	4520067	4823763	1.067
OLIV	3412355	3119956	0.914
CER	1889348	2045033	1.082
ORG_VEG	1052916	953429	0.906
CITRUS	886545	882617	0.996
ORG_OLIV	825455	825045	1.0
HOPS	557721	578429	1.037
FRUIT	497370	507381	1.02
SUNFL	358767	363697	1.014
ORG_CER	168745	169780	1.006
GRAZ	119119	163912	1.376
ORG_NUTS	60765	61947	1.019
ORG_FRUIT	56438	55685	0.987
NUTS	53306	53173	0.998
ORG_OTHER	42483	123628	2.91
PROT	15902	16116	1.013
ORG_HOPS	4825	5123	1.062
ORG_PROT	507	460	0.907
ORG_SUNFL	467	398	0.852
SET_ASIDE	0	0	1.0
ORG_GRAZ	0	0	1.0
ORG_CITRUS	0	0	1.0

Table 6. Andalusia use case, 2014: quantity sold ratio comparison

Year 2018

Figure 23. Comparison of Categorical Variables for the Andalusia Use Case 2018

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
1150.value	0	0	6679.22	6700.549	422480	422481.22	17401.558	17570.503	0.252	0.252	0.788	Similar	0.914	Similar	0	0.002
1400.value	0	0	2991.227	2993.834	226650	226651.14	8629.244	8528.739	0.339	0.339	0.158	Similar	0.912	Similar	0	0.002
1600.value	0	0	11.168	11.148	4318	4318.969	127.684	127.588	0.99	0.99	0.999	Similar	1	Similar	0	0.002
1700.value	0	0	7.152	7.107	1176	1177.212	87.732	87.361	0.993	0.993	1	Similar	1	Similar	0.001	0.007
23113.value	0	0	0.557	0.557	700	701.256	18.083	18.124	0.999	0.999	1	Similar	1	Similar	0	0
2313.value	0	0	41.855	41.23	29293	29293.887	767.489	754.939	0.983	0.983	0.998	Similar	1	Similar	0	0.002
2315.value	0	0	4.302	4.364	1569	1569.777	60.796	61.863	0.994	0.994	1	Similar	1	Similar	0	0.002
2317.value	0	0	50.007	49.968	32938	32938.912	985.954	997.543	0.994	0.994	1	Similar	1	Similar	0	0.002
2318.value	0	0	17.249	17.125	5915	5916.324	174.553	167.565	0.969	0.969	0.999	Similar	1	Similar	0	0.003
2322.value	0	0	349.801	354.882	90213	90213.933	2657.68	2670.085	0.963	0.963	1	Similar	1	Similar	0	0.002
2323.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
23312.value	0	0	71.49	71.862	3180	3180.672	302.072	303.746	0.926	0.926	1	Similar	1	Similar	0	0.003
2333.value	0	0	0.337	0.337	1712	1712	24.026	24.026	1	1	1	Similar	1	Similar	0	0
2334.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2335.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
9900.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
9901.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
CER.cropProduction	0	0	50209.015	51772.518	21463150	21463150	364122.77	382178.64	0.811	0.813	0	Different	0.13	Similar	0	0.002
CER.cultivatedArea	0	0	4.902	4.92	696	697.605	20.275	20.763	0.811	0.811	0.04	Different	0.957	Similar	0	0.002
CER.irrigatedArea	0	0	1.021	1.155	696	696	11.945	12.549	0.964	0.948	0	Different	0	Different	0	0.002
CER.quantitySold	0	0	20.887	21.023	6313.4	6313.4	132.648	134.271	0.824	0.825	0.001	Different	0.456	Similar	0	0.004
CER.quantityUsed	0	0	0.541	0.729	266.061	266.061	6.764	7.247	0.98	0.977	0.002	Different	0.109	Similar	0.003	0.013
CER.sellingPrice	0	0	35.602	35.681	363.158	363.158	79.542	80.087	0.824	0.825	0.012	Different	0.652	Similar	0.004	0.015
CER.valueSales	0	0	4893.042	5000.216	2146315	2146315	36383.771	38177.264	0.824	0.825	0	Different	0.473	Similar	0	0.002
CITRUS.cropProduction	0	0	41257.227	38913.446	55663600	55663600	890772.75	891895.13	0.969	0.969	0.859	Similar	1	Similar	0	0.001
CITRUS.cultivatedArea	0	0	0.534	0.519	264.52	265.705	6.458	6.317	0.969	0.969	0.983	Similar	1	Similar	0	0.005
CITRUS.irrigatedArea	0	0	0.439	0.432	264.52	264.52	5.781	5.733	0.974	0.974	0.982	Similar	1	Similar	0	0.001
CITRUS.quantitySold	0	0	17.295	16.226	7735.5	7735.5	218.096	208.423	0.969	0.969	0.995	Similar	1	Similar	0	0.002
CITRUS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
CITRUS.sellingPrice	0	0	8.84	8.299	1200	1200	68.253	62.583	0.969	0.969	1	Similar	1	Similar	0.001	0.009
CITRUS.valueSales	0	0	4125.723	3891.345	5566360	5566360	89077.276	89189.513	0.969	0.969	0.859	Similar	1	Similar	0	0.001
DAIRY.dairyCows	0	0	0.557	0.348	330	330	9.331	6.842	0.995	0.995	0.974	Similar	1	Similar	0.003	0.012
DAIRY.eggsProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.eggsTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.eggsTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.manureTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.milkProductionSold	0	0	3.985	2.482	2372.3	2372.3	65.311	47.022	0.995	0.995	0.971	Similar	1	Similar	0.005	0.013
DAIRY.milkTotalProduction	0	0	3.985	2.482	2372.3	2372.3	65.311	47.022	0.995	0.995	0.971	Similar	1	Similar	0.005	0.013
DAIRY.milkTotalSales	0	0	1285.027	804.436	711732	711732	20715.736	14938.987	0.995	0.995	0.971	Similar	1	Similar	0.002	0.012
DAIRY.numberAnimalsForSlaughtering	0	0	0.075	0.068	54	54	1.36	1.279	0.995	0.995	1	Similar	1	Similar	0.003	0.01
DAIRY.numberAnimalsRearingBreading	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.numberOfAnimals	0	0	0.087	0.089	75	76.031	1.341	1.43	0.974	0.974	0.129	Similar	1	Similar	0	0.004
DAIRY.numberOfAnimalsSold	0	0	0.079	0.076	54	54	1.391	1.378	0.994	0.994	1	Similar	1	Similar	0.003	0.011
DAIRY.valueAnimalsRearingBreading	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.valueSlaughteredAnimals	0	0	58.489	65.766	135095	135095	2263.575	2437.196	0.995	0.995	1	Similar	1	Similar	0	0.003
DAIRY.valueSoldAnimals	0	0	62.824	71.213	135095	135095	2286.108	2451.016	0.994	0.994	0.994	Similar	1	Similar	0	0.002
DAIRY.variableCostsAnimals	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.woolProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.woolTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
FRUIT.cropProduction	0	0	65755.491	69832.995	28563300	28563300	828630.99	886998.28	0.961	0.962	0.906	Similar	0.914	Similar	0	0.005
FRUIT.cultivatedArea	0	0	0.232	0.239	75	75.272	2.454	2.482	0.959	0.959	0.451	Similar	1	Similar	0.001	0.009
FRUIT.irrigatedArea	0	0	0.163	0.162	75	75	1.971	1.926	0.967	0.97	0.364	Similar	0.154	Similar	0.001	0.009
FRUIT.quantitySold	0	0	8.792	9.021	4502.5	4502.5	107.586	106.668	0.963	0.964	0.699	Similar	0.618	Similar	0.001	0.006
FRUIT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
FRUIT.sellingPrice	0	0	31.594	29.471	3723.373	3723.373	230.407	221.559	0.963	0.964	0.862	Similar	0.622	Similar	0.003	0.014
FRUIT.valueSales	0	0	6574.661	6999.54	2856330	2856330	82863.167	88703.209	0.963	0.964	0.839	Similar	0.618	Similar	0	0.005
GRAZ.cropProduction	0	0	528.248	624.02	691110	691110	16634.966	18205.092	0.999	0.998	1	Similar	1	Similar	0	0.003
GRAZ.cultivatedArea	0	0	10.868	10.548	2100	2100.648	60.561	58.996	0.855	0.855	0.709	Similar	1	Similar	0	0.003
GRAZ.irrigatedArea	0	0	0.008	0.011	23.62	23.603	0.401	0.471	1	0.999	1	Similar	1	Similar	0	0.003
GRAZ.quantitySold	0	0	0.646	0.664	905	905	20.873	20.89	0.999	0.999	1	Similar	1	Similar	0	0.001
GRAZ.quantityUsed	0	0	0.21	0.258	684.28	684.28	11.823	12.954	0.999	0.999	1	Similar	1	Similar	0	0.002
GRAZ.sellingPrice	0	0	0.088	0.096	120.193	120.193	2.738	2.923	0.999	0.999	1	Similar	1	Similar	0	0.001
GRAZ.valueSales	0	0	46.055	50.137	69111	69111	1475.473	1579.97	0.999	0.999	1	Similar	1	Similar	0	0.001
HOPS.cropProduction	0	0	15116.529	15312.538	4092710	4092710	116686.59	117145.30	0.926	0.927	0.079	Similar	0.949	Similar	0.001	0.006
HOPS.cultivatedArea	0	0	0.855	0.842	197	198.172	6.144	6.074	0.926	0.926	0.148	Similar	0.999	Similar	0	0.003
HOPS.irrigatedArea	0	0	0.759	0.781	197	197	5.939	5.925	0.941	0.936	0.046	Different	0.023	Different	0	0.003
HOPS.quantitySold	0	0	3.166	3.198	836.9	836.9	24.182	24.249	0.926	0.927	0.066	Similar	0.945	Similar	0	0.005
HOPS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
HOPS.sellingPrice	0	0	34.813	34.793	1000	1000	125.563	125.792	0.926	0.927	0.405	Similar	0.983	Similar	0.001	0.008
HOPS.valueSales	0	0	1511.653	1532.63	409271	409271	11668.659	11716.029	0.926	0.927	0.067	Similar	0.947	Similar	0	0.005
NUTS.cropProduction	0	0	22543.583	21982.875	5250000	5250000	127483.42	124867.11	0.909	0.91	0.238	Similar	0.872	Similar	0	0.003
NUTS.cultivatedArea	0	0	2.629	2.61	175	176	10.488	10.379	0.904	0.904	0.92	Similar	1	Similar	0.002	0.011
NUTS.irrigatedArea	0	0	0.222	0.209	175	175	4.027	3.93	0.988	0.989	0.909	Similar	0.782	Similar	0	0.004
NUTS.quantitySold	0	0	1.308	1.281	105	105	5.487	5.443	0.909	0.91	0.345	Similar	0.944	Similar	0.001	0.008
NUTS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
NUTS.sellingPrice	0	0	152.552	151.024	7735.714	7735.714	531.315	526.15	0.909	0.91	0.536	Similar	0.978	Similar	0.001	0.008
NUTS.valueSales	0	0	2245.484	2186.623	525000	525000	12737.439	12481.381	0.909	0.91	0.201	Similar	0.9	Similar	0	0.004
OLIV.cropProduction	0	0	248866.21	248295.89	16709100	16709100	659382.31	666839.00	0.435	0.436	0	Different	0	Different	0	0.004
OLIV.cultivatedArea	0	0	10.514	10.567	855.4	856.362	27.385	27.398	0.428	0.428	0	Different	0.016	Different	0	0.002
OLIV.irrigatedArea	0	0	3.242	2.906	855.4	855.4	16.509	16.618	0.79	0.828	0	Different	0	Different	0	0.002
OLIV.quantitySold	0	0	38.378	37.661	2931.2	2931.2	107.429	108.329	0.444	0.45	0	Different	0	Different	0	0.004
OLIV.quantityUsed	0	0	0	0.008	3.215	3.215	0.036	0.164	1	0.997	0.876	Similar	0.323	Similar	0.002	0.014
OLIV.sellingPrice	0	0	422.225	445.158	3485.61	3485.61	547.974	619.433	0.444	0.45	0	Different	0	Different	0.016	0.032
OLIV.valueSales	0	0	24727.252	24836.762	1670910	1670910	65855.316	66636.961	0.444	0.45	0	Different	0	Different	0	0.004
ORG_CER.cropProduction	0	0	488.602	471.072	274350	274350	6262.756	6058.257	0.981	0.982	1	Similar	1	Similar	0.001	0.006
ORG_CER.cultivatedArea	0	0	0.118	0.121	28.005	29.591	1.068	1.086	0.981	0.981	0.987	Similar	1	Similar	0.007	0.019
ORG_CER.irrigatedArea	0	0	0.003	0.003	9.55	9.55	0.178	0.169	1	1	1	Similar	1	Similar	0	0.002
ORG_CER.quantitySold	0	0	0.191	0.196	93.1	93.1	2.291	2.247	0.986	0.984	1	Similar	0.793	Similar	0.001	0.006
ORG_CER.quantityUsed	0	0	0.018	0.016	20.171	20.171	0.364	0.377	0.992	0.995	0.642	Similar	0.161	Similar	0.001	0.008
ORG_CER.sellingPrice	0	0	3.096	3.234	294.683	294.683	26.077	25.809	0.986	0.984	0.999	Similar	0.791	Similar	0.001	0.009
ORG_CER.valueSales	0	0	43.773	42.878	27435	27435	607.398	584.676	0.986	0.984	0.999	Similar	0.792	Similar	0.001	0.006
ORG_CITRUS.cropProduction	0	0	22.904	22.904	75232.5	75232.5	1312.487	1312.487	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.cultivatedArea	0	0	0	0	1.468	1.468	0.026	0.026	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.irrigatedArea	0	0	0	0	1.468	1.468	0.026	0.026	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.quantitySold	0	0	0.01	0.01	31.275	31.275	0.546	0.546	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.sellingPrice	0	0	0.073	0.073	240.552	240.552	4.197	4.197	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.valueSales	0	0	2.29	2.29	7523.25	7523.25	131.249	131.249	1	1	1	Similar	1	Similar	0	0
ORG_FRUIT.cropProduction	0	0	4605.621	4169.002	3057820	3057820	112231.89	104983.69	0.996	0.997	1	Similar	1	Similar	0	0.002
ORG_FRUIT.cultivatedArea	0	0	0.004	0.005	4.875	5.859	0.105	0.107	0.996	0.996	1	Similar	1	Similar	0.007	0.019
ORG_FRUIT.irrigatedArea	0	0	0.004	0.003	4.875	4.875	0.096	0.088	0.998	0.998	1	Similar	1	Similar	0.001	0.009
ORG_FRUIT.quantitySold	0	0	0.229	0.226	255.25	255.25	5.37	5.395	0.996	0.997	1	Similar	1	Similar	0	0.005
ORG_FRUIT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_FRUIT.sellingPrice	0	0	5.582	4.936	3723.373	3723.373	128.448	118.652	0.996	0.997	1	Similar	1	Similar	0	0.002
ORG_FRUIT.valueSales	0	0	460.562	416.9	305782	305782	11223.189	10498.37	0.996	0.997	1	Similar	1	Similar	0	0.002
ORG_GRAZ.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.cultivatedArea	0	0	0.282	0.273	198.425	199.397	5.44	5.204	0.989	0.989	1	Similar	1	Similar	0	0.003
ORG_GRAZ.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.valueSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.cropProduction	0	0	4.238	4.238	24912.5	24912.5	324.918	324.918	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.cultivatedArea	0	0	0	0	1.375	1.375	0.018	0.018	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.irrigatedArea	0	0	0	0	1.375	1.375	0.018	0.018	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.quantitySold	0	0	0.001	0.001	4.9	4.9	0.064	0.064	1	1	1	Similar	1	Similar	0	0

Figure 24. Statistical results: Andalusia 2018 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_HOPS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.sellingPrice	0	0	0.086	0.086	508.418	508.418	6.631	6.631	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.valueSales	0	0	0.424	0.424	2491.25	2491.25	32.492	32.492	1	1	1	Similar	1	Similar	0	0
ORG_NUTS.cropProduction	0	0	707.756	628.696	176637.5	176637.5	9242.269	8354.739	0.988	0.988	1	Similar	1	Similar	0.001	0.01
ORG_NUTS.cultivatedArea	0	0	0.063	0.063	12.112	13.37	0.748	0.748	0.988	0.988	0.997	Similar	1	Similar	0.013	0.031
ORG_NUTS.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_NUTS.quantitySold	0	0	0.051	0.045	12.525	12.525	0.656	0.589	0.989	0.989	1	Similar	1	Similar	0.001	0.008
ORG_NUTS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_NUTS.sellingPrice	0	0	15.178	15.295	1950	1950	147.692	151.599	0.989	0.989	1	Similar	1	Similar	0.001	0.007
ORG_NUTS.valueSales	0	0	70.728	62.805	17663.75	17663.75	924.229	835.476	0.989	0.989	1	Similar	1	Similar	0.001	0.01
ORG_OLIV.cropProduction	0	0	16439.586	16753.002	1834257.5	1834257.5	62928.018	62236.725	0.829	0.829	0	Different	0.115	Similar	0.001	0.007
ORG_OLIV.cultivatedArea	0	0	0.92	0.917	87.65	88.667	3.382	3.363	0.827	0.827	0	Different	0.261	Similar	0.002	0.011
ORG_OLIV.irrigatedArea	0	0	0.088	0.067	15.518	15.518	0.691	0.586	0.974	0.98	0.02	Different	0.002	Different	0.002	0.011
ORG_OLIV.quantitySold	0	0	2.193	2.207	327.55	327.55	10.145	10.032	0.829	0.829	0	Different	0.28	Similar	0.001	0.009
ORG_OLIV.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_OLIV.sellingPrice	0	0	138.216	147.111	3485.61	3485.61	336.736	386.617	0.829	0.829	0	Different	0.373	Similar	0.005	0.018
ORG_OLIV.valueSales	0	0	1629.79	1664.051	183425.75	183425.75	6270.444	6204.887	0.829	0.829	0	Different	0.096	Similar	0.001	0.006
ORG_OTHER.cropProduction	0	0	84.445	87.863	84572.5	84572.5	1698.682	1504.736	0.993	0.99	0.53	Similar	0.114	Similar	0.004	0.011
ORG_OTHER.cultivatedArea	0	0	0.008	0.019	10	11.31	0.136	0.161	0.965	0.965	0	Different	0.075	Similar	0.014	0.034
ORG_OTHER.irrigatedArea	0	0	0.001	0.002	3.625	3.625	0.048	0.055	1	0.996	0.46	Similar	0.091	Similar	0.003	0.017
ORG_OTHER.quantitySold	0	0	0.047	0.07	72.85	72.85	1.073	1.146	0.996	0.993	0.805	Similar	0.274	Similar	0.002	0.012
ORG_OTHER.quantityUsed	0	0	0.011	0.011	6.494	6.39	0.218	0.198	0.995	0.993	1	Similar	0.906	Similar	0.003	0.008
ORG_OTHER.sellingPrice	0	0	0.62	0.759	420.214	420.214	12.805	11.133	0.996	0.993	0.824	Similar	0.272	Similar	0.002	0.011
ORG_OTHER.valueSales	0	0	6.842	8.012	8457.25	8457.25	161.259	148.594	0.996	0.993	0.805	Similar	0.272	Similar	0.002	0.013
ORG_PROT.cropProduction	0	0	4.734	4.823	10000	10000	197.719	200.261	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_PROT.cultivatedArea	0	0	0.002	0.002	3.655	4.818	0.073	0.075	0.999	0.999	1	Similar	1	Similar	0.002	0.012
ORG_PROT.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_PROT.quantitySold	0	0	0.001	0.001	1.625	1.625	0.035	0.036	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_PROT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_PROT.sellingPrice	0	0	0.602	0.565	800	800	20.733	20.045	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_PROT.valueSales	0	0	0.473	0.482	1000	1000	19.772	20.026	0.999	0.999	1	Similar	1	Similar	0	0.001
ORG_SUNFL.cropProduction	0	0	2.651	2.651	11385	11385	173.694	173.694	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.cultivatedArea	0	0	0	0	1.5	1.5	0.023	0.023	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.quantitySold	0	0	0.001	0.001	3.45	3.45	0.053	0.053	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.sellingPrice	0	0	0.077	0.077	330	330	5.035	5.035	1	1	1	Similar	1	Similar	0	0
ORG_SUNFL.valueSales	0	0	0.265	0.265	1138.5	1138.5	17.369	17.369	1	1	1	Similar	1	Similar	0	0
ORG_VEG.cropProduction	0	0	29943.129	29507.443	6573575	6573575	289390.27	267430.67	0.963	0.963	0.772	Similar	1	Similar	0.001	0.008
ORG_VEG.cultivatedArea	0	0	0.035	0.039	7.25	8.091	0.283	0.298	0.963	0.963	0.038	Different	1	Similar	0.009	0.026
ORG_VEG.irrigatedArea	0	0	0.028	0.032	7.25	7.25	0.216	0.245	0.967	0.968	0.083	Similar	0.984	Similar	0.004	0.018
ORG_VEG.quantitySold	0	0	3.408	3.58	544.4	544.4	27.151	27.098	0.965	0.966	0.589	Similar	0.898	Similar	0.002	0.01
ORG_VEG.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_VEG.sellingPrice	0	0	30.701	30.46	3723.373	3723.373	202.637	205.378	0.965	0.966	0.968	Similar	0.911	Similar	0.002	0.012
ORG_VEG.valueSales	0	0	2993.685	2949.847	657357.5	657357.5	28939.089	26743.223	0.965	0.966	0.772	Similar	0.897	Similar	0.001	0.008
OTHER.cropProduction	0	0	19998.994	17345.294	4900390	4900390	134553.35	120090.38	0.877	0.865	0	Different	0	Different	0.005	0.015
OTHER.cultivatedArea	0	0	1.104	1.2	188.8	189.501	6.344	6.156	0.552	0.552	0	Different	0	Different	0	0.004
OTHER.irrigatedArea	0	0	0.364	0.404	188	188	4.578	4.263	0.949	0.938	0	Different	0	Different	0.002	0.011
OTHER.quantitySold	0	0	31.852	30.922	12126	12126	308.875	285.331	0.893	0.901	0	Different	0	Different	0	0.005
OTHER.quantityUsed	0	0	0.413	0.238	205.03	205.03	5.351	4.203	0.986	0.99	0.061	Similar	0.102	Similar	0.02	0.017
OTHER.sellingPrice	0	0	20.536	32.783	12347.6	12347.6	258.109	513.667	0.885	0.898	0	Different	0	Different	0.002	0.012
OTHER.valueSales	0	0	2459.464	1861.827	906846	906846	18307.527	13984.017	0.885	0.898	0	Different	0	Different	0.003	0.012
OTHER_LIVESTOCK.dairyCows	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.eggsProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.eggsTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.eggsTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.manureTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.milkProductionSold	0	0	2.446	2.425	500	500	21.124	21.028	0.971	0.971	1	Similar	1	Similar	0	0.003
OTHER_LIVESTOCK.milkTotalProduction	0	0	2.446	2.425	500	500.769	21.124	21.027	0.971	0.971	1	Similar	1	Similar	0	0.004
OTHER_LIVESTOCK.milkTotalSales	0	0	1501.869	1489.993	303167	303167	12602.11	12671.82	0.971	0.971	0.99	Similar	1	Similar	0.001	0.006
R_LIVESTOCK.numberAnimalsForSlaughtering	0	0	316.634	357.83	590720	590720	9513.937	10487.732	0.891	0.895	0.311	Similar	0.063	Similar	0	0.001
LIVESTOCK.numberAnimalsRearingBreading	0	0	0.356	0.278	230	230	5.683	5.363	0.992	0.995	0.695	Similar	0.188	Similar	0.002	0.01
OTHER_LIVESTOCK.numberOfAnimals	0	0	250.597	250.935	80000	80001.374	3195.844	3161.213	0.868	0.868	0.95	Similar	1	Similar	0	0.003
OTHER_LIVESTOCK.numberOfAnimalsSold	0	0	317.563	359.099	590720	590720	9513.924	10487.708	0.883	0.883	0.986	Similar	1	Similar	0	0.001
ER_LIVESTOCK.valueAnimalsRearingBreading	0	0	42.509	32.324	23100	23100	603.527	562.844	0.992	0.995	0.695	Similar	0.188	Similar	0.002	0.01
OTHER_LIVESTOCK.valueSlaughteredAnimals	0	0	7472.08	7619.903	3791449	3791449	88279.444	91555.885	0.891	0.895	0.166	Similar	0.063	Similar	0	0.002
OTHER_LIVESTOCK.valueSoldAnimals	0	0	7693.199	7949.96	3791449	3791449	88309.889	91600.415	0.883	0.883	0.062	Similar	0.892	Similar	0	0.002
OTHER_LIVESTOCK.variableCostsAnimals	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.woolProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OTHER_LIVESTOCK.woolTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
PROT.cropProduction	0	0	4312.008	3826.76	1065750	1065750	41881.016	40512.963	0.972	0.972	0.503	Similar	1	Similar	0.001	0.006
PROT.cultivatedArea	0	0	0.46	0.446	126	126.733	4.325	4.166	0.971	0.971	1	Similar	1	Similar	0	0.004
PROT.irrigatedArea	0	0	0.016	0.016	72	72	0.908	0.929	0.999	0.999	1	Similar	1	Similar	0	0.002
PROT.quantitySold	0	0	0.804	0.747	625.1	625.1	12.536	12.458	0.973	0.974	0.543	Similar	1	Similar	0	0.002
PROT.quantityUsed	0	0	0.01	0.013	16.828	16.828	0.269	0.294	0.998	0.997	1	Similar	0.988	Similar	0	0.004
PROT.sellingPrice	0	0	19.596	17.598	1659.425	1659.425	141.008	129.23	0.973	0.974	0.938	Similar	1	Similar	0.002	0.01
PROT.valueSales	0	0	409.073	357.673	106575	106575	4145.635	4006.999	0.973	0.974	0.348	Similar	1	Similar	0.001	0.006
SET_ASIDE.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.cultivatedArea	0	0	2.277	2.263	300	301.167	12.085	12.294	0.825	0.825	0.088	Similar	0.935	Similar	0.001	0.008
SET_ASIDE.irrigatedArea	0	0	0.013	0.018	37	37	0.55	0.757	0.999	0.998	1	Similar	1	Similar	0.001	0.008
SET_ASIDE.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SET_ASIDE.valueSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SUNFL.cropProduction	0	0	7109.71	7182.693	1024000	1024000	45433.926	45049.31	0.936	0.936	0.808	Similar	1	Similar	0.001	0.006
SUNFL.cultivatedArea	0	0	1.36	1.354	161.5	163.014	8.835	8.765	0.936	0.936	0.429	Similar	1	Similar	0.008	0.012
SUNFL.irrigatedArea	0	0	0.152	0.185	140	140	3.582	3.427	0.993	0.985	0.003	Different	0	Different	0.002	0.013
SUNFL.quantitySold	0	0	2.23	2.247	358.4	358.4	14.85	14.722	0.936	0.936	0.824	Similar	1	Similar	0	0.003
SUNFL.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
SUNFL.sellingPrice	0	0	21.503	22.233	1300	1300	84.5	90.429	0.936	0.936	0.309	Similar	1	Similar	0.002	0.01
SUNFL.valueSales	0	0	710.971	717.998	102400	102400	4543.393	4504.667	0.936	0.936	0.892	Similar	1	Similar	0.001	0.006
VEG.cropProduction	0	0	402658.74	366773.08	45267840	45267840	1828394.8	1808358.5	0.821	0.821	0	Different	0	Different	0.001	0.007
VEG.cultivatedArea	0	0	1.593	1.585	900	900.659	19.017	19.613	0.821	0.821	0.002	Different	0.825	Similar	0	0.002
VEG.irrigatedArea	0	0	1.485	1.472	900	900	18.968	19.557	0.839	0.842	0.021	Different	0.166	Similar	0	0.002
VEG.quantitySold	0	0	88.006	85.535	20000	20000	540.487	552.612	0.824	0.831	0	Different	0.001	Different	0	0.003
VEG.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
VEG.sellingPrice	0	0	106.463	91.861	3723.373	3723.373	298.808	271.689	0.824	0.831	0	Different	0	Different	0.005	0.017
VEG.valueSales	0	0	40264.28	36514.59	4526784	4526784	182839.79	180478.76	0.824	0.831	0	Different	0	Different	0.001	0.007
agriculturalLandArea	0	0	37.677	37.786	2110	2110.613	81.395	82.004	0.015	0.015	0	Different	0	Different	0	0.002
agriculturalLandHectaresAdquisition	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
agriculturalLandValue	0	0	232750.03	252399.86	24750000	24750000	766856.73	793169.65	0.156	0.169	0	Different	0	Different	0.001	0.009
depreciation	0	0	4533.003	4597.319	281976	281976	7822.55	9163.479	0.035	0.053	0	Different	0	Different	0.004	0.016
farmBuildingsValue	0	0	20108.195	21679.519	2049378	2049378	80540.086	85638.875	0.247	0.27	0	Different	0	Different	0.006	0.02
farmNetIncome	-294605	-294605	43612.445	54942.937	3498146	3498146	104436.56	137243.50	0	0	0	Different	0	Different	0.007	0.022
fixedAssets	0	0	302372.55	326014.22	26287505	26287505	826522.28	854593.88	0.004	0.005	0	Different	0	Different	0.001	0.009
forestLandArea	0	0	0.056	0.062	20.61	20.61	0.979	1.051	0.993	0.993	1	Similar	1	Similar	0.001	0.006
forestLandValue	0	0	151.543	172.133	81280	81280	3337.922	3583.577	0.995	0.995	1	Similar	0.999	Similar	0	0.005
grossFarmIncome	-142316.5	-142316.5	62350.782	75687.138	5186397	5186397	151292.28	191137.37	0	0	0	Different	0	Different	0.005	0.019
intangibleAssetsNonTradable	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
intangibleAssetsTradable	0	0	10519.64	11485.39	658160	658160	23929.294	25387.853	0.19	0.198	0	Different	0	Different	0.001	0.009
landImprovements	0	0	8378.941	9042.845	546035	546035	30111.781	28134.2	0.302	0.255	0	Different	0	Different	0.006	0.019
longAndMediumTermLoans	0	0	1478.492	1436.742	1540000	1540000	23964.585	17371.194	0.973	0.974	0.913	Similar	1	Similar	0	0.005
machinery	0	0	15208.524	15672.045	418634	418634	23038.28	27090.025	0.037	0.032	0	Different	0	Different	0.008	0.024
machineryAndEquipment	0	0	15208.524	15672.034	418634	418634	23038.28	27090.031	0.037	0.032	0	Different	0	Different	0.008	0.024
otherNonCurrentAssets	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
otherOutputs	0	0	89.008	84.879	115000	115000	2092.502	2888.598	0.997	0.996	0.993	Similar	0.63	Similar	0.002	0.01

Figure 25. Statistical results: Andalusia 2018 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
plantationsValue	0	0	2696.896	2864.929	294498	252063	11287.818	13227.448	0.563	0.606	0	Different	0	Different	0.019	0.032
rentPaid	0	0	237.107	234.477	15555.556	15556.93	958.18	945.748	0.682	0.682	0.255	Similar	0.979	Similar	0	0.002
specificCropCosts	0	0	2563.507	2252.666	95377.89	95377.89	7588.458	7026.464	0.088	0.137	0	Different	0	Different	0.007	0.021
subsidiesOnInvestments	0	0	0.962	0.348	2051	691	37.637	15.149	0.999	0.999	1	Similar	1	Similar	0.009	0.01
taxes	0	0	644.213	788.03	45740	45740	1682.12	1773.372	0.129	0.123	0	Different	0	Different	0.008	0.023
totalCurrentAssets	1499	1499	147677.56	195462.38	8354719	8354719	377241.51	529870.48	0	0	0	Different	0	Different	0.007	0.023
totalExternalFactors	0	0	14188.86	16148.925	1632507	1632507	55344.536	63131.186	0.276	0.329	0	Different	0	Different	0.005	0.019
totalIntermediateConsumption	1827	1827	31086.905	37737.971	1884772	1884772	75704.614	77659.39	0	0	0	Different	0	Different	0.004	0.017
totalOutputCropsAndCropProduction	0	0	69123.204	82833.048	5566360	5566360	174319.31	218447.48	0.061	0.079	0	Different	0	Different	0.005	0.019
totalOutputLivestockAndLivestockProduction	-4611.32	-4611.32	10452.84	15980.342	2781598.6	2781598.6	81130.661	87589.585	0.868	0.834	0	Different	0	Different	0.007	0.022
vatBalanceExcludingInvestments	-1635	-1635	1154.759	1345.665	526314	526314	11015.605	12309.921	0.919	0.924	0	Different	0.028	Different	0.002	0.013
vatBalanceOnInvestments	-62544	-62544	-17.436	0.841	188287	188287	3681.321	4149.943	0.986	0.986	0.894	Similar	1	Similar	0.001	0.008

Figure 26. Statistical results: Andalusia 2018 (sheet 3)

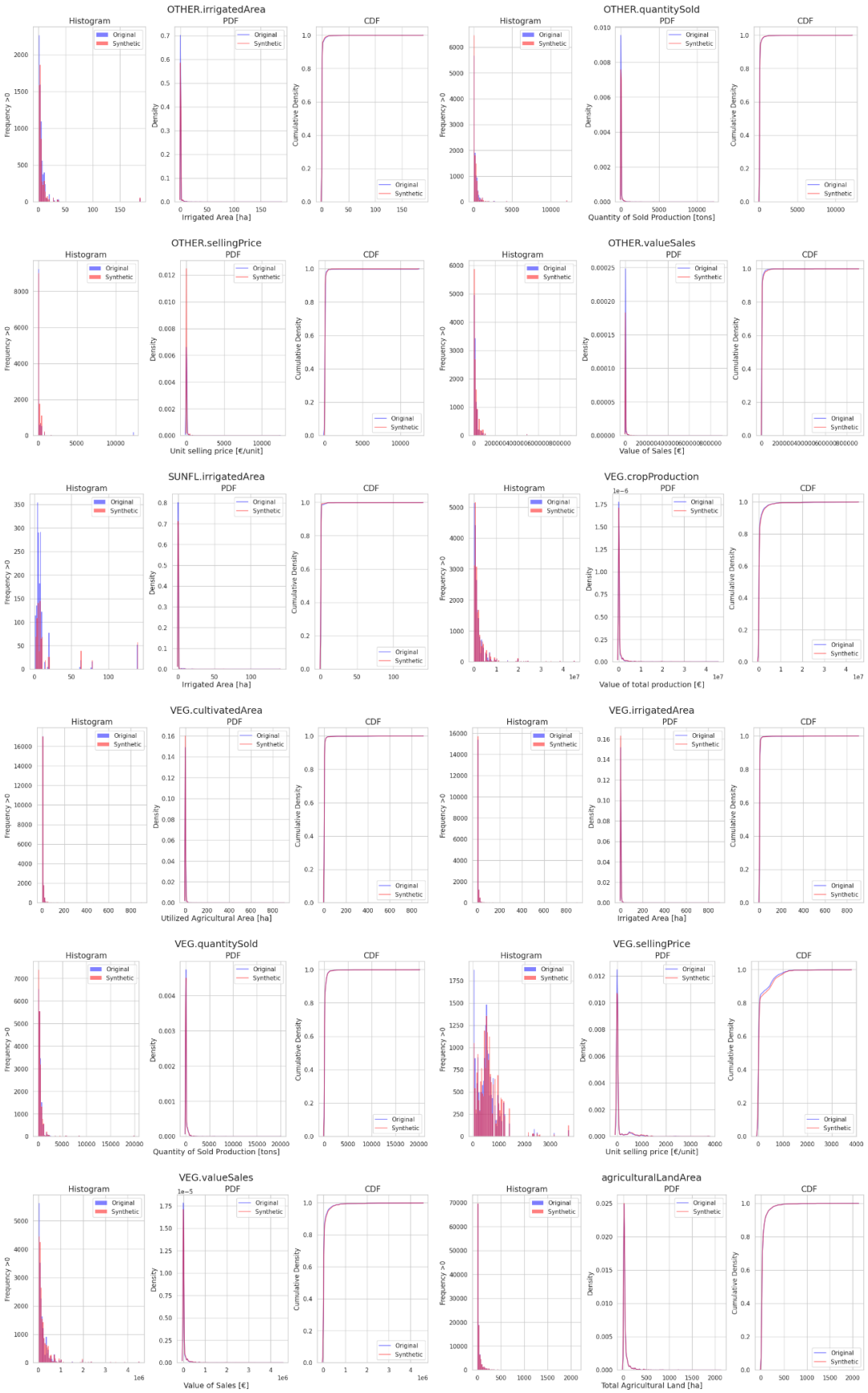

Figure 27. Comparison of Continuous Variables: Andalusia Use Case 2018 (Sheet 1)

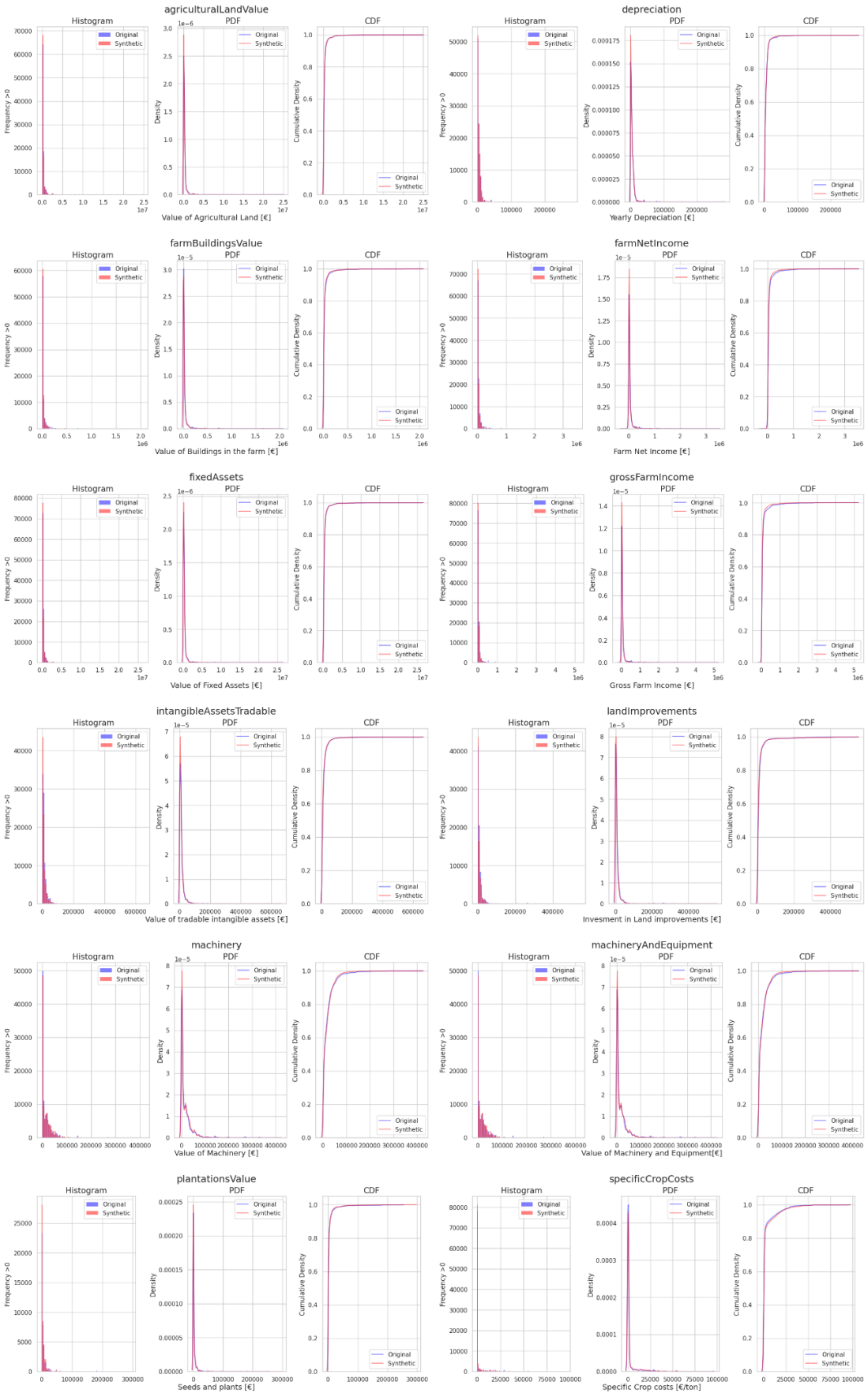

Figure 28. Comparison of Continuous Variables: Andalusia Use Case 2018 (Sheet 2)

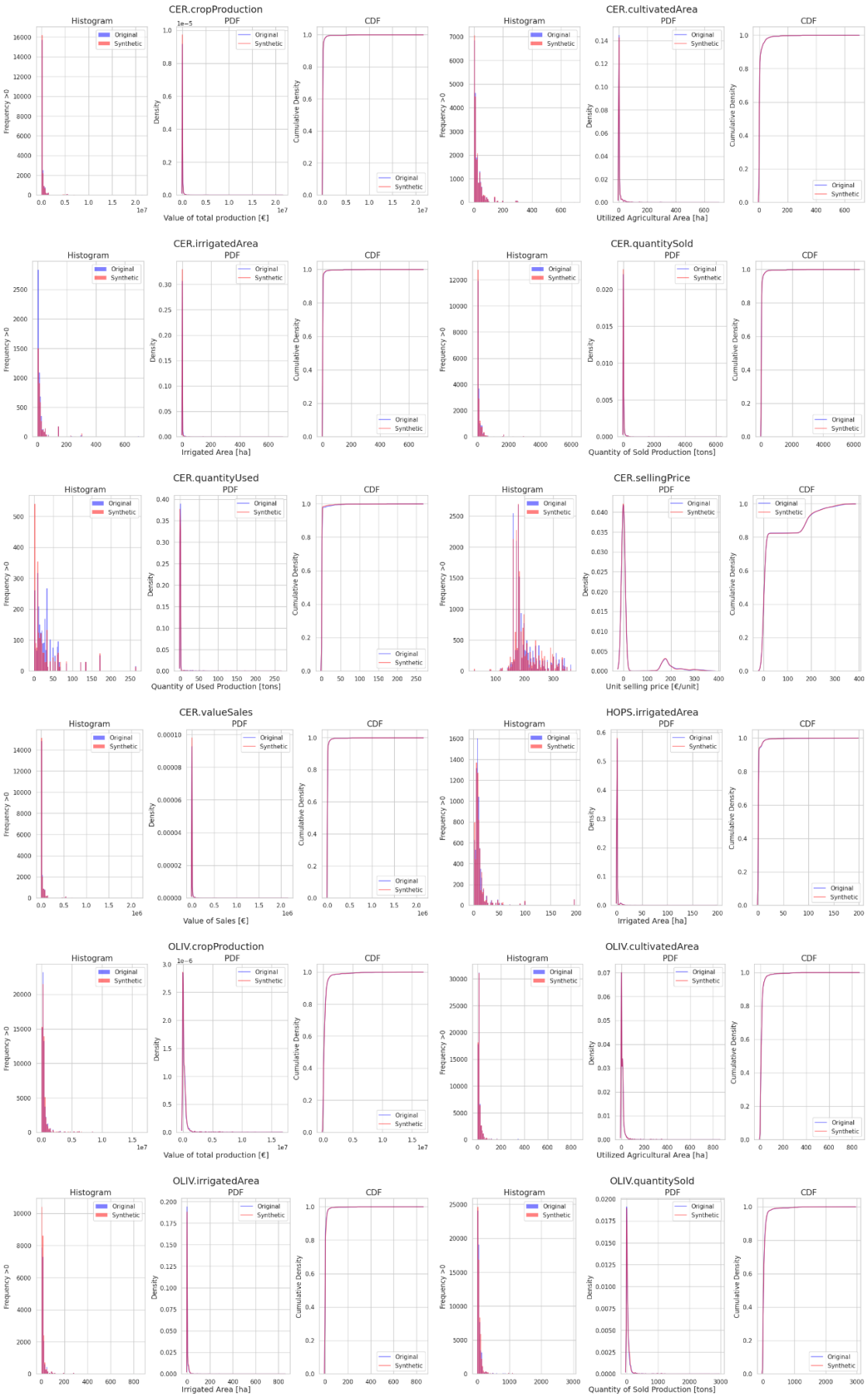

Figure 29. Comparison of Continuous Variables: Andalusia Use Case 2018 (Sheet 3)

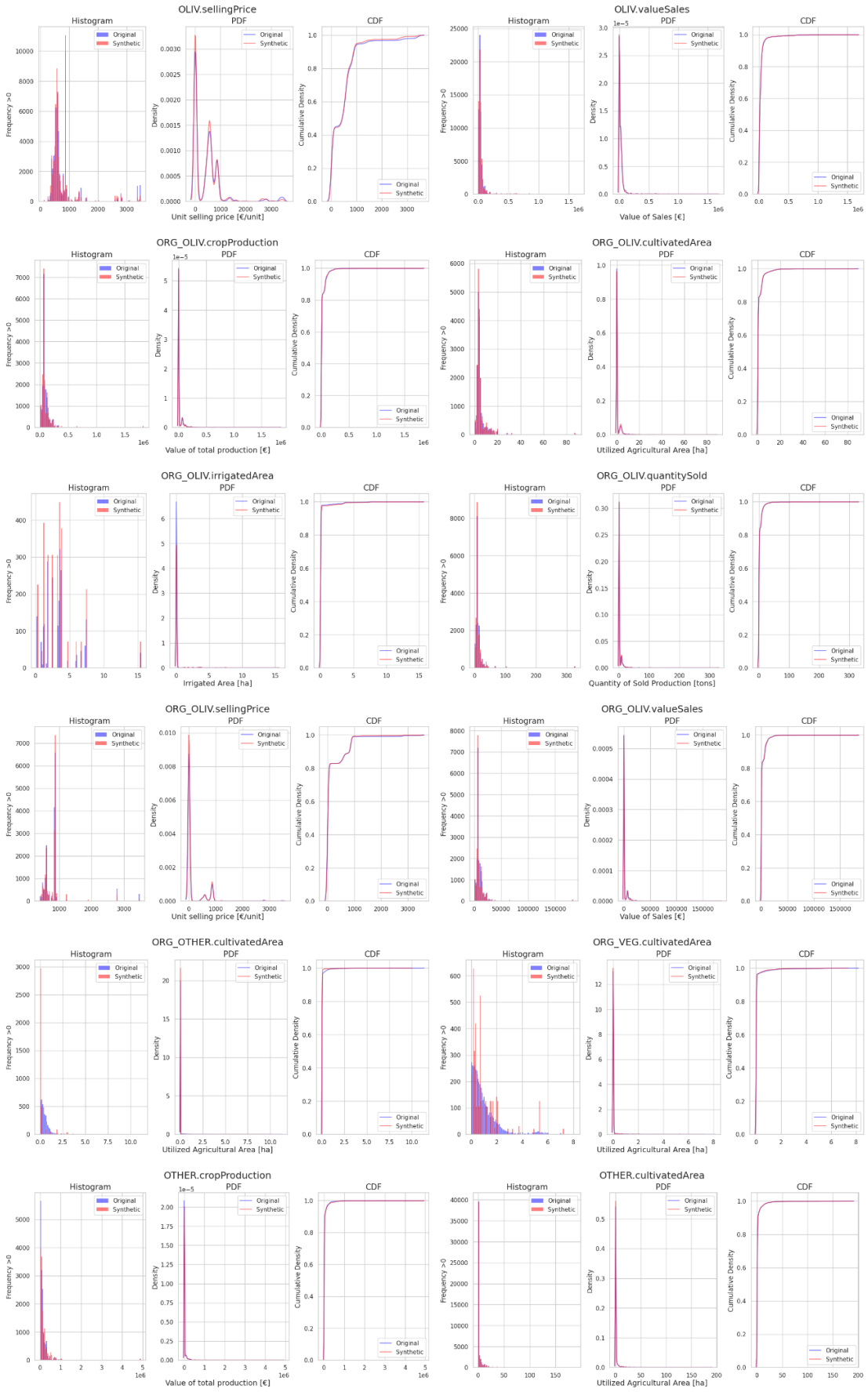

Figure 30. Comparison of Continuous Variables: Andalusia Use Case 2018 (Sheet 4)

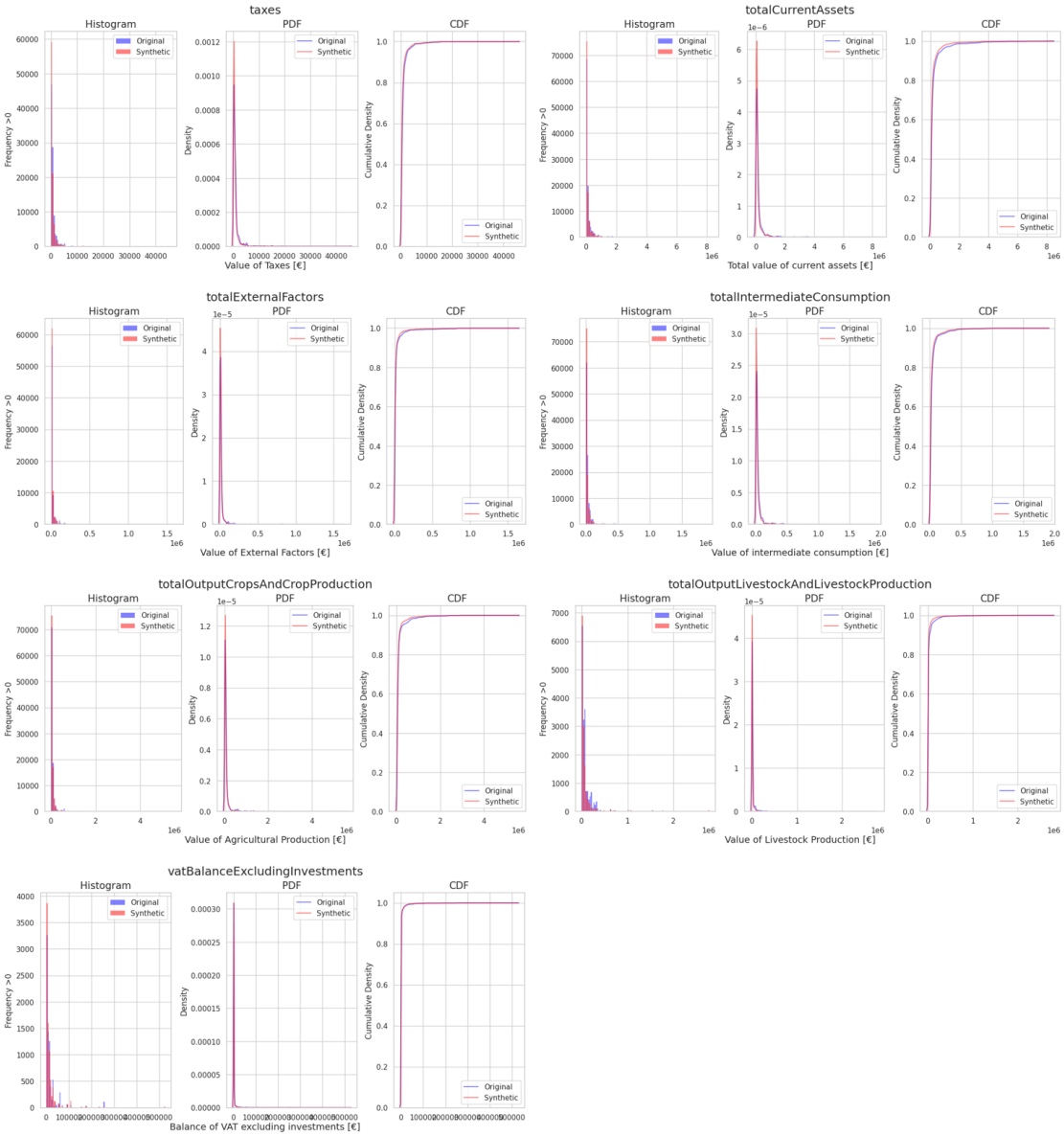

Figure 31. Comparison of Continuous Variables: Andalusia Use Case 2018 (Sheet 5)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
GRAZ	1213703	1177998	0.971
OLIV	1174164	1180068	1.005
CER	547429	549507	1.004
NUTS	293569	291424	0.993
SET_ASIDE	254252	252710	0.994
VEG	177911	176957	0.995
SUNFL	151897	151238	0.996
OTHER	123292	134050	1.087
ORG_OLIV	102708	102447	0.997
HOPS	95473	94053	0.985
CITRUS	59680	58012	0.972
PROT	51349	49838	0.971
ORG_GRAZ	31486	30451	0.967
FRUIT	25902	26720	1.032
ORG_CER	13151	13476	1.025
ORG_NUTS	7014	7022	1.001
ORG_VEG	3880	4309	1.111
ORG_OTHER	879	2072	2.357
ORG_FRUIT	489	525	1.074
ORG_PROT	197	205	1.041
ORG_CITRUS	49	49	1.0
ORG_SUNFL	39	39	1.0
ORG_HOPS	26	26	1.0

Table 7. Andalusia use case, 2018: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
VEG	44968122837	40960484805	0.911
OLIV	27792881225	27729189357	0.998
FRUIT	7343441711	7798809244	1.062
CER	5607242407	5781851228	1.031
CITRUS	4607524635	4345775800	0.943
ORG_VEG	3343988749	3295332183	0.985
NUTS	2517622231	2455003523	0.975
OTHER	2233447674	1937087780	0.867
ORG_OLIV	1835940080	1870941743	1.019
HOPS	1688183672	1710073615	1.013
SUNFL	793998180	802148735	1.01
ORG_FRUIT	514346570	465585785	0.905
PROT	481556440	427364918	0.887
ORG_NUTS	79040777	70211513	0.888
GRAZ	58993714	69689291	1.181
ORG_CER	54566072	52608352	0.964
ORG_OTHER	9430654	9812333	1.04
ORG_CITRUS	2557905	2557905	1.0
ORG_PROT	528645	538660	1.019
ORG_HOPS	473337	473337	1.0
ORG_SUNFL	296010	296010	1.0
SET_ASIDE	0	0	1.0
ORG_GRAZ	0	0	1.0

Table 8. Andalusia use case, 2018: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
VEG	9828297	9552367	0.972
OLIV	4285961	4205866	0.981
OTHER	3557186	3453255	0.971
CER	2332595	2347807	1.007
CITRUS	1931498	1812032	0.938
FRUIT	981920	1007418	1.026
ORG_VEG	380578	399770	1.05
HOPS	353579	357144	1.01
SUNFL	249012	250927	1.008
ORG_OLIV	244869	246508	1.007
NUTS	146044	143056	0.98
PROT	89747	83411	0.929
GRAZ	72151	74109	1.027
ORG_FRUIT	25628	25184	0.983
ORG_CER	21365	21931	1.026
ORG_NUTS	5696	4974	0.873
ORG_OTHER	5230	7769	1.485
ORG_CITRUS	1063	1063	1.0
ORG_PROT	100	102	1.02
ORG_HOPS	93	93	1.0
ORG_SUNFL	89	89	1.0
SET_ASIDE	0	0	1.0
ORG_GRAZ	0	0	1.0

Table 9. Andalusia use case, 2018: quantity sold ratio comparison

3.5 Definition of the simulation scenario

3.5.1 Policies scenario in Andalusia

To trace the policies scenario, the first step is to perform an analysis on the subsidies values available in microdata. These values help to better understand the subsidies that typically farmers receive. Apart from the overall economic compensation, other relevant factors, are possible to determine by analysing the RECAN dataset. These include the years in which the subsidy was active, the crops associated in case of coupled subsidies and the economic compensation per hectare.

The information above mentioned is sumarised in a table which contains all the fields required by the model to perform the simulations and load the data associated with policies. Basically, the information is disposed into two main groups of policies: decoupled policies and coupled policies. Decoupled policies are those policies where the actions or incentives are independent of the output or production level of the system. These policies provide financial support or regulatory conditions without being directly linked to specific production choices or levels. On the other hand, coupled policies are those that are directly linked to the output or production levels of the system. In this case, the incentives or regulations are designed to influence specific actions, such as increasing production of certain goods, reducing emissions to a particular level, or meeting other performance-related metrics.

In the case of coupled subsidies, the economic compensation has been adjusted for two different crop groupings. First, the FADN guide categorizes coupled subsidies by similar crops. For example, a subsidy linked to vegetables may apply to several individual crops according to the FADN methodology. Additionally, a crop aggregation is used to simplify the number of crops managed by the model. These two groupings have been linked by first

identifying the crops associated with each subsidy. Then, the crop representativeness from the product groups is used to weight the economic compensation of each subsidy according to the presence of each crop in the microdata. After this analysis, an approximate economic compensation by hectare is obtained for all the subsidies and product groups associated.

An extra subset of subsidies should be described to fully capture the subsidies appearing in the table. These are the new subsidies that were not active in the analyzed data but are relevant for the use case in question. Two different subsidies can be identified: "Organic conversion of crops" and "Organic olive conversion", both related to organic farming. In these cases, the economic compensations do not rely on computed values or data-derived information, but rather on known fixed values, as stipulated by official regulations or policy guidelines specific to organic farming practices.

The information related with subsidies is provided to the model in two artifacts. The first one is the set variables contained in the synthetic population that contain the economic compensations for the virtual agents. These values will have the trends and representativeness shown by the real farmers considering different farming practices. The second artifact containing information about subsidies is the table subsidies. This table is presented below and contains not only economic compensation information but also other key parameters related to the subsidies managed by the simulation engine. The information ranges from the description of the subsidy, detailing its characteristics and scope, the unique FADN code associated with each subsidy, if the subsidy is coupled or not, and if it is coupled, the corresponding product group is also included in the aggregated product category. The "Economic Compensation" column shows the average amount received for decoupled subsidies by agricultural holding, while for coupled subsidies, it displays the compensation per hectare. Additionally, the table includes the years during which the subsidy was observable in the analyzed data, as well as labels that characterize the subsidy, such as the scheme it belongs to or any associated environmental practices.

Subsidy_Code	Description	Coupled	Aggregated_product	Economic_compensation	StartYear	EndYear	Label
1150	Basic payment scheme	N		13698	2015	2020	Basic
1400	Payment for agricultural practices beneficial for the climate and the environment	N		6608	2015	2020	Greening
1600	Payment for young farmers	N		3981	2015	2020	
1700	Small farmers scheme	N		943	2016	2020	
23113	Protein crops	Y	OTHER	56	2015	2020	
23113	Protein crops	Y	ORG_OTHER	56	2015	2020	
2313	Potatoes	Y	VEG	831	2014	2020	
2313	Potatoes	Y	ORG_VEG	831	2014	2020	
2315	Vegetables	Y	VEG	94	2015	2020	
2315	Vegetables	Y	OTHER	94	2015	2020	
2315	Vegetables	Y	FRUIT	94	2015	2020	
2315	Vegetables	Y	ORG_VEG	94	2015	2020	
2315	Vegetables	Y	ORG_OTHER	94	2015	2020	
2315	Vegetables	Y	ORG_FRUIT	94	2015	2020	
2317	Rice	Y	CER	117	2015	2020	
2317	Rice	Y	ORG_CER	117	2015	2020	
2318	Grain legumes	Y	OTHER	60	2015	2020	
2318	Grain legumes	Y	ORG_OTHER	60	2015	2020	
2322	Crop specific payment for cotton	Y	HOPS	938	2015	2020	
2322	Crop specific payment for cotton	Y	ORG_HOPS	938	2015	2020	
2323	National restructuring programme for the cotton sector	Y	HOPS	966	2015	2019	
2323	National restructuring programme for the cotton sector	Y	ORG_HOPS	966	2015	2019	
23312	Nuts	Y	NUTS	78	2015	2020	
23312	Nuts	Y	ORG_NUTS	78	2015	2020	
2333	Citrus plantations	Y	CITRUS	35	2017	2018	
2334	Olive plantations	Y	OLIV	10	2014	2020	
2334	Olive plantations	Y	ORG_OLIV	10	2014	2020	
2335	Vineyards	Y	OTHER	413	2014	2017	
2335	Vineyards	Y	ORG_OTHER	413	2014	2017	
9900	Organic conversion of crops	Y	ORG_FRUIT	311	2015	2020	
9900	Organic conversion of crops	Y	ORG_CITRUS	311	2015	2020	
9900	Organic conversion of crops	Y	ORG_GRAZ	180	2015	2020	
9901	Organic olive conversion	Y	ORG_OLIVE	272	2015	2020	

Table 10. Subsidies result, Andalusia

The subsidies included in the previous table correspond to the default subsidies defined and introduced into the platform. This means that using the default configuration to run a simulation will only consider the subsidies described in the table above. The interface allows the user to add new subsidies when setting the context for a simulation, which occurs during the simulation setup process. In this way, the list of subsidies managed by the model can be expanded with each new simulation, allowing for a more customized analysis that reflects evolving policies or specific user-defined scenarios.

4 UC2: Impact assessment on ecosystem services in Polish agriculture

The second use case presented corresponds to the Polish use case. This use case focuses on the impact of M10.1-Agri-Environmental-Climate Commitments[12]. This measure is promoted under the European Union's Common Agricultural Policy and it is focused on promoting environmentally sustainable farming practices. The measure aims to support farmers who voluntarily commit to practices that go beyond the mandatory environmental requirements, including the application of sustainable agricultural practices, to conserve the biodiversity, protect water resources, improve soil health, and overall, to mitigate climate change.

The general landscape of the application of the measure requires that farmers to adopt these practices for a certain number of years, so they can receive the economic compensations for the additional costs and income losses associated with implementing more sustainable practices in their professional habits.

The relevance of this use case stems from the high proportion of the rural population in Poland, which correlates with a significant number of agricultural holdings. This combination of regulatory and social factors creates an ideal context for analyzing the impact and implementation of EU environmental goals in a society where agriculture plays a crucial role. In alignment with the general commitments of the measure implemented for the Polish use case, the overall goals are well-defined. Therefore, the primary objective is to examine how farmers can enhance the environmental performance of agriculture while simultaneously contributing to broader EU objectives related to climate action and biodiversity.

4.1 Presentation of the data used for the generation of the synthetic population

4.1.1 Used data sources

The development of the Polish use case involved utilizing a range of datasets to create a virtual representation of the agricultural landscape in Poland for the studied agricultural campaigns.

Initially, a data requirement mapping was performed based on the estimations made during the project's development phase. The general design and parameterization of the virtual agents in the agent-based simulation scenario dictated the data needed to initialize all agent parameters. Essentially, these parameters are related to accounting from a farming perspective.

According to this consideration, the most straightforward database available to be used in this use case is the Polish branch of the FADN. This is a comprehensive database collected by the Polish Agricultural Accountancy Department and follows the same methodologies as those used in other FADN member countries, thus emphasising consistency and compatibility across all the use case managed in the project.

However, the request of Polish FADN data was not successful, and alternative databases were studied to fulfil the information gap. As contingency action, data was requested to the European FADN, who finally provided a dataset for several accountancy years. In this way, this database was finally used as starting point to build the Polish use case and obtain relevant information about the accountancy and farming activities across various regions of Poland.

The data was presented in a structured tabular format, gathered from surveys conducted on approximately 12,000 agricultural holdings of varying economic sizes and techno-economic orientations, covering all NUTS2 regions of Poland. As noted, this dataset represents a sample of the broader agricultural sector. In fact, the sample is representative of around 700,000 farms, meaning that the selected holdings are carefully chosen to reflect specific groups and typologies within the sector, ensuring that the data accurately represents the diversity of Polish agriculture. The dataset utilised complies with the anonymity and confidentiality standards, and omitting any relevant identifiable information that may risk the privacy of the agricultural holdings represented.

One key feature of this dataset is its significant heterogeneity, offering a broad representation of diverse farming practices, management styles, economic activities, social profiles, and the agricultural landscapes influenced by policy and environmental conditions across the entire country. This diversity ensures that the dataset accurately captures the complexity of the Polish agricultural sector, allowing for deeper analyses and evaluations of the impacts of agricultural policies across multiple dimensions. However, this richness presents a challenge from a modelling perspective: for many variables, there is a limited number of non-zero records, which can constrain the robustness of certain analyses.

In addition to the FADN, other public databases were used to develop the Polish use case. Among them, Eurostat[13] was the most useful, as it provides a wide range of economic, social and environmental data for all European countries. However, despite the diversity of information available, the Eurostat dataset could not be used to create instances directly targeting farmers. Instead, it was mainly used to obtain statistics, averages and totals for the main agricultural indicators. These data were essential to initialise some agent parameters from empirical distributions, and also to verify the results obtained after the generation of the synthetic population.

Finally, the Statistical Yearbook of Agriculture[14] was used as a complementary data source. This is a comprehensive publication in the scope of agriculture statistics produced by the Department of Agriculture of Poland. It is published in intervals of three years and covers topics related to the agricultural landscape. Specifically, information pertains to basic production factors, agricultural production results, and food economy among others. It is a hybrid between the FADN database, as it contains granular information about relevant agricultural topics and the Eurostat database, as it does not provide an instance-based format, but is based on aggregates and totals.

4.1.2 How the data sources were acquired

Two of the mentioned data sources were of public nature. This means that no request or formal procedure was necessary to obtain the data. Specifically, both the Eurostat database and the Statistical Yearbook of Agriculture are publicly accessible resources, which facilitate the retrieval of information without the need for special permissions. This public data access supports transparency and ensures that no issues related to data privacy arise, especially considering that neither of these datasets includes individual farmer information.

For the case of the FADN data, a different approach has been followed. The first approach made to obtain this data was to directly communicate with the Agricultural Accountancy Department, as it is the organization responsible for collection the data. Several requests were made to the Dr. Eng. Joanna Pawłowska-Tyszko, the Plenipotentiary Director for the FADN and Head of the Department of Accounting and Agricultural Farms, by the end of 2020. After some administrative operations including the elaboration of a letter to expose the necessary use of the data for administrative purposes and the contact with Department of Accounting and Agricultural Farms Manager, Dr Eng. Dariusz Osuch, the data request was finally denied, arguing confidentiality issues.

Ultimately, the issue was resolved, and the data was acquired through a formal request to the European FADN. The process was highly bureaucratic, requiring compliance with stringent cybersecurity protocols. Additionally, it was extremely time-consuming due to the imposed limit on the number of variables, all of which had to be selected and reviewed manually. This challenge was further compounded by the lack of prior knowledge regarding the most representative crops in the regions under analysis.

4.1.3 Data sources limitations

For this use case several data limitations were found. Unlike other use cases in which the use case was built upon the FADN dataset as main dataset, different issues and errors provoked that for the Polish use case the FADN dataset did not serve as a comprehensive support to determine the actual agricultural landscape. As consequence, some key problems were derived from this misalignment in data.

The first and most significant issue identified was the absence of the variable that indicates the representativeness of each farm in the real world, commonly referred to as "weights." This variable is crucial as it quantifies how many actual farms are represented by each farm included in the sample. As previously noted, the FADN data comprises a sample derived from surveys, where not all farms are interviewed. Instead, surveys are conducted with a selection of representative farms based on criteria such as economic size, techno-economic orientation, and geospatial location (NUTS2). The absence of this representativeness variable is a major drawback because it impedes the ability to accurately or directly extrapolate the true size of the entire population. Without these weights, the procedure to estimate the real size and characteristics of the farm population becomes both inaccurate and unfeasible.

Another significant issue identified is the lack of adequate geospatial resolution in the microdata obtained. The ABM model relies on three geospatial resolution levels: NUTS2 (regional level 1), NUTS3 (regional level 2), and agrarian regions (regional level 3). However, the data provided only included NUTS2-level information, without additional variables at finer levels of detail. This limitation restricts the accurate geospatial mapping of farms and reduces the ability to effectively address weighting issues. Since one of the dimensions used to compute weights is geospatial, higher-resolution data would have enabled more accurate weight calculations. Moreover, this finer granularity would have allowed the identification of distinct patterns in crop cultivation and livestock ownership, both of which are critical for determining farm representativeness.

The data request to the FADN was submitted only once due to the lengthy and complex nature of the process. Although the issue primarily impacted the Polish use case—and the Greek use case, which will be addressed later—the Spanish and Italian use cases already had robust data support from FADN-related institutions. Nonetheless, the request was made to cover all countries involved in the AGRICORE project. Given this, the variable selection process should have been neutral, particularly for crop-related variables, as differing climatic conditions, soil suitability, and socio-economic contexts would naturally lead to different trends across countries. However, the selection process unintentionally focused on crops that were highly representative of the Spanish and Italian use cases, resulting in a biased selection. As a consequence, the microdata for the Polish use case includes only a limited and unrepresentative set of crops, while key crops specific to the Polish context were overlooked due to this oversight.

This issue is not limited to crop codes; it also affects several crop-related variables. Specifically, the dataset does not break down crop costs by individual crops. Instead, these costs are aggregated under the variable SE284, as per the FADN guide. Additionally, the dataset lacks land value data specific to crop types. This is a significant omission since land quality varies, affecting land value, and permanent crops generally have a higher expected value compared to land used for arable or rotational crops.

In addition to specific crops related variables, two other key variables were missing for all crop codes requested. There are the variables related to the production methods applied by the holding. One of them expresses the organic farming practices according to four different possibilities, being that the farm does not apply organic production methods, the farm applies only organic production methods, the farm applies both organic and conventional production methods or the farm is converting to organic production methods. Additionally,

the other variable missing is the sectors in organic farming in which the farm is specialized. This variable is relevant when the farm applies both production methods, as it is the only way to determine the sector or crops in which the farm is applying organic production.

Finally, various social aspects related to farmers were also missing. This issue stems from two causes. First, some social variables are absent because they are not directly available through the FADN methodology. These include variables such as holder successors, their age, and holder family members. Second, there is another set of social parameters that, while defined in the FADN methodology, were not requested when the data was collected. These include the age and gender of the holder.

As can be observed, there is an extensive and undesirable list of gaps in the analysis of the Polish use case. One potential consequence of these gaps is the distortion and lack of representativeness of the agricultural landscape, which could undermine the reliability of the simulation results for this use case. To address this issue, either a supplemental data request to FADN or a recalibration of the analysis to better account for the incomplete crop representation in the Polish context will be necessary. However, neither option is feasible in the short term, so these actions should be prioritized as part of the next steps in the continuation of the AGRICORE project.

4.2 Crop grouping analysis

Crop grouping analysis process was also applied for the Polish use case. This section contains the results of the analysis performed to base product grouping actions in informed decisions. Additional details are included in section Crop grouping: justification and methodology.

4.2.1 Distribution of crops in the regions of interest

As in the Andalusian use case, a crop representativeness analysis was performed for Poland. This analysis evaluates the representativeness of each crop based on various indicators, including the total cultivated area dedicated to each crop, total production, and economic indicators. These metrics were used to develop a ranking, ordering the crops according to their prevalence in the studied region.

This use case includes a total of 19 individual crops, as described by FADN. While this is a notable reduction compared to the Andalusian use case, it is due to data limitations. When factoring in the breakdown between conventional and organic production methods, the total number of individual crops increases to 38.

The following figure presents a pie chart showing the distribution of the individual crops based on cultivated area:

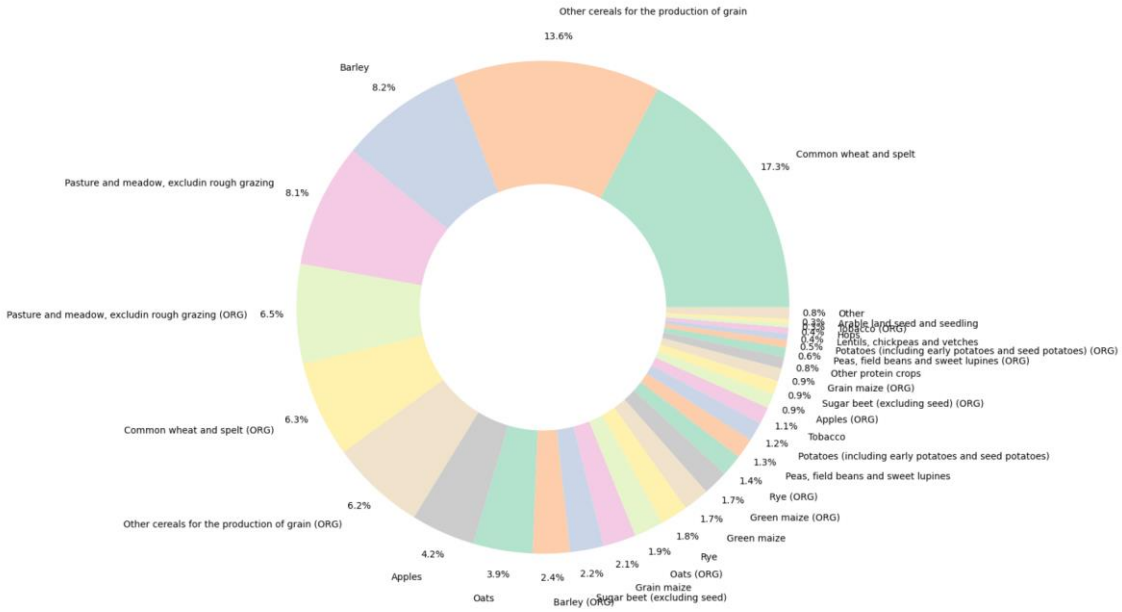

Figure 32. Polish crops by cultivated area

As can be observed, the main crops reflected in the data belong to the cereal family. Common wheat, spelt, and barley, for both organic and conventional production methods, occupy a significant portion of the crop distribution. In general, most of the cultivated land is dedicated to crops under conventional production methods. This is evident in the trends shown in the graph, where crops with a smaller presence are grouped towards the tail of the pie chart, with lower percentages.

A significant presence of pastures and meadows is notable, as they account for nearly 15% of the total cultivated area represented, for both conventional and organic production.

Finally, the distribution of crops based on economic indicators is presented. In contrast to the area distribution, different crops emerge as more prominent in terms of gross income. Crops with relatively low cultivated areas, such as apples, tobacco, and sugar beet, stand out as the dominant crops in terms of economic value. Common wheat and spelt are the only crops that maintain a consistent level of representativeness across both cultivated area and economic indicators.

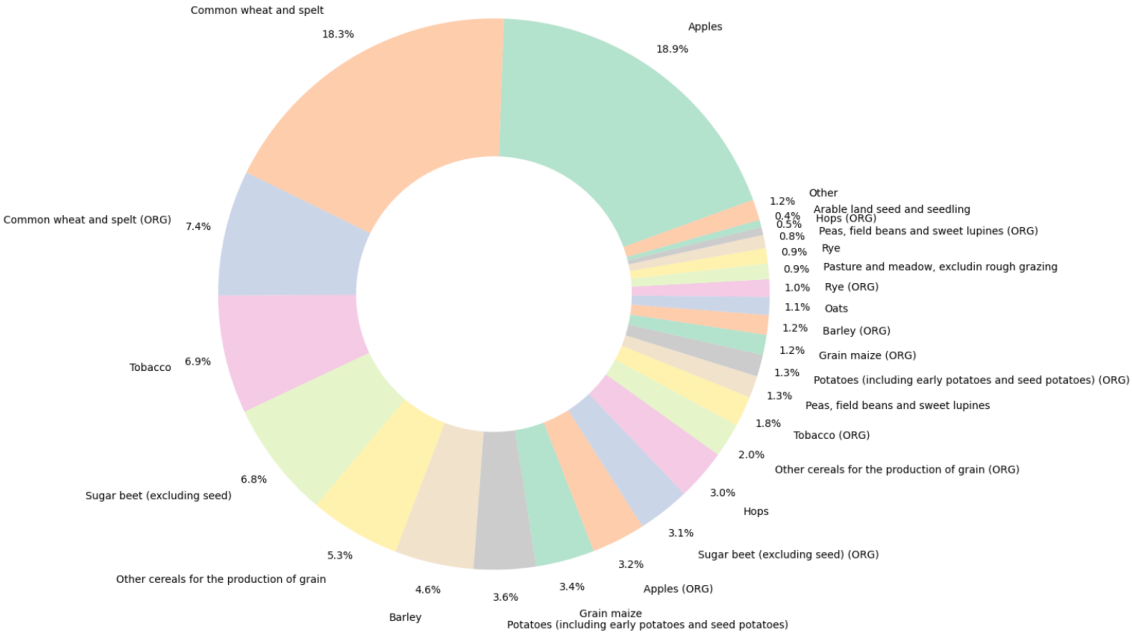

Figure 33. Polish crops by sales quantity

In general, the data shown indicates a clear lack of crop related information due to the missing crops when requesting the data to the FADN. Despite this fact a crop representativeness analysis has been performed. It is possible to assume that, the crop variety is very low, and most of the most representative and important crops for the current use case are missing.

	FADN Code	Description	Group	Frequency	Frequency Rel	Total Area	Production Quantity	Sales Quantity	Sales Value	average_area	Share Area	# Crops Combination	Production Method
0	10110	Common wheat and spelt	CER	34341.0	0.384170	1576.738706	8.348087e+05	6.566980e+05	1.007687e+08	1.542797	0.091533	5.074723	CONVENTIONAL
5	10190	Other cereals for the production of grain	CER	36994.0	0.413849	1240.785299	4.620709e+05	1.954593e+05	2.940972e+07	1.214076	0.092226	4.854034	CONVENTIONAL
2	10140	Barley	CER	25038.0	0.280098	744.440582	3.091080e+05	1.751751e+05	2.539605e+07	0.728415	0.063353	5.059472	CONVENTIONAL
16	30100	Pasture and meadow, excludin rough grazing	GRAZING	28419.0	0.317921	739.273373	2.044262e+05	2.032206e+05	5.016435e+06	0.723359	0.052252	5.437155	CONVENTIONAL
35	30100	Pasture and meadow, excludin rough grazing (ORG)	ORG_GRAZING	13689.0	0.153138	594.451274	7.802933e+05	3.786566e+04	9.834155e+05	0.581655	0.023369	5.618262	ORGANIC
19	10110	Common wheat and spelt (ORG)	ORG_CER	14509.0	0.162311	576.780773	3.201227e+05	2.599972e+05	4.047787e+07	0.564365	0.029416	5.623460	ORGANIC
24	10190	Other cereals for the production of grain (ORG)	ORG_CER	18379.0	0.205605	567.889754	2.153561e+05	7.576003e+04	1.104997e+07	0.555665	0.053289	5.363184	ORGANIC
18	40111	Apples	FRUITS	14232.0	0.159212	382.743608	9.625802e+05	9.130304e+05	1.038646e+08	0.374505	0.047262	2.254221	CONVENTIONAL
3	10150	Oats	CER	11915.0	0.133292	355.444746	1.117154e+05	5.067718e+04	5.806313e+06	0.347793	0.031290	4.724379	CONVENTIONAL
21	10140	Barley (ORG)	ORG_CER	11287.0	0.126267	222.182134	9.516589e+04	4.509330e+04	6.345890e+06	0.217399	0.014732	5.870609	ORGANIC
10	10400	Sugar beet (excluding seed)	BEET	6261.0	0.070041	201.265515	1.177501e+06	1.177501e+06	3.768180e+07	0.196933	0.009069	5.653534	CONVENTIONAL
4	10160	Grain maize	MAIZE	2761.0	0.030887	195.506415	1.813354e+05	1.662629e+05	1.894901e+07	0.191298	0.005688	5.097958	CONVENTIONAL
22	10150	Oats (ORG)	ORG_CER	6323.0	0.070735	175.038529	6.670650e+04	1.252898e+04	1.593911e+06	0.171271	0.009536	5.531272	ORGANIC
1	10130	Rye	CER	8179.0	0.091498	164.864316	5.476352e+04	4.308053e+04	4.991103e+06	0.161315	0.012563	5.468533	CONVENTIONAL
13	10921	Green maize	GRAZING	6073.0	0.067938	154.296400	3.281045e+04	2.630133e+05	7.475168e+05	0.150975	0.006075	5.881200	CONVENTIONAL
32	10921	Green maize (ORG)	ORG_GRAZING	2448.0	0.027386	151.001428	2.153840e+05	0.000000e+00	0.000000e+00	0.147751	0.002903	6.137787	ORGANIC
20	10130	Rye (ORG)	ORG_CER	4622.0	0.051706	129.029632	4.695594e+04	4.208974e+04	5.628516e+06	0.126252	0.005448	5.682796	ORGANIC
6	10210	Peas, field beans and sweet lupines	PROT	5941.0	0.066462	121.407768	2.787958e+04	1.819335e+04	7.041797e+06	0.118794	0.006724	5.532031	CONVENTIONAL
9	10300	Potatoes (including early potatoes and seed po...	POTATO	27771.0	0.310672	112.492915	2.697739e+05	1.803096e+05	1.997152e+07	0.110071	0.009293	5.500914	CONVENTIONAL
11	10601	Tobacco	OTHER	4722.0	0.052825	102.933369	2.547213e+04	2.140245e+04	3.816267e+07	0.100718	0.010477	6.196768	CONVENTIONAL
37	40111	Apples (ORG)	ORG_FRUITS	3916.0	0.043808	85.601320	1.318674e+05	1.158458e+05	1.742237e+07	0.083759	0.007992	4.127030	ORGANIC
29	10400	Sugar beet (excluding seed) (ORG)	ORG_BEET	2213.0	0.024757	81.224723	5.087670e+05	5.087670e+05	1.681095e+07	0.079476	0.003057	5.400987	ORGANIC
23	10160	Grain maize (ORG)	ORG_MAIZE	2078.0	0.023246	78.123510	6.848537e+04	6.447007e+04	6.494756e+06	0.076442	0.002419	5.002670	ORGANIC
8	10290	Other protein crops	PROT	1837.0	0.020550	69.104170	2.311765e+04	8.799302e+03	1.357747e+06	0.067617	0.003011	5.591483	CONVENTIONAL
25	10210	Peas, field beans and sweet lupines (ORG)	ORG_PROT	3031.0	0.033908	56.822511	1.306974e+04	8.876521e+03	4.235747e+06	0.055599	0.004494	5.602381	ORGANIC
28	10300	Potatoes (including early potatoes and seed po...	ORG_POTATO	14158.0	0.158385	44.973919	1.002259e+05	6.440648e+04	7.028487e+06	0.044006	0.003430	5.752457	ORGANIC
7	10220	Lentils, chickpeas and vetches	PROT	2385.0	0.026681	38.553754	6.503664e+03	4.881525e+03	1.082604e+06	0.037724	0.003614	5.614922	CONVENTIONAL
12	10602	Hops	OTHER	1473.0	0.016478	36.339178	5.718455e+03	5.694649e+03	1.648504e+07	0.035557	0.004146	2.338217	CONVENTIONAL
30	10601	Tobacco (ORG)	ORG_OTHER	1522.0	0.017027	26.181649	5.903772e+03	5.007959e+03	9.817922e+06	0.025618	0.002219	9.151620	ORGANIC
15	11000	Arable land seed and seedling	OTHER	1004.0	0.011232	24.376244	1.113842e+04	9.004490e+03	2.362835e+06	0.023852	0.001126	5.693661	CONVENTIONAL
27	10290	Other protein crops (ORG)	ORG_PROT	771.0	0.008625	23.702018	7.587685e+03	2.659330e+03	4.572389e+05	0.023192	0.001092	5.601599	ORGANIC
33	10923	Other plants harvested green but not mentioned...	ORG_OTHER	448.0	0.005012	14.246661	0.000000e+00	0.000000e+00	0.000000e+00	0.013940	0.001331	4.585775	ORGANIC
17	30200	Rough grazing	GRAZING	1759.0	0.019678	7.346594	0.000000e+00	0.000000e+00	0.000000e+00	0.007188	0.001085	5.324014	CONVENTIONAL
31	10602	Hops (ORG)	ORG_OTHER	447.0	0.005001	6.412120	8.005560e+02	8.017408e+02	2.535263e+06	0.006274	0.000679	2.882951	ORGANIC
36	30200	Rough grazing (ORG)	ORG_GRAZING	888.0	0.009934	5.561415	0.000000e+00	0.000000e+00	0.000000e+00	0.005442	0.000688	6.106956	ORGANIC
14	10923	Other plants harvested green but not mentioned...	OTHER	545.0	0.006097	4.860264	6.390909e+02	6.390909e+02	1.720740e+04	0.004756	0.000213	6.307195	CONVENTIONAL
34	11000	Arable land seed and seedling (ORG)	ORG_OTHER	170.0	0.001902	3.676689	1.971019e+03	2.001546e+03	3.652082e+05	0.003598	0.000162	6.194267	ORGANIC
26	10220	Lentils, chickpeas and vetches (ORG)	ORG_PROT	279.0	0.003121	3.232294	2.231017e+02	1.218962e+02	7.908060e+04	0.003163	0.000162	5.505437	ORGANIC

Table 11. Crop representativeness results for Poland

The above table contains all the information generated from the crop grouping analysis for the Polish use case. Crops have been ranked according to the total area dedicated to each.

4.2.2 Crop grouping decisions in Poland

After analyzing the distribution of individual crops, a crop grouping transformation has been defined. The objective is to link each individual FADN crop to a defined ad-hoc product group based on crop similarities, representativeness, and relevance to the use case.

Both the area dedicated to each crop and economic indicators have been crucial in determining the product groupings.

Cereals represent the most significant family of crops, considering both area and economic impact. This group includes wheat, barley, oats, and other cereals, which share similar cultivation methods, campaigns, and production ratios.

Sugar beet ranks as the fourth most economically significant crop. Given the lack of similar crops, it was decided to create a separate product group for sugar beet, as it differs from the other individual crops.

Fruit product group was created to encompass all individual permanent crops present in the microdata, with apples standing out as the unique but highly representative crop in economic terms.

Grazing product group includes pastures in various forms, mainly used as livestock feed.

Maize has its own product group due to its possibilities during the simulation. Although it is a minority crop, it can server as feed for livestock, so it will have special product group characterization, so an isolated product group is defined to that end.

Potato product group was created due to the lack of similar crops in the microdata. Although adding potatoes to the "other" group was considered, this would have reduced the variability of crops managed in the use case.

Protein product group is defined by nitrogen-fixing crops, such as soybean, sunflower, beans, chickpeas, flax, and lentils. This group is essential for each use case, as the simulation engine needs to recognize it for model execution. Therefore, the decision is based on technical requirements rather than macro indicators.

Other group was created to include remaining crops, either due to low representativeness or their absence from the use case. Tobacco, a non-common crop, is included here to balance indicators with other crops in this group.

The final product groups for crops defined are presented in the table below:

#	Product group	Abbreviation	Description
1	Sugar beet	BEET	Olive tree and all its varieties and derived products
2	Cereals	CER	All kind of cereals, including maize, wheat, rice, rye, barley…
3	Fruit	FRUIT	All types of fruit-producing crops, especially for the case of apples.
4	Grazing	GRAZ	All crops that can be used as fodder or as feed for livestock, including pasture, meadows, rough grazing, green maize and plants harvested green.
5	Maize	MAIZE	Maize crop for different purposes, including the production of grain and livestock food as fodder

6	Potato	POTATO	All types of potato.
7	Protein crops	PROT	Agricultural plants that are cultivated for their high protein content including lentils, chickpeas, beans… Crops that serve as nitrogen-fixing.
8	Other	OTHER	Group of crops with low representativeness or without a relevant impact on the use case study. Grapes, wooded area, flowers,

Table 12. Andalusia crops grouping

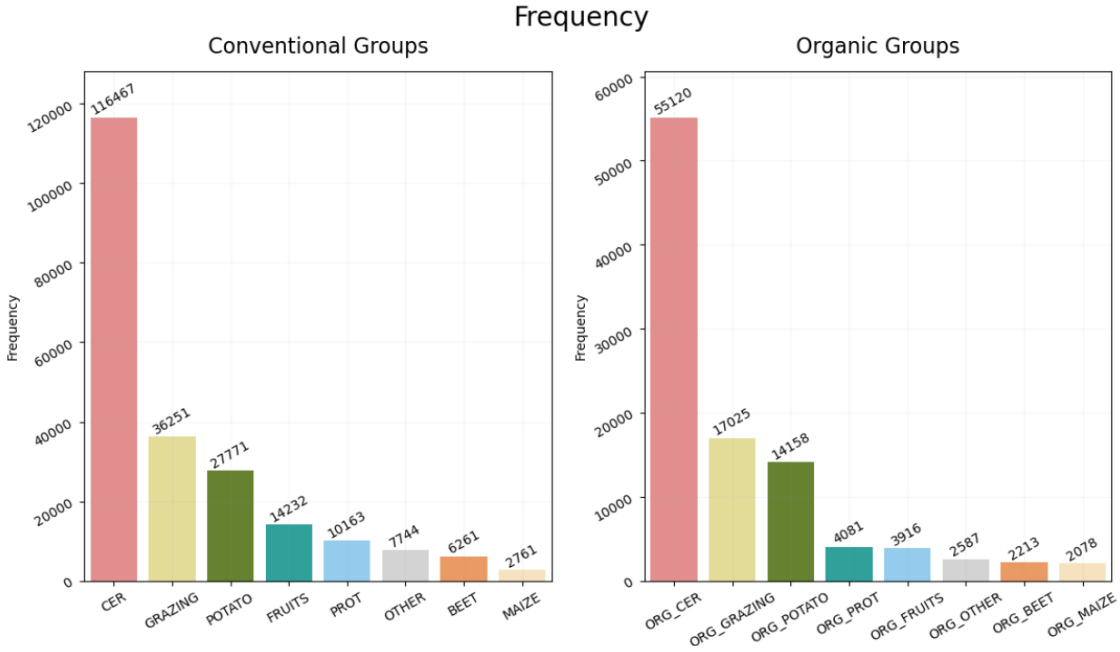

Figure 34. Poland crop grouping result: frequency

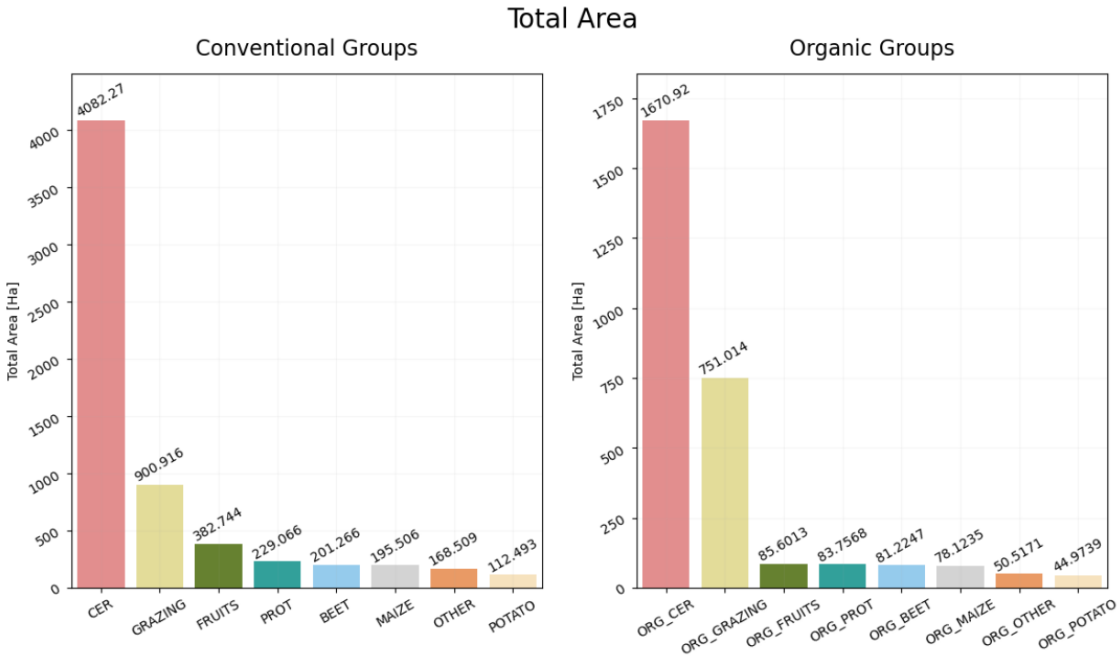

Figure 35. Poland crop grouping result: total area

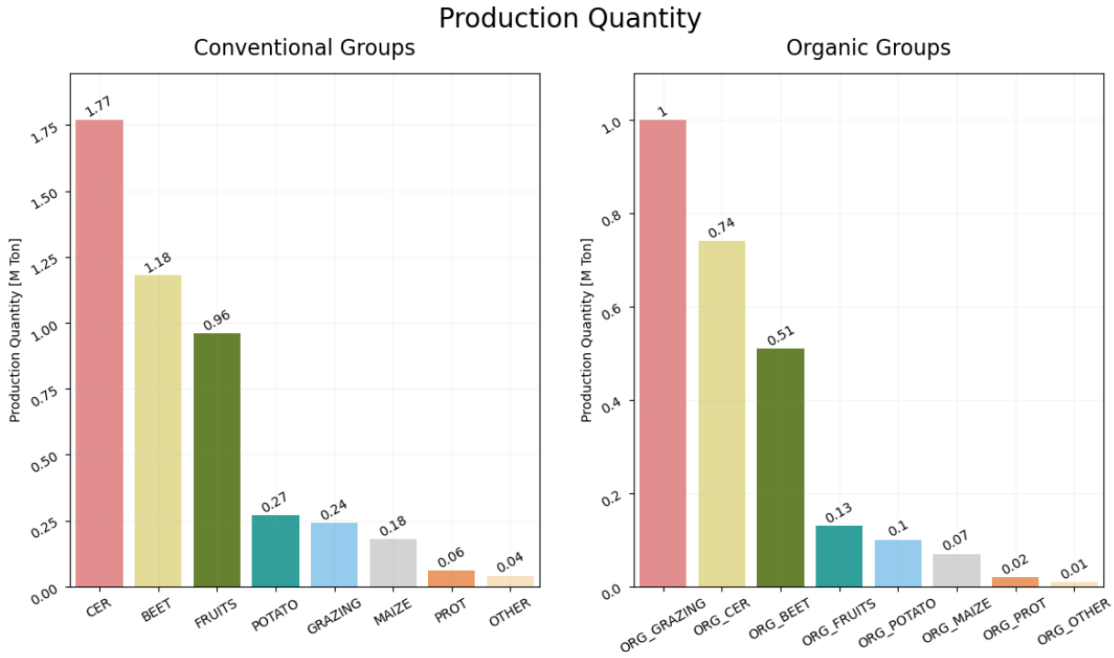

Figure 36. Poland crop grouping result: production quantity

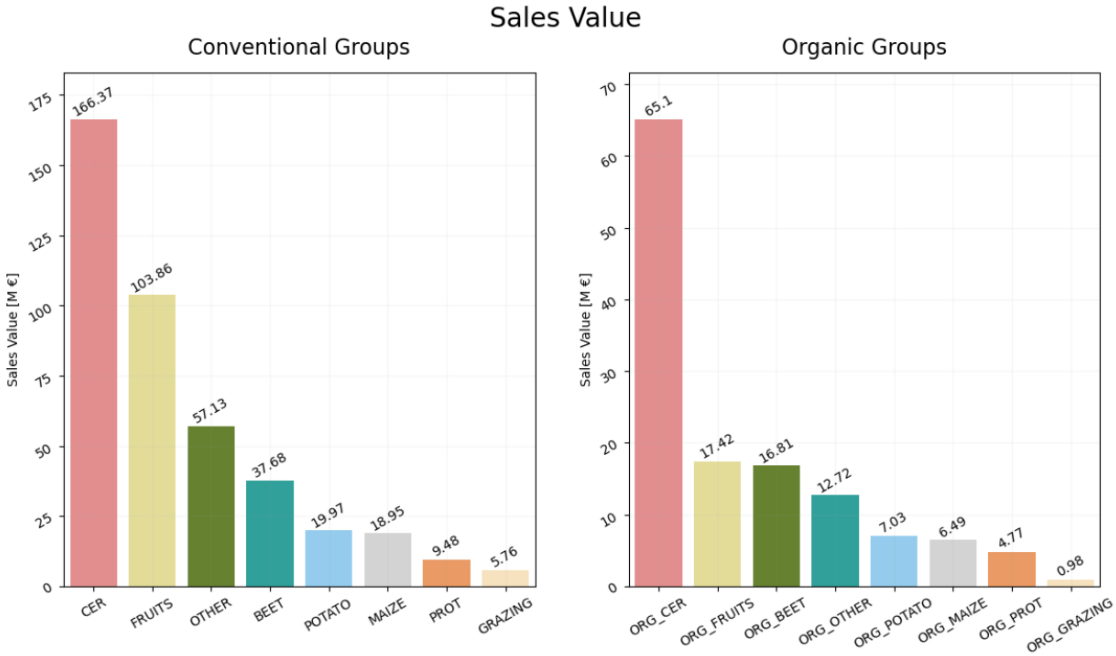

Figure 37. Andalusia crop grouping result: sales value

The above figures show the results of the product grouping operations for the Polish use case. As previously mentioned, the results are strongly biased due to the lack of data for the most representative crops. Cereals stand out as the most representative product group in this classification, and this dominance is evident across all the analyzed parameters. Unlike the previous use case, the imbalance between conventional and organic production methods is less pronounced here. For most of the defined product groups, the difference is now below one order of magnitude.

The following table describes all the links identified for the current use case according to the product groups defined:

	FADN Code	Description	Group
0	10110	Common wheat and spelt	CER
1	10130	Rye	CER
2	10140	Barley	CER
3	10150	Oats	CER
4	10160	Grain maize	MAIZE
5	10190	Other cereals for the production of grain	CER
6	10210	Peas, field beans and sweet lupines	PROT
7	10220	Lentils, chickpeas and vetches	PROT
8	10290	Other protein crops	PROT
9	10300	Potatoes (including early potatoes and seed po...	POTATO
10	10400	Sugar beet (excluding seed)	BEET
11	10601	Tobacco	OTHER
12	10602	Hops	OTHER
13	10921	Green maize	GRAZING
14	10923	Other plants harvested green but not mentioned...	OTHER
15	11000	Arable land seed and seedling	OTHER
16	30100	Pasture and meadow, excludin rough grazing	GRAZING
17	30200	Rough grazing	GRAZING
18	40111	Apples	FRUITS
19	10110	Common wheat and spelt	ORG_CER
20	10130	Rye	ORG_CER
21	10140	Barley	ORG_CER
22	10150	Oats	ORG_CER
23	10160	Grain maize	ORG_MAIZE
24	10190	Other cereals for the production of grain	ORG_CER
25	10210	Peas, field beans and sweet lupines	ORG_PROT
26	10220	Lentils, chickpeas and vetches	ORG_PROT
27	10290	Other protein crops	ORG_PROT
28	10300	Potatoes (including early potatoes and seed po...	ORG_POTATO
29	10400	Sugar beet (excluding seed)	ORG_BEET
30	10601	Tobacco	ORG_OTHER
31	10602	Hops	ORG_OTHER
32	10921	Green maize	ORG_GRAZING
33	10923	Other plants harvested green but not mentioned...	ORG_OTHER
34	11000	Arable land seed and seedling	ORG_OTHER
35	30100	Pasture and meadow, excludin rough grazing	ORG_GRAZING
36	30200	Rough grazing	ORG_GRAZING
37	40111	Apples	ORG_FRUITS

Table 13. Poland use case: crop grouping results

4.3 Building of the synthetic population

This section outlines the process used to build the synthetic population for the Poland use case. Two distinct accountancy years, 2014 and 2018, were generated for this use case. The synthetic population generation module created farms based on the actual number of farms for each year. However, not all existing farms were included in the synthetic population, as certain farms with smaller economic sizes were not represented in the microdata sample. As a result, the synthetic population for Poland consists of farms with economic sizes above the threshold for professional holdings, specifically excluding those below €4,000, which aligns with farms in economic size class 3 or higher according to FADN classification.

4.3.1 Generation of synthetic data to solve data unavailability

The building of the Poland use case faced strong challenges when generating the synthetic population. The main issue was the lack of variables in the base dataset, as explained in previous sections of the present document. When possible, different alternative data sources have been used to extract information and fill the encountered gaps, although the alternative data sources did not contain information specific to each individual farm.

The main challenge in this use case was addressing the missing weights variable, which quantifies the representativeness of each farm within the dataset. To overcome this gap, the Empirical Likelihood (EL) method to estimate these weights was utilized.

Empirical Likelihood is a non-parametric statistical technique that allows for the estimation of probability distributions without making strong assumptions about the underlying data distribution. This method is particularly useful when dealing with incomplete or missing data, as it leverages the available data to estimate parameters in a way that is robust to model assumptions.

The application of the method starts with a data aggregation on the available data to compute the totals by crop and then to compute the averages. In this case, both cultivated area, crop production and economic indicators were utilized. Then, by using the empirical likelihood function, different weightings of the farms are computed. After that, an optimization process is applied to maximize the empirical likelihood function and hence the representativeness of each farm according to the totals and averages obtained. And finally, the optimized weights are extracted to be used as the representativeness of each farm in the dataset.

Although this method can differ from the real representativeness of farms, the results showed a reliable view of how each farm in the synthetic population corresponds to the actual farms, and allowing for the extrapolation of the sample.

Other social aspect variables were supplemented using the Eurostat database. Key statistical indicators for each variable were identified and integrated with the FADN microdata. This included data on farm structure, age distribution of family members, and other relevant indicators, which were crucial for filling these information gaps.

The selling price for crops was calculated by dividing the total sales amount in euros by the total tons sold during the accounting year.

Regarding geospatial location, Eurostat databases were utilized to compute the probability distributions for each region at level 2 (NUTS3) and level 3 (agrarian region). This provided the necessary geospatial resolution for the model.

Finally, variable costs per crop were computed by solving an optimization problem. Details about the procedure applied are included in Annex B.

4.3.2 Use-case's population-specific assumptions

The Polish use case was generated with a geospatial limitation, focusing on the Lubelskie region (PL81 NUTS2 code). It was assumed that any missing entries in the microdata represent zero values. Economic size limitations also apply to this use case. The FADN economic size classification does not include the three smallest categories, which correspond to economic sizes below €4,000. Consequently, the synthetic population will only reflect the data available, excluding farms with these unrepresented economic sizes.

Additionally, assumptions were made regarding milk variable costs, as this information was not available in the database. A constant value was imputed based on trends observed in the Statistical Yearbook of Agriculture.

For the greening area, the following assumptions were applied: If a synthetic holding receives the greening subsidy, a variable amount of land, no more than 5%, is allocated to greening practices. Furthermore, only areas used for crops with the nitrogen-fixing flag are included in the greening area calculation.

4.4 Analysis and verification of the synthetic population

The content presented in this section depicts the results generated during the synthetic population analysis and verification. The methods and techniques utilized to objectively assess the synthetic population are described in 2.4Techniques to compare and assess synthetic population fidelity. Due to the absence of categorical variables in the original dataset, comparisons for these variables have been omitted. Numerical and statistical validations for the remaining variables in the synthetic population are provided for both simulation years. Finally, the goodness-of-fit analysis includes a totals comparison, where ratios for key crop-related variables are examined.

4.4.1 Report on the generated population probability distribution vs the sample one

Year 2014

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
1150.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
1400.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
1600.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
1700.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2313.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2313.value	0	0	95.608	94.812	32817	32817.585	1042.17	1046.896	0.98	0.98	1	Similar	1	Similar	0	0.002
2315.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2317.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2318.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2322.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2323.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
23312.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2333.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
2334.value	0	0	0.23	0.23	208	208	6.909	6.909	0.999	0.999	1	Similar	1	Similar	0	0
2335.value	0	0	0.997	0.997	4445	4445	66.573	66.573	1	1	1	Similar	1	Similar	0	0
9900.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
9901.value	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
CER.cropProduction	0	0	37242.77	40131.531	7125400	7125400	193370.96	185287.79	0.822	0.824	0	Different	0.002	Different	0.001	0.008
CER.cultivatedArea	0	0	4.651	4.574	250.69	251.43	17.38	17.05	0.811	0.811	0	Different	0.733	Similar	0.001	0.007
CER.irrigatedArea	0	0	0.437	0.514	250.69	250.69	5.619	5.285	0.973	0.963	0	Different	0	Different	0.001	0.008
CER.quantitySold	0	0	16.304	17.647	2375	2375	78.402	75.889	0.834	0.835	0	Different	0.001	Different	0.002	0.012
CER.quantityUsed	0	0	0.291	0.203	113.974	113.974	3.806	2.638	0.984	0.987	0.689	Similar	0.186	Similar	0.003	0.014
CER.sellingPrice	0	0	35.486	35.601	397.769	397.769	82.407	83.236	0.834	0.835	0	Different	0.203	Similar	0.015	0.03
CER.valueSales	0	0	3650.922	3973.972	712540	712540	19350.08	18580.562	0.834	0.835	0	Different	0.002	Different	0.001	0.009
CITRUS.cropProduction	0	0	10624.481	10585.528	1295640	1295640	85216.131	86209.471	0.974	0.975	0.996	Similar	1	Similar	0.002	0.01
CITRUS.cultivatedArea	0	0	0.285	0.288	35	36.244	2.36	2.391	0.974	0.974	1	Similar	1	Similar	0.007	0.023
CITRUS.irrigatedArea	0	0	0.283	0.283	35	35	2.36	2.372	0.975	0.976	1	Similar	1	Similar	0.001	0.008
CITRUS.quantitySold	0	0	7.65	7.616	860.1	860.1	63.785	64.207	0.974	0.975	0.999	Similar	1	Similar	0.002	0.011
CITRUS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
CITRUS.sellingPrice	0	0	3.999	3.982	355.769	355.769	26.247	26.278	0.974	0.975	0.995	Similar	1	Similar	0.002	0.01
CITRUS.valueSales	0	0	1062.448	1058.553	129564	129564	8521.613	8620.947	0.974	0.975	0.996	Similar	1	Similar	0.002	0.01
DAIRY.dairyCows	0	0	0.494	0.391	295	295	8.314	7.188	0.995	0.996	1	Similar	0.89	Similar	0.002	0.011
DAIRY.eggsProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.eggsTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.eggsTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.manureTotalSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.milkProductionSold	0	0	3.576	2.788	2212.5	2212.5	61.295	52.096	0.995	0.996	1	Similar	0.89	Similar	0.002	0.009
DAIRY.milkTotalProduction	0	0	3.572	2.786	2212.5	2212.5	61.243	52.059	0.995	0.996	1	Similar	0.89	Similar	0.001	0.009
DAIRY.milkTotalSales	0	0	1280.184	1007.911	747130	747130	21496.219	18471.033	0.995	0.996	1	Similar	0.89	Similar	0.001	0.009
DAIRY.numberAnimalsForSlaughtering	0	0	0.088	0.072	55	55	1.508	1.402	0.993	0.991	0.95	Similar	0.441	Similar	0.002	0.01
DAIRY.numberAnimalsRearingBreading	0	0	0.007	0.003	50	5	0.364	0.113	0.999	0.999	1	Similar	1	Similar	0.017	0.012
DAIRY.numberOfAnimals	0	0	0.116	0.115	60	61.363	1.515	1.517	0.973	0.973	0.116	Similar	1	Similar	0.003	0.013
DAIRY.numberOfAnimalsSold	0	0	0.108	0.087	73	55	1.606	1.394	0.99	0.988	0.926	Similar	0.392	Similar	0.017	0.024
DAIRY.valueAnimalsRearingBreading	0	0	7.483	2.325	67500	4566	466.26	103	0.999	0.999	1	Similar	1	Similar	0.01	0.012
DAIRY.valueSlaughteredAnimals	0	0	80.04	71.684	63000	63000	1683.58	1638.352	0.993	0.991	0.95	Similar	0.441	Similar	0.001	0.007
DAIRY.valueSoldAnimals	0	0	124.555	104.606	79920	63000	1941.282	1776.687	0.99	0.988	0.926	Similar	0.394	Similar	0.027	0.026
DAIRY.variableCostsAnimals	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.woolProductionSold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
DAIRY.woolTotalProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
FRUIT.cropProduction	0	0	26744.736	25940.305	4261520	4261520	266221.30	253660.60	0.977	0.977	0.999	Similar	1	Similar	0.002	0.011
FRUIT.cultivatedArea	0	0	0.156	0.16	22.36	23.426	1.435	1.45	0.977	0.977	0.917	Similar	1	Similar	0.008	0.024
FRUIT.irrigatedArea	0	0	0.074	0.065	22.36	22.36	1.03	0.961	0.988	0.988	1	Similar	1	Similar	0.001	0.009
FRUIT.quantitySold	0	0	4.292	4.378	597.8	597.8	37.969	38.332	0.977	0.977	1	Similar	1	Similar	0.001	0.01
FRUIT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
FRUIT.sellingPrice	0	0	14.766	13.13	1700.476	1700.476	118.207	102.815	0.977	0.977	1	Similar	1	Similar	0.002	0.011
FRUIT.valueSales	0	0	2674.474	2594.16	426152	426152	26622.13	25366.143	0.977	0.977	0.999	Similar	1	Similar	0.002	0.011
GRAZ.cropProduction	0	0	399.909	591.276	316800	316800	9122.667	10690.589	0.997	0.995	0.953	Similar	0.448	Similar	0.001	0.009
GRAZ.cultivatedArea	0	0	10.676	10.442	1460	1461.614	71.193	69.506	0.901	0.901	0.609	Similar	1	Similar	0	0.002
GRAZ.irrigatedArea	0	0	0.02	0.027	17.45	17.45	0.47	0.515	0.997	0.995	0.986	Similar	0.657	Similar	0.001	0.01
GRAZ.quantitySold	0	0	1.028	1.414	990	990	24.927	27.863	0.998	0.996	0.996	Similar	0.672	Similar	0.001	0.009
GRAZ.quantityUsed	0	0	0.084	0.188	232.537	232.537	4.036	6.361	0.999	0.999	1	Similar	1	Similar	0	0.004
GRAZ.sellingPrice	0	0	0.09	0.159	56.93	56.93	1.876	2.517	0.998	0.996	0.969	Similar	0.67	Similar	0.001	0.008
GRAZ.valueSales	0	0	37.884	54.744	31680	31680	907.382	1059.53	0.998	0.996	0.996	Similar	0.672	Similar	0.001	0.009
HOPS.cropProduction	0	0	15385.984	16037.874	1078000	1078000	63789.07	65670.356	0.868	0.872	0	Different	0.064	Similar	0.003	0.014
HOPS.cultivatedArea	0	0	1.383	1.403	110.19	111.505	5.594	5.709	0.868	0.868	0.001	Different	0.581	Similar	0.001	0.01
HOPS.irrigatedArea	0	0	0.795	0.905	66	66	4.161	4.247	0.942	0.924	0	Different	0	Different	0.007	0.022
HOPS.quantitySold	0	0	4.813	4.991	350	350	19.881	20.455	0.868	0.872	0.005	Different	0.068	Similar	0.002	0.012
HOPS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
HOPS.sellingPrice	0	0	41.863	41.052	500.885	500.885	108.314	107.68	0.868	0.872	0	Different	0.014	Different	0.01	0.023
HOPS.valueSales	0	0	1538.598	1603.807	107800	107800	6378.907	6567.351	0.868	0.872	0	Different	0.066	Similar	0.003	0.014
NUTS.cropProduction	0	0	8522.343	8835.183	805352.75	805352.75	46019.044	47568.825	0.951	0.952	0.422	Similar	1	Similar	0.002	0.012
NUTS.cultivatedArea	0	0	1.267	1.287	85.91	87.058	6.989	7.093	0.951	0.951	0.986	Similar	1	Similar	0.003	0.015
NUTS.irrigatedArea	0	0	0.012	0.017	14.77	14.77	0.295	0.361	0.997	0.996	1	Similar	0.999	Similar	0.001	0.008
NUTS.quantitySold	0	0	0.46	0.459	40	40	2.479	2.463	0.951	0.952	0.513	Similar	1	Similar	0.002	0.011
NUTS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
NUTS.sellingPrice	0	0	94.274	98.225	6581.25	6581.25	445.695	475.48	0.951	0.952	0.946	Similar	1	Similar	0.001	0.007
NUTS.valueSales	0	0	851.709	884.388	78571	78571	4592.909	4746.062	0.951	0.952	0.398	Similar	1	Similar	0.001	0.008
OLIV.cropProduction	0	0	142332.96	129065.94	6404500	6404500	377787.33	352107.13	0.606	0.607	0	Different	0.001	Different	0.007	0.019
OLIV.cultivatedArea	0	0	6.683	6.658	190	190.958	15.957	15.94	0.605	0.605	0	Different	0.011	Different	0.001	0.01
OLIV.irrigatedArea	0	0	2.917	2.522	190	190	11.317	10.969	0.806	0.83	0	Different	0	Different	0.005	0.017
OLIV.quantitySold	0	0	29.446	26.923	1601.1	1601.1	77.244	72.68	0.615	0.617	0	Different	0	Different	0.012	0.025
OLIV.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
OLIV.sellingPrice	0	0	192.109	191.339	3960	3960	310.6	311.308	0.614	0.617	0	Different	0	Different	0.005	0.017
OLIV.valueSales	0	0	14154.414	12767.464	640450	640450	37748.801	35193.456	0.614	0.617	0	Different	0	Different	0.006	0.018
ORG_CER.cropProduction	0	0	4214.043	4291.133	3755360	3755360	93285.291	90526.16	0.978	0.977	0.992	Similar	0.824	Similar	0	0.003
ORG_CER.cultivatedArea	0	0	1.233	1.265	230.3	231.216	8.852	9.122	0.959	0.959	0.992	Similar	1	Similar	0.001	0.01
ORG_CER.irrigatedArea	0	0	0.078	0.059	33.2	33.2	1.556	1.354	0.998	0.998	1	Similar	1	Similar	0.001	0.01
ORG_CER.quantitySold	0	0	1.456	1.465	1341.2	1341.2	32.829	31.672	0.983	0.982	0.999	Similar	0.996	Similar	0	0.003
ORG_CER.quantityUsed	0	0	0.155	0.18	161	161	3.338	3.685	0.993	0.991	1	Similar	0.909	Similar	0	0.003
ORG_CER.sellingPrice	0	0	3.473	3.634	313.659	313.659	26.667	27.449	0.983	0.982	1	Similar	1	Similar	0.001	0.007
ORG_CER.valueSales	0	0	363.893	363.061	375536	375536	9042.666	8689.356	0.983	0.982	1	Similar	1	Similar	0	0.003
ORG_CITRUS.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.cultivatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_CITRUS.valueSales	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_FRUIT.cropProduction	0	0	3742.028	3705.145	1116582.5	1116582.5	55666.406	55909.291	0.992	0.992	1	Similar	1	Similar	0	0.002
ORG_FRUIT.cultivatedArea	0	0	0.018	0.018	7.05	8.492	0.238	0.243	0.992	0.992	1	Similar	1	Similar	0.011	0.028
ORG_FRUIT.irrigatedArea	0	0	0.004	0.004	3.8	3.8	0.085	0.085	0.997	0.997	1	Similar	1	Similar	0.001	0.01
ORG_FRUIT.quantitySold	0	0	0.487	0.481	149.8	149.8	6.99	7.027	0.993	0.993	1	Similar	1	Similar	0	0.002
ORG_FRUIT.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_FRUIT.sellingPrice	0	0	4.662	4.487	1055.414	1055.414	58.045	57.176	0.993	0.993	1	Similar	1	Similar	0	0.002
ORG_FRUIT.valueSales	0	0	374.11	370.42	111658.25	111658.25	5566.646	5590.935	0.993	0.993	1	Similar	1	Similar	0	0.002
ORG_GRAZ.cropProduction	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.cultivatedArea	0	0	3.028	3.067	793.7	794.617	25.307	25.582	0.948	0.948	0.819	Similar	1	Similar	0	0.002
ORG_GRAZ.irrigatedArea	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.quantitySold	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.quantityUsed	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.sellingPrice	0	0	0	0	0	0	0	0	1	1	1	Similar	1	Similar	0	0
ORG_GRAZ.valueSales	0	0	4.28	4.28	16000	16000	261.655	261.655	1	1	1	Similar	1	Similar	0	0
ORG_HOPS.cropProduction	0	0	130.204	136.476	225800	225800	4207.057	4423.894	0.998	0.998	1	Similar	1	Similar	0	0.002
ORG_HOPS.cultivatedArea	0	0	0.01	0.01	17.7	18.384	0.323	0.34	0.998	0.998	1	Similar	1	Similar	0.001	0.009
ORG_HOPS.irrigatedArea	0	0	0.002	0.002	5	5	0.077	0.097	0.999	0.999	1	Similar	1	Similar	0	0.005
ORG_HOPS.quantitySold	0	0	0.042	0.044	80.1	80.1	1.423	1.509	0.998	0.998	1	Similar	1	Similar	0	0.001

Figure 38. Statistical results: Poland 2014 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_FRUITS.cultivatedArea	0.0	0.0	0.16	0.13	16.9	38.0	0.854	0.936	0.9	0.95	0.0	Different	0.0	Different	0.1624	0.0534
ORG_FRUITS.irrigatedArea	0.0	0.0	0.0	0.01	8.8	37.9	0.169	0.476	1.0	1.0	1.0	Similar	1.0	Similar	0.0001	0.0024
ORG_FRUITS.quantitySold	0.0	0.0	4.33	2.66	761.8	1476.5	25.455	26.142	0.912	0.96	0.0	Different	0.0	Different	0.4025	0.0534
ORG_FRUITS.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_FRUITS.sellingPrice	0.0	0.0	8.78	5.03	526.2	526.2	37.21	31.849	0.912	0.96	0.0	Different	0.0	Different	0.1033	0.0598
ORG_FRUITS.valueSales	0.0	0.0	408.52	345.94	98511.0	483628.3	3188.359	6409.972	0.912	0.96	0.0	Different	0.0	Different	0.0572	0.0391
ORG_GRAZING.cropProduction	0.0	0.0	22.11	23.55	6192.7	4712.6	166.192	186.073	0.966	0.961	0.0	Different	0.021	Different	0.0359	0.0432
ORG_GRAZING.cultivatedArea	0.0	0.0	0.42	0.41	71.8	58.1	1.851	1.988	0.835	0.857	0.0	Different	0.0	Different	0.0154	0.0252
ORG_GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.001	1.0	0.997	0.942	Similar	0.422	Similar	10.2962	0.4468
ORG_GRAZING.quantitySold	0.0	0.0	0.92	4.16	230.0	19760.4	7.199	256.795	0.966	0.961	0.027	Different	0.025	Different	0.3022	0.0503
ORG_GRAZING.quantityUsed	0.0	0.0	0.0	0.0	2.2	0.0	0.028	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4255	0.4637
ORG_GRAZING.sellingPrice	0.0	0.0	1.2	1.29	95.6	88.3	7.269	7.131	0.966	0.961	0.001	Different	0.022	Different	0.2893	0.07
ORG_GRAZING.valueSales	0.0	0.0	22.08	30.41	6192.7	47222.8	165.703	637.309	0.966	0.961	0.0	Different	0.021	Different	0.2807	0.0499
ORG_MAIZE.cropProduction	0.0	0.0	88.89	53.68	105459.7	43949.1	2006.793	832.075	0.978	0.979	0.983	Similar	1.0	Similar	0.0051	0.0159
ORG_MAIZE.cultivatedArea	0.0	0.0	0.09	0.06	70.3	35.0	1.506	0.782	0.976	0.978	0.092	Similar	0.601	Similar	0.0102	0.0213
ORG_MAIZE.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_MAIZE.quantitySold	0.0	0.0	0.77	0.47	869.8	360.0	16.941	6.723	0.978	0.979	0.981	Similar	1.0	Similar	0.0088	0.02
ORG_MAIZE.quantityUsed	0.0	0.0	0.03	0.04	111.7	120.4	1.363	1.833	0.998	0.999	1.0	Similar	1.0	Similar	0.0067	0.0104
ORG_MAIZE.sellingPrice	0.0	0.0	2.79	2.71	196.3	262.9	19.423	19.433	0.978	0.979	0.986	Similar	1.0	Similar	0.1946	0.0515
ORG_MAIZE.valueSales	0.0	0.0	92.22	52.67	125691.5	49898.4	2336.155	815.426	0.978	0.979	0.994	Similar	1.0	Similar	0.005	0.0174
ORG_OTHER.cropProduction	0.0	0.0	228.01	180.09	29688.5	56533.2	2056.488	1719.6	0.977	0.967	0.0	Different	0.0	Different	0.1441	0.0569
ORG_OTHER.cultivatedArea	0.0	0.0	0.06	0.05	6.8	13.1	0.43	0.41	0.967	0.961	0.044	Different	0.008	Different	0.1439	0.0531
ORG_OTHER.irrigatedArea	0.0	0.0	0.0	0.0	1.4	0.0	0.022	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4248	0.4644
ORG_OTHER.quantitySold	0.0	0.0	0.16	0.11	546.4	120.0	6.64	2.05	0.976	0.967	0.0	Different	0.0	Different	0.004	0.019
ORG_OTHER.quantityUsed	0.0	0.0	0.0	0.0	0.7	0.0	0.022	0.0	0.998	1.0	0.972	Similar	0.503	Similar	26.4163	0.4644
ORG_OTHER.sellingPrice	0.0	0.0	44.18	62.86	3319.1	3364.6	299.457	357.357	0.976	0.967	0.0	Different	0.0	Different	0.0406	0.044
ORG_OTHER.valueSales	0.0	0.0	164.3	168.2	26914.2	56533.2	1443.733	1709.235	0.976	0.967	0.0	Different	0.0	Different	0.1745	0.0583
ORG_POTATO.cropProduction	0.0	0.0	100.14	95.99	45057.2	29872.1	787.167	811.349	0.861	0.903	0.0	Different	0.0	Different	0.0118	0.0269
ORG_POTATO.cultivatedArea	0.0	0.0	0.05	0.04	30.0	30.0	0.445	0.412	0.814	0.86	0.0	Different	0.0	Different	0.0302	0.0173
ORG_POTATO.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_POTATO.quantitySold	0.0	0.0	0.66	0.53	530.0	530.0	8.683	8.078	0.849	0.903	0.0	Different	0.0	Different	0.0069	0.0142
ORG_POTATO.quantityUsed	0.0	0.0	0.3	0.22	486.0	486.0	5.772	6.18	0.868	0.906	0.0	Different	0.0	Different	0.0006	0.0055
ORG_POTATO.sellingPrice	0.0	0.0	18.48	12.82	910.4	335.0	47.507	41.499	0.849	0.903	0.0	Different	0.0	Different	0.9008	0.1552
ORG_POTATO.valueSales	0.0	0.0	66.21	64.1	41685.8	21109.6	638.161	589.386	0.849	0.903	0.0	Different	0.0	Different	0.0088	0.0234
ORG_PROT.cropProduction	0.0	0.0	68.38	48.91	29067.5	19907.3	756.567	521.141	0.967	0.96	0.013	Different	0.001	Different	0.0502	0.0365
ORG_PROT.cultivatedArea	0.0	0.0	0.11	0.11	16.6	36.0	0.733	0.747	0.94	0.934	0.0	Different	0.002	Different	0.0465	0.0313
ORG_PROT.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.009	1.0	0.995	0.152	Similar	0.018	Different	28.5065	0.4581
ORG_PROT.quantitySold	0.0	0.0	0.13	0.14	43.5	78.4	1.256	1.356	0.947	0.96	0.0	Different	0.0	Different	0.0242	0.0212
ORG_PROT.quantityUsed	0.0	0.0	0.02	0.02	17.9	44.3	0.321	0.657	0.973	0.977	0.0	Different	0.02	Different	0.0389	0.0167
ORG_PROT.sellingPrice	0.0	0.0	23.86	24.6	1675.1	2302.8	136.765	187.929	0.947	0.96	0.0	Different	0.0	Different	0.1196	0.0555
ORG_PROT.valueSales	0.0	0.0	55.94	46.5	27744.1	18974.8	600.313	481.543	0.947	0.96	0.0	Different	0.0	Different	0.0349	0.0356
OTHER.cropProduction	0.0	0.0	651.05	679.5	59024.4	59024.4	3299.147	3482.23	0.935	0.938	0.0	Different	0.155	Similar	0.0054	0.0162
OTHER.cultivatedArea	0.0	0.0	0.19	0.2	28.7	28.7	0.883	0.908	0.924	0.921	0.002	Different	0.171	Similar	0.0086	0.0193
OTHER.irrigatedArea	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.031	1.0	1.0	1.0	Similar	1.0	Similar	26.0764	0.4644
OTHER.quantitySold	0.0	0.0	0.34	0.38	120.0	546.4	2.266	6.29	0.934	0.938	0.002	Different	0.145	Similar	0.1951	0.0498
OTHER.quantityUsed	0.0	0.0	0.0	0.0	0.7	0.7	0.009	0.022	0.998	0.996	0.991	Similar	0.968	Similar	0.0027	0.0143
OTHER.sellingPrice	0.0	0.0	142.82	121.58	3364.6	3319.1	546.471	500.179	0.93	0.938	0.0	Different	0.0	Different	0.1055	0.0483
OTHER.valueSales	0.0	0.0	614.54	586.54	64802.2	64802.2	3156.007	3008.073	0.93	0.938	0.0	Different	0.001	Different	0.0186	0.0274
OTHER_LIVESTOCK.dairyCows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.manureTotalSales	0.0	0.0	0.0	55.07	0.0	100818.0	0.0	1201.951	1.0	0.656	0.0	Different	0.0	Different	14.906	0.4172
OTHER_LIVESTOCK.milkProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalSales	0.0	0.0	34.98	0.0	77699.6	0.0	1648.173	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.423	0.4173
OTHER_LIVESTOCK.numberAnimalsForSlaughtering	0.0	0.0	25.25	24.48	50409.0	50409.0	601.724	601.135	0.623	0.676	0.0	Different	0.0	Different	0.0	0.0013
OTHER_LIVESTOCK.numberAnimalsRearingBreading	0.0	0.0	1.45	1.58	1496.0	1496.0	19.616	15.843	0.949	0.948	0.4	Similar	0.998	Similar	0.0003	0.0047
OTHER_LIVESTOCK.numberOfAnimals	0.0	0.0	12.26	12.01	10000.0	10000.7	133.6	132.268	0.656	0.656	0.0	Different	0.0	Different	0.0	0.0013
OTHER_LIVESTOCK.numberOfAnimalsSold	0.0	0.0	28.14	27.42	50409.0	50409.0	603.018	602.145	0.618	0.671	0.0	Different	0.0	Different	0.0	0.001
OTHER_LIVESTOCK.valueAnimalsRearingBreading	0.0	0.0	53.77	55.08	78433.6	78433.6	972.202	702.318	0.949	0.948	0.487	Similar	0.998	Similar	0.0003	0.0043
OTHER_LIVESTOCK.valueSlaughteredAnimals	0.0	0.0	2410.17	2308.8	1013772.4	1013772.4	19622.284	19365.936	0.623	0.676	0.0	Different	0.0	Different	0.0001	0.0026
OTHER_LIVESTOCK.valueSoldAnimals	0.0	0.0	2499.12	2381.48	1013772.4	1013772.4	19732.906	19314.821	0.618	0.671	0.0	Different	0.0	Different	0.0001	0.0028
OTHER_LIVESTOCK.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
POTATO.cropProduction	0.0	0.0	321.55	324.45	118768.2	118768.2	2278.438	2152.417	0.797	0.755	0.0	Different	0.0	Different	0.0028	0.0131
POTATO.cultivatedArea	0.0	0.0	0.12	0.14	29.9	29.9	0.661	0.677	0.712	0.67	0.0	Different	0.0	Different	0.0088	0.017
POTATO.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
POTATO.quantitySold	0.0	0.0	2.05	2.04	801.7	801.7	19.075	18.713	0.773	0.753	0.0	Different	0.0	Different	0.0029	0.0093
POTATO.quantityUsed	0.0	0.0	0.45	0.54	88.5	88.5	2.353	2.411	0.81	0.772	0.0	Different	0.0	Different	0.0059	0.0168
POTATO.sellingPrice	0.0	0.0	28.58	30.44	360.8	910.4	56.459	57.025	0.773	0.753	0.0	Different	0.0	Different	2.292	0.19
POTATO.valueSales	0.0	0.0	234.52	222.2	128674.9	128674.9	2125.256	1979.949	0.773	0.753	0.0	Different	0.0	Different	0.0017	0.0093
PROT.cropProduction	0.0	0.0	115.2	140.16	22334.3	29067.5	884.972	1022.724	0.949	0.943	0.022	Different	0.002	Different	0.0148	0.0227
PROT.cultivatedArea	0.0	0.0	0.23	0.23	36.0	27.9	1.204	1.183	0.909	0.9	0.0	Different	0.0	Different	0.0135	0.0265
PROT.irrigatedArea	0.0	0.0	0.0	0.0	0.5	0.4	0.035	0.015	0.995	0.998	0.256	Similar	0.227	Similar	0.002	0.0102

Figure 39. Statistical results: Poland 2014 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
PROT.quantitySold	0.0	0.0	0.35	0.31	155.0	155.0	3.231	2.929	0.928	0.941	0.0	Different	0.0	Different	0.0009	0.0081
PROT.quantityUsed	0.0	0.0	0.03	0.03	44.3	17.9	0.718	0.384	0.973	0.966	0.06	Similar	0.005	Different	0.0073	0.0189
PROT.sellingPrice	0.0	0.0	35.38	33.11	2302.8	2302.8	197.713	185.01	0.928	0.941	0.0	Different	0.0	Different	0.0235	0.0376
PROT.valueSales	0.0	0.0	101.15	110.46	22334.3	27744.1	763.688	836.321	0.928	0.941	0.0	Different	0.0	Different	0.0125	0.0226
agriculturalLandArea	0.0	0.0	13.06	13.06	1487.0	1487.4	34.248	34.176	0.0	0.0	0.0	Different	0.0	Different	0.0	0.0012
agriculturalLandHectaresAdquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
agriculturalLandValue	0.0	0.0	44655.82	45238.32	1194885.9	1194885.9	45309.835	45110.753	0.002	0.002	0.0	Different	0.0	Different	0.0005	0.0057
depreciation	270.6	270.6	4313.14	4632.54	213780.9	213780.9	6443.164	6501.174	0.0	0.0	0.0	Different	0.0	Different	0.0052	0.0184
farmBuildingsValue	0.0	0.0	26645.68	28178.59	2630349.9	2630349.9	63274.268	63913.966	0.034	0.017	0.0	Different	0.0	Different	0.0001	0.0031
farmNetIncome	-114186.9	-114186.9	6864.17	7520.85	248150.8	248150.8	11711.412	11788.197	0.0	0.0	0.0	Different	0.0	Different	0.0015	0.0099
fixedAssets	7576.0	7576.0	100914.34	105879.0	4303004.7	4303004.7	132498.495	132351.457	0.0	0.0	0.0	Different	0.0	Different	0.0007	0.0067
forestLandArea	0.0	0.0	0.9	0.94	18.2	18.2	1.267	1.325	0.283	0.285	0.0	Different	0.0	Different	0.0042	0.0163
forestLandValue	0.0	0.0	2093.31	2303.18	57862.7	57862.7	3823.026	4245.439	0.282	0.285	0.0	Different	0.0	Different	0.0111	0.0265
grossFarmIncome	-2038.2	-2038.2	13106.58	14359.64	1347814.5	1347814.5	32212.972	32309.523	0.0	0.0	0.0	Different	0.0	Different	0.0005	0.0055
intangibleAssetsNonTradable	0.0	0.0	2.27	3.14	792.2	792.2	36.136	40.552	0.995	0.993	0.912	Similar	0.423	Similar	0.0008	0.0075
intangibleAssetsTradable	0.0	0.0	736.94	756.66	588179.2	588179.2	12681.336	12693.591	0.703	0.707	0.0	Different	0.008	Different	0.0	0.0011
landImprovements	0.0	0.0	44.32	48.18	34482.8	34482.8	518.638	627.355	0.961	0.963	0.016	Different	0.469	Similar	0.0001	0.0029
longAndMediumTermLoans	0.0	0.0	2861.3	3143.11	548189.7	548189.7	15065.601	15495.247	0.817	0.805	0.0	Different	0.0	Different	0.0038	0.0158
machinery	0.0	0.0	20788.85	23169.02	638057.8	638057.8	36284.625	36488.27	0.025	0.029	0.0	Different	0.0	Different	0.0083	0.0231
machineryAndEquipment	0.0	0.0	20788.85	23169.02	638057.8	638057.8	36284.625	36488.27	0.025	0.029	0.0	Different	0.0	Different	0.0083	0.0231
otherNonCurrentAssets	0.0	0.0	18.61	18.21	59744.3	59744.3	871.314	865.203	0.987	0.991	0.386	Similar	0.131	Similar	0.0	0.0006
otherOutputs	0.0	0.0	469.27	432.29	473708.0	473708.0	8147.15	7990.427	0.635	0.654	0.0	Different	0.0	Different	0.0	0.0002
plantationsValue	0.0	0.0	743.48	1676.19	148703.3	148703.3	2699.808	10283.923	0.122	0.113	0.0	Different	0.0	Different	0.0125	0.0317
rentPaid	0.0	0.0	45.33	45.59	357.6	360.2	70.379	70.757	0.538	0.538	0.0	Different	0.097	Similar	0.0092	0.0248
specificCropCosts	0.0	0.0	398.96	485.25	51623.0	51623.0	2068.896	2239.65	0.022	0.026	0.0	Different	0.0	Different	0.0076	0.0249
subsidiesOnInvestments	0.0	0.0	252.45	294.79	21313.4	21313.4	1083.841	1111.78	0.873	0.865	0.0	Different	0.0	Different	0.0075	0.0229
taxes	0.0	0.0	283.43	288.34	73264.7	73264.7	1590.527	1589.812	0.006	0.01	0.0	Different	0.0	Different	0.0	0.0004
totalCurrentAssets	0.0	0.0	11826.76	12689.96	2102699.0	2102699.0	47368.445	47336.636	0.046	0.06	0.0	Different	0.0	Different	0.0002	0.0034
totalExternalFactors	0.0	0.0	1985.02	2169.3	974152.5	974152.5	21140.886	21188.636	0.254	0.223	0.0	Different	0.0	Different	0.0	0.0017
totalIntermediateConsumption	1605.6	1605.6	10859.77	11656.91	1707867.1	1707867.1	40040.802	40152.743	0.0	0.0	0.0	Different	0.0	Different	0.0001	0.0027
totalOutputCropsAndCropProduction	-5823.4	-5823.4	13698.54	15170.54	480764.8	480764.8	18353.436	19552.79	0.0	0.0	0.0	Different	0.0	Different	0.0057	0.0193
totalOutputLivestockAndLivestockProduction	-2613.3	-2613.3	5412.37	5857.82	2269417.5	2269417.5	50882.167	50888.808	0.468	0.447	0.0	Different	0.0	Different	0.0002	0.0031
vatBalanceExcludingInvestments	-3969.0	-3969.0	27.06	36.15	10159.3	10159.3	492.064	471.041	0.243	0.263	0.0	Different	0.0	Different	0.0061	0.0199
vatBalanceOnInvestments	-26990.1	-26990.1	-196.7	-233.86	0.0	0.0	1003.516	1073.882	0.817	0.814	0.0	Different	0.006	Different	0.0049	0.0179

Figure 40. Statistical results: Poland 2014 (sheet 3)

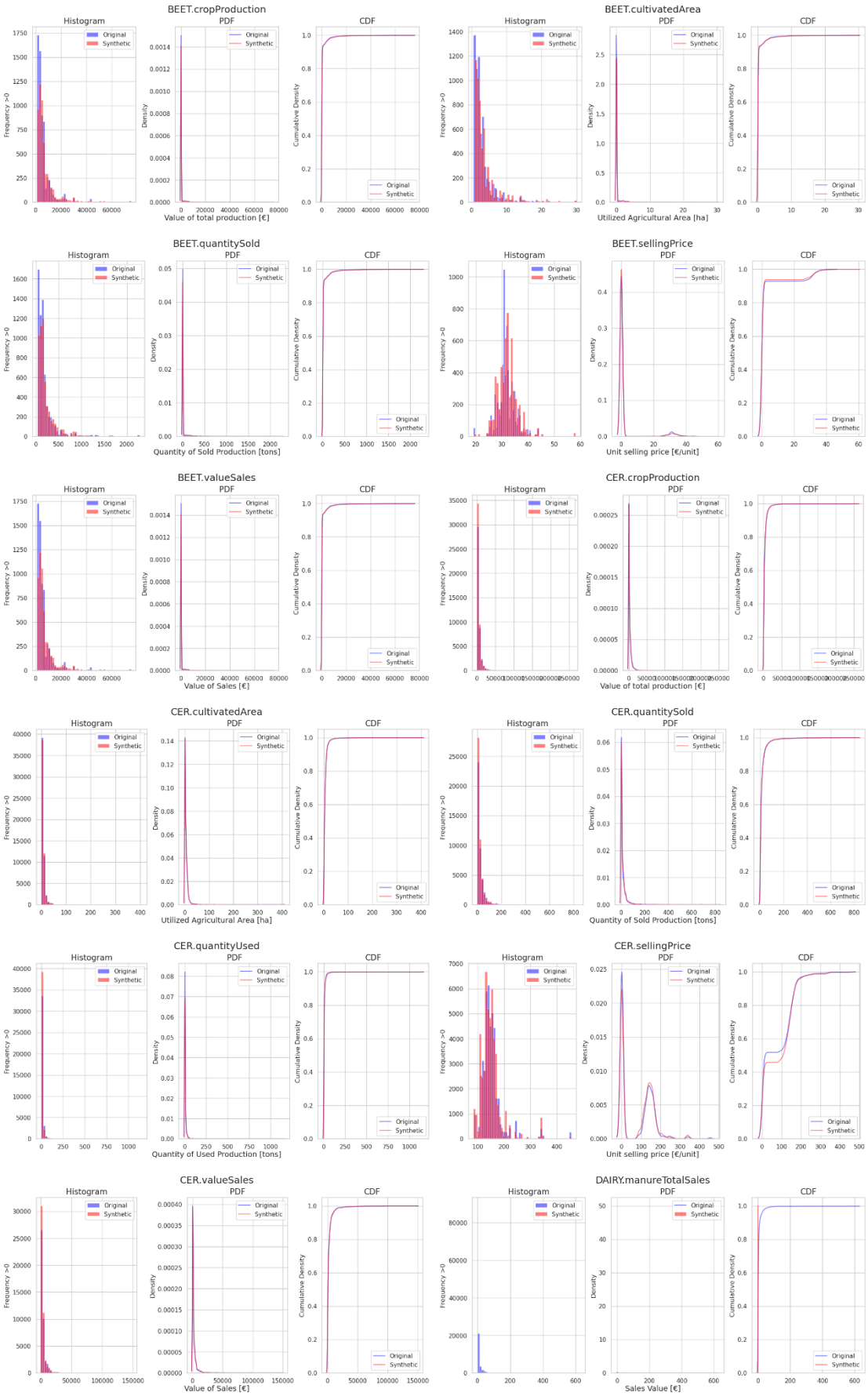

Figure 41. Statistical results: Poland 2014 (sheet 1)

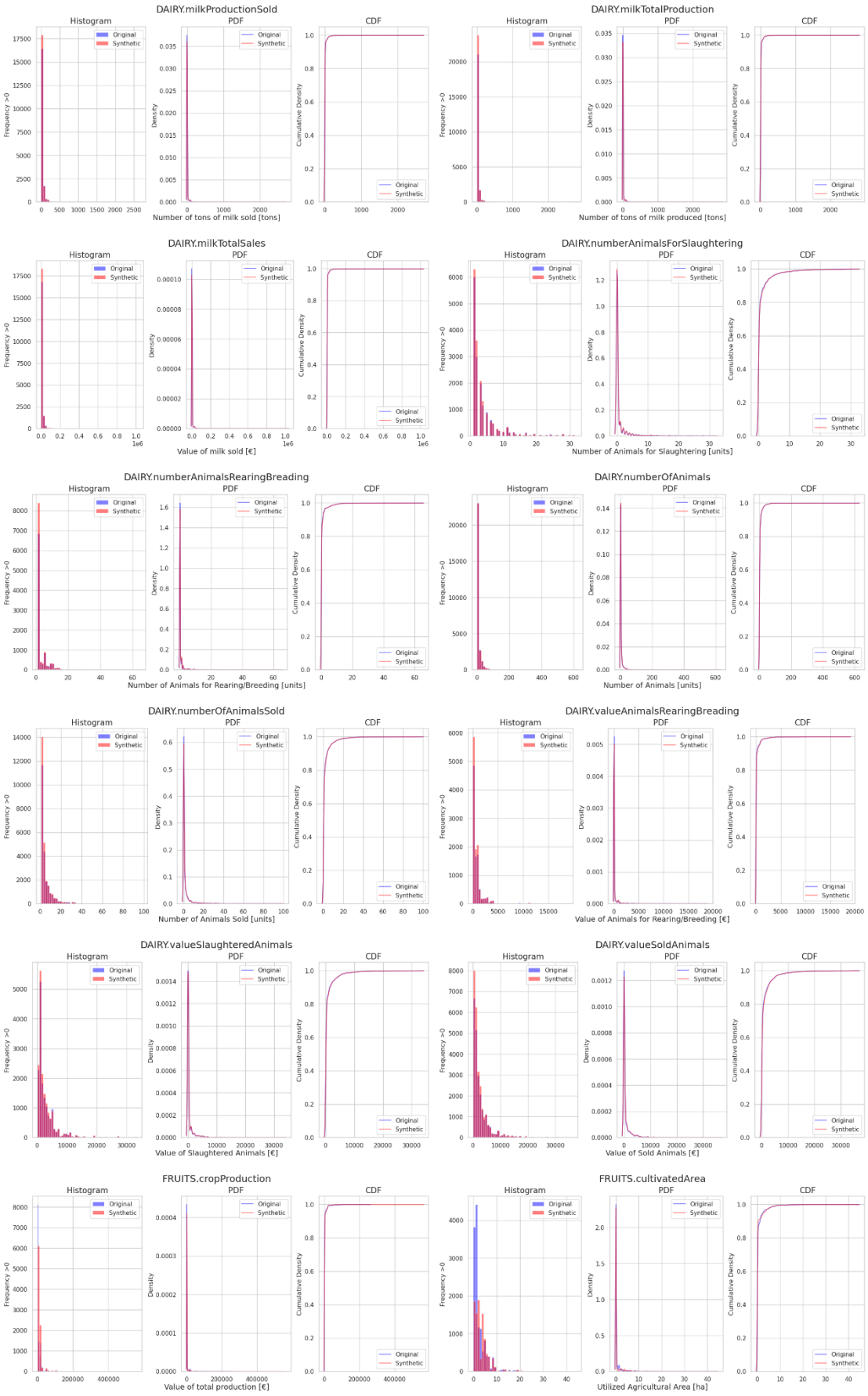

Figure 42. Statistical results: Poland 2014 (sheet 2)

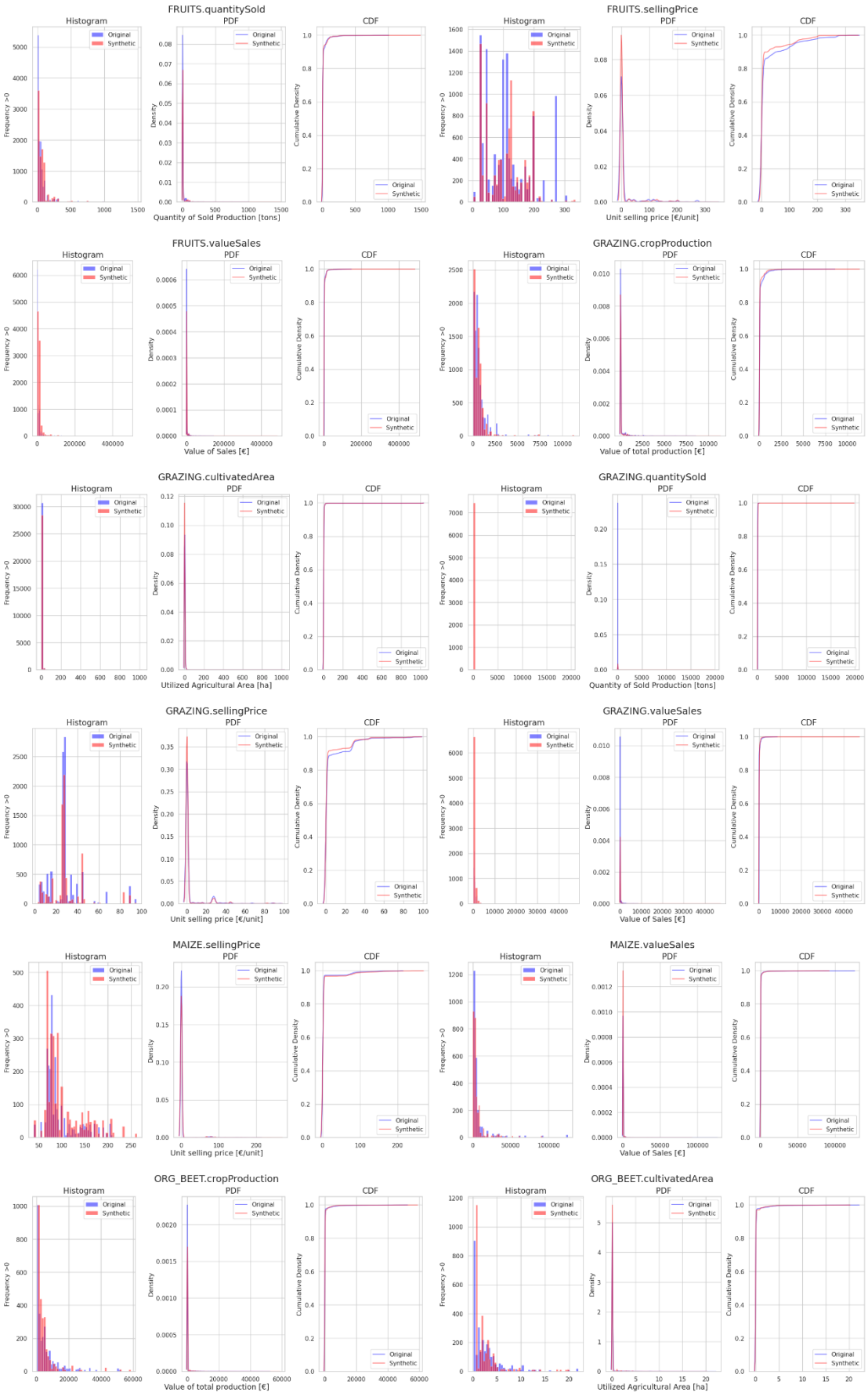

Figure 43. Statistical results: Poland 2014 (sheet 3)

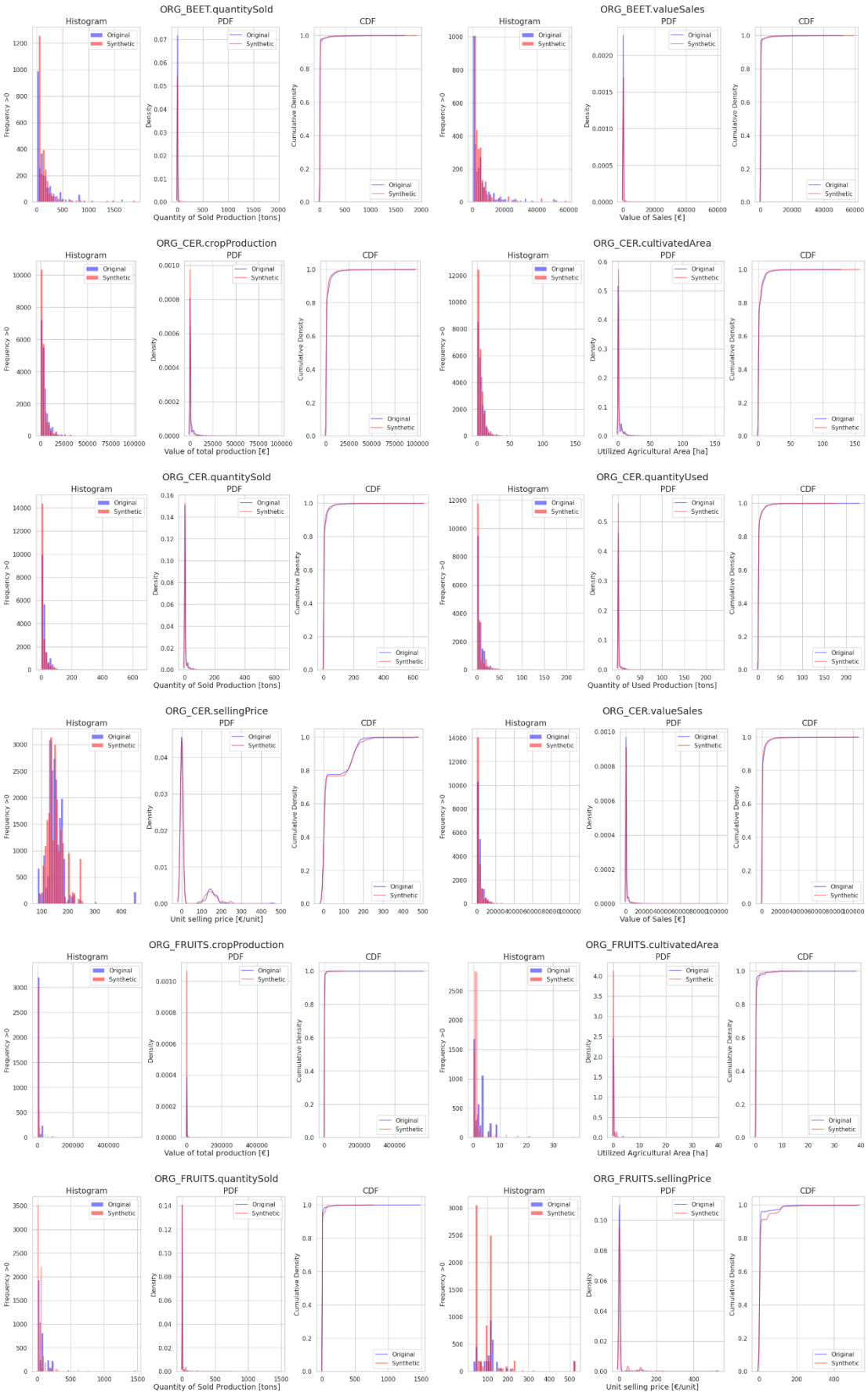

Figure 44. Statistical results: Poland 2014 (sheet 4)

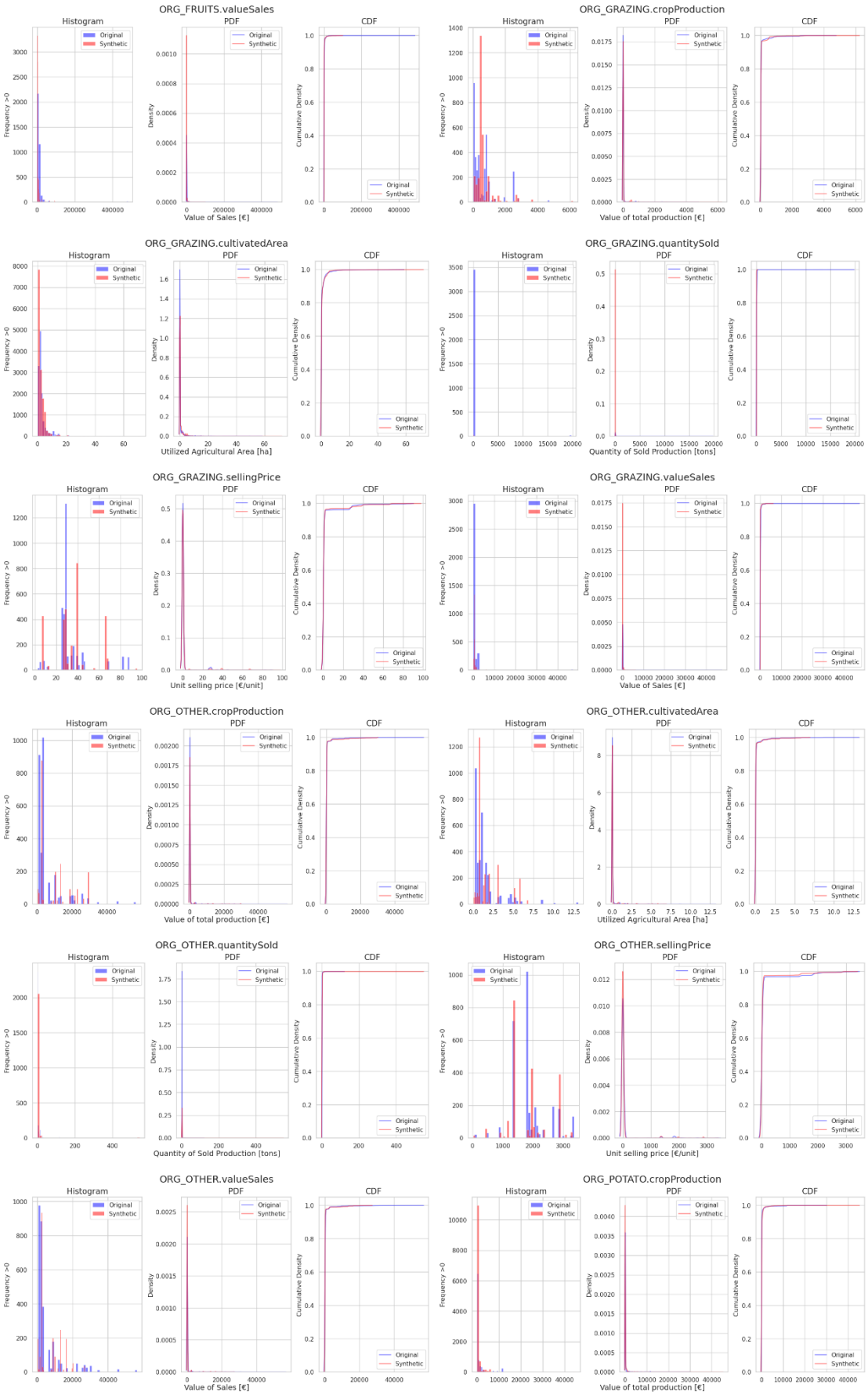

Figure 45. Statistical results: Poland 2014 (sheet 5)

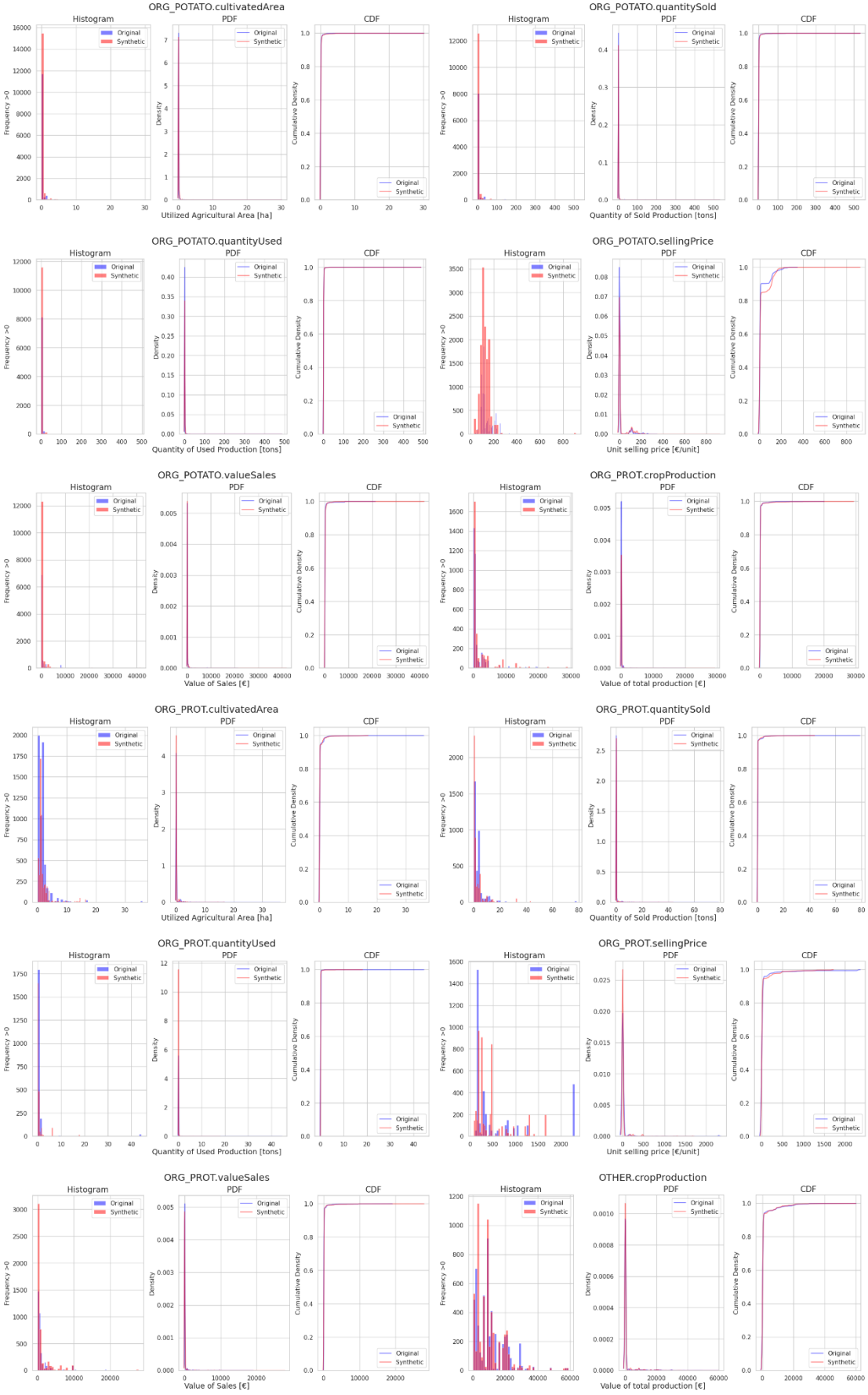

Figure 46. Statistical results: Poland 2014 (sheet 6)

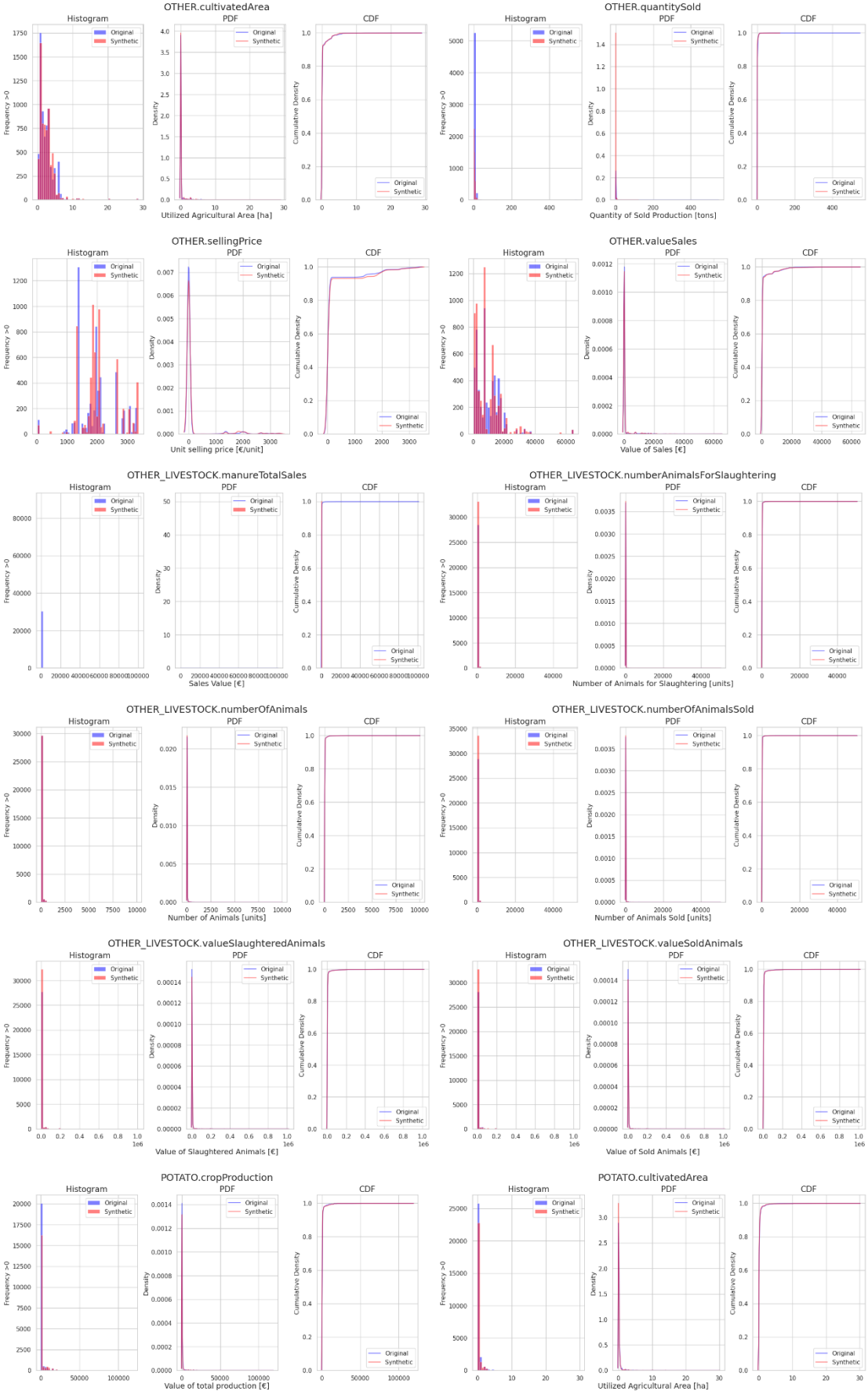

Figure 47. Statistical results: Poland 2014 (sheet 7)

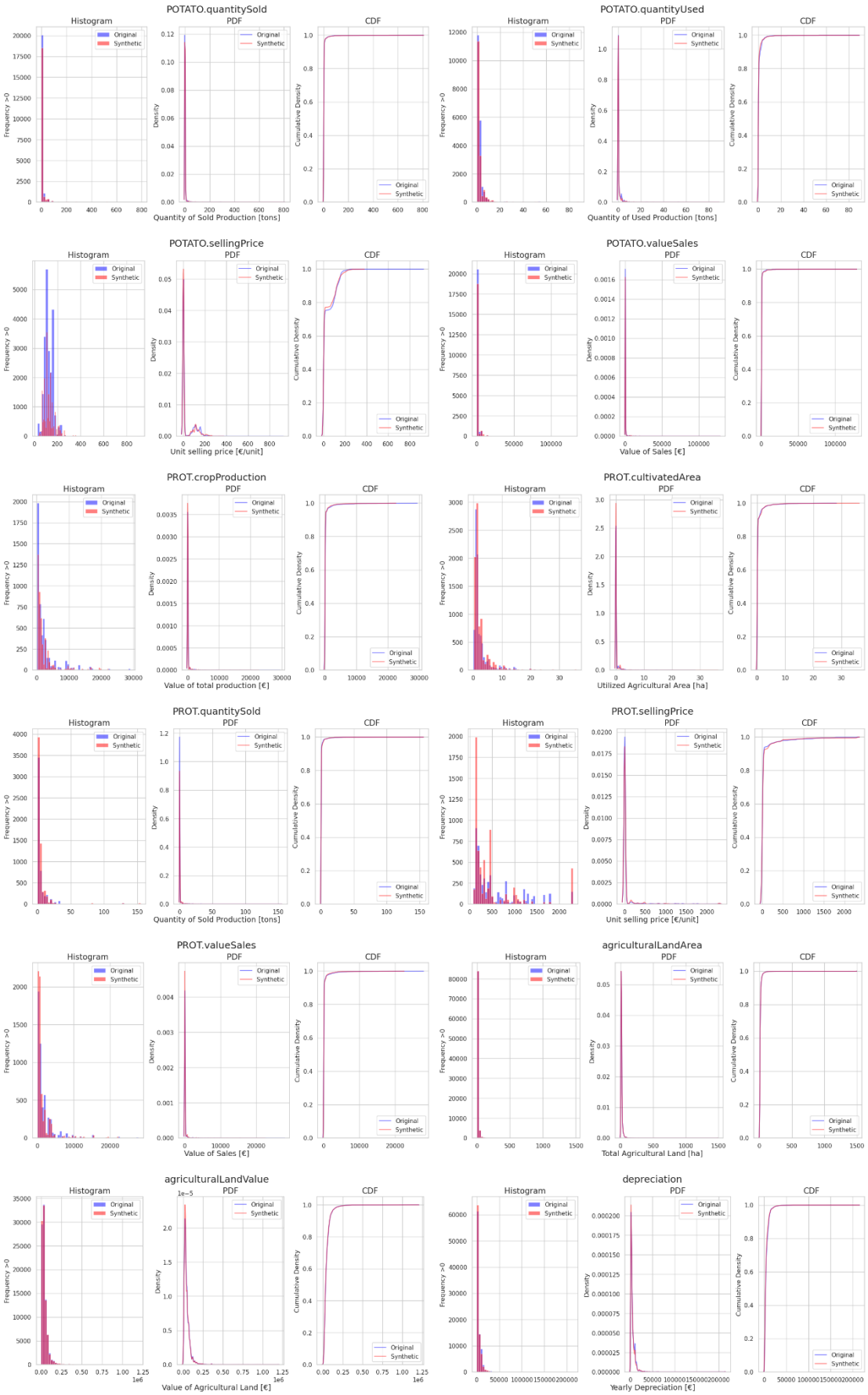

Figure 48. Statistical results: Poland 2014 (sheet 8)

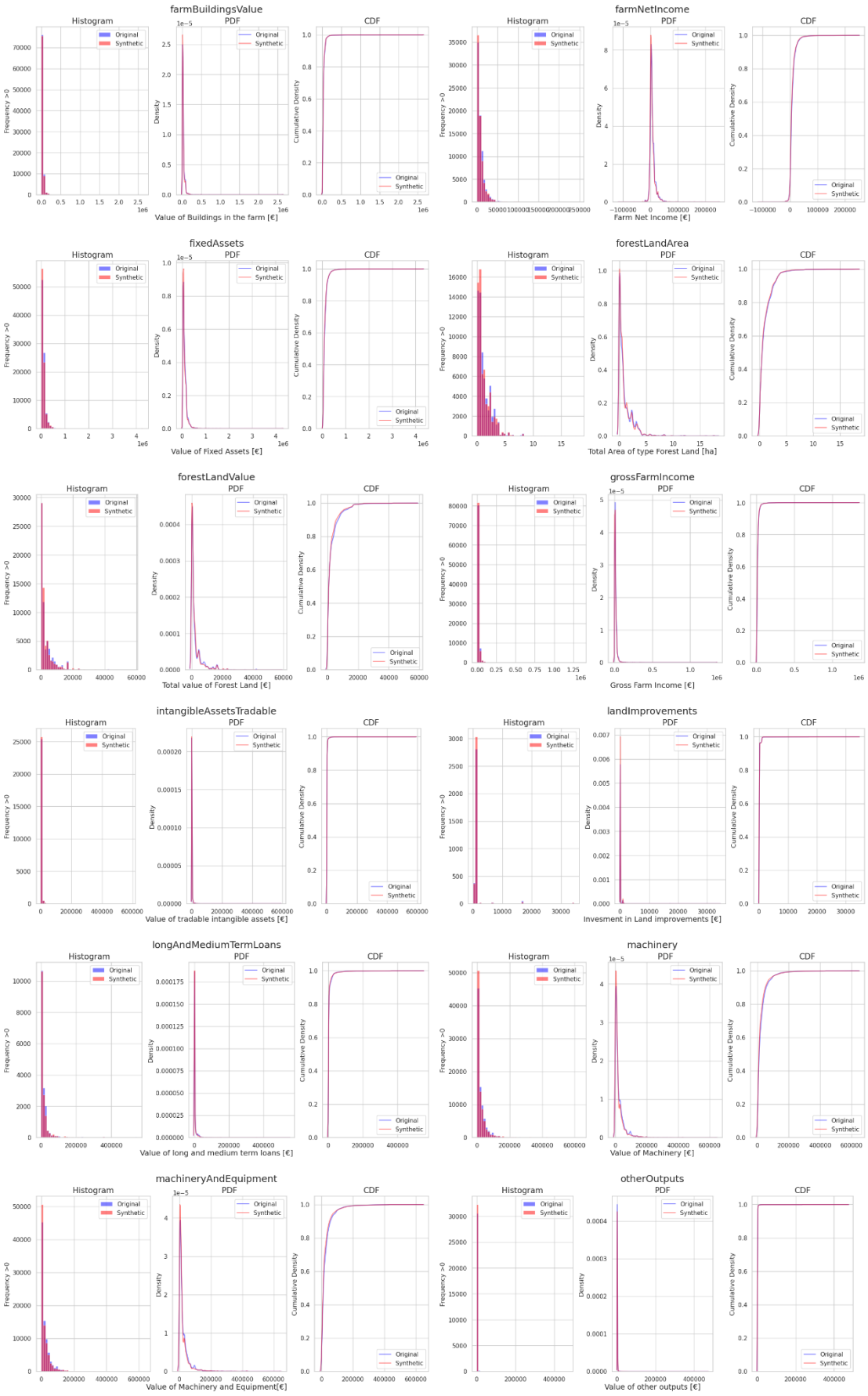

Figure 49. Statistical results: Poland 2014 (sheet 9)

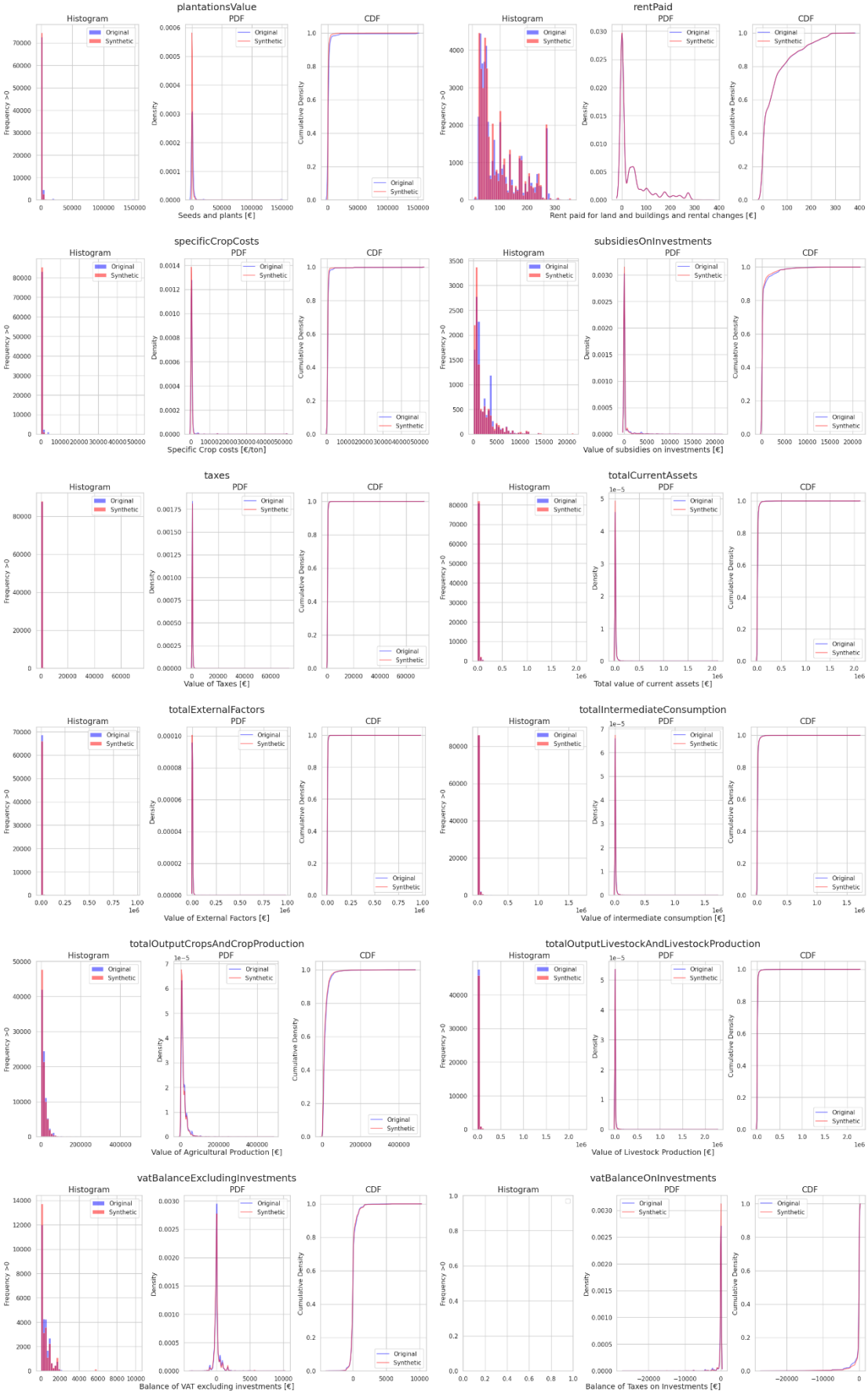

Figure 50. Statistical results: Poland 2014 (sheet 10)

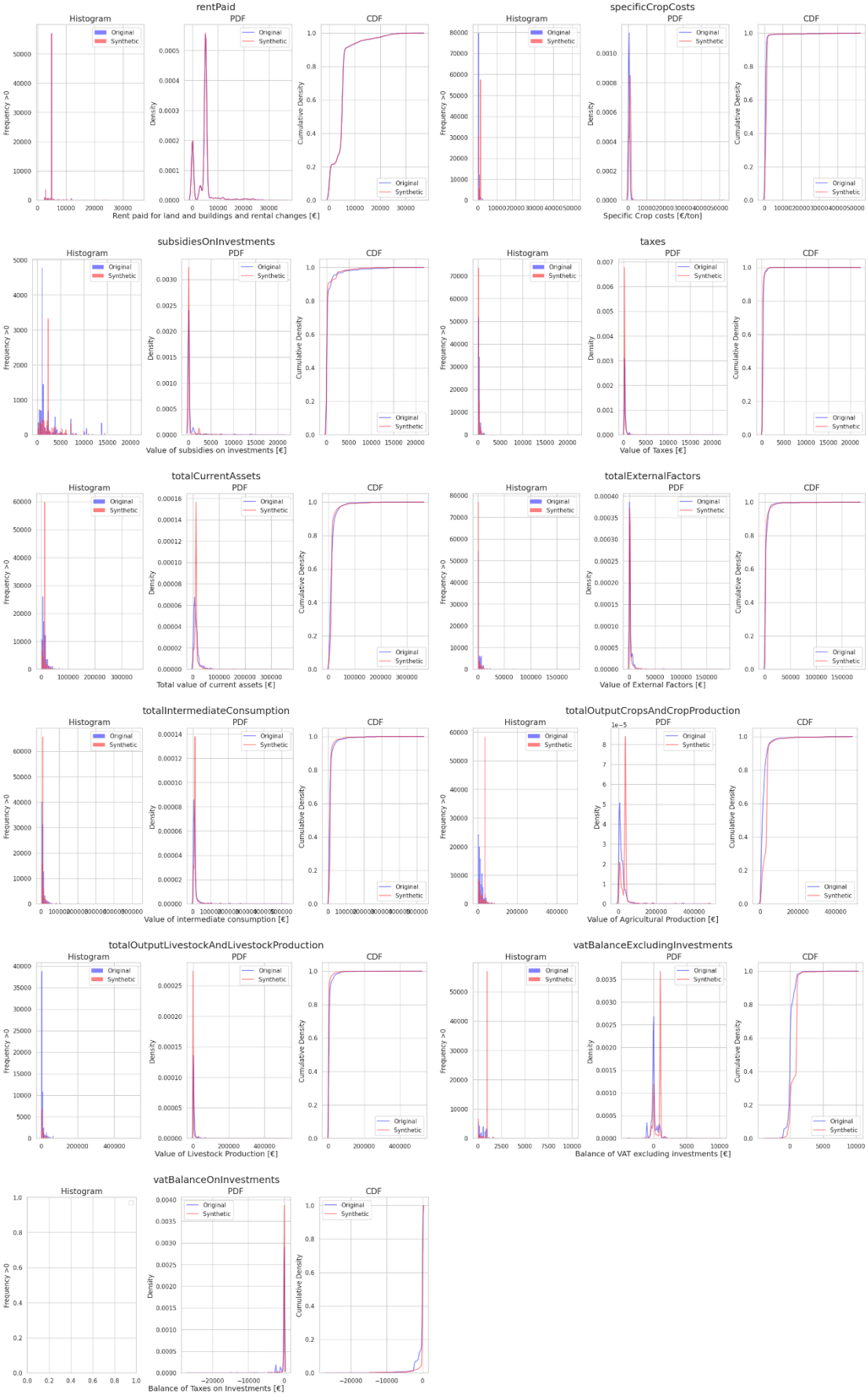

Figure 51. Statistical results: Poland 2014 (sheet 11)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
CER	426668	411481	0.964
ORG_CER	139346	157629	1.131
GRAZING	125894	136845	1.087
ORG_GRAZING	37024	36716	0.992
FRUITS	32410	34146	1.054
PROT	20872	20860	0.999
BEET	20362	19602	0.963
MAIZE	18636	19430	1.043
OTHER	16658	17334	1.041
ORG_FRUITS	14087	11563	0.821
POTATO	10831	12187	1.125
ORG_PROT	9760	9386	0.962
ORG_MAIZE	7800	5640	0.723
ORG_BEET	6912	7513	1.087
ORG_OTHER	5037	4504	0.894
ORG_POTATO	4739	3158	0.666

Table 14. Poland use case, 2014: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
CER	249690724	240724073	0.964
FRUITS	93944751	95710977	1.019
ORG_CER	72080421	89206558	1.238
OTHER	57851189	60378624	1.044
BEET	39582873	36742509	0.928
ORG_FRUITS	35934721	31661948	0.881
POTATO	28572383	28829773	1.009
ORG_OTHER	20260075	16002804	0.79
MAIZE	17588997	18415214	1.047
ORG_BEET	12997793	14857625	1.143
PROT	10236392	12453898	1.217
ORG_POTATO	8898089	8529180	0.959
ORG_MAIZE	7899018	4769989	0.604
ORG_PROT	6076021	4345720	0.715
GRAZING	4047193	6240809	1.542
ORG_GRAZING	1964549	2092188	1.065

Table 15. Poland use case, 2014: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
BEET	1220614	1139253	0.933
CER	1156782	1132463	0.979
FRUITS	635560	684676	1.077
ORG_BEET	406654	468007	1.151
GRAZING	399838	252465	0.631
ORG_FRUITS	384692	236064	0.614
ORG_CER	367761	447021	1.216
POTATO	182362	181655	0.996
MAIZE	154371	160141	1.037
ORG_GRAZING	82118	369438	4.499
ORG_MAIZE	68659	41908	0.61
ORG_POTATO	59000	46811	0.793
PROT	30712	27446	0.894
OTHER	29813	34106	1.144
ORG_OTHER	14185	9966	0.703
ORG_PROT	11841	12051	1.018

Table 16. Poland use case, 2014: quantity sold ratio comparison

Year 2018

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
1400.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1600.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1700.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
23113.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
2313.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
9900.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
9901.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
BEET.cropProduction	0.0	0.0	502.59	463.28	80656.7	60550.0	3081.668	2726.643	0.93	0.93	0.024	Different	0.98	Similar	0.0156	0.0272
BEET.cultivatedArea	0.0	0.0	0.31	0.3	38.0	30.6	1.685	1.546	0.93	0.93	0.068	Similar	0.968	Similar	0.0126	0.0212
BEET.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
BEET.quantitySold	0.0	0.0	19.38	17.8	3337.1	2344.6	119.164	103.45	0.93	0.93	0.004	Different	0.877	Similar	0.0126	0.0219
BEET.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
BEET.sellingPrice	0.0	0.0	1.82	1.82	56.1	58.7	6.787	6.757	0.93	0.93	0.26	Similar	0.995	Similar	0.0269	0.0274
BEET.valueSales	0.0	0.0	502.57	462.94	80656.7	60550.0	3081.665	2726.206	0.93	0.93	0.024	Different	0.977	Similar	0.0156	0.0271
CER.cropProduction	0.0	0.0	3213.79	3003.61	119314.0	119314.0	6551.938	6555.779	0.38	0.52	0.0	Different	0.0	Different	0.0039	0.0152
CER.cultivatedArea	0.0	0.0	5.4	4.82	284.0	102.0	8.915	7.868	0.324	0.433	0.0	Different	0.0	Different	0.2558	0.1371
CER.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
CER.quantitySold	0.0	0.0	16.78	15.66	765.1	653.8	38.174	37.577	0.382	0.522	0.0	Different	0.0	Different	0.0158	0.032
CER.quantityUsed	0.0	0.0	3.58	2.82	504.7	180.1	11.438	8.128	0.456	0.596	0.0	Different	0.0	Different	0.0502	0.0618
CER.sellingPrice	0.0	0.0	93.39	75.38	901.3	901.3	84.027	85.953	0.374	0.52	0.0	Different	0.0	Different	0.084	0.0711
CER.valueSales	0.0	0.0	2564.32	2436.63	122733.2	110809.4	6200.772	6095.407	0.374	0.52	0.0	Different	0.0	Different	0.0206	0.0343
DAIRY.dairyCows	0.0	0.0	0.95	0.95	431.0	431.0	7.815	7.819	0.839	0.839	1.0	Similar	1.0	Similar	0.0	0.0012
DAIRY.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.manureTotalSales	0.0	0.0	0.0	4.07	0.0	768.0	0.0	16.806	1.0	0.748	0.0	Different	0.0	Different	19.7833	0.4254
DAIRY.milkProductionSold	0.0	0.0	4.49	4.49	3535.3	3535.3	60.3	60.387	0.899	0.907	0.01	Different	0.001	Different	0.0	0.0005
DAIRY.milkTotalProduction	0.0	0.0	4.98	4.96	3596.1	3596.1	61.359	61.441	0.827	0.838	0.0	Different	0.0	Different	0.0	0.0006
DAIRY.milkTotalSales	0.0	0.0	1363.63	1363.58	1204148.0	1204148.0	20302.569	20329.978	0.899	0.907	0.01	Different	0.001	Different	0.0	0.0012
DAIRY.numberAnimalsForSlaughtering	0.0	0.0	0.96	0.82	72.0	72.0	3.296	3.175	0.768	0.816	0.0	Different	0.0	Different	0.0013	0.0082
DAIRY.numberAnimalsRearingBreading	0.0	0.0	0.37	0.35	40.0	40.0	1.964	1.935	0.893	0.9	0.051	Similar	0.004	Different	0.0004	0.0052
DAIRY.numberOfAnimals	0.0	0.0	3.1	3.09	734.0	734.3	14.757	14.751	0.748	0.748	0.0	Different	0.001	Different	0.0	0.0007
DAIRY.numberOfAnimalsSold	0.0	0.0	1.74	1.54	337.0	337.0	7.099	7.034	0.723	0.779	0.0	Different	0.0	Different	0.0002	0.0037
DAIRY.valueAnimalsRearingBreading	0.0	0.0	169.87	160.81	20755.0	20755.0	821.074	811.707	0.893	0.9	0.051	Similar	0.004	Different	0.0004	0.0047
DAIRY.valueSlaughteredAnimals	0.0	0.0	942.3	826.74	82140.7	82140.7	3428.805	3328.055	0.768	0.816	0.0	Different	0.0	Different	0.0011	0.008
DAIRY.valueSoldAnimals	0.0	0.0	1341.97	1182.38	146018.4	146018.4	4457.787	4384.471	0.723	0.779	0.0	Different	0.0	Different	0.0004	0.0047
DAIRY.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
FRUITS.cropProduction	0.0	0.0	487.96	464.72	158179.6	118444.1	4501.644	4175.401	0.932	0.947	0.0	Different	0.0	Different	0.0214	0.0328
FRUITS.cultivatedArea	0.0	0.0	0.16	0.15	19.3	22.4	0.931	0.938	0.918	0.929	0.0	Different	0.0	Different	0.0544	0.0402
FRUITS.irrigatedArea	0.0	0.0	0.0	0.0	10.9	8.3	0.2	0.167	0.999	0.999	1.0	Similar	1.0	Similar	0.0095	0.0117
FRUITS.quantitySold	0.0	0.0	3.27	3.1	1149.2	1149.2	28.752	27.642	0.931	0.947	0.0	Different	0.0	Different	0.0155	0.0195
FRUITS.quantityUsed	0.0	0.0	0.0	0.0	1.6	1.6	0.067	0.065	0.998	0.998	1.0	Similar	1.0	Similar	0.0	0.0006
FRUITS.sellingPrice	0.0	0.0	15.21	10.38	894.1	894.1	91.614	73.903	0.931	0.947	0.0	Different	0.0	Different	0.0112	0.0221
FRUITS.valueSales	0.0	0.0	467.25	441.13	227500.8	227500.8	4539.758	4817.128	0.931	0.947	0.0	Different	0.0	Different	0.0059	0.0154
GRAZING.cropProduction	0.0	0.0	253.56	61.79	715643.5	8449.5	11336.563	341.476	0.789	0.878	0.0	Different	0.0	Different	0.0558	0.0694
GRAZING.cultivatedArea	0.0	0.0	1.3	1.08	708.7	48.9	11.521	2.676	0.569	0.63	0.0	Different	0.0	Different	0.2214	0.1361
GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.quantitySold	0.0	0.0	5.26	4.0	180.0	256.3	18.39	17.476	0.789	0.878	0.0	Different	0.0	Different	0.285	0.0813
GRAZING.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.sellingPrice	0.0	0.0	5.08	3.57	117.4	117.4	14.485	13.572	0.789	0.878	0.0	Different	0.0	Different	0.104	0.0733
GRAZING.valueSales	0.0	0.0	74.5	67.23	11735.4	8449.5	370.529	356.698	0.789	0.878	0.0	Different	0.0	Different	0.0242	0.0364
MAIZE.cropProduction	0.0	0.0	202.0	142.99	62712.9	57293.9	2013.317	1911.741	0.972	0.98	0.009	Different	0.0	Different	0.0172	0.0271
MAIZE.cultivatedArea	0.0	0.0	0.17	0.13	40.0	32.5	1.551	1.308	0.969	0.973	0.031	Different	0.09	Similar	0.0362	0.0235
MAIZE.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
MAIZE.quantitySold	0.0	0.0	1.42	1.1	305.7	467.3	13.587	14.593	0.972	0.98	0.009	Different	0.001	Different	0.035	0.0287
MAIZE.quantityUsed	0.0	0.0	0.16	0.02	554.0	32.0	8.786	0.605	0.996	0.998	0.999	Similar	0.858	Similar	0.0016	0.0116
MAIZE.sellingPrice	0.0	0.0	3.92	2.55	281.7	180.6	23.339	18.341	0.971	0.98	0.001	Different	0.0	Different	0.2639	0.0628
MAIZE.valueSales	0.0	0.0	195.1	145.74	42340.7	62427.8	1854.037	1980.605	0.971	0.98	0.002	Different	0.0	Different	0.073	0.0321
ORG_BEET.cropProduction	0.0	0.0	137.76	185.92	33295.5	80656.7	1295.392	2189.056	0.973	0.979	0.06	Similar	0.01	Different	0.0239	0.0223
ORG_BEET.cultivatedArea	0.0	0.0	0.09	0.11	16.2	38.1	0.788	1.149	0.973	0.979	0.036	Different	0.01	Different	0.0535	0.0259
ORG_BEET.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_BEET.quantitySold	0.0	0.0	5.37	7.22	1147.9	3337.1	50.282	87.387	0.973	0.979	0.086	Similar	0.01	Different	0.0319	0.0277
ORG_BEET.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_BEET.sellingPrice	0.0	0.0	0.72	0.56	58.7	52.6	4.341	3.883	0.973	0.979	0.01	Different	0.009	Different	0.0307	0.0375
ORG_BEET.valueSales	0.0	0.0	137.76	185.89	33295.5	80656.7	1295.392	2189.045	0.973	0.979	0.06	Similar	0.01	Different	0.0239	0.0223
ORG_CER.cropProduction	0.0	0.0	1353.67	1707.9	68309.8	156024.4	3831.385	4607.228	0.67	0.681	0.0	Different	0.0	Different	0.0773	0.0533
ORG_CER.cultivatedArea	0.0	0.0	2.2	2.76	94.7	378.9	5.345	7.9	0.637	0.616	0.0	Different	0.0	Different	0.4519	0.1042
ORG_CER.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_CER.quantitySold	0.0	0.0	6.48	8.45	349.5	1020.1	21.551	26.414	0.67	0.681	0.0	Different	0.0	Different	0.1409	0.0534
ORG_CER.quantityUsed	0.0	0.0	1.4	1.57	168.2	672.9	5.478	11.218	0.715	0.738	0.0	Different	0.0	Different	0.2164	0.0693
ORG_CER.sellingPrice	0.0	0.0	53.82	52.65	901.3	901.3	85.057	85.298	0.669	0.681	0.0	Different	0.0	Different	0.079	0.0395
ORG_CER.valueSales	0.0	0.0	1023.2	1340.78	58343.8	163644.3	3411.455	4227.64	0.669	0.681	0.0	Different	0.0	Different	0.0801	0.0482
ORG_FRUITS.cropProduction	0.0	0.0	280.37	299.46	97321.1	210906.1	2982.911	4138.693	0.965	0.967	0.001	Different	0.394	Similar	0.0177	0.0265
ORG_FRUITS.cultivatedArea	0.0	0.0	0.09	0.1	22.3	16.9	0.716	0.711	0.962	0.959	0.008	Different	0.261	Similar	0.0239	0.0344
ORG_FRUITS.irrigatedArea	0.0	0.0	0.01	0.01	8.0	14.5	0.183	0.255	0.999	0.999	1.0	Similar	1.0	Similar	0.0033	0.0081

Figure 52. Statistical results: Poland 2018 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_FRUITS.quantitySold	0.0	0.0	2.07	2.42	521.8	635.1	17.842	22.633	0.965	0.967	0.008	Different	0.417	Similar	0.0637	0.0399
ORG_FRUITS.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_FRUITS.sellingPrice	0.0	0.0	10.78	4.08	894.1	447.0	87.461	27.668	0.965	0.967	0.001	Different	0.376	Similar	0.0479	0.0544
ORG_FRUITS.valueSales	0.0	0.0	244.56	276.5	98287.7	135944.8	2707.416	3306.463	0.965	0.967	0.001	Different	0.377	Similar	0.038	0.0307
ORG_GRAZING.cropProduction	0.0	0.0	77.2	246.56	238547.8	954191.3	3779.429	14335.66	0.909	0.906	0.0	Different	0.0	Different	0.0	0.0003
ORG_GRAZING.cultivatedArea	0.0	0.0	0.42	0.63	236.2	945.0	4.036	14.284	0.795	0.786	0.0	Different	0.0	Different	0.037	0.0243
ORG_GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.quantitySold	0.0	0.0	1.06	1.46	256.3	140.0	8.141	6.719	0.909	0.906	0.0	Different	0.0	Different	0.0643	0.0573
ORG_GRAZING.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.sellingPrice	0.0	0.0	2.19	3.06	111.8	117.4	9.835	13.219	0.909	0.906	0.0	Different	0.01	Different	0.1662	0.0732
ORG_GRAZING.valueSales	0.0	0.0	17.63	33.21	4855.7	11735.4	137.04	283.276	0.909	0.906	0.0	Different	0.0	Different	0.0752	0.0404
ORG_MAIZE.cropProduction	0.0	0.0	69.93	110.88	56148.0	62712.9	1322.739	1519.259	0.988	0.982	0.007	Different	0.017	Different	0.0171	0.0242
ORG_MAIZE.cultivatedArea	0.0	0.0	0.06	0.11	32.0	40.2	1.016	1.38	0.984	0.979	0.015	Different	0.022	Different	0.0304	0.0274
ORG_MAIZE.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_MAIZE.quantitySold	0.0	0.0	0.56	0.77	467.3	288.9	10.927	9.93	0.988	0.983	0.006	Different	0.015	Different	0.0154	0.0234
ORG_MAIZE.quantityUsed	0.0	0.0	0.05	0.15	198.8	756.3	3.161	10.024	0.997	0.996	1.0	Similar	0.998	Similar	0.0015	0.0038
ORG_MAIZE.sellingPrice	0.0	0.0	1.5	2.2	158.5	281.7	13.858	16.992	0.988	0.983	0.157	Similar	0.027	Different	0.142	0.0539
ORG_MAIZE.valueSales	0.0	0.0	70.54	95.39	62427.8	40356.9	1422.885	1223.378	0.988	0.983	0.008	Different	0.025	Different	0.0091	0.0243
ORG_OTHER.cropProduction	0.0	0.0	301.81	201.97	56007.1	56007.1	2740.931	2016.295	0.98	0.981	0.072	Similar	0.996	Similar	0.0404	0.0302
ORG_OTHER.cultivatedArea	0.0	0.0	0.06	0.08	11.0	40.1	0.514	0.906	0.977	0.974	0.578	Similar	0.305	Similar	0.1585	0.0372
ORG_OTHER.irrigatedArea	0.0	0.0	0.0	0.0	10.2	0.0	0.138	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4236	0.4564
ORG_OTHER.quantitySold	0.0	0.0	0.11	0.1	24.8	57.5	0.985	1.084	0.98	0.981	0.397	Similar	1.0	Similar	0.0957	0.0357
ORG_OTHER.quantityUsed	0.0	0.0	0.0	0.0	0.1	3.3	0.001	0.04	1.0	0.999	1.0	Similar	1.0	Similar	0.0029	0.0041
ORG_OTHER.sellingPrice	0.0	0.0	64.93	38.18	5086.6	5026.1	463.464	302.729	0.978	0.981	0.0	Different	0.255	Similar	0.0934	0.0426
ORG_OTHER.valueSales	0.0	0.0	293.21	207.7	56202.7	39481.9	2652.259	2041.633	0.978	0.981	0.147	Similar	0.336	Similar	0.0652	0.0419
ORG_POTATO.cropProduction	0.0	0.0	69.63	126.4	21935.4	55742.7	557.949	1568.475	0.887	0.89	0.0	Different	0.0	Different	0.0241	0.0298
ORG_POTATO.cultivatedArea	0.0	0.0	0.03	0.05	7.5	26.1	0.201	0.636	0.812	0.817	0.0	Different	0.0	Different	0.0632	0.0343
ORG_POTATO.irrigatedArea	0.0	0.0	0.0	0.0	3.6	0.0	0.044	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4256	0.4624
ORG_POTATO.quantitySold	0.0	0.0	0.39	0.84	196.0	1319.9	4.401	20.082	0.887	0.89	0.0	Different	0.0	Different	0.0285	0.0228
ORG_POTATO.quantityUsed	0.0	0.0	0.5	0.14	82.3	85.2	2.505	1.773	0.893	0.895	0.0	Different	0.0	Different	0.1277	0.0613
ORG_POTATO.sellingPrice	0.0	0.0	17.6	15.48	234.7	469.5	43.069	47.504	0.845	0.89	0.0	Different	0.0	Different	1.839	0.1526
ORG_POTATO.valueSales	0.0	0.0	46.52	95.9	21935.4	107212.5	467.598	1862.56	0.845	0.89	0.0	Different	0.0	Different	0.0331	0.0265
ORG_PROT.cropProduction	0.0	0.0	59.88	75.11	12283.8	27989.4	494.705	678.907	0.964	0.952	0.0	Different	0.0	Different	0.0271	0.0268
ORG_PROT.cultivatedArea	0.0	0.0	0.15	0.18	21.0	46.2	0.782	1.247	0.925	0.927	0.0	Different	0.308	Similar	0.0428	0.0351
ORG_PROT.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_PROT.quantitySold	0.0	0.0	0.17	0.19	84.3	43.7	1.706	1.268	0.964	0.953	0.0	Different	0.0	Different	0.0218	0.0386
ORG_PROT.quantityUsed	0.0	0.0	0.02	0.02	9.5	9.6	0.181	0.22	0.974	0.969	0.07	Similar	0.055	Similar	0.0394	0.0236
ORG_PROT.sellingPrice	0.0	0.0	20.27	21.43	1093.2	1173.5	95.954	116.56	0.946	0.953	0.0	Different	0.002	Different	0.0728	0.0611
ORG_PROT.valueSales	0.0	0.0	75.03	70.59	13498.1	29453.3	554.237	585.704	0.946	0.953	0.022	Different	0.004	Different	0.0439	0.0339
OTHER.cropProduction	0.0	0.0	547.7	624.29	67996.8	67996.8	3650.683	4064.646	0.961	0.963	0.198	Similar	0.709	Similar	0.0327	0.0306
OTHER.cultivatedArea	0.0	0.0	0.13	0.12	30.0	17.3	0.908	0.779	0.947	0.951	0.074	Similar	0.092	Similar	0.0128	0.0318
OTHER.irrigatedArea	0.0	0.0	0.0	0.0	5.5	10.2	0.067	0.159	1.0	0.999	1.0	Similar	0.995	Similar	0.001	0.0102
OTHER.quantitySold	0.0	0.0	0.24	0.24	57.5	45.4	1.719	1.636	0.961	0.963	0.03	Different	0.651	Similar	0.0091	0.0237
OTHER.quantityUsed	0.0	0.0	0.0	0.0	3.3	0.1	0.04	0.002	0.999	0.999	1.0	Similar	1.0	Similar	0.0056	0.0101
OTHER.sellingPrice	0.0	0.0	101.31	107.09	5433.1	5433.1	517.387	588.222	0.957	0.963	0.033	Different	0.009	Different	0.0673	0.0395
OTHER.valueSales	0.0	0.0	560.19	615.22	88477.3	88477.3	3692.755	4035.855	0.957	0.963	0.088	Similar	0.009	Different	0.0172	0.0266
OTHER_LIVESTOCK.dairyCows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.manureTotalSales	0.0	0.0	0.0	101.09	0.0	233928.0	0.0	2857.275	1.0	0.748	0.0	Different	0.0	Different	14.0643	0.4169
OTHER_LIVESTOCK.milkProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalSales	0.0	0.0	6.98	0.0	27838.8	0.0	440.807	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4247	0.418
OTHER_LIVESTOCK.numberAnimalsForSlaughtering	0.0	0.0	31.07	30.95	116964.0	116964.0	1379.982	1376.35	0.717	0.792	0.0	Different	0.0	Different	0.0	0.0
OTHER_LIVESTOCK.numberAnimalsRearingBreading	0.0	0.0	18.42	15.77	9700.0	9700.0	420.284	383.738	0.982	0.971	0.0	Different	0.0	Different	0.0	0.0013
OTHER_LIVESTOCK.numberOfAnimals	0.0	0.0	15.48	15.22	8616.0	8617.8	114.893	112.525	0.748	0.748	0.0	Different	0.0	Different	0.0001	0.0018
OTHER_LIVESTOCK.numberOfAnimalsSold	0.0	0.0	50.71	47.87	116964.0	116964.0	1442.227	1428.741	0.704	0.789	0.0	Different	0.0	Different	0.0	0.0013
OTHER_LIVESTOCK.valueAnimalsRearingBreading	0.0	0.0	46.86	50.43	21935.4	21935.4	952.197	876.105	0.982	0.971	0.0	Different	0.0	Different	0.0038	0.0178
OTHER_LIVESTOCK.valueSlaughteredAnimals	0.0	0.0	1393.63	1757.95	425613.1	425613.1	12458.959	11441.46	0.717	0.792	0.0	Different	0.0	Different	0.0201	0.0381
OTHER_LIVESTOCK.valueSoldAnimals	0.0	0.0	1476.41	1857.33	425613.1	425613.1	12504.877	11632.091	0.704	0.789	0.0	Different	0.0	Different	0.0189	0.0367
OTHER_LIVESTOCK.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
POTATO.cropProduction	0.0	0.0	297.64	227.08	76309.5	76309.5	2267.08	1767.154	0.813	0.854	0.0	Different	0.0	Different	0.0124	0.0156
POTATO.cultivatedArea	0.0	0.0	0.12	0.1	34.7	34.7	0.927	0.693	0.699	0.776	0.0	Different	0.0	Different	0.0104	0.0152
POTATO.irrigatedArea	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.042	1.0	1.0	1.0	Similar	1.0	Similar	25.1517	0.4624
POTATO.quantitySold	0.0	0.0	2.12	1.73	1319.9	759.2	24.127	16.773	0.813	0.854	0.0	Different	0.0	Different	0.0092	0.0172
POTATO.quantityUsed	0.0	0.0	0.3	0.57	85.2	82.3	2.325	2.724	0.84	0.878	0.0	Different	0.0	Different	0.0397	0.0487
POTATO.sellingPrice	0.0	0.0	34.64	19.36	469.5	410.1	65.909	48.449	0.756	0.848	0.0	Different	0.0	Different	0.4967	0.1154
POTATO.valueSales	0.0	0.0	240.66	189.56	107212.5	76229.2	2300.802	1667.468	0.756	0.848	0.0	Different	0.0	Different	0.0087	0.0192
PROT.cropProduction	0.0	0.0	223.69	188.93	35339.2	35339.2	1276.453	1185.07	0.895	0.912	0.0	Different	0.0	Different	0.0062	0.0144
PROT.cultivatedArea	0.0	0.0	0.38	0.35	34.6	22.0	1.456	1.189	0.832	0.829	0.0	Different	0.085	Similar	0.0402	0.0414
PROT.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
PROT.quantitySold	0.0	0.0	0.53	0.44	74.5	84.3	2.491	2.707	0.894	0.912	0.0	Different	0.0	Different	0.0236	0.0286
PROT.quantityUsed	0.0	0.0	0.04	0.04	13.3	13.1	0.343	0.264	0.939	0.948	0.0	Different	0.0	Different	0.0111	0.0216
PROT.sellingPrice	0.0	0.0	53.1	41.47	1643.0	1643.0	188.558	172.439	0.886	0.91	0.0	Different	0.0	Different	0.0168	0.0287

Figure 53. Statistical results: Poland 2018 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
PROT.valueSales	0.0	0.0	210.52	172.29	36399.4	36399.4	1121.16	1082.095	0.886	0.91	0.0	Different	0.0	Different	0.0068	0.0184
agriculturalLandArea	1.1	0.6	14.18	14.46	1480.8	1481.2	27.806	32.889	0.0	0.0	0.0	Different	0.0	Different	0.0001	0.0024
agriculturalLandHectaresAdquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
agriculturalLandValue	0.0	0.0	58180.94	65007.91	1185279.1	1185279.1	55855.92	58672.918	0.002	0.001	0.0	Different	0.0	Different	0.0383	0.0486
depreciation	0.0	0.0	4465.11	5889.37	203827.2	203827.2	5561.636	6459.04	0.005	0.008	0.0	Different	0.0	Different	0.0281	0.0431
farmBuildingsValue	0.0	0.0	22722.15	29547.29	2430863.0	2430863.0	46549.29	57594.935	0.054	0.072	0.0	Different	0.0	Different	0.0098	0.0261
farmNetIncome	-1037336.3	-1037336.3	5738.22	7317.83	270933.1	270933.1	20733.025	24872.268	0.0	0.0	0.0	Different	0.0	Different	0.0282	0.043
fixedAssets	11880.7	11880.7	110783.79	135090.95	3751582.4	3751582.4	118305.582	129550.244	0.0	0.0	0.0	Different	0.0	Different	0.0448	0.0541
forestLandArea	0.0	0.0	0.76	0.76	12.5	12.5	1.196	1.274	0.401	0.416	0.0	Different	0.0	Different	0.0596	0.0571
forestLandValue	0.0	0.0	2114.44	2109.92	51781.0	51781.0	4231.122	4401.175	0.403	0.418	0.0	Different	0.0	Different	0.0118	0.0268
grossFarmIncome	319.9	319.9	11974.42	15562.46	425597.8	425597.8	17691.296	19171.511	0.0	0.0	0.0	Different	0.0	Different	0.039	0.0508
intangibleAssetsNonTradable	0.0	0.0	3.27	6.58	763.1	763.1	43.011	65.074	0.993	0.988	0.322	Similar	0.07	Similar	0.0027	0.0149
intangibleAssetsTradable	0.0	0.0	150.55	163.14	35879.0	35879.0	1131.243	1345.824	0.747	0.847	0.0	Different	0.0	Different	0.0016	0.0105
landImprovements	0.0	0.0	166.37	183.88	26282.5	26282.5	806.219	920.018	0.866	0.884	0.0	Different	0.0	Different	0.0022	0.0117
longAndMediumTermLoans	0.0	0.0	2592.82	2995.66	313993.3	313993.3	12725.131	13482.094	0.858	0.846	0.0	Different	0.0	Different	0.0019	0.011
machinery	0.0	0.0	22383.92	28307.62	484177.8	484177.8	37244.209	39168.853	0.05	0.034	0.0	Different	0.0	Different	0.0357	0.0477
machineryAndEquipment	0.0	0.0	22383.92	28307.62	484177.8	484177.8	37244.209	39168.853	0.05	0.034	0.0	Different	0.0	Different	0.0357	0.0477
otherNonCurrentAssets	0.0	0.0	6.98	11.52	13613.1	13613.1	253.103	298.727	0.998	0.997	1.0	Similar	1.0	Similar	0.0004	0.005
otherOutputs	0.0	0.0	135.38	127.16	30506.7	30506.7	813.164	857.828	0.786	0.835	0.0	Different	0.0	Different	0.0011	0.0081
plantationsValue	0.0	0.0	651.39	867.18	138112.5	138112.5	2156.092	3504.629	0.059	0.063	0.0	Different	0.0	Different	0.0034	0.0133
rentPaid	0.0	0.0	50.44	51.19	13470.2	13475.1	272.397	292.192	0.6	0.6	0.0	Different	0.049	Different	0.0	0.0007
specificCropCosts	0.0	0.0	241.36	288.96	7704.4	7704.4	250.654	268.393	0.002	0.002	0.0	Different	0.0	Different	0.027	0.0424
subsidiesOnInvestments	0.0	0.0	153.39	231.05	14082.5	14082.5	795.329	964.163	0.941	0.914	0.0	Different	0.0	Different	0.0085	0.0246
taxes	0.0	0.0	278.82	295.28	78785.1	78785.1	1301.315	1594.762	0.002	0.001	0.0	Different	0.0	Different	0.0001	0.0023
totalCurrentAssets	0.0	0.0	12933.16	14422.57	1567526.4	1567526.4	32474.073	37885.911	0.026	0.053	0.0	Different	0.0	Different	0.0014	0.0097
totalExternalFactors	0.0	0.0	1600.13	2268.79	1259106.9	1259106.9	21137.225	25779.022	0.459	0.35	0.0	Different	0.0	Different	0.0	0.0015
totalIntermediateConsumption	688.3	688.3	9892.74	11430.56	1840431.6	1840431.6	32480.958	39134.246	0.0	0.0	0.0	Different	0.0	Different	0.0001	0.0029
totalOutputCropsAndCropProduction	742.1	742.1	13550.56	17398.46	413188.1	413188.1	19855.634	21072.718	0.0	0.0	0.0	Different	0.0	Different	0.0425	0.0535
totalOutputLivestockAndLivestockProduction	-8985.4	-8985.4	4010.66	4744.79	1748603.7	1748603.7	30706.31	37278.438	0.457	0.605	0.0	Different	0.0	Different	0.0002	0.0033
vatBalanceExcludingInvestments	-4035.3	-4035.3	12.32	106.39	14910.5	14910.5	518.106	600.192	0.138	0.212	0.0	Different	0.0	Different	0.0249	0.0416
vatBalanceOnInvestments	-23644.6	-23644.6	-324.35	-453.63	0.0	0.0	1172.405	1341.115	0.773	0.693	0.0	Different	0.0	Different	0.0173	0.0348

Figure 54. Statistical results: Poland 2018 (sheet 3)

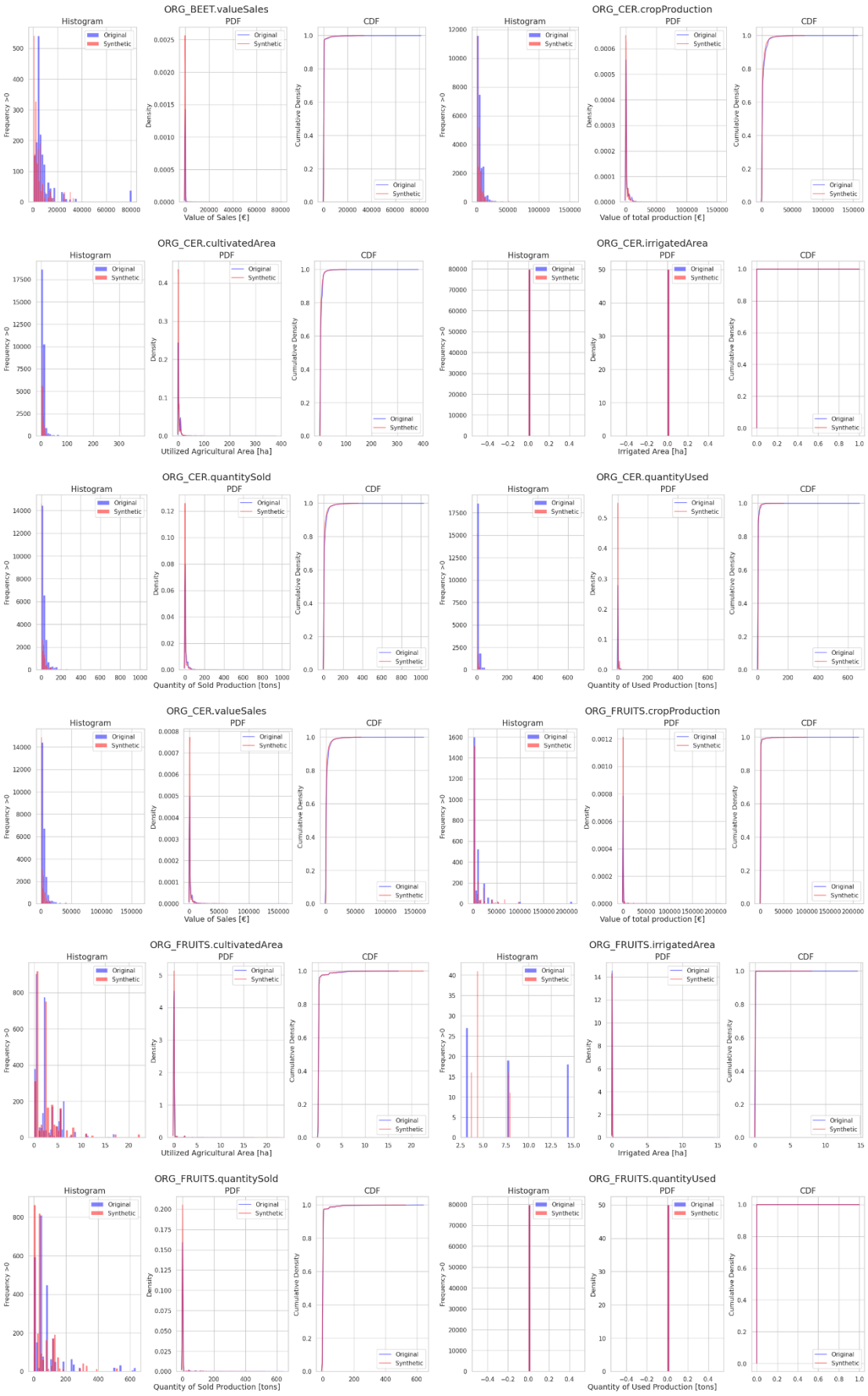

Figure 55. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 1)

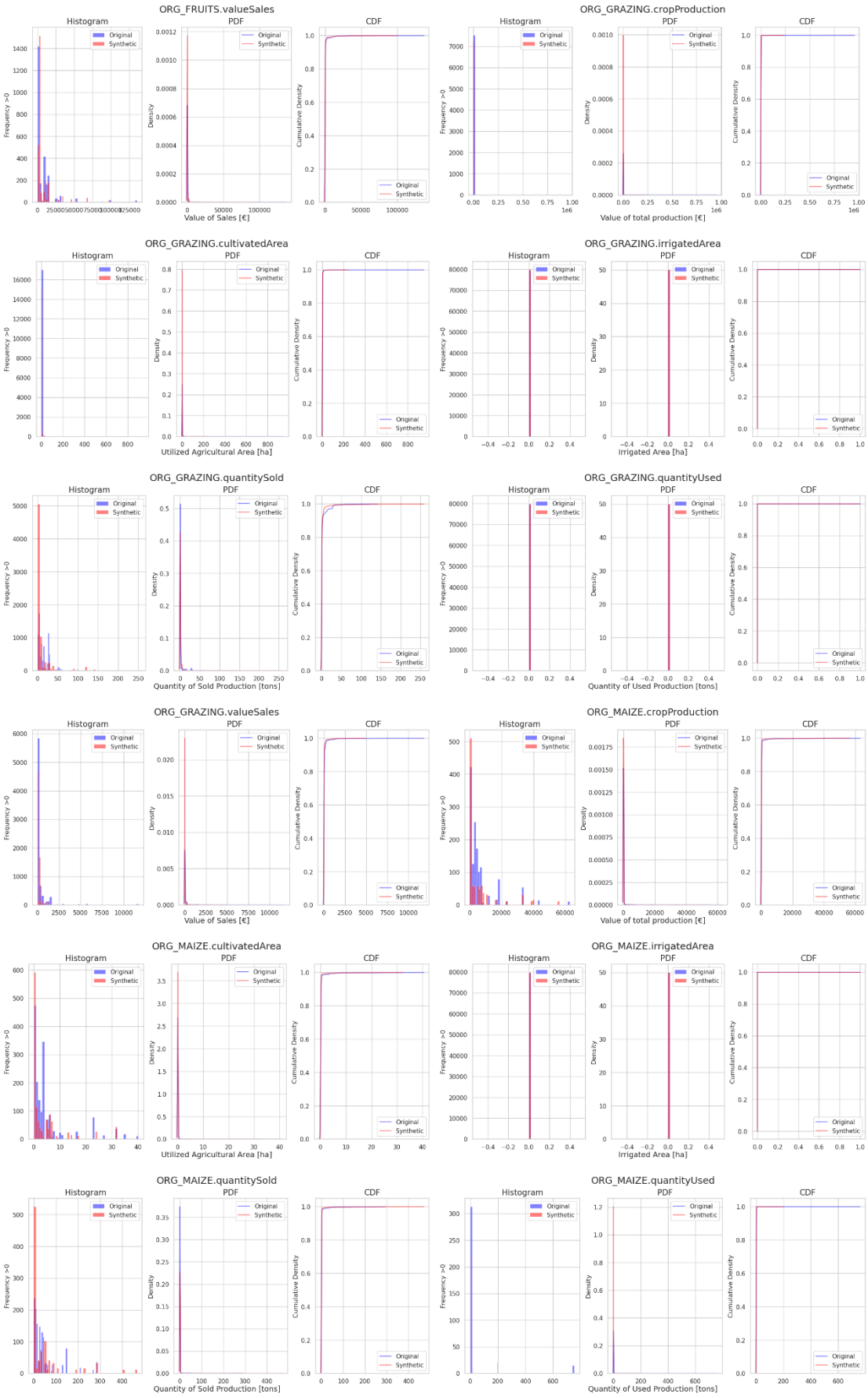

Figure 56. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 2)

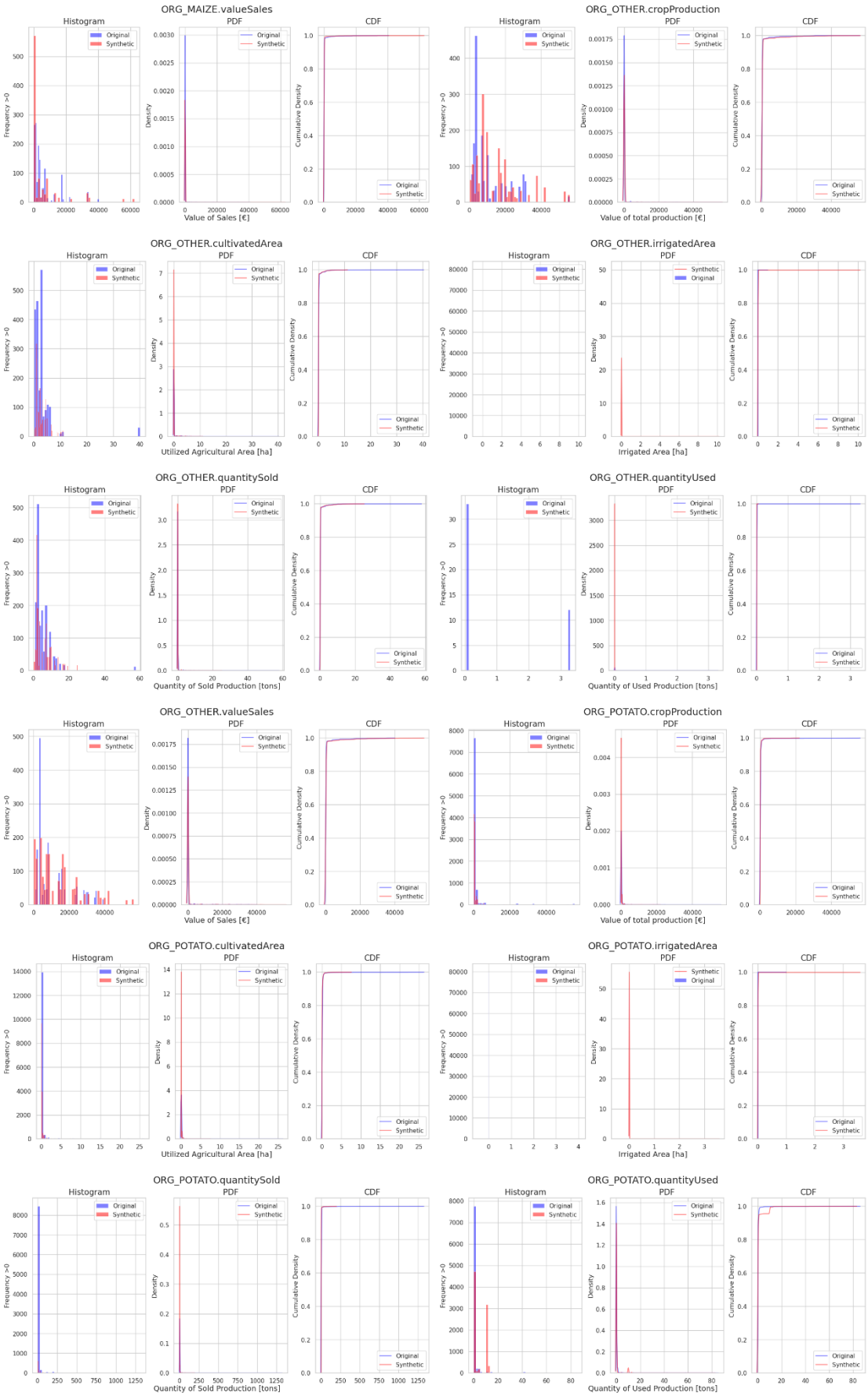

Figure 57. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 3)

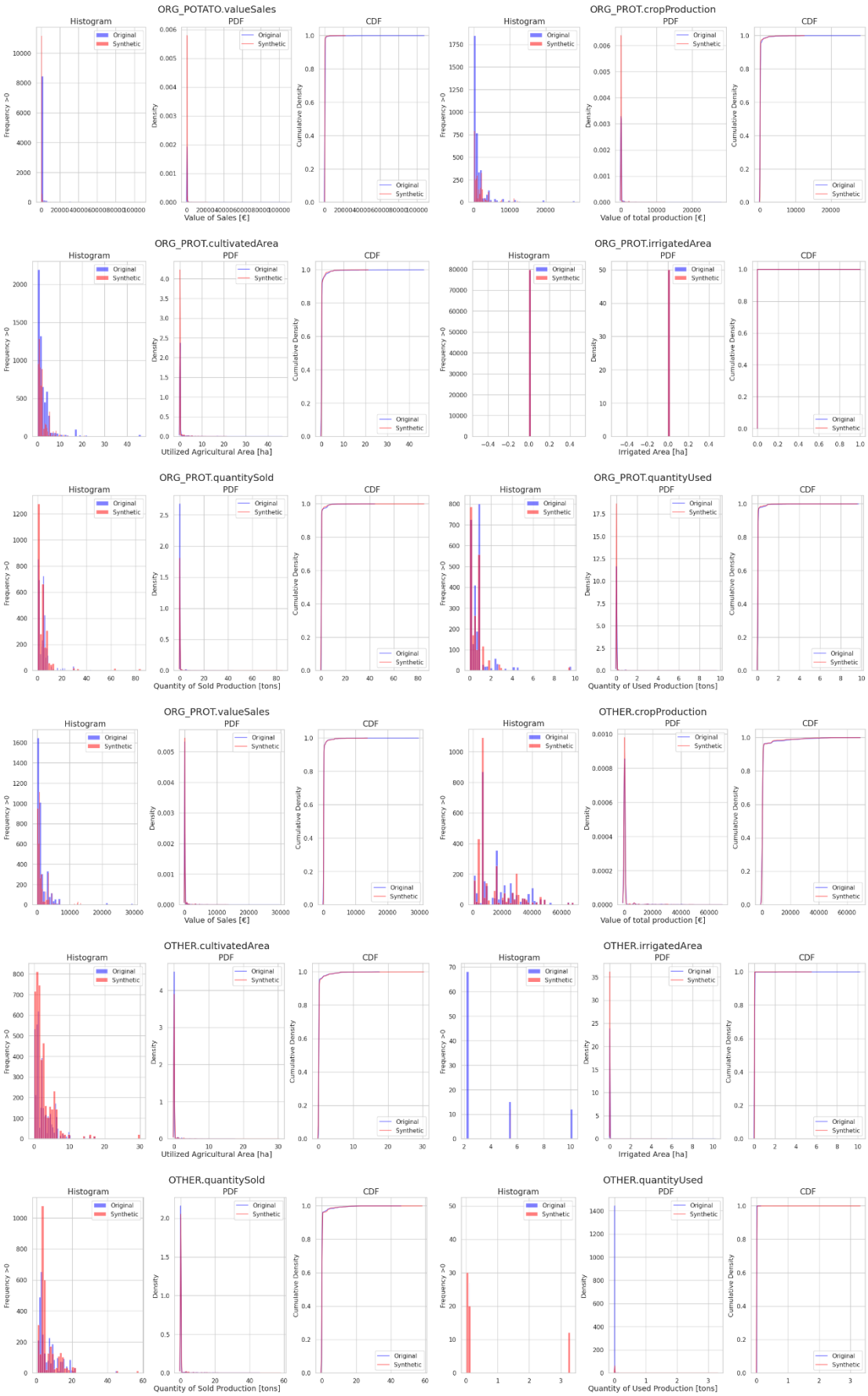

Figure 58. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 4)

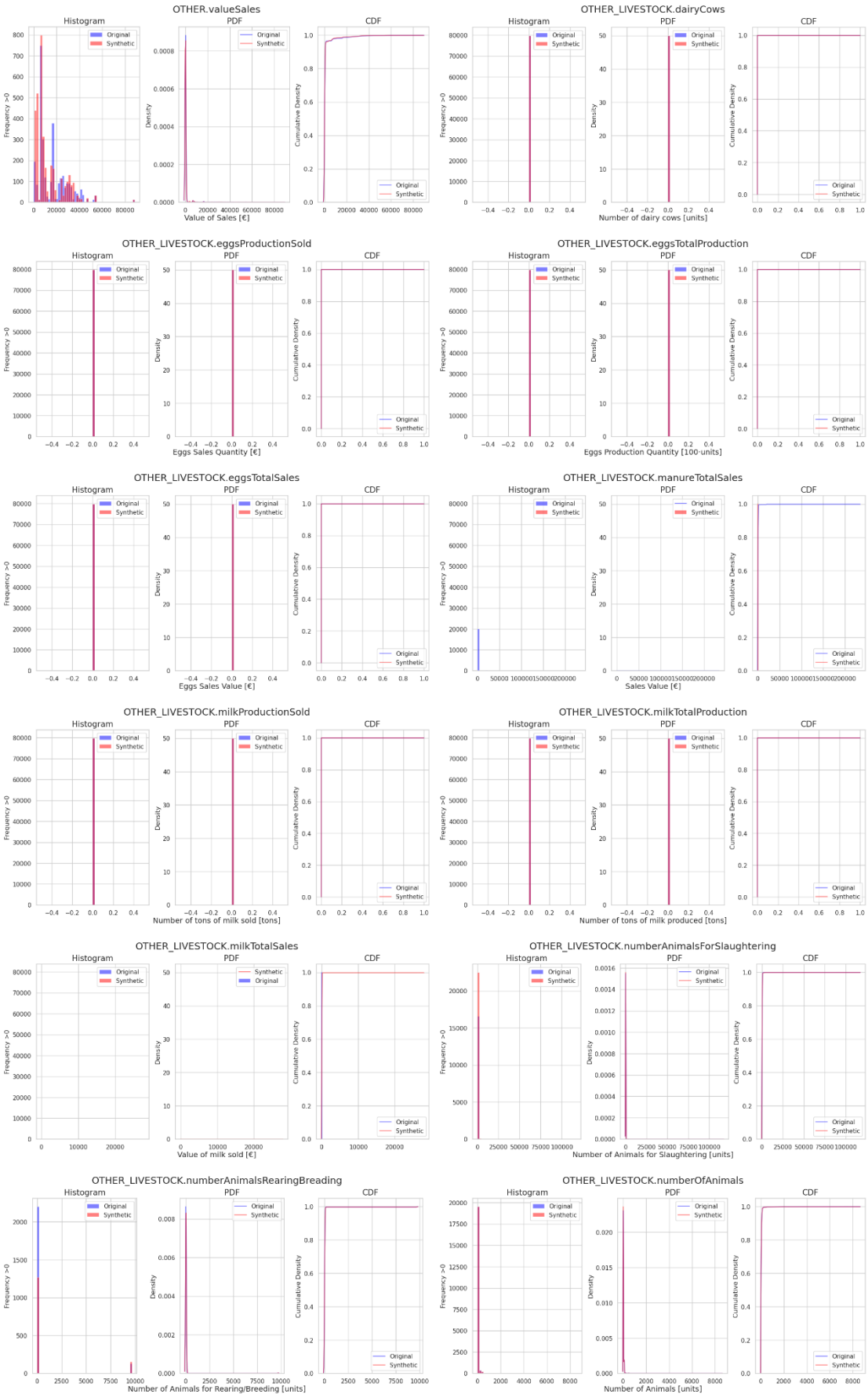

Figure 59. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 5)

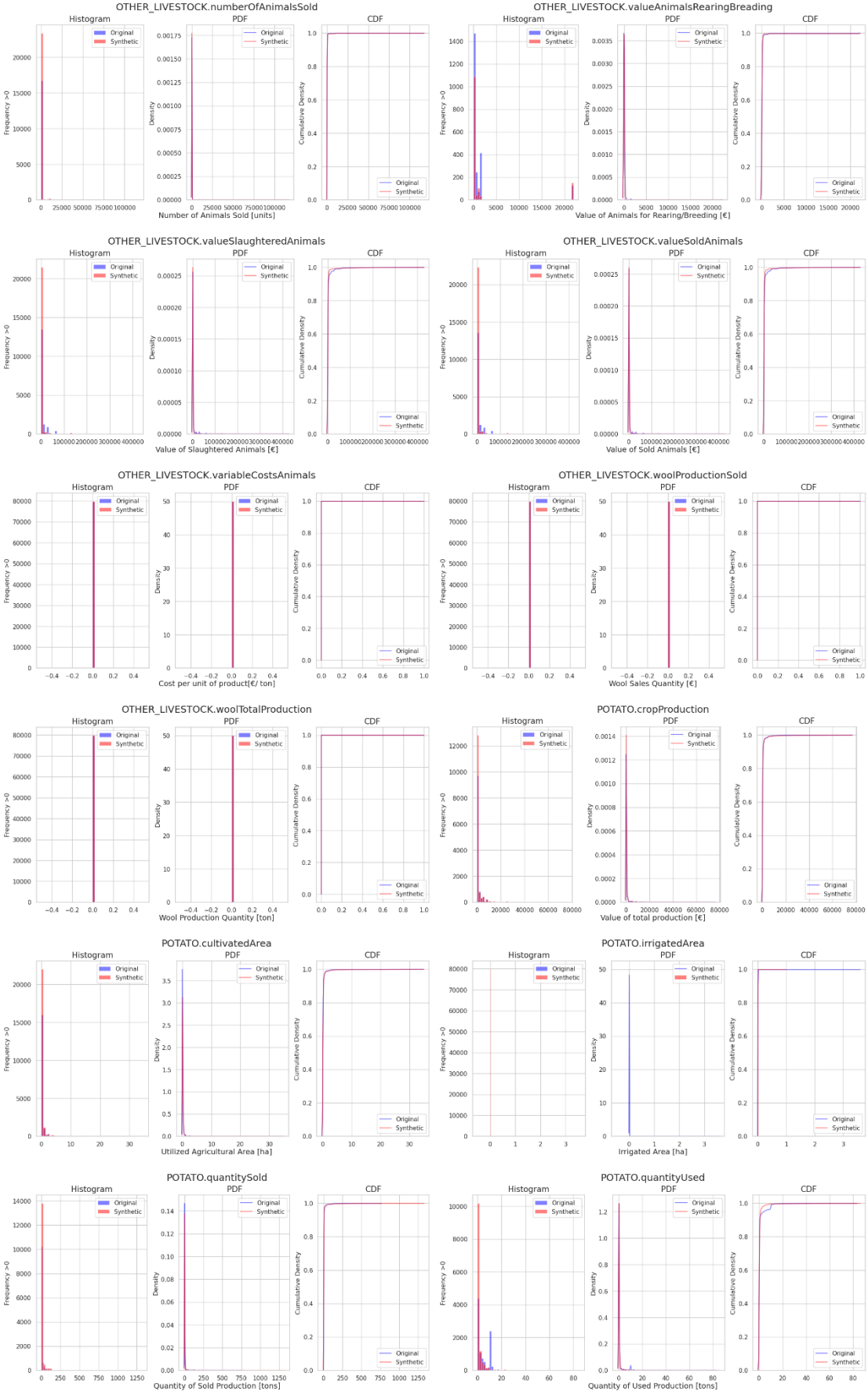

Figure 60. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 6)

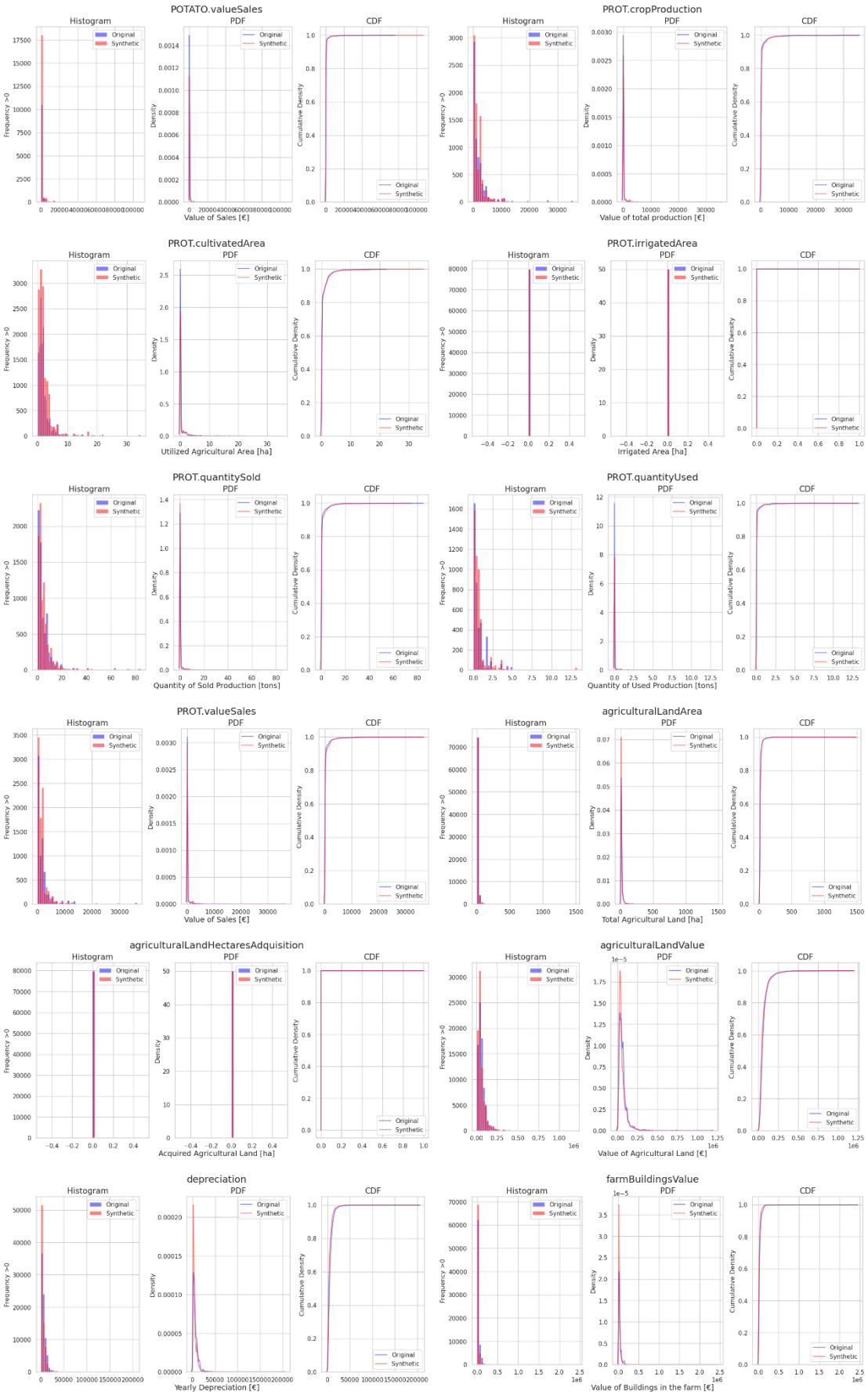

Figure 61. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 7)

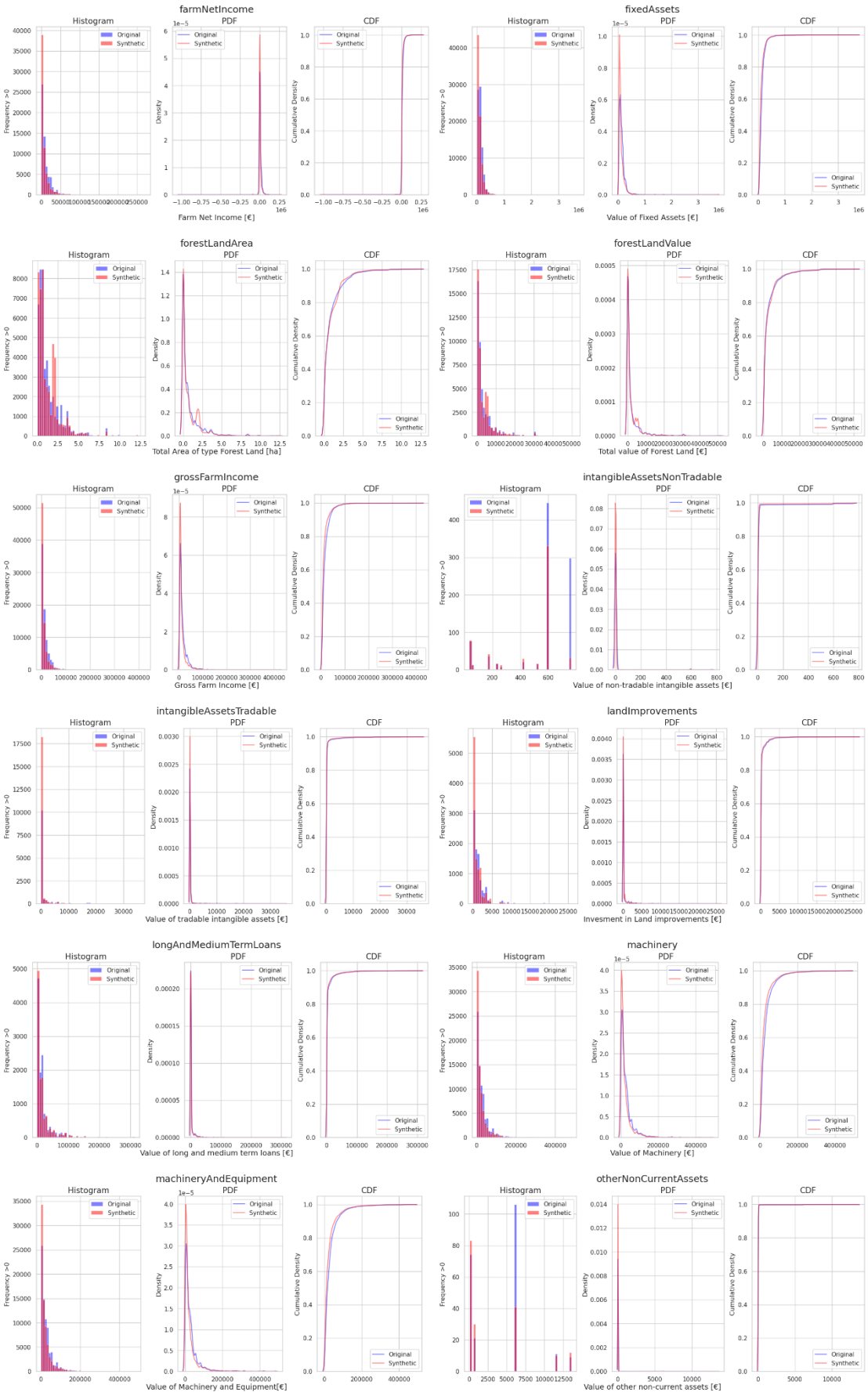

Figure 62. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 8)

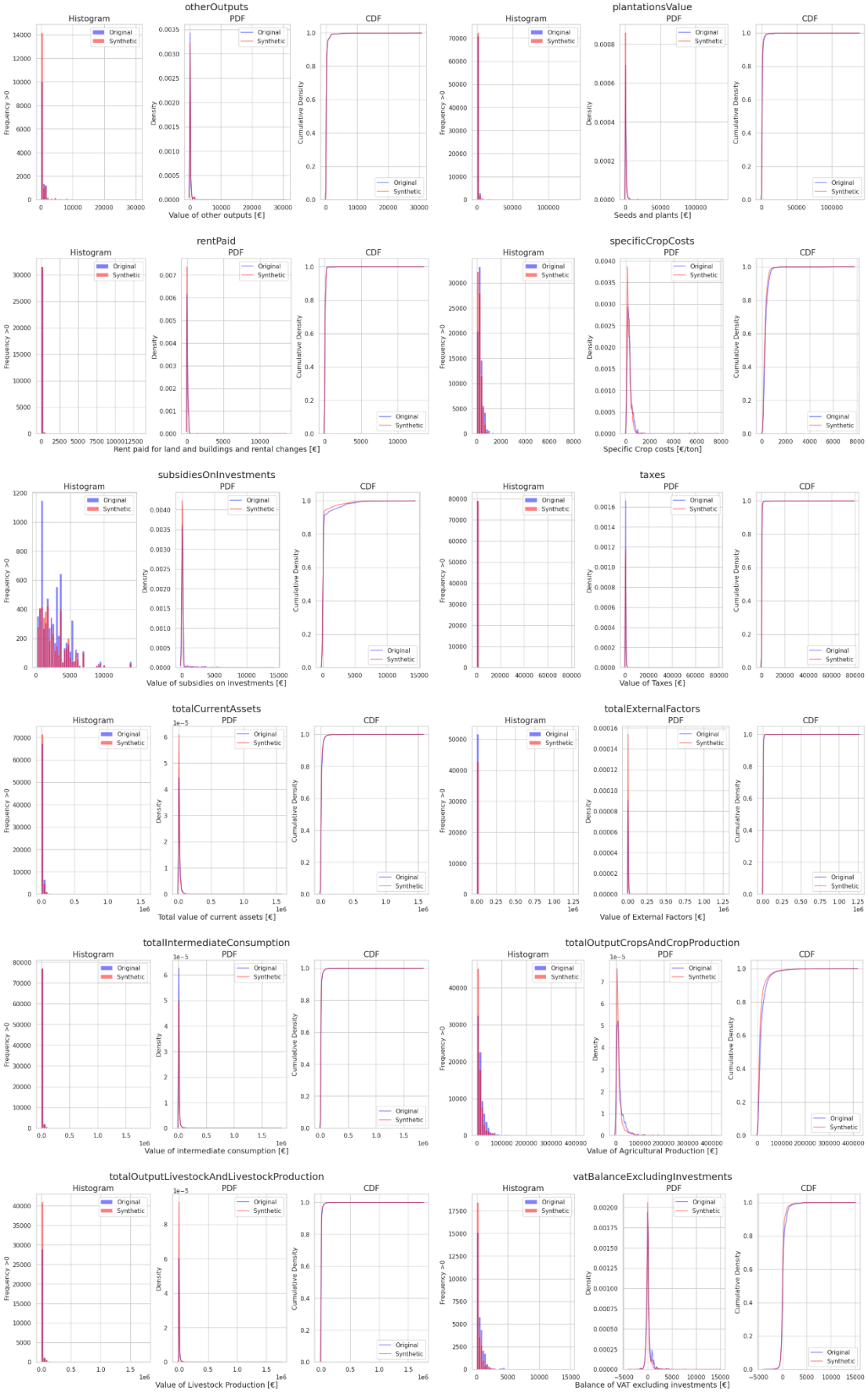

Figure 63. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 9)

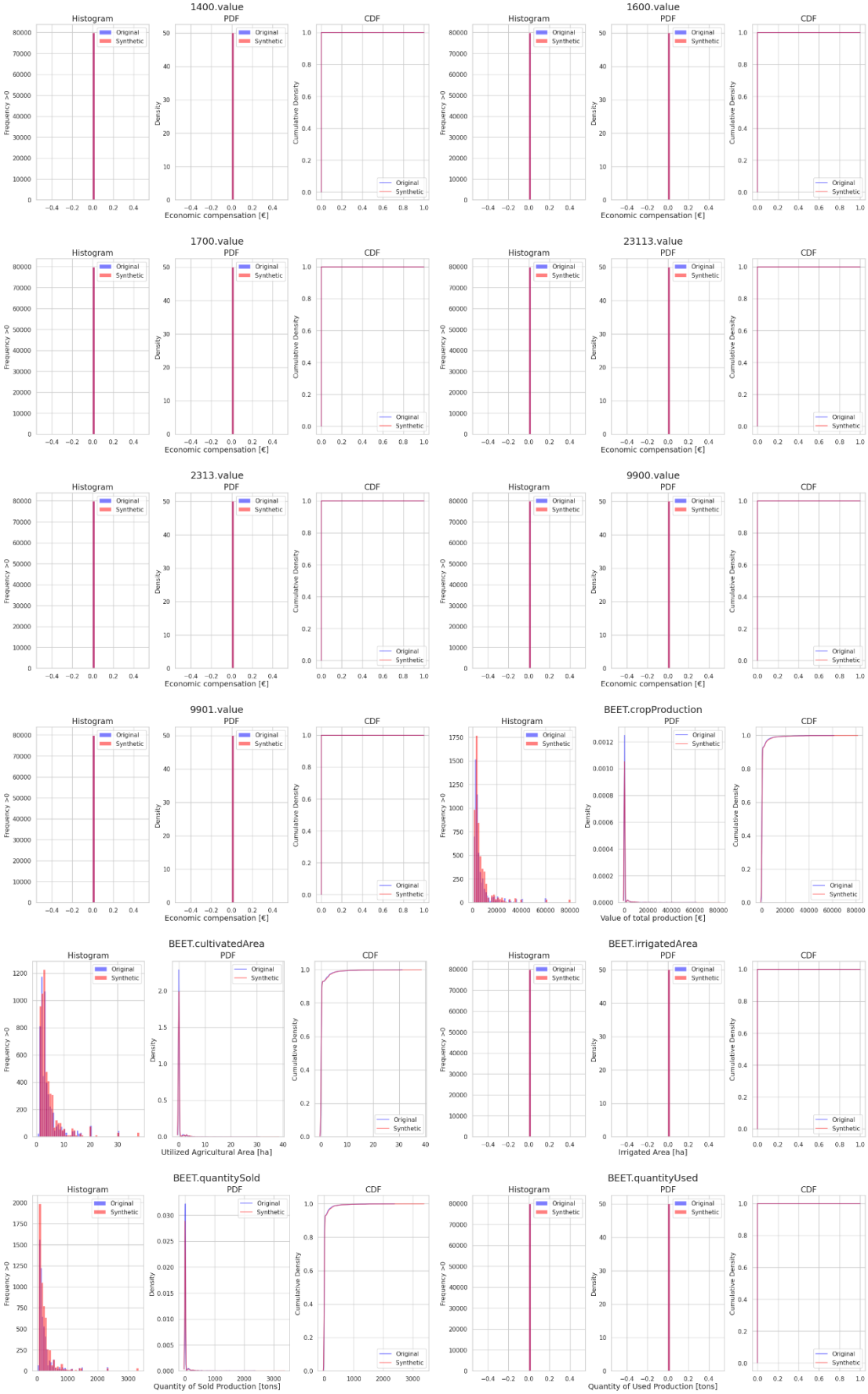

Figure 64. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 10)

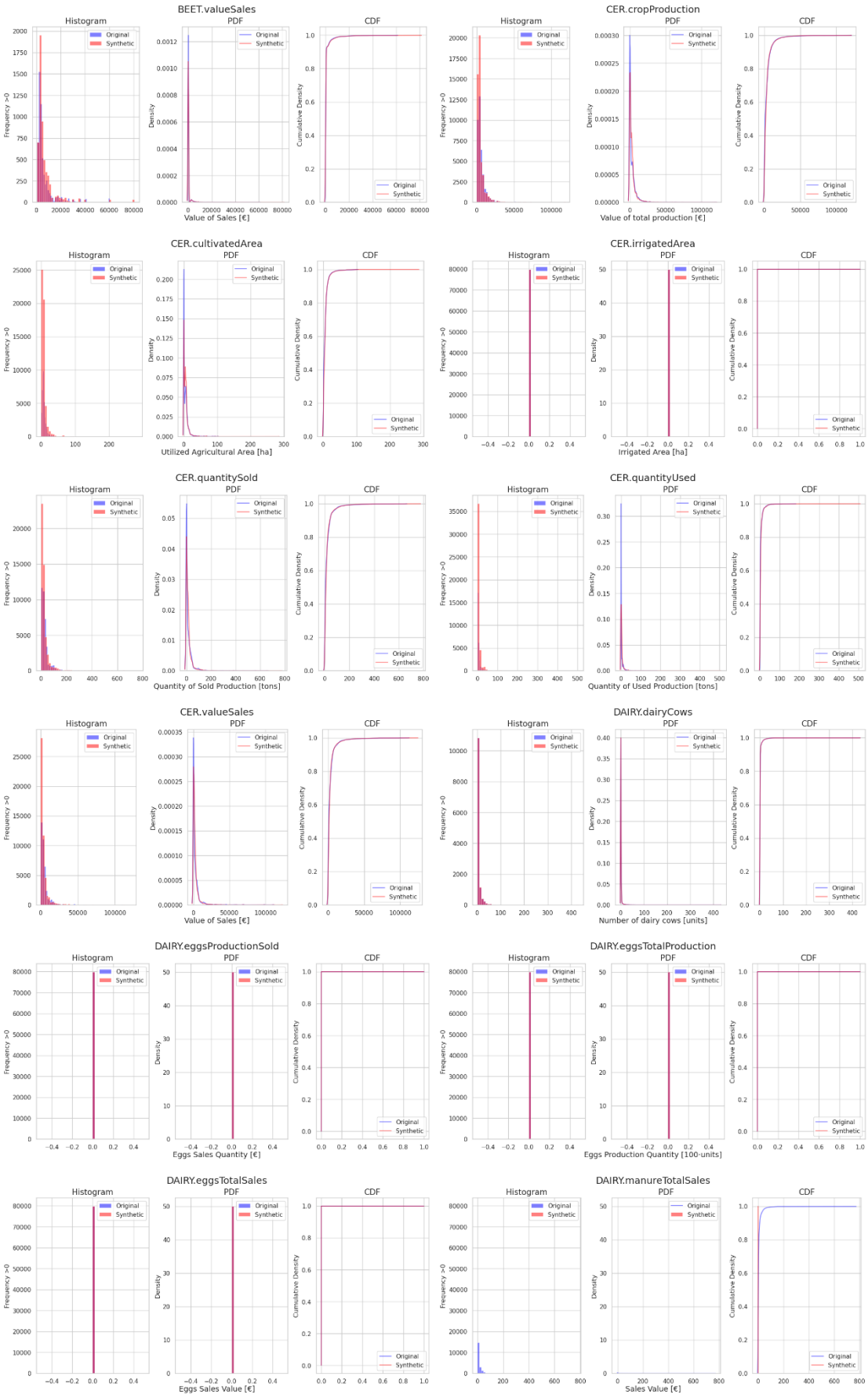

Figure 65. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 11)

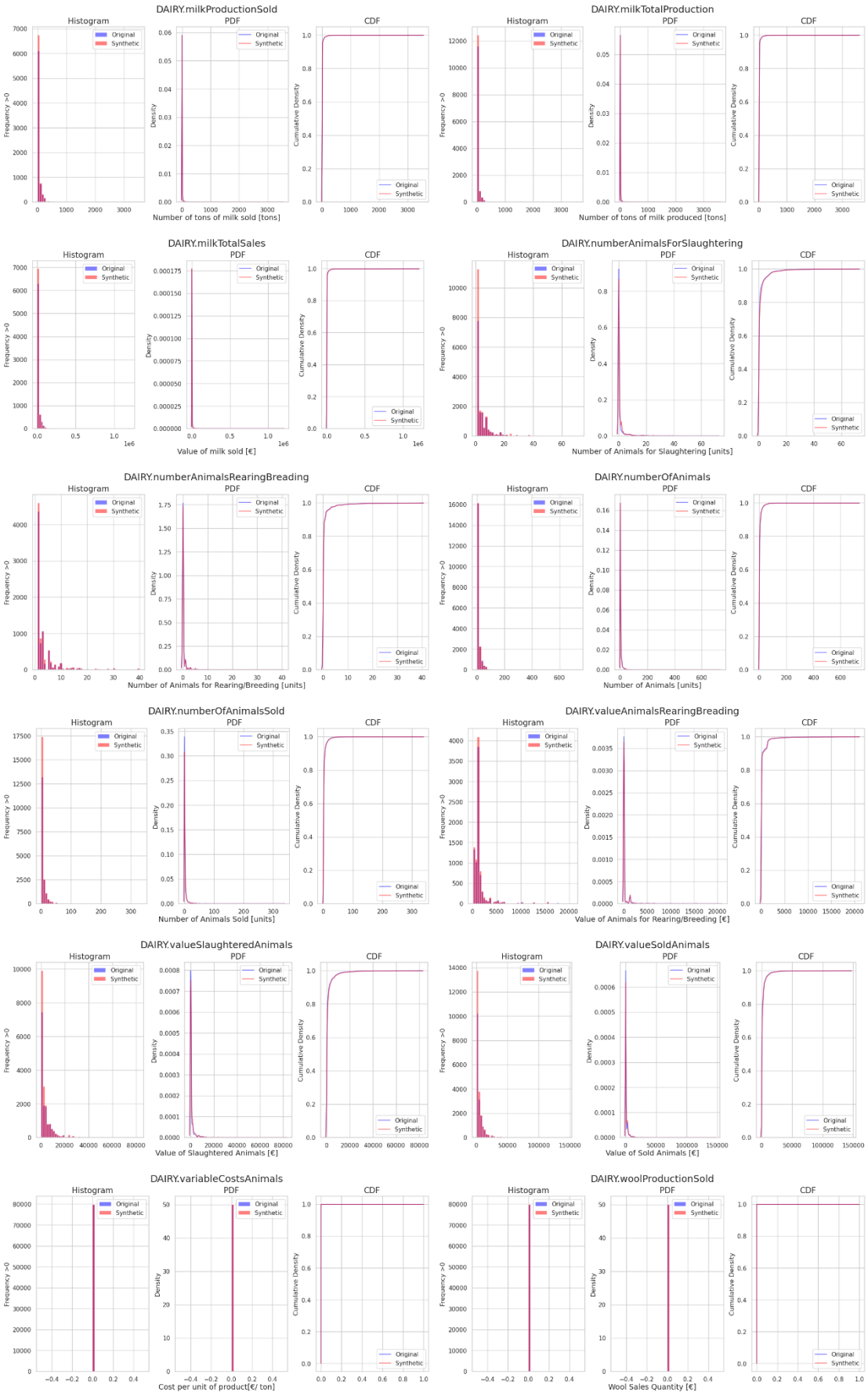

Figure 66. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 12)

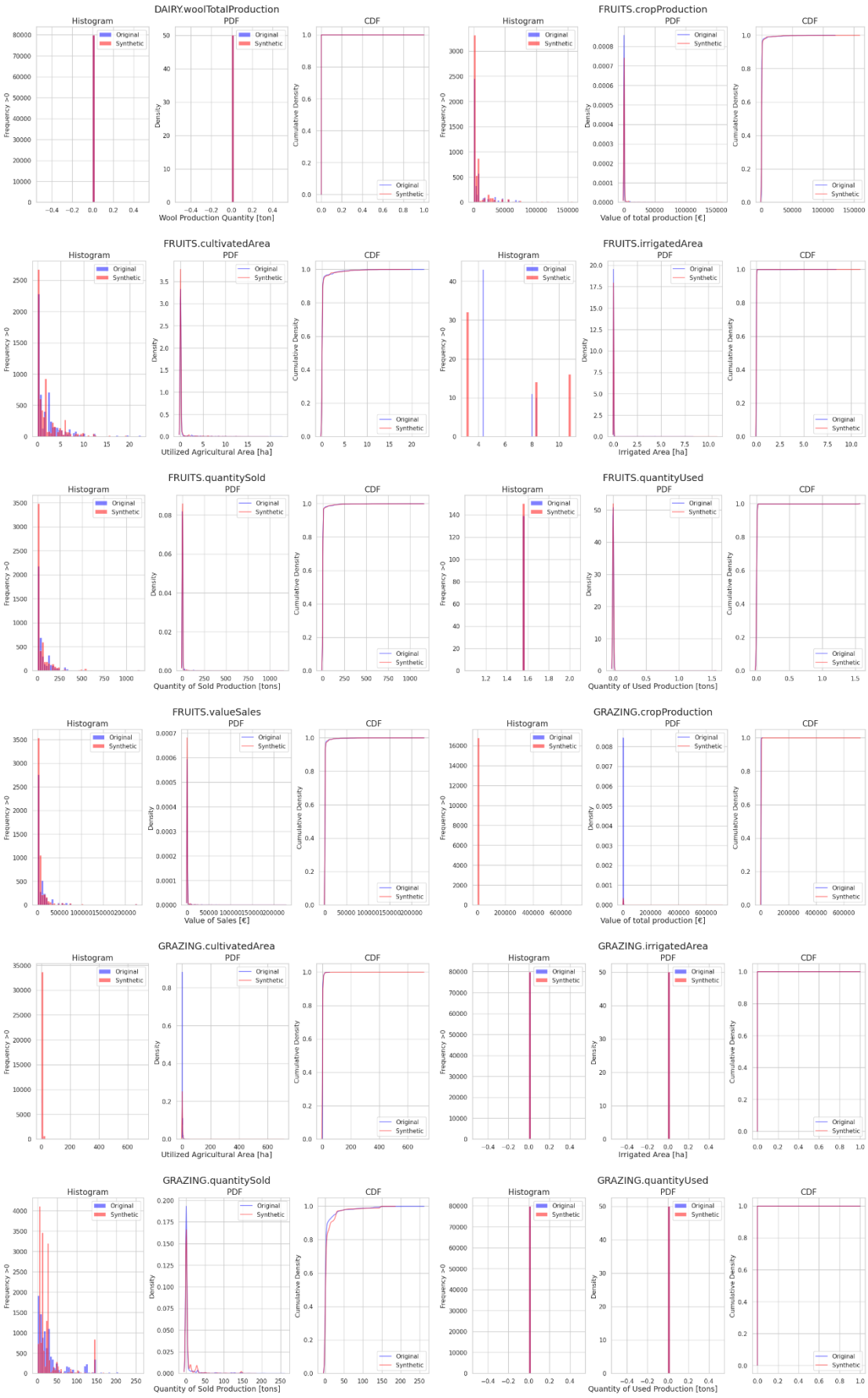

Figure 67. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 13)

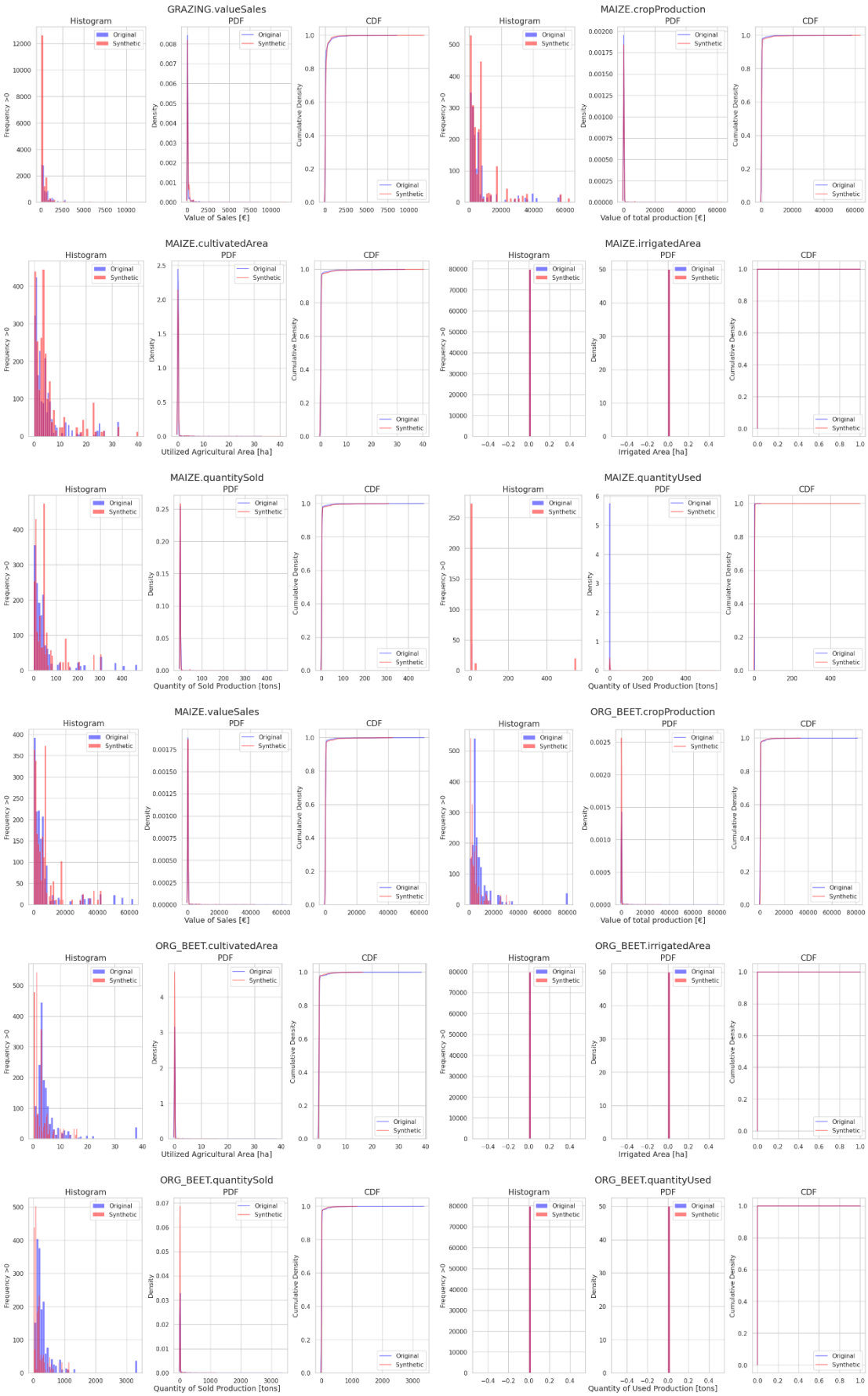

Figure 68. Comparison of Continuous Variables: Poland Use Case 2018 (Sheet 14)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
CER	430817	384155	0.892
ORG_CER	175679	220194	1.253
GRAZING	104051	86227	0.829
ORG_GRAZING	33693	50247	1.491
PROT	30698	27814	0.906
BEET	24880	23567	0.947
MAIZE	13828	10093	0.73
FRUITS	13004	12068	0.928
ORG_PROT	11772	14453	1.228
OTHER	10743	9822	0.914
POTATO	9595	7819	0.815
ORG_FRUITS	7433	8063	1.085
ORG_BEET	7158	8982	1.255
ORG_MAIZE	5069	8661	1.709
ORG_OTHER	4855	6044	1.245
ORG_POTATO	2616	4287	1.639

Table 17. Poland use case, 2018: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
CER	256296185	239535178	0.935
ORG_CER	107954213	136203652	1.262
OTHER	43678605	49786877	1.14
BEET	40081223	36945910	0.922
FRUITS	38914432	37061295	0.952
ORG_OTHER	24069380	16107066	0.669
POTATO	23736568	18109584	0.763
ORG_FRUITS	22359165	23881729	1.068
GRAZING	20220813	4927529	0.244
PROT	17838790	15066618	0.845
MAIZE	16109234	11403071	0.708
ORG_BEET	10986573	14826997	1.35
ORG_GRAZING	6156930	19662576	3.194
ORG_MAIZE	5577186	8842317	1.585
ORG_POTATO	5552658	10080201	1.815
ORG_PROT	4775063	5990240	1.254

Table 18. Poland use case, 2018: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
BEET	1545298	1419809	0.919
CER	1337960	1248697	0.933
ORG_CER	517103	673972	1.303
ORG_BEET	428227	575528	1.344
GRAZING	419661	318665	0.759
FRUITS	260995	247520	0.948
POTATO	169416	137750	0.813
ORG_FRUITS	165008	193303	1.171
MAIZE	113297	88052	0.777
ORG_GRAZING	84170	116262	1.381
ORG_MAIZE	44352	61578	1.388
PROT	41897	35478	0.847
ORG_POTATO	31108	67278	2.163
OTHER	19532	18792	0.962
ORG_PROT	13170	14962	1.136
ORG_OTHER	8447	8178	0.968

Table 19. Poland use case, 2018: quantity sold ratio comparison

4.5 Definition of the simulation scenario:

4.5.1 Policies scenario: Poland

To trace the policy scenarios, the initial step involves analyzing the subsidy values available in the microdata. These values provide insights into the typical subsidies received by farmers. In addition to overall economic compensation, other relevant details can be determined from the FADN dataset, including the years when subsidies were active, the crops associated with coupled subsidies, and the economic compensation per hectare.

This information is summarized in a table that includes all necessary fields for the model to conduct simulations and incorporate policy-related data. The data is categorized into two main policy groups: decoupled and coupled policies. Additional details about the table are available in section 3.5.1Policies scenario in Andalusia

	Description	Subsidy_Code	Coupled	Aggregated_product	Economic_compensation	StartYear	EndYear	Label
0	Payment for agricultural practices beneficial ...	1400	N	0	3113.27	2015	2020	Greening
1	Payment for young farmers	1600	N	0	1228.77	2015	2020	0
2	Small farmers scheme	1700	N	0	726.86	2015	2020	0
3	Protein crops	23113	Y	LEGUMES	145.68	2015	2020	0
4	Protein crops	23113	Y	ORG_LEGUMES	145.68	2015	2020	0
5	Potatoes	2313	Y	POTATO	8564.48	2015	2020	0
6	Potatoes	2313	Y	ORG_POTATO	8564.48	2015	2020	0
7	Organic conversion of crops	9900	Y	ORG_FRUIT	311.25	2015	2020	0
8	Organic conversion of crops	9900	Y	ORG_CITRUS	311.25	2015	2020	0
9	Organic conversion of crops	9900	Y	ORG_GRAZ	180.73	2015	2020	0
10	Organic olive conversion	9901	Y	ORG_OLIVE	272.69	2015	2020	0

Table 20. Subsidies result, Poland

5 UC3: Socio-economic impact assessment in Greek agriculture

The third use case included is the Greek use case. This use case is focuses on assessing the impact of Sub-Measure 6.1, "Start-up Aid for Young Farmers"[15], which is part of the Greek Rural Development Programme for 2014-2020. This sub-measure aims to enhance the competitiveness of Greek agriculture by focusing on generational renewal and fostering entrepreneurial spirit among young farmers. Greece faces a significant demographic challenge in its rural areas, characterized by a very low proportion of young farmers and a high percentage of elderly farmers. This demographic imbalance poses difficulties for the future development of the sector. Given that a substantial portion of the Greek workforce is employed in agriculture, evaluating the socio-economic impact of Sub-Measure 6.1 is crucial.

The measure is designed to address the demographic challenges faced by Greece, including the low proportion of young farmers and the high percentage of older farmers. By encouraging the next generation to engage in agriculture, this sub-measure aims to rejuvenate the rural workforce and sustain agricultural productivity.

Given the significant role of agriculture in Greece and its impact on the rural economy, this use case is particularly relevant. It provides an opportunity to assess how effectively Sub-Measure 6.1 can contribute to achieving EU objectives related to rural development and agricultural sustainability. The focus is on evaluating the success of initiatives that promote age renewal and enhance the competitiveness of young farmers, ultimately supporting the broader goals of economic revitalization and sectoral innovation in Greek agriculture.

This use case is focused on the region of Central Macedonia, where agriculture plays a vital role in the local economy, but also represents one of the most productive agricultural areas in the overall Greek agricultural landscape.

5.1 Presentation of the data used for the generation of the synthetic population

5.1.1 Used data sources

The Greek use case development is sustained on the utilization of the FADN microdata. In this case, the organizations in charge of gathering this data is the Ministry of Agricultural Development of the Greek government together with the Hellenic Statistical Authority (ELSTAT). These organisms are in charge of organizing and control the FADN program at Greece level. For that, they define the features of the farms that should be surveyed to carry out the surveys to build the annual FADN sample.

Similar to other use cases, FADN microdata is crucial for constructing this use case. The diverse range of variables covering various aspects of the agricultural sector provides a comprehensive view of farmers' realities. This includes economic, social, and management dimensions, allowing for a nuanced and multi-faceted portrayal of agricultural practices.

The process of acquiring this data was started by AUTH. For that, AUTH contacted with Unit of Agricultural Policy, Documentation, and International Relations at Ministry of Agricultural Development and Food. Dr. Apostolos Polymeros, Policy Officer and Head of the Unit, was thoroughly briefed on the AGRICORE project and its research objectives. As result, the AUTH team was granted access to the Greek FADN datasets for the years 2015, 2016, 2017, and 2018 in early 2021.

The data was organized into a detailed tabular format, derived from surveys conducted on approximately 4.700 agricultural holdings throughout Greece regions. This sample provides an insight into the broader agricultural landscape, representing a variety of economic sizes and techno-economic profiles. It is carefully selected to ensure it mirrors the broader spectrum of Greek agriculture. The dataset follows rigorous confidentiality and anonymity protocols to protect the privacy of the agricultural holdings involved.

In constructing the Greek use case, additional data sources were utilized alongside the FADN dataset. Eurostat [13] emerged as a key resource, offering a wide array of accessible economic, social, and environmental data. Its comprehensive coverage and user-friendly interface make it a valuable complement to the primary FADN data.

5.1.2 Data sources limitations

Greek use case building found meaningful limitations when building, similar as the ones occurred when building the Polish use case. In essence, limitations were similar, as in this case, farms representativeness were also missing. Again, statistical techniques must to be applied to overcome this situation.

An important issue was the inadequate geospatial resolution of the microdata. The ABM model requires data at NUTS2, NUTS3, and agrarian region levels, but only NUTS2-level data was provided. This limitation impairs precise farm mapping and complicates the weighting process. Higher-resolution data would have improved weight accuracy and revealed critical patterns in crop and livestock management essential for assessing farm representativeness.

The dataset once again faced limitations due to the restricted number of included crops. Many crops were omitted, resulting in reduced heterogeneity and representativeness. Additionally, crucial social features were missing from the FADN dataset, such as information on ages and family successors.

5.2 Crop grouping analysis

This section explain the different results obtained from the crops analysis to perform the crop grouping as well as the final decisions made and crops links established for the available crops. Additional details are included in section Crop grouping: justification and methodology.

5.2.1 Distribution of crops in the regions of interest

The decisions made on the product grouping are sustained on the typical representativeness analysis performed in previous use cases. Same indicators as in other cases were utilized to take the final decisions according to crop affinity, total cultivated area, economic indicators or alignment with the use case objectives.

This use case includes a total of 23 individual crops, as described by FADN. While this is a notable reduction compared to the Andalusian use case, it is due to data limitations. When factoring in the breakdown between conventional and organic production methods, the total number of individual crops increases to 46.

The following figure presents a pie chart showing the distribution of the individual crops based on cultivated area:

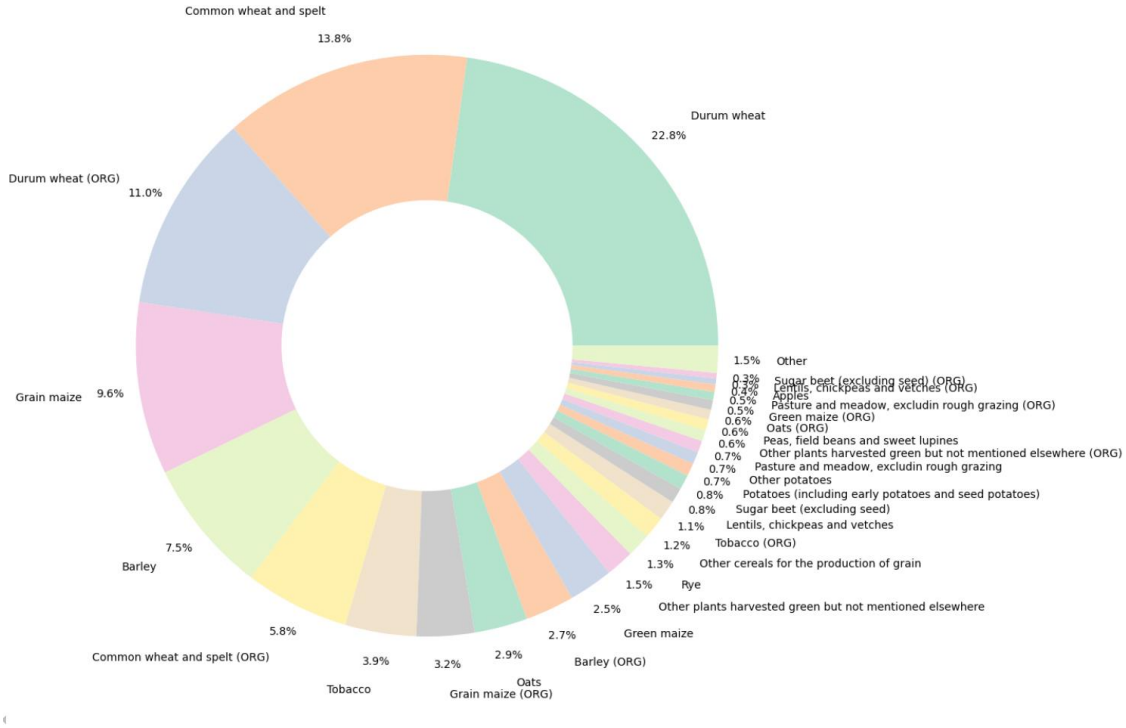

Figure 69. Greek crops by cultivated area

The most representative crop family is cereals, with wheat, in its various forms such as durum wheat and other wheat species, leading in terms of cultivated area, both under conventional and organic production methods. Grain maize is also significant, accounting for almost 10% of the total cultivated area. Tobacco, though less common, holds meaningful representation in the crop landscape, ranking seventh overall.

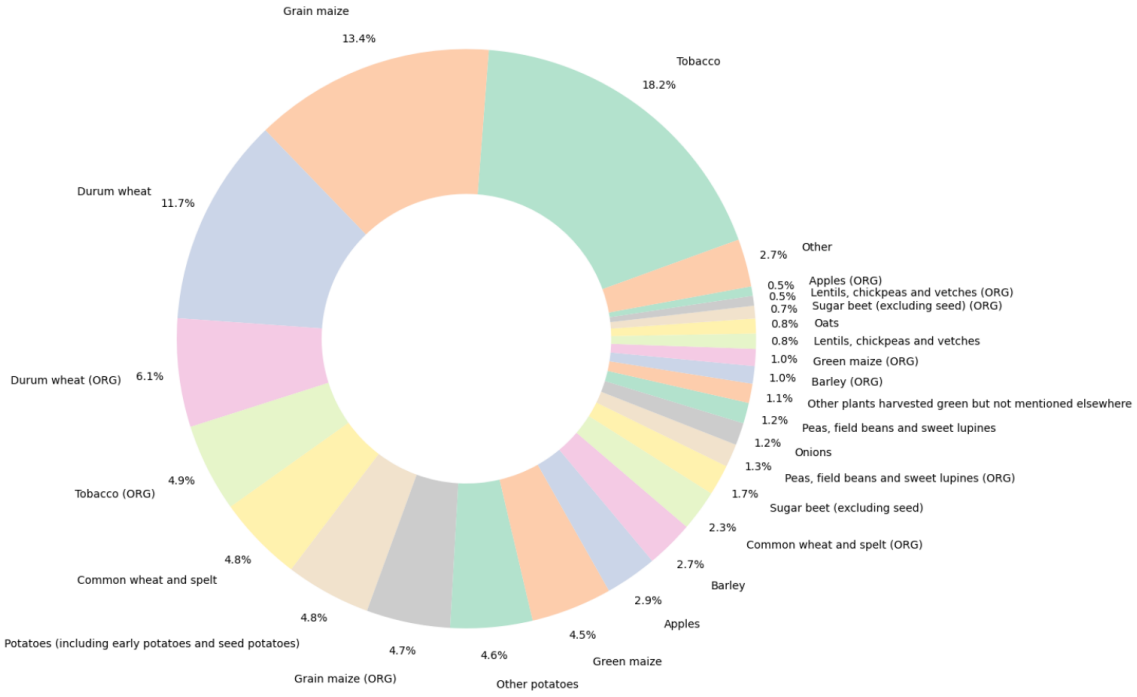

Figure 70. Greek crops by sales quantity

The figure above shows the economic weight of each crop in the region. Surprisingly, tobacco holds the top position, indicating that this crop plays a significant role in Central Macedonia. Grain maize also has substantial economic importance, contributing to 13% of the region's total agricultural economic activity. Several cereal species follow in terms of economic representativeness. Additionally, some vegetable varieties, with higher economic weight than their share of cultivated area, hold a notable portion of the region's agricultural economy.

Despite a broader crop representation compared to the Polish use case, there is still a noticeable misrepresentation in crop variety. Based on these indicators, adjustments in crop aggregation decisions will be necessary.

	FADN Code	Description	Group	Frequency	Frequency Rel	Total Area	Production Quantity	Sales Quantity	Sales Value	average_area	Share Area	# Crops Combination	Production Method
0	10734	Sweet corn	VEG	83.0	0.001396	0.072886	27.638554	27.638554	3.038855e+04	0.000067	0.000006	5.338885	CONVENTIONAL
1	10290	Other protein crops	ORG_PROT	29.0	0.000488	0.147318	13.470629	13.470629	3.362727e+04	0.000136	0.000004	3.550707	ORGANIC
2	11000	Arable land seed and seedling	OTHER	13.0	0.000219	0.481386	36.204545	0.000000	0.000000e+00	0.000443	0.000009	3.000000	CONVENTIONAL
3	10737	Carrots	VEG	237.0	0.003985	0.522000	1177.600000	1177.600000	9.313600e+05	0.000481	0.000142	2.310868	CONVENTIONAL
4	10310	Potatoes for starch	POTATO	23.0	0.000387	0.718935	1613.558442	1382.389611	6.906169e+05	0.000662	0.000048	3.000000	CONVENTIONAL
5	10310	Potatoes for starch	ORG_POTATO	28.0	0.000471	0.985526	2675.000001	2675.000001	8.025000e+05	0.000907	0.000046	4.000000	ORGANIC
6	10735	Onions	ORG_VEG	192.0	0.003229	1.412152	4265.625991	4262.806713	8.704605e+05	0.001300	0.000095	4.660562	ORGANIC
7	10390	Other potatoes	ORG_POTATO	374.0	0.006289	2.064835	4532.814839	4492.579252	1.022245e+06	0.001901	0.000207	4.317527	ORGANIC
8	40111	Apples	ORG_FRUITS	502.0	0.008441	2.586323	4758.808988	4715.446208	1.919636e+06	0.002382	0.000486	2.640375	ORGANIC
9	10300	Potatoes (including early potatoes and seed po...	ORG_POTATO	402.0	0.006760	3.050362	7207.814840	7167.579253	1.824745e+06	0.002809	0.000254	4.295311	ORGANIC
10	10735	Onions	VEG	775.0	0.013032	3.725144	10836.655922	10674.727286	4.591011e+06	0.003430	0.001304	3.862626	CONVENTIONAL
11	10130	Rye	ORG_CER	142.0	0.002388	5.460804	1416.097533	78.909091	1.102966e+04	0.005028	0.000889	1.945293	ORGANIC
12	10290	Other protein crops	PROT	185.0	0.003111	6.652988	3085.134020	3085.134020	4.405562e+05	0.006126	0.000223	4.015845	CONVENTIONAL
13	10190	Other cereals for the production of grain	ORG_CER	132.0	0.002220	8.348538	1790.545997	172.193182	5.618898e+04	0.007687	0.000234	3.151927	ORGANIC
14	10210	Peas, field beans and sweet lupines	ORG_PROT	406.0	0.006827	8.618460	7817.828502	7817.828502	4.746765e+06	0.007936	0.000551	2.632382	ORGANIC
15	10400	Sugar beet (excluding seed)	ORG_OTHER	375.0	0.006306	9.179845	69536.920361	69536.920361	2.593284e+06	0.008453	0.000598	3.594610	ORGANIC
16	10220	Lentils, chickpeas and vetches	ORG_PROT	529.0	0.008895	9.675069	2232.595510	2146.542363	2.024539e+06	0.008909	0.000574	3.693000	ORGANIC
17	40111	Apples	FRUITS	1541.0	0.025912	12.581825	28698.897899	28420.965682	1.065651e+07	0.011585	0.001974	2.219416	CONVENTIONAL
18	30100	Pasture and meadow, excludin rough grazing	ORG_GRAZING	192.0	0.003229	13.538838	636.651515	0.000000	0.000000e+00	0.012467	0.001212	1.692047	ORGANIC
19	10921	Green maize	ORG_MAIZE	373.0	0.006272	16.141606	84749.202782	84749.202782	3.504299e+06	0.014863	0.000837	2.831512	ORGANIC
20	10150	Oats	ORG_CER	317.0	0.005330	16.465951	3803.846128	936.596978	1.794475e+05	0.015162	0.000898	5.029164	ORGANIC
21	10210	Peas, field beans and sweet lupines	PROT	1273.0	0.021406	18.187819	8868.556284	8833.608732	4.256922e+06	0.016748	0.001704	3.921840	CONVENTIONAL
22	10923	Other plants harvested green but not mentioned...	ORG_OTHER	317.0	0.005330	18.687747	10158.511718	6740.693937	1.044166e+06	0.017208	0.000973	2.583189	ORGANIC
23	30100	Pasture and meadow, excludin rough grazing	GRAZING	479.0	0.008054	19.496973	3236.781040	0.000000	0.000000e+00	0.017953	0.003726	1.365346	CONVENTIONAL
24	10390	Other potatoes	POTATO	1329.0	0.022347	20.329180	56658.817147	55500.586071	1.685882e+07	0.018719	0.004206	3.558157	CONVENTIONAL
25	10300	Potatoes (including early potatoes and seed po...	POTATO	1352.0	0.022734	21.048115	58272.375590	56882.975682	1.754943e+07	0.019381	0.004254	3.548615	CONVENTIONAL
26	10400	Sugar beet (excluding seed)	OTHER	728.0	0.012241	24.614370	169356.911411	169148.859463	6.334456e+06	0.022665	0.001517	3.229885	CONVENTIONAL
27	10220	Lentils, chickpeas and vetches	PROT	1496.0	0.025156	25.391689	3792.940607	3614.122906	3.124185e+06	0.023381	0.001820	3.408364	CONVENTIONAL
28	10601	Tobacco	ORG_TOBACO	2593.0	0.043602	32.979326	5213.447432	5213.447432	1.814977e+07	0.030368	0.006302	2.398237	ORGANIC
29	10190	Other cereals for the production of grain	CER	527.0	0.008862	36.626924	10466.947750	7729.724122	1.459709e+06	0.033726	0.001030	3.377107	CONVENTIONAL
30	10130	Rye	CER	338.0	0.005684	39.906074	6619.529340	2952.781308	4.136509e+05	0.036746	0.000836	3.660316	CONVENTIONAL
31	10923	Other plants harvested green but not mentioned...	OTHER	1659.0	0.027896	46.324942	44050.847325	32388.845208	3.962317e+06	0.042656	0.004337	2.362261	CONVENTIONAL
32	10921	Green maize	MAIZE	1192.0	0.020044	73.483932	426187.618746	415152.302728	1.664593e+07	0.067665	0.002951	2.523263	CONVENTIONAL
33	10140	Barley	ORG_CER	2849.0	0.047907	81.298471	22595.207120	20461.148001	3.595423e+06	0.074860	0.005543	3.542101	ORGANIC
34	10150	Oats	CER	1255.0	0.021103	88.176169	20224.018100	14256.054306	3.070164e+06	0.081194	0.004262	3.099552	CONVENTIONAL
35	10160	Grain maize	ORG_MAIZE	4170.0	0.070119	95.814169	113502.948439	112809.070709	1.724004e+07	0.088227	0.010037	2.944632	ORGANIC
36	10601	Tobacco	TOBACO	6994.0	0.117606	117.937731	18939.002553	18460.063159	6.710394e+07	0.108598	0.022081	2.193079	CONVENTIONAL
37	10110	Common wheat and spelt	ORG_WHEAT	5593.0	0.094047	173.500221	51498.170380	48726.123526	8.395336e+06	0.159761	0.013625	2.673141	ORGANIC
38	10140	Barley	CER	6997.0	0.117656	223.771450	65351.691534	56896.559836	9.811370e+06	0.206051	0.018579	2.832969	CONVENTIONAL
39	10160	Grain maize	MAIZE	8149.0	0.137027	286.422811	333692.181422	328761.582424	4.955231e+07	0.263741	0.023485	2.469330	CONVENTIONAL
40	10120	Durum wheat	ORG_WHEAT	5088.0	0.085556	330.076948	89297.454804	88650.723305	2.232100e+07	0.303938	0.016362	2.520996	ORGANIC
41	10110	Common wheat and spelt	WHEAT	10569.0	0.177720	411.797042	116218.687684	103541.366649	1.774057e+07	0.379187	0.030191	2.558092	CONVENTIONAL
42	10120	Durum wheat	WHEAT	9600.0	0.161426	681.550899	184231.661304	179364.039355	4.295396e+07	0.627579	0.035876	2.334094	CONVENTIONAL

Table 21. Crop representativeness results for Greece

The above table contains all the information generated from the crop grouping analysis for the Greek use case. Crops have been ranked according to the total area dedicated to each.

5.2.2 Crop grouping decisions in Greece

Following the analysis of individual crop distribution, a crop grouping transformation has been established. The goal is to align each FADN crop with a designated product group, considering crop similarities, representativeness, and relevance to the specific use case.

Cereals represent the most significant family of crops, considering both area and economic impact. This group includes wheat, barley, oats, and other cereals, which share similar cultivation methods, campaigns, and production ratios.

Fruit product group was created to encompass all individual permanent crops present in the microdata, with apples standing out as the unique but highly representative crop in economic terms.

Grazing product group includes pastures in various forms, mainly used as livestock feed.

Maize has its own product group due to its possibilities during the simulation. Although it is a minority crop, it can server as feed for livestock, so it will have special product group characterization, so an isolated product group is defined to that end.

Potato product group has been created considering the overall weight of the original crops related with potato in the economic landscape.

Protein product group is defined by nitrogen-fixing crops, such as soybean, sunflower, beans, chickpeas, flax, and lentils. This group is essential for each use case, as the simulation engine needs to recognize it for model execution. Therefore, the decision is based on technical requirements rather than macro indicators.

Tobacco has been assigned its own product group due to its distinct characteristics compared to other agricultural products and its leading position in terms of economic significance for the entire region.

Vegetables product group includes both onions and carrots. The decision to create a separate group for these crops was made to enhance the use case by increasing the variability and diversity of crop selection options.

Other group was created to include remaining crops, either due to low representativeness or their absence from the use case. Tobacco, a non-common crop, is included here to balance indicators with other crops in this group.

The final product groups for crops defined are presented in the table below:

#	Product group	Abbreviation	Description
1	Cereals	CER	All kind of cereals, including wheat, rice, rye, barley…
2	Fruit	FRUIT	All types of fruit-producing crops, especially for the case of apples.
3	Grazing	GRAZ	All crops that can be used as fodder or as feed for livestock, including pasture, meadows, rough grazing, green maize and plants harvested green.
4	Maize	MAIZE	Maize crop for different purposes, including the production of grain and livestock food as fodder
5	Potato	POTATO	All types of potato.
6	Protein crops	PROT	Agricultural plants that are cultivated for their high protein content including lentils, chickpeas, beans… Crops that serve as nitrogen-fixing.
7	Tobacco	TOBACCO	Cultivation of tobacco.
8	Vegetables	VEG	All kind of vegetables, including onions, and carrots.

8	Other	OTHER	Group of crops with low representativeness or without a relevant impact on the use case study. Grapes, wooded area, flowers,

Table 22. Greece crops grouping

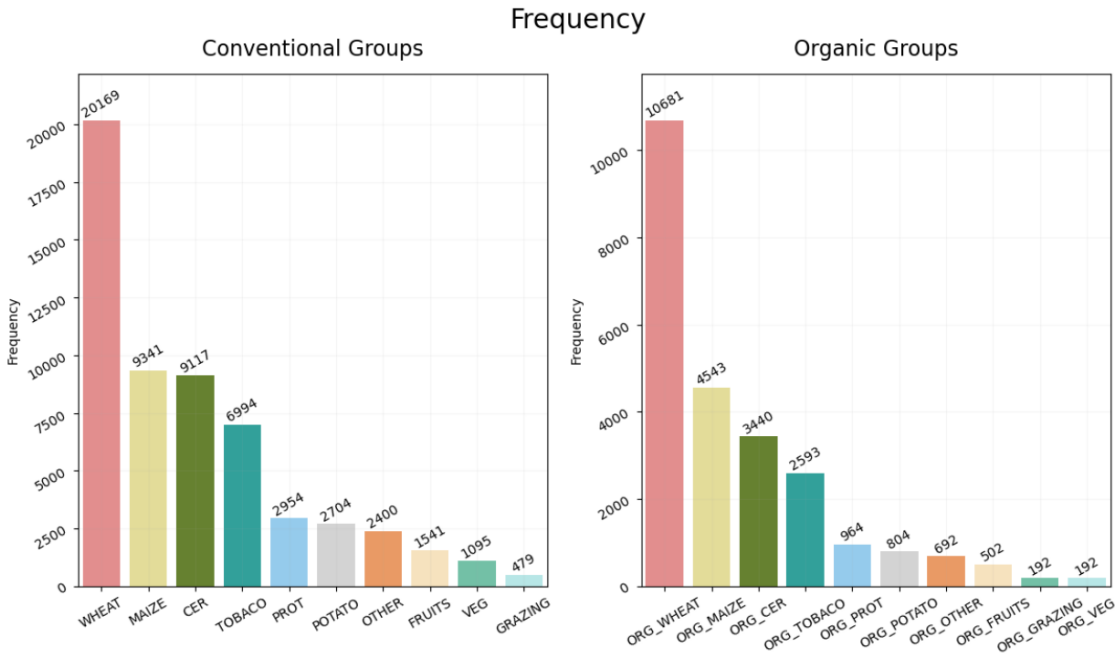

Figure 71. Greece crop grouping result: frequency

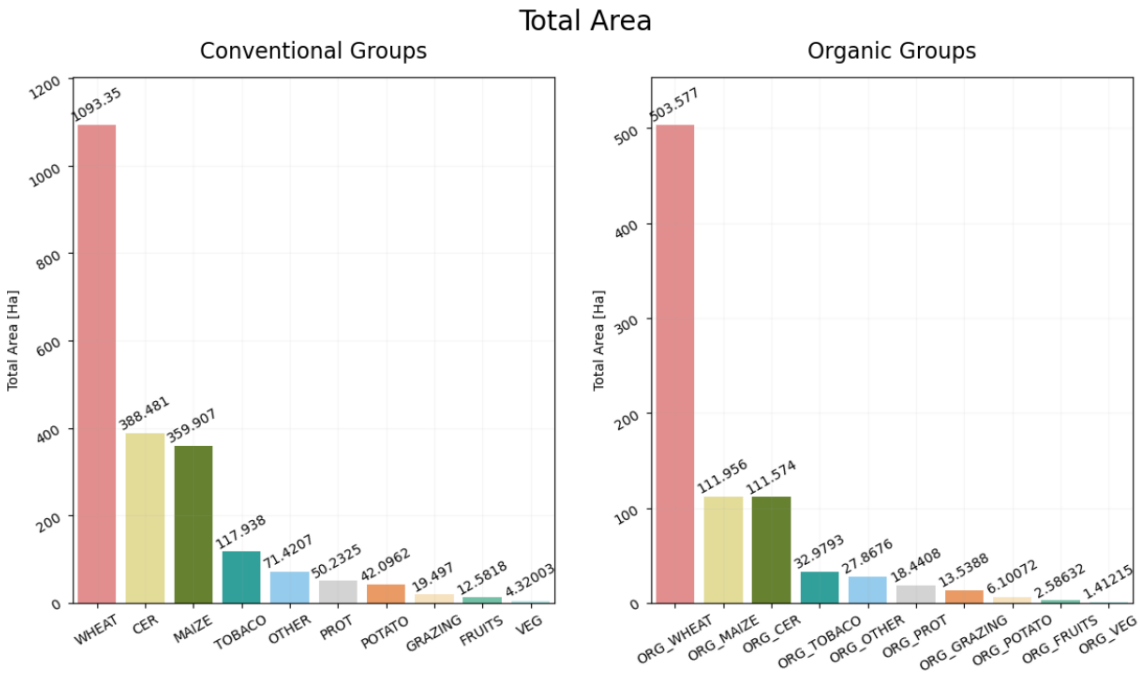

Figure 72. Greece crop grouping result: total area

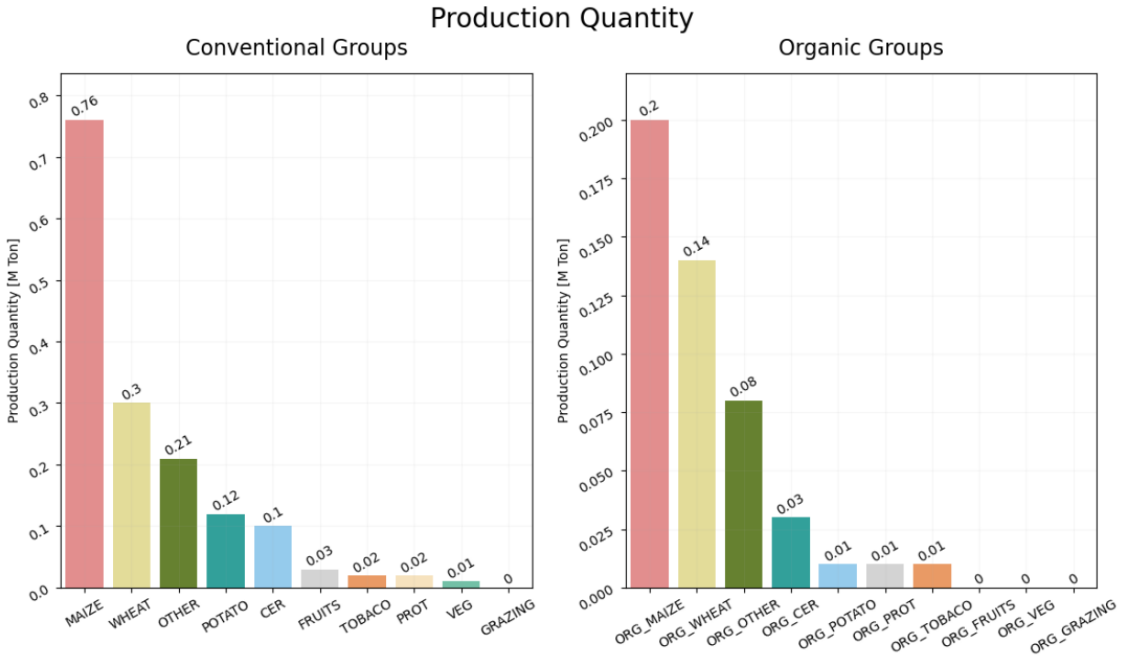

Figure 73. Greece crop grouping result: production quantity

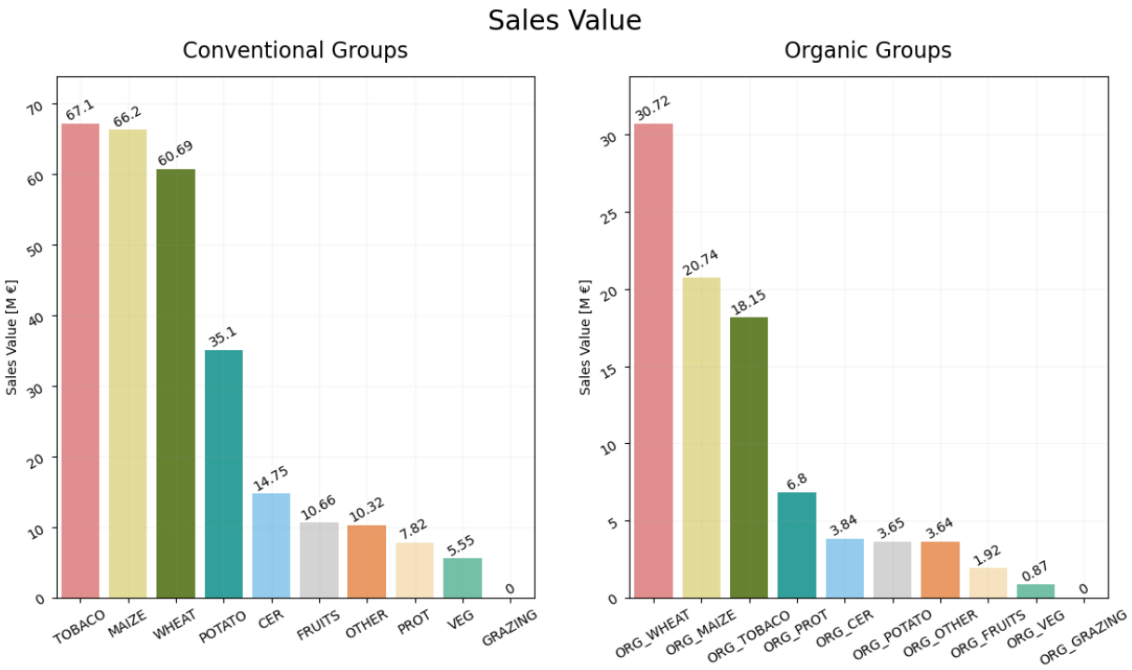

Figure 74. Greece crop grouping result: sales value

The figures above illustrate the results of the product grouping process for the Greek use case. While the outcomes may exhibit a slight bias due to the moderate diversity of crops, the grouping was conducted based on key indicators derived from the available data.

The next table illustrates all the links identified for the current use case according to the product groups defined:

	FADN Code	Description	Group
0	10110	Common wheat and spelt	WHEAT
1	10120	Durum wheat	WHEAT
2	10130	Rye	CER
3	10140	Barley	CER
4	10150	Oats	CER
5	10160	Grain maize	MAIZE
6	10190	Other cereals for the production of grain	CER
7	10210	Peas, field beans and sweet lupines	PROT
8	10220	Lentils, chickpeas and vetches	PROT
9	10290	Other protein crops	PROT
10	10300	Potatoes (including early potatoes and seed po...	POTATO
11	10310	Potatoes for starch	POTATO
12	10390	Other potatoes	POTATO
13	10400	Sugar beet (excluding seed)	OTHER
14	10601	Tobacco	TOBACO
15	10734	Sweet corn	VEG
16	10735	Onions	VEG
17	10737	Carrots	VEG
18	10921	Green maize	MAIZE
19	10923	Other plants harvested green but not mentioned...	OTHER
20	11000	Arable land seed and seedling	OTHER
21	30100	Pasture and meadow, excludin rough grazing	GRAZING
22	40111	Apples	FRUITS
23	10110	Common wheat and spelt	ORG_WHEAT
24	10120	Durum wheat	ORG_WHEAT
25	10130	Rye	ORG_CER
26	10140	Barley	ORG_CER
27	10150	Oats	ORG_CER
28	10160	Grain maize	ORG_MAIZE
29	10190	Other cereals for the production of grain	ORG_CER
30	10210	Peas, field beans and sweet lupines	ORG_PROT
31	10220	Lentils, chickpeas and vetches	ORG_PROT
32	10290	Other protein crops	ORG_PROT
33	10300	Potatoes (including early potatoes and seed po...	ORG_POTATO
34	10310	Potatoes for starch	ORG_POTATO
35	10390	Other potatoes	ORG_POTATO
36	10400	Sugar beet (excluding seed)	ORG_OTHER
37	10601	Tobacco	ORG_TOBACO
38	10735	Onions	ORG_VEG
39	10921	Green maize	ORG_MAIZE
40	10923	Other plants harvested green but not mentioned...	ORG_OTHER
41	30100	Pasture and meadow, excludin rough grazing	ORG_GRAZING
42	40111	Apples	ORG_FRUITS

Table 23. Poland use case: crop grouping results

5.3 Building of the synthetic population

This section outlines the process used to build the synthetic population for the Greece use case. Two distinct accountancy years, 2014 and 2018, were generated for this use case. The synthetic population generation module created farms based on the actual number of farms for each year according to the representativeness found in the FADN microdata. In consequence, some economic size ranges were not included in the generation process as they did not appear in the base image of the real agricultural structure for the region of Central Macedonia.

5.3.1 Generation of synthetic data to solve data unavailability

As in the Polish use case, the main challenge to generate synthetic populations for Greece has been to compute accurate weights that allow to represent rigorously the real representativeness of the farms in base to specific crop related indicators. Details about the process and methods applied can be found in 4.3.1Generation of synthetic data to solve data unavailability.

Although this method may not perfectly capture the true representativeness of farms, it provides a reliable approximation of how each farm in the synthetic population aligns with actual farms, thereby triggering the possibility to generate a synthetic population from the original sample.

To address gaps in social aspect variables, data from the Eurostat database was used. Key statistical indicators were identified and merged with the FADN microdata, covering farm structure, age distribution of family members, and other relevant metrics essential for completing the information set.

Crop selling prices were calculated by dividing the total sales revenue in euros by the total tons sold during the accounting year.

For geospatial data, Eurostat databases were employed to determine probability distributions for regions at NUTS3 and agrarian levels, ensuring the required geospatial resolution for the model.

Lastly, variable costs per crop were determined through an optimization process, with procedural details provided in Annex B.

5.3.2 Use-case's population-specific assumptions

The Greek use case was created with a geospatial limitation, concentrating on the Central Macedonia region (EL52 NUTS2 code). It was assumed that any missing entries in the microdata equate to zero values. Economic size constraints are also applicable to this use case. The FADN economic size classification excludes the three smallest categories, which represent economic sizes below €4,000. As a result, the synthetic population will only reflect the available data, omitting farms with these unrepresented economic sizes.

With regard to the greening area calculation, a variable portion of land up to 5% is designated for greening practices if a synthetic holding qualifies for the greening subsidy. Additionally, for the calculation of greening area only land used for crop with nitrogen-fixing properties is considered.

5.4 Analysis and verification of the synthetic population

This section presents the outcomes of the synthetic population analysis and verification. The methods and techniques used for objectively evaluating the synthetic population are detailed in the section on Techniques to Compare and Assess Synthetic Population Fidelity. Due to the lack of categorical variables in the original dataset, comparisons for these variables have been excluded. Numerical and statistical validations for the remaining variables in the synthetic population are provided for both simulation years. Finally, the goodness-of-fit analysis includes a comparison of totals, focusing on ratios for key crop-related variables.

5.4.1 Report on the generated population probability distribution vs the sample one

Year 2014

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
1150.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1400.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1600.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1700.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
23111.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
23113.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
2313.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
9900.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
9901.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
CER.cropProduction	0.0	0.0	221.42	251.06	25636.0	32400.0	1404.159	1631.716	0.895	0.901	0.001	Different	0.033	Different	0.0248	0.0332
CER.cultivatedArea	0.0	0.0	0.59	0.65	61.5	104.6	3.044	3.576	0.861	0.866	0.004	Different	0.1	Similar	0.0487	0.0267
CER.irrigatedArea	0.0	0.0	0.05	0.04	12.4	11.7	0.56	0.467	0.981	0.987	0.259	Similar	0.049	Different	0.083	0.0317
CER.quantitySold	0.0	0.0	1.26	1.39	135.0	180.0	7.494	8.56	0.893	0.902	0.002	Different	0.002	Different	0.0365	0.0284
CER.quantityUsed	0.0	0.0	0.01	0.02	15.3	21.8	0.322	0.415	0.996	0.995	1.0	Similar	0.886	Similar	0.0283	0.0201
CER.sellingPrice	0.0	0.0	18.58	17.28	495.0	350.0	56.07	53.565	0.895	0.903	0.047	Different	0.008	Different	0.4389	0.1208
CER.valueSales	0.0	0.0	221.25	249.15	25636.0	32400.0	1402.221	1623.017	0.895	0.903	0.0	Different	0.007	Different	0.0279	0.0309
DAIRY.dairyCows	0.0	0.0	0.3	0.31	68.0	68.0	3.895	3.956	0.989	0.989	1.0	Similar	1.0	Similar	0.0001	0.0019
DAIRY.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.manureTotalSales	0.0	0.0	0.0	0.82	0.0	135.0	0.0	8.496	1.0	0.982	0.0	Different	0.0	Different	10.293	0.4349
DAIRY.milkProductionSold	0.0	0.0	1.85	1.89	410.5	410.5	24.894	25.328	0.99	0.991	1.0	Similar	1.0	Similar	0.0	0.0013
DAIRY.milkTotalProduction	0.0	0.0	1.85	1.9	412.0	412.0	24.975	25.411	0.989	0.99	1.0	Similar	0.999	Similar	0.0	0.0013
DAIRY.milkTotalSales	0.0	0.0	760.51	777.7	168305.0	168305.0	10133.273	10300.118	0.99	0.991	1.0	Similar	1.0	Similar	0.0001	0.0018
DAIRY.numberAnimalsForSlaughtering	0.0	0.0	0.1	0.09	31.0	16.0	1.064	0.968	0.988	0.988	1.0	Similar	1.0	Similar	0.1204	0.0393
DAIRY.numberAnimalsRearingBreading	0.0	0.0	0.1	0.1	33.0	33.0	1.396	1.432	0.99	0.99	1.0	Similar	1.0	Similar	0.0001	0.0022
DAIRY.numberOfAnimals	0.0	0.0	0.67	0.7	117.0	118.1	7.29	7.45	0.982	0.982	1.0	Similar	1.0	Similar	0.0012	0.0103
DAIRY.numberOfAnimalsSold	0.0	0.0	0.22	0.22	49.0	49.0	2.288	2.274	0.983	0.983	1.0	Similar	1.0	Similar	0.003	0.0053
DAIRY.valueAnimalsRearingBreading	0.0	0.0	59.41	61.42	29700.0	29700.0	1105.964	1127.036	0.99	0.99	1.0	Similar	1.0	Similar	0.0	0.0014
DAIRY.valueSlaughteredAnimals	0.0	0.0	84.84	79.03	31000.0	20400.0	966.585	857.856	0.988	0.988	1.0	Similar	1.0	Similar	0.0769	0.0381
DAIRY.valueSoldAnimals	0.0	0.0	184.39	177.19	39300.0	39300.0	2066.745	2017.442	0.983	0.983	1.0	Similar	1.0	Similar	0.0001	0.0019
DAIRY.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
FRUITS.cropProduction	0.0	0.0	192.67	192.33	66150.0	66150.0	1960.06	2019.126	0.976	0.976	1.0	Similar	1.0	Similar	0.0007	0.0068
FRUITS.cultivatedArea	0.0	0.0	0.02	0.02	6.3	6.3	0.214	0.213	0.973	0.974	0.848	Similar	0.997	Similar	0.0011	0.0079
FRUITS.irrigatedArea	0.0	0.0	0.02	0.02	6.3	6.3	0.211	0.21	0.979	0.979	0.668	Similar	1.0	Similar	0.0021	0.0107
FRUITS.quantitySold	0.0	0.0	0.5	0.51	206.8	206.8	5.824	6.026	0.976	0.976	1.0	Similar	1.0	Similar	0.0005	0.0059
FRUITS.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
FRUITS.sellingPrice	0.0	0.0	11.45	10.17	1000.0	1000.0	79.645	67.823	0.976	0.976	0.946	Similar	1.0	Similar	0.0039	0.0166
FRUITS.valueSales	0.0	0.0	189.81	189.37	66150.0	66150.0	1941.297	2000.187	0.976	0.976	1.0	Similar	1.0	Similar	0.0007	0.0068
GRAZING.cropProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.cultivatedArea	0.0	0.0	0.05	0.03	26.7	20.1	0.674	0.544	0.99	0.992	0.978	Similar	0.783	Similar	0.0647	0.0269
GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.quantitySold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.sellingPrice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.valueSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
MAIZE.cropProduction	0.0	0.0	1079.24	1139.89	55440.0	75184.0	4228.055	4634.715	0.849	0.857	0.008	Different	0.008	Different	0.0282	0.0289
MAIZE.cultivatedArea	0.0	0.0	0.57	0.62	30.2	40.1	2.147	2.44	0.839	0.845	0.009	Different	0.07	Similar	0.0229	0.0229
MAIZE.irrigatedArea	0.0	0.0	0.57	0.61	30.2	40.0	2.139	2.428	0.842	0.846	0.009	Different	0.103	Similar	0.0335	0.0248
MAIZE.quantitySold	0.0	0.0	12.28	12.86	1386.0	1386.0	66.162	67.533	0.849	0.858	0.01	Different	0.004	Different	0.0087	0.0178
MAIZE.quantityUsed	0.0	0.0	0.05	0.05	49.1	36.8	1.099	1.035	0.995	0.995	1.0	Similar	1.0	Similar	0.0084	0.0144
MAIZE.sellingPrice	0.0	0.0	29.28	28.02	30034.3	30034.3	481.38	496.771	0.849	0.858	0.0	Different	0.0	Different	0.0	0.0002
MAIZE.valueSales	0.0	0.0	1076.61	1131.15	55440.0	75184.0	4199.964	4618.196	0.849	0.858	0.007	Different	0.003	Different	0.0305	0.0311
ORG_CER.cropProduction	0.0	0.0	93.07	59.69	18629.0	18629.0	883.945	567.832	0.956	0.957	0.193	Similar	0.959	Similar	0.0402	0.0266
ORG_CER.cultivatedArea	0.0	0.0	0.25	0.17	104.5	60.0	2.48	1.523	0.942	0.947	0.124	Similar	0.095	Similar	0.0087	0.0194
ORG_CER.irrigatedArea	0.0	0.0	0.01	0.01	10.3	12.4	0.209	0.281	0.994	0.997	0.953	Similar	0.564	Similar	0.0447	0.0205
ORG_CER.quantitySold	0.0	0.0	0.48	0.33	103.5	103.5	4.472	3.169	0.955	0.957	0.491	Similar	0.549	Similar	0.0327	0.0232
ORG_CER.quantityUsed	0.0	0.0	0.01	0.0	21.8	2.1	0.314	0.037	0.999	0.999	1.0	Similar	1.0	Similar	0.005	0.0102
ORG_CER.sellingPrice	0.0	0.0	8.04	7.87	350.0	495.0	37.785	39.13	0.956	0.957	0.001	Different	0.653	Similar	0.5233	0.0807
ORG_CER.valueSales	0.0	0.0	90.62	59.42	18629.0	18629.0	867.793	563.686	0.956	0.957	0.134	Similar	0.96	Similar	0.0391	0.0253
ORG_FRUITS.cropProduction	0.0	0.0	21.0	32.7	9066.7	9066.7	373.001	483.657	0.995	0.992	0.99	Similar	0.61	Similar	0.0253	0.0266
ORG_FRUITS.cultivatedArea	0.0	0.0	0.0	0.0	0.7	1.5	0.037	0.06	0.995	0.992	0.566	Similar	0.34	Similar	0.066	0.0343
ORG_FRUITS.irrigatedArea	0.0	0.0	0.0	0.0	0.7	1.5	0.033	0.06	0.996	0.993	0.561	Similar	0.336	Similar	0.0395	0.0302
ORG_FRUITS.quantitySold	0.0	0.0	0.05	0.08	19.6	22.6	0.86	1.168	0.995	0.992	0.99	Similar	0.609	Similar	0.0628	0.0325
ORG_FRUITS.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_FRUITS.sellingPrice	0.0	0.0	2.14	3.84	526.1	1000.0	30.631	48.512	0.995	0.992	0.774	Similar	0.607	Similar	0.0508	0.0325
ORG_FRUITS.valueSales	0.0	0.0	20.81	32.32	8930.0	8930.0	368.405	479.341	0.995	0.992	0.99	Similar	0.61	Similar	0.0253	0.0266
ORG_GRAZING.cropProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.cultivatedArea	0.0	0.0	0.01	0.02	12.2	12.3	0.337	0.484	0.999	0.997	0.997	Similar	0.689	Similar	0.0022	0.0147
ORG_GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.quantitySold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0

Figure 75. Statistical results: Greece 2014 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_GRAZING.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.sellingPrice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.valueSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_MAIZE.cropProduction	0.0	0.0	379.68	352.41	75184.0	35600.0	2616.809	2037.731	0.942	0.927	0.0	Different	0.0	Different	0.0153	0.0322
ORG_MAIZE.cultivatedArea	0.0	0.0	0.22	0.19	40.0	17.7	1.438	1.055	0.937	0.924	0.0	Different	0.0	Different	0.0234	0.0338
ORG_MAIZE.irrigatedArea	0.0	0.0	0.22	0.19	40.0	17.6	1.436	1.048	0.937	0.924	0.0	Different	0.0	Different	0.0235	0.0338
ORG_MAIZE.quantitySold	0.0	0.0	3.46	3.31	1100.3	620.0	30.041	25.258	0.943	0.927	0.0	Different	0.0	Different	0.0182	0.0275
ORG_MAIZE.quantityUsed	0.0	0.0	0.01	0.01	8.7	12.3	0.196	0.292	0.999	0.999	1.0	Similar	1.0	Similar	0.0117	0.0126
ORG_MAIZE.sellingPrice	0.0	0.0	8.56	10.74	380.0	378.6	36.655	40.739	0.942	0.927	0.0	Different	0.0	Different	0.0174	0.0238
ORG_MAIZE.valueSales	0.0	0.0	379.6	349.82	75184.0	35600.0	2616.337	2007.083	0.942	0.927	0.0	Different	0.0	Different	0.0162	0.0329
ORG_OTHER.cropProduction	0.0	0.0	56.88	57.44	24540.0	27047.0	857.004	865.176	0.99	0.99	0.991	Similar	1.0	Similar	0.0106	0.0195
ORG_OTHER.cultivatedArea	0.0	0.0	0.03	0.05	10.3	16.1	0.387	0.608	0.985	0.988	0.779	Similar	0.305	Similar	0.0387	0.0265
ORG_OTHER.irrigatedArea	0.0	0.0	0.03	0.02	10.3	7.5	0.359	0.323	0.99	0.991	0.992	Similar	1.0	Similar	0.0519	0.0297
ORG_OTHER.quantitySold	0.0	0.0	1.25	1.24	713.5	797.5	21.253	22.446	0.99	0.99	0.991	Similar	1.0	Similar	0.0217	0.0177
ORG_OTHER.quantityUsed	0.0	0.0	0.0	0.05	5.7	42.2	0.112	1.379	1.0	0.999	1.0	Similar	1.0	Similar	0.0005	0.0067
ORG_OTHER.sellingPrice	0.0	0.0	0.91	0.92	184.9	180.0	11.112	10.979	0.99	0.99	1.0	Similar	1.0	Similar	0.0308	0.0242
ORG_OTHER.valueSales	0.0	0.0	56.8	57.34	24540.0	27047.0	856.658	864.818	0.99	0.99	0.991	Similar	1.0	Similar	0.0111	0.021
ORG_POTATO.cropProduction	0.0	0.0	80.41	61.87	69741.6	57000.0	2002.653	1331.906	0.995	0.993	0.801	Similar	0.813	Similar	0.0038	0.0186
ORG_POTATO.cultivatedArea	0.0	0.0	0.01	0.01	8.3	7.1	0.216	0.199	0.995	0.993	0.999	Similar	0.809	Similar	0.049	0.0263
ORG_POTATO.irrigatedArea	0.0	0.0	0.01	0.01	8.3	7.0	0.216	0.199	0.995	0.993	0.999	Similar	0.815	Similar	0.0493	0.0267
ORG_POTATO.quantitySold	0.0	0.0	0.21	0.24	168.0	190.0	4.456	4.934	0.995	0.993	0.993	Similar	0.815	Similar	0.032	0.0227
ORG_POTATO.quantityUsed	0.0	0.0	0.01	0.0	17.4	0.0	0.343	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4236	0.4521
ORG_POTATO.sellingPrice	0.0	0.0	1.35	2.49	499.6	576.9	21.185	33.1	0.995	0.993	0.906	Similar	0.812	Similar	0.0586	0.033
ORG_POTATO.valueSales	0.0	0.0	72.08	61.46	59750.0	57000.0	1720.699	1329.976	0.995	0.993	0.801	Similar	0.813	Similar	0.0086	0.0247
ORG_PROT.cropProduction	0.0	0.0	43.52	103.86	25500.0	113328.0	653.122	2434.714	0.987	0.985	0.491	Similar	0.829	Similar	0.023	0.022
ORG_PROT.cultivatedArea	0.0	0.0	0.03	0.03	27.2	9.3	0.555	0.33	0.984	0.985	0.198	Similar	0.999	Similar	0.018	0.0275
ORG_PROT.irrigatedArea	0.0	0.0	0.01	0.02	5.5	6.4	0.149	0.236	0.993	0.99	0.321	Similar	0.407	Similar	0.0228	0.0286
ORG_PROT.quantitySold	0.0	0.0	0.05	0.15	35.0	188.9	0.914	4.021	0.987	0.985	0.25	Similar	0.825	Similar	0.0295	0.0243
ORG_PROT.quantityUsed	0.0	0.0	0.0	0.0	2.6	0.0	0.04	0.0	1.0	1.0	1.0	Similar	1.0	Similar	26.4248	0.4634
ORG_PROT.sellingPrice	0.0	0.0	20.64	25.76	2444.4	4450.0	200.207	255.439	0.987	0.985	0.953	Similar	0.838	Similar	0.1027	0.0452
ORG_PROT.valueSales	0.0	0.0	43.12	103.78	25500.0	113328.0	650.681	2434.571	0.987	0.985	0.491	Similar	0.825	Similar	0.0203	0.0191
ORG_TOBACO.cropProduction	0.0	0.0	308.25	319.05	38850.0	40320.0	2163.495	2090.799	0.96	0.956	0.12	Similar	0.257	Similar	0.0562	0.0365
ORG_TOBACO.cultivatedArea	0.0	0.0	0.06	0.06	10.0	5.5	0.396	0.357	0.96	0.956	0.116	Similar	0.27	Similar	0.0456	0.0416
ORG_TOBACO.irrigatedArea	0.0	0.0	0.04	0.03	7.4	5.5	0.292	0.275	0.97	0.97	0.361	Similar	1.0	Similar	0.0722	0.0394
ORG_TOBACO.quantitySold	0.0	0.0	0.08	0.09	10.5	9.6	0.583	0.573	0.961	0.956	0.019	Different	0.078	Similar	0.102	0.0442
ORG_TOBACO.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_TOBACO.sellingPrice	0.0	0.0	143.48	153.64	4175.7	4200.0	706.583	727.202	0.96	0.956	0.547	Similar	0.276	Similar	0.015	0.0324
ORG_TOBACO.valueSales	0.0	0.0	308.43	320.78	38850.0	40320.0	2163.843	2099.184	0.96	0.956	0.109	Similar	0.258	Similar	0.0566	0.0371
ORG_VEG.cropProduction	0.0	0.0	7.4	13.68	17300.0	17300.0	342.92	375.635	0.999	0.997	0.996	Similar	0.669	Similar	0.0051	0.0154
ORG_VEG.cultivatedArea	0.0	0.0	0.0	0.0	1.3	1.4	0.026	0.049	0.999	0.997	0.995	Similar	0.655	Similar	0.0092	0.0164
ORG_VEG.irrigatedArea	0.0	0.0	0.0	0.0	0.3	1.4	0.007	0.041	1.0	0.998	1.0	Similar	0.839	Similar	0.0012	0.011
ORG_VEG.quantitySold	0.0	0.0	0.04	0.07	101.6	101.6	2.006	2.102	0.999	0.997	0.996	Similar	0.668	Similar	0.0019	0.0135
ORG_VEG.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_VEG.sellingPrice	0.0	0.0	0.27	0.92	500.0	400.0	10.622	16.989	0.999	0.997	0.996	Similar	0.668	Similar	0.0069	0.0168
ORG_VEG.valueSales	0.0	0.0	7.4	13.68	17300.0	17300.0	342.92	375.61	0.999	0.997	0.996	Similar	0.669	Similar	0.0051	0.0154
ORG_WHEAT.cropProduction	0.0	0.0	429.05	524.54	132710.0	60499.0	3204.155	2883.401	0.882	0.845	0.0	Different	0.0	Different	0.0135	0.0331
ORG_WHEAT.cultivatedArea	0.0	0.0	0.67	0.85	191.5	95.5	4.529	4.233	0.876	0.837	0.0	Different	0.0	Different	0.0193	0.0399
ORG_WHEAT.irrigatedArea	0.0	0.0	0.03	0.04	32.9	16.1	0.589	0.625	0.983	0.98	0.015	Different	0.271	Similar	0.0288	0.0303
ORG_WHEAT.quantitySold	0.0	0.0	1.91	2.34	603.2	208.8	14.651	12.365	0.882	0.846	0.0	Different	0.0	Different	0.0276	0.0473
ORG_WHEAT.quantityUsed	0.0	0.0	0.02	0.01	11.3	13.3	0.432	0.271	0.993	0.994	0.86	Similar	0.971	Similar	0.0635	0.0309
ORG_WHEAT.sellingPrice	0.0	0.0	24.33	32.15	321.9	500.0	67.654	77.685	0.882	0.846	0.0	Different	0.0	Different	0.8011	0.1296
ORG_WHEAT.valueSales	0.0	0.0	425.19	520.8	132710.0	60499.0	3190.468	2881.899	0.882	0.846	0.0	Different	0.0	Different	0.0116	0.0308
OTHER.cropProduction	0.0	0.0	177.63	170.86	57584.0	57584.0	1703.4	1596.249	0.968	0.968	0.997	Similar	1.0	Similar	0.0062	0.016
OTHER.cultivatedArea	0.0	0.0	0.13	0.11	55.5	41.6	1.373	1.166	0.962	0.96	0.649	Similar	0.659	Similar	0.0459	0.0301
OTHER.irrigatedArea	0.0	0.0	0.05	0.06	19.2	19.2	0.603	0.597	0.975	0.975	0.992	Similar	1.0	Similar	0.004	0.0091
OTHER.quantitySold	0.0	0.0	3.39	3.41	1536.8	1536.8	43.02	40.247	0.968	0.968	0.844	Similar	1.0	Similar	0.0074	0.0191
OTHER.quantityUsed	0.0	0.0	0.06	0.03	42.2	37.2	1.519	0.842	0.998	0.998	1.0	Similar	1.0	Similar	0.0092	0.0108
OTHER.sellingPrice	0.0	0.0	10.48	10.29	2000.0	2000.0	118.257	117.689	0.968	0.968	0.998	Similar	1.0	Similar	0.0003	0.0045
OTHER.valueSales	0.0	0.0	176.91	170.28	57584.0	57584.0	1699.061	1592.809	0.968	0.968	0.997	Similar	1.0	Similar	0.0061	0.0161
OTHER_LIVESTOCK.dairyCows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.manureTotalSales	0.0	0.0	0.0	15.23	0.0	7200.0	0.0	302.798	1.0	0.994	0.175	Similar	0.021	Different	17.5452	0.4195
OTHER_LIVESTOCK.milkProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalSales	0.0	0.0	52.56	5.69	83885.0	83949.1	1775.24	515.121	0.997	1.0	0.997	Similar	0.722	Similar	0.003	0.0113
OTHER_LIVESTOCK.numberAnimalsForSlaughtering	0.0	0.0	6.55	7.58	3600.0	3600.0	141.077	151.329	0.994	0.994	1.0	Similar	1.0	Similar	0.0001	0.0023
OTHER_LIVESTOCK.numberAnimalsRearingBreading	0.0	0.0	0.04	0.03	70.0	70.0	1.484	1.223	0.999	0.999	1.0	Similar	1.0	Similar	0.0002	0.0033
OTHER_LIVESTOCK.numberOfAnimals	0.0	0.0	6.16	7.08	3800.0	3826.9	145.138	155.223	0.994	0.994	1.0	Similar	1.0	Similar	0.0001	0.0023
OTHER_LIVESTOCK.numberOfAnimalsSold	0.0	0.0	6.59	7.61	3600.0	3600.0	141.188	151.403	0.993	0.994	1.0	Similar	1.0	Similar	0.0001	0.0023
OTHER_LIVESTOCK.valueAnimalsRearingBreading	0.0	0.0	4.04	2.74	7000.0	7000.0	155.439	128.609	0.999	0.999	1.0	Similar	1.0	Similar	0.0002	0.0033
OTHER_LIVESTOCK.valueSlaughteredAnimals	0.0	0.0	181.98	225.0	175147.0	175147.0	5206.966	5965.479	0.994	0.994	1.0	Similar	1.0	Similar	0.0001	0.0021

Figure 76. Statistical results: Greece 2014 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
OTHER_LIVESTOCK.valueSoldAnimals	0.0	0.0	188.14	229.1	175147.0	175147.0	5243.178	5988.978	0.993	0.994	1.0	Similar	1.0	Similar	0.0001	0.0021
OTHER_LIVESTOCK.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
POTATO.cropProduction	0.0	0.0	589.89	614.62	71374.0	71374.0	4732.0	5135.792	0.972	0.977	0.29	Similar	0.075	Similar	0.0504	0.0297
POTATO.cultivatedArea	0.0	0.0	0.07	0.07	12.4	12.6	0.636	0.682	0.972	0.977	0.393	Similar	0.075	Similar	0.0297	0.0226
POTATO.irrigatedArea	0.0	0.0	0.07	0.07	12.4	12.4	0.636	0.68	0.972	0.977	0.393	Similar	0.075	Similar	0.03	0.023
POTATO.quantitySold	0.0	0.0	1.94	1.94	285.6	285.6	17.211	17.795	0.972	0.977	0.29	Similar	0.075	Similar	0.0092	0.0191
POTATO.quantityUsed	0.0	0.0	0.01	0.02	7.5	17.4	0.233	0.425	0.999	0.998	1.0	Similar	1.0	Similar	0.0084	0.0139
POTATO.sellingPrice	0.0	0.0	11.0	9.14	1200.0	1200.0	72.506	66.803	0.972	0.977	0.397	Similar	0.074	Similar	0.043	0.0204
POTATO.valueSales	0.0	0.0	580.65	596.45	71374.0	71374.0	4634.239	4929.134	0.972	0.977	0.29	Similar	0.075	Similar	0.0206	0.0251
PROT.cropProduction	0.0	0.0	196.48	121.4	113328.0	34946.0	2707.011	1069.158	0.958	0.966	0.009	Different	0.004	Different	0.0127	0.0304
PROT.cultivatedArea	0.0	0.0	0.09	0.08	27.7	27.8	0.804	0.86	0.952	0.957	0.035	Different	0.054	Similar	0.0168	0.0164
PROT.irrigatedArea	0.0	0.0	0.05	0.04	12.3	12.3	0.439	0.401	0.97	0.976	0.041	Different	0.032	Different	0.0503	0.0213
PROT.quantitySold	0.0	0.0	0.38	0.26	188.9	117.6	5.342	3.457	0.957	0.966	0.041	Different	0.003	Different	0.0192	0.0263
PROT.quantityUsed	0.0	0.0	0.0	0.0	1.1	2.6	0.016	0.044	1.0	1.0	1.0	Similar	1.0	Similar	0.0001	0.0035
PROT.sellingPrice	0.0	0.0	68.28	48.8	4450.0	3925.3	396.419	321.567	0.958	0.966	0.007	Different	0.004	Different	0.1564	0.0541
PROT.valueSales	0.0	0.0	202.34	128.56	113328.0	34946.0	2751.513	1201.744	0.958	0.966	0.006	Different	0.004	Different	0.0119	0.0291
TOBACO.cropProduction	0.0	0.0	1126.53	1123.15	75880.0	75880.0	4136.548	4297.076	0.881	0.883	0.001	Different	0.289	Similar	0.0055	0.0184
TOBACO.cultivatedArea	0.0	0.0	0.2	0.2	10.5	10.5	0.684	0.713	0.88	0.882	0.028	Different	0.56	Similar	0.0177	0.0232
TOBACO.irrigatedArea	0.0	0.0	0.12	0.12	5.7	7.4	0.5	0.508	0.923	0.927	0.004	Different	0.175	Similar	0.0563	0.0404
TOBACO.quantitySold	0.0	0.0	0.31	0.31	17.2	17.2	1.149	1.171	0.882	0.884	0.002	Different	0.353	Similar	0.0152	0.0256
TOBACO.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.001	0.001	1.0	0.999	1.0	Similar	1.0	Similar	0.0003	0.0044
TOBACO.sellingPrice	0.0	0.0	419.39	408.96	4926.3	4926.3	1149.053	1139.668	0.881	0.884	0.438	Similar	0.251	Similar	0.0098	0.013
TOBACO.valueSales	0.0	0.0	1122.75	1098.02	75880.0	75880.0	4128.098	4252.387	0.881	0.884	0.0	Different	0.128	Similar	0.0059	0.0187
VEG.cropProduction	0.0	0.0	102.07	92.76	14110.0	14110.0	1019.814	1000.59	0.982	0.985	0.968	Similar	0.495	Similar	0.0012	0.008
VEG.cultivatedArea	0.0	0.0	0.01	0.01	1.4	1.3	0.084	0.072	0.982	0.985	0.736	Similar	0.501	Similar	0.1058	0.0311
VEG.irrigatedArea	0.0	0.0	0.01	0.01	1.4	1.3	0.083	0.071	0.986	0.988	0.765	Similar	0.836	Similar	0.1125	0.0313
VEG.quantitySold	0.0	0.0	0.23	0.2	42.3	31.5	2.386	2.25	0.982	0.985	0.941	Similar	0.493	Similar	0.1498	0.0417
VEG.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
VEG.sellingPrice	0.0	0.0	8.67	7.78	1500.0	1500.0	71.131	69.046	0.982	0.985	0.968	Similar	0.498	Similar	0.0086	0.0115
VEG.valueSales	0.0	0.0	100.96	91.65	14110.0	14110.0	1012.516	992.903	0.982	0.985	0.968	Similar	0.495	Similar	0.0012	0.0081
WHEAT.cropProduction	0.0	0.0	1136.47	1054.34	86400.0	99532.5	3913.358	3828.357	0.68	0.722	0.0	Different	0.0	Different	0.0297	0.0262
WHEAT.cultivatedArea	0.0	0.0	2.0	1.86	111.4	143.7	6.119	6.104	0.663	0.699	0.0	Different	0.0	Different	0.0437	0.0286
WHEAT.irrigatedArea	0.0	0.0	0.16	0.12	38.2	38.2	1.146	1.106	0.947	0.963	0.0	Different	0.0	Different	0.0061	0.0191
WHEAT.quantitySold	0.0	0.0	5.12	4.82	320.0	452.4	16.346	17.132	0.68	0.723	0.0	Different	0.0	Different	0.0339	0.0309
WHEAT.quantityUsed	0.0	0.0	0.05	0.07	21.8	21.8	0.626	0.703	0.985	0.98	0.091	Similar	0.09	Similar	0.01	0.0179
WHEAT.sellingPrice	0.0	0.0	66.31	57.89	2674.3	2674.3	113.321	119.965	0.68	0.725	0.0	Different	0.0	Different	0.0192	0.0217
WHEAT.valueSales	0.0	0.0	1104.3	1026.59	86400.0	99532.5	3793.748	3740.332	0.68	0.725	0.0	Different	0.0	Different	0.0269	0.0252
agriculturalLandArea	0.0	0.0	9.36	9.29	191.5	191.8	13.624	13.505	0.021	0.021	0.0	Different	0.164	Similar	0.0002	0.0037
agriculturalLandHectaresAdquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
agriculturalLandValue	0.0	0.0	44621.64	46287.1	609000.0	609000.0	51127.091	53390.321	0.09	0.095	0.0	Different	0.0	Different	0.0023	0.0121
depreciation	0.0	0.0	3688.0	3931.3	29546.1	29546.1	2885.806	3010.127	0.019	0.016	0.0	Different	0.0	Different	0.0073	0.0215
farmBuildingsValue	0.0	0.0	6868.33	7095.14	238950.0	238950.0	13777.299	13679.283	0.266	0.262	0.0	Different	0.0	Different	0.0023	0.0119
farmNetIncome	-49944.0	-49944.0	9414.03	9858.43	230337.0	230337.0	15590.071	16073.571	0.0	0.0	0.0	Different	0.0	Different	0.0025	0.0129
fixedAssets	0.0	0.0	101700.5	107460.56	849407.0	849407.0	83361.627	85599.973	0.003	0.003	0.0	Different	0.0	Different	0.005	0.0177
forestLandArea	0.0	0.0	0.04	0.05	50.0	50.0	1.381	1.413	0.994	0.992	0.999	Similar	0.795	Similar	0.0001	0.002
forestLandValue	0.0	0.0	38.47	39.64	14621.0	14621.0	605.375	622.867	0.995	0.995	1.0	Similar	1.0	Similar	0.001	0.0075
grossFarmIncome	-23426.0	-23426.0	16689.66	17463.78	258788.0	258788.0	19056.832	19472.077	0.0	0.0	0.0	Different	0.0	Different	0.0028	0.0131
intangibleAssetsNonTradable	0.0	0.0	1.26	1.41	2970.0	2970.0	61.098	64.659	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0004
intangibleAssetsTradable	0.0	0.0	5456.54	5634.36	111606.0	111606.0	7172.821	7018.532	0.124	0.118	0.0	Different	0.0	Different	0.0026	0.0129
landImprovements	0.0	0.0	1765.06	2035.91	94575.0	94575.0	5523.594	5993.396	0.712	0.692	0.0	Different	0.0	Different	0.0058	0.0196
longAndMediumTermLoans	0.0	0.0	43.72	52.17	87000.0	87000.0	1530.182	1684.14	0.998	0.997	1.0	Similar	0.996	Similar	0.0007	0.0067
machinery	0.0	0.0	28413.55	29516.48	434721.0	434721.0	32913.154	33535.726	0.036	0.04	0.0	Different	0.0	Different	0.0018	0.0109
machineryAndEquipment	0.0	0.0	28413.55	29517.29	434721.0	434721.0	32913.154	33535.11	0.036	0.04	0.0	Different	0.0	Different	0.0018	0.0109
otherNonCurrentAssets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
otherOutputs	0.0	0.0	559.1	535.1	40000.0	40000.0	2475.455	2369.585	0.885	0.891	0.224	Similar	0.039	Different	0.001	0.0078
plantationsValue	0.0	0.0	1092.55	1131.0	49000.0	49000.0	2657.634	2593.958	0.242	0.251	0.0	Different	0.0	Different	0.0071	0.0202
rentPaid	0.0	0.0	272.21	271.39	3643.4	3652.5	329.604	326.406	0.279	0.279	0.0	Different	0.037	Different	0.0044	0.0167
specificCropCosts	0.0	0.0	753.14	745.77	14656.6	14656.6	826.559	811.612	0.025	0.025	0.006	Different	0.076	Similar	0.0008	0.0067
subsidiesOnInvestments	0.0	0.0	149.77	143.62	80784.0	80784.0	2662.54	2542.799	0.995	0.995	1.0	Similar	1.0	Similar	0.0002	0.0031
taxes	0.0	0.0	29.01	26.29	6091.4	6091.4	230.313	195.534	0.962	0.962	0.996	Similar	1.0	Similar	0.0011	0.008
totalCurrentAssets	180.0	180.0	4615.17	4884.07	64540.0	64540.0	6422.091	6554.793	0.0	0.0	0.0	Different	0.0	Different	0.0049	0.0174
totalExternalFactors	0.0	0.0	3737.06	4065.42	72000.0	72000.0	5637.514	5738.488	0.085	0.068	0.0	Different	0.0	Different	0.0053	0.0183
totalIntermediateConsumption	1400.0	1400.0	13792.89	14451.01	174012.0	174012.0	17883.73	17514.201	0.0	0.0	0.0	Different	0.0	Different	0.0065	0.02
totalOutputCropsAndCropProduction	0.0	0.0	18548.38	19242.89	321360.0	321360.0	22433.836	22834.571	0.031	0.034	0.0	Different	0.0	Different	0.0015	0.0097
totalOutputLivestockAndLivestockProduction	-14786.8	-14786.8	4098.69	4676.26	197104.7	197104.7	17782.695	17997.097	0.868	0.85	0.0	Different	0.0	Different	0.0074	0.0217
vatBalanceExcludingInvestments	-19000.0	-19000.0	-372.72	-354.61	0.0	0.0	1031.853	1008.038	0.668	0.693	0.0	Different	0.0	Different	0.0008	0.0074
vatBalanceOnInvestments	-46.0	-46.0	-0.34	-0.47	0.0	0.0	3.823	4.481	0.992	0.989	0.97	Similar	0.497	Similar	0.0005	0.0058

Figure 77. Statistical results: Grece 2014 (sheet 3)

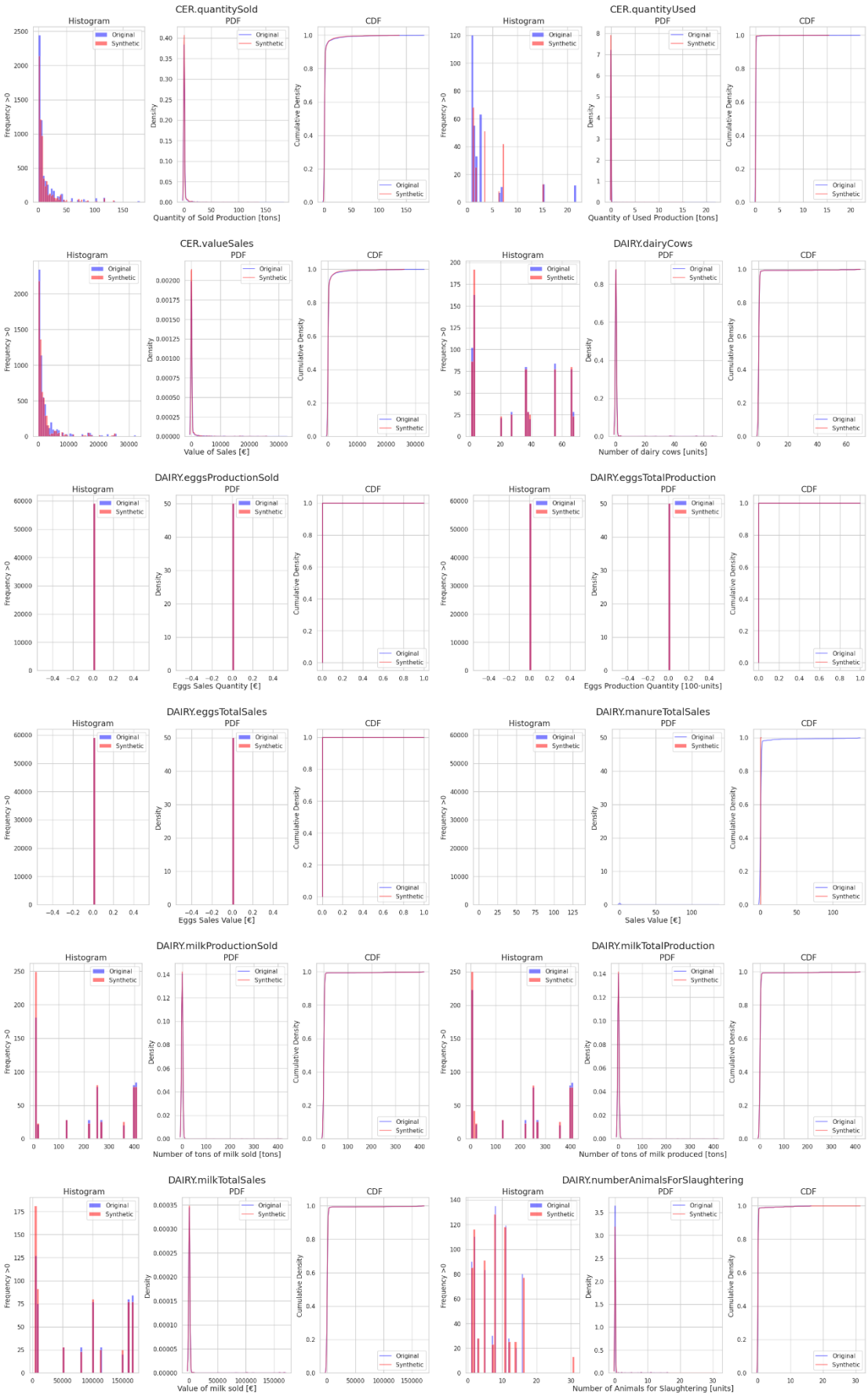

Figure 78. Statistical results: Greece 2014 (sheet 1)

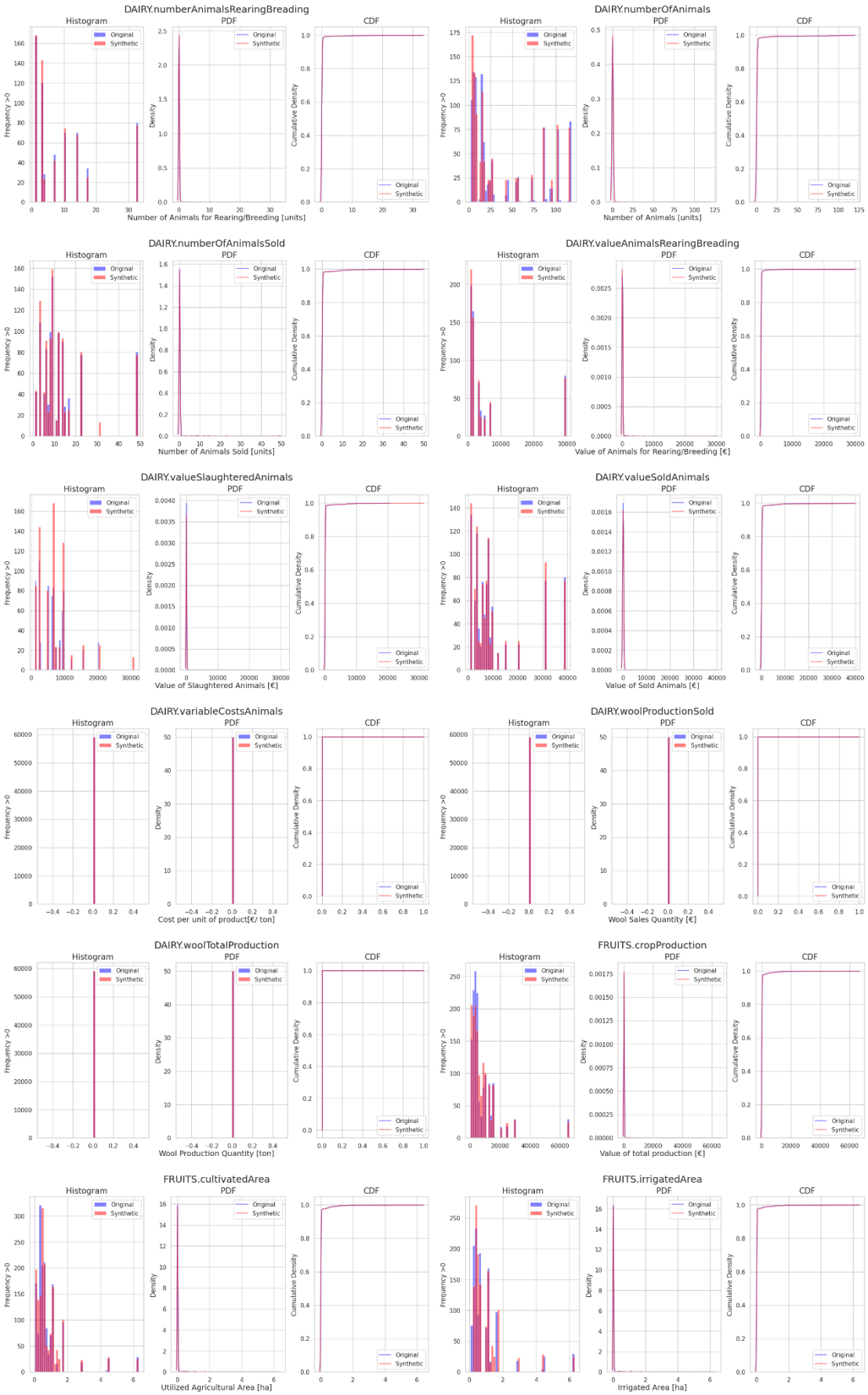

Figure 79. Statistical results: Greece 2014 (sheet 2)

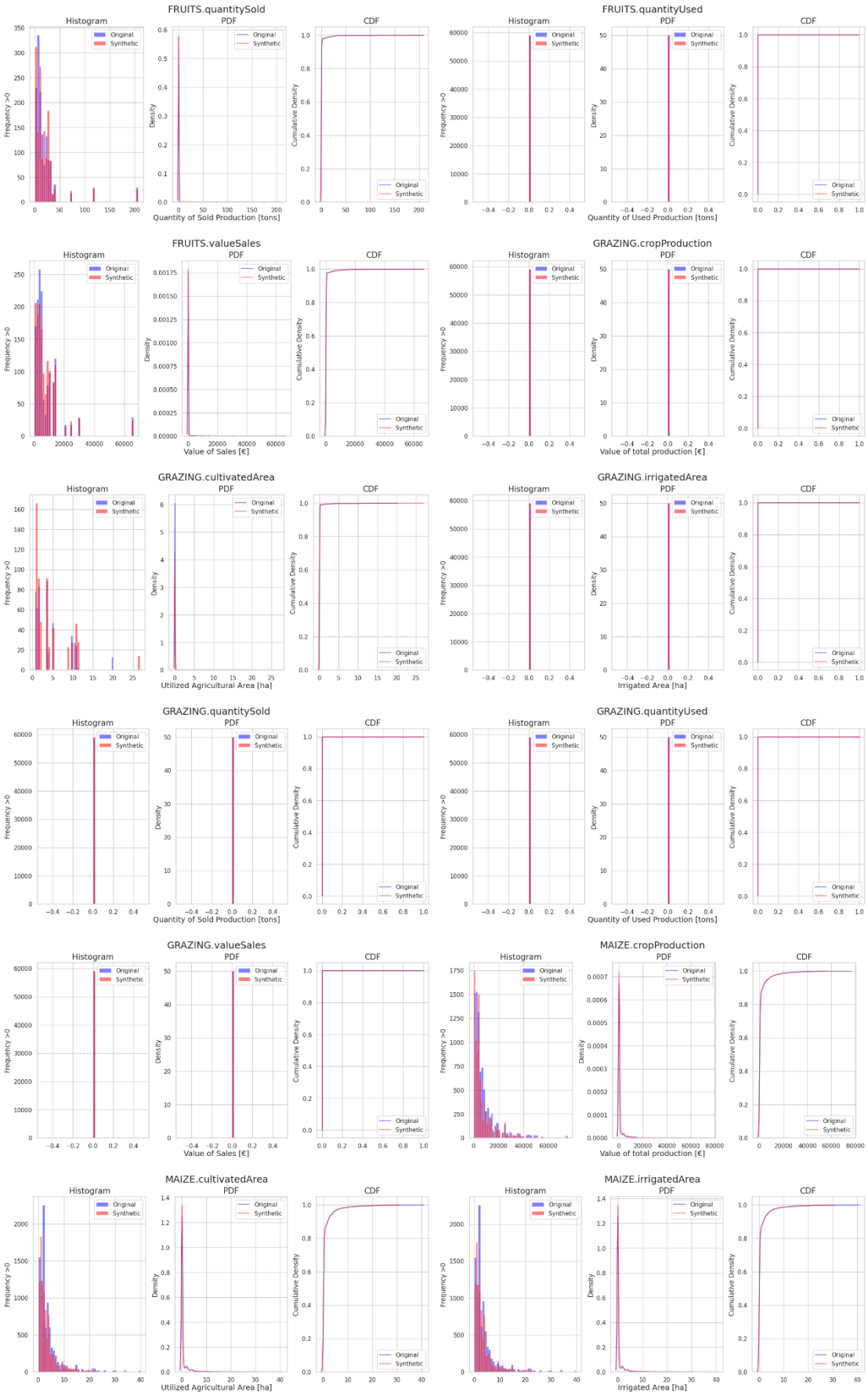

Figure 80. Statistical results: Greece 2014 (sheet 3)

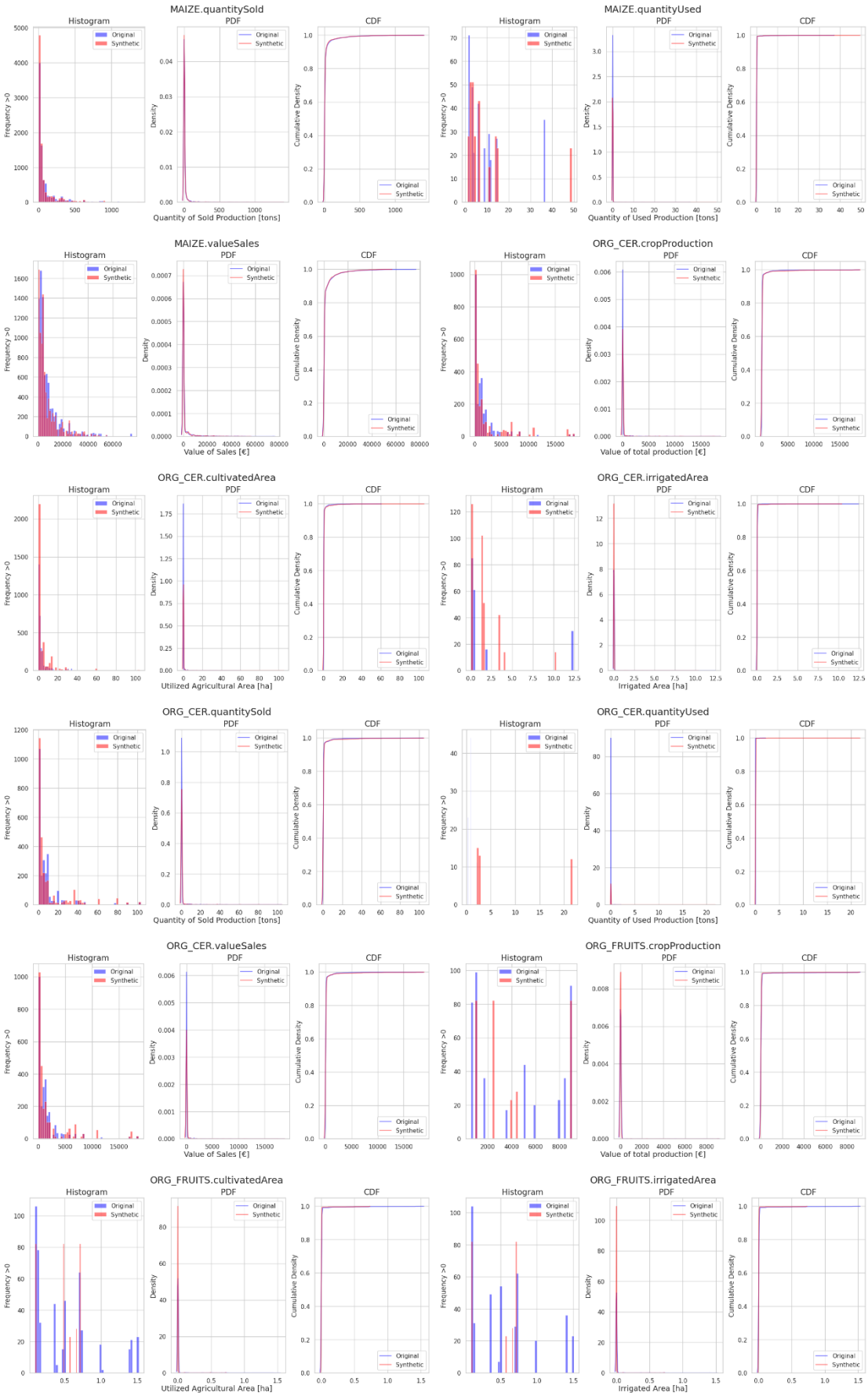

Figure 81. Statistical results: Greece 2014 (sheet 4)

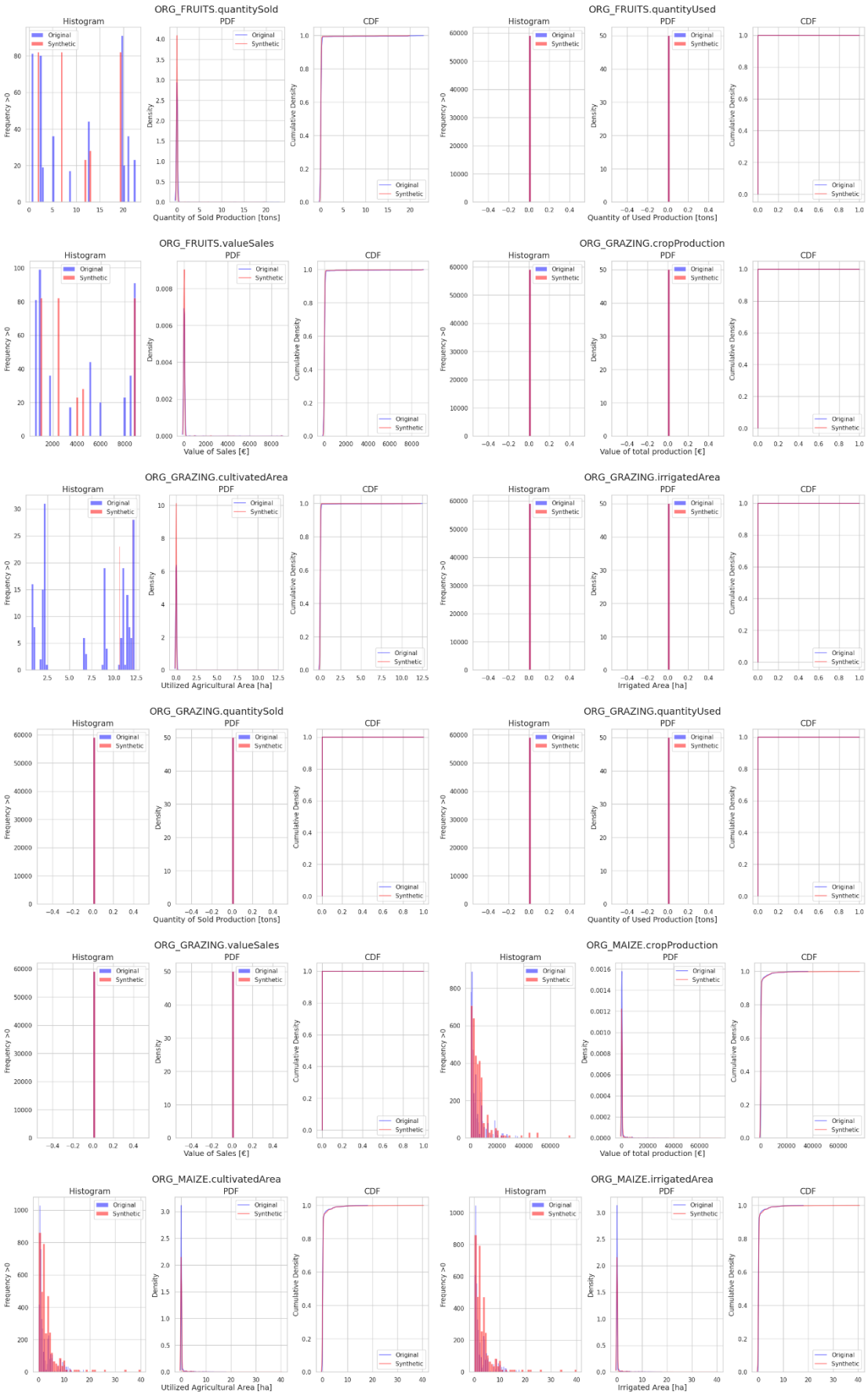

Figure 82. Statistical results: Greece 2014 (sheet 5)

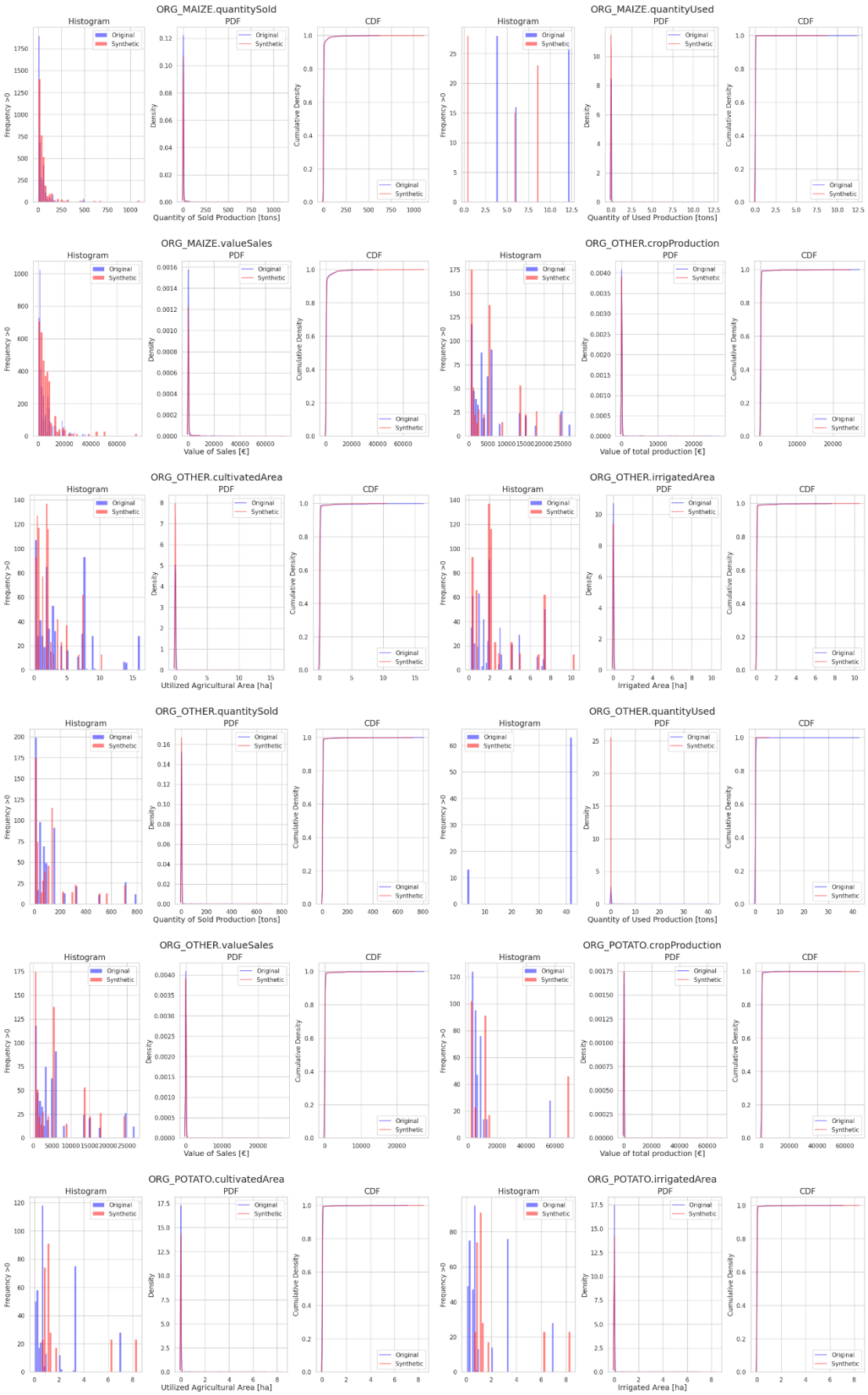

Figure 83. Statistical results: Greece 2014 (sheet 6)

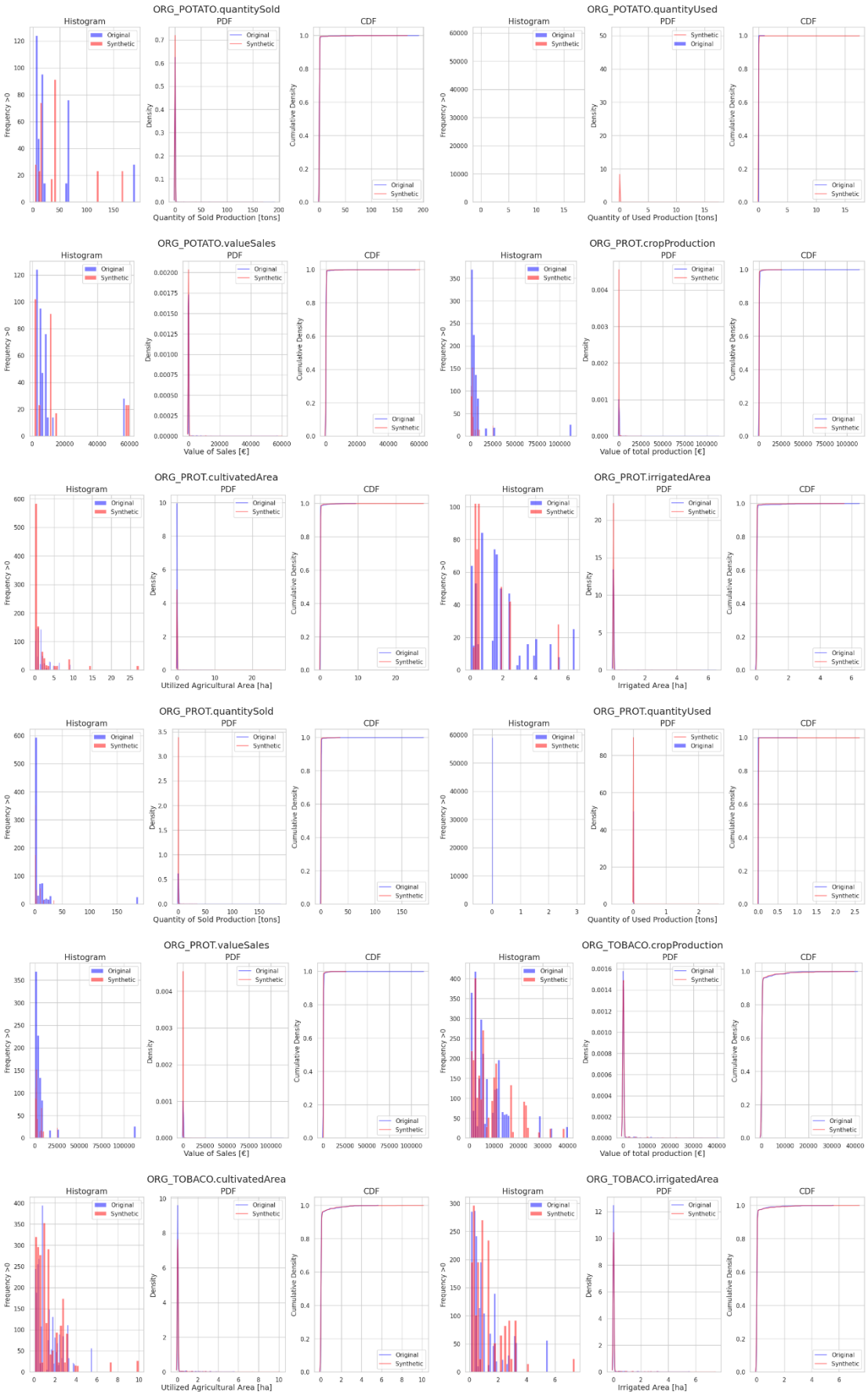

Figure 84. Statistical results: Greece 2014 (sheet 7)

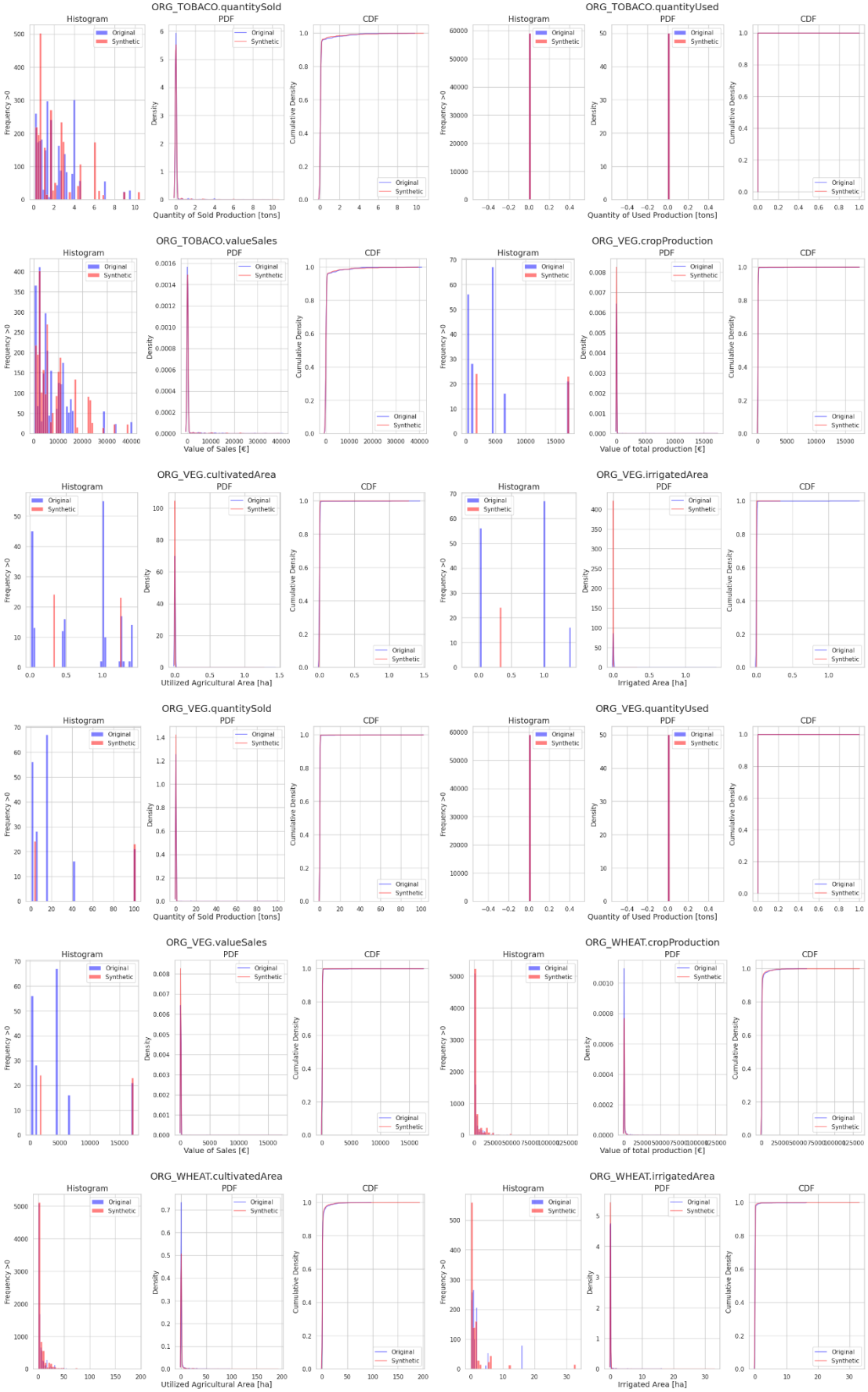

Figure 85. Statistical results: Greece 2014 (sheet 8)

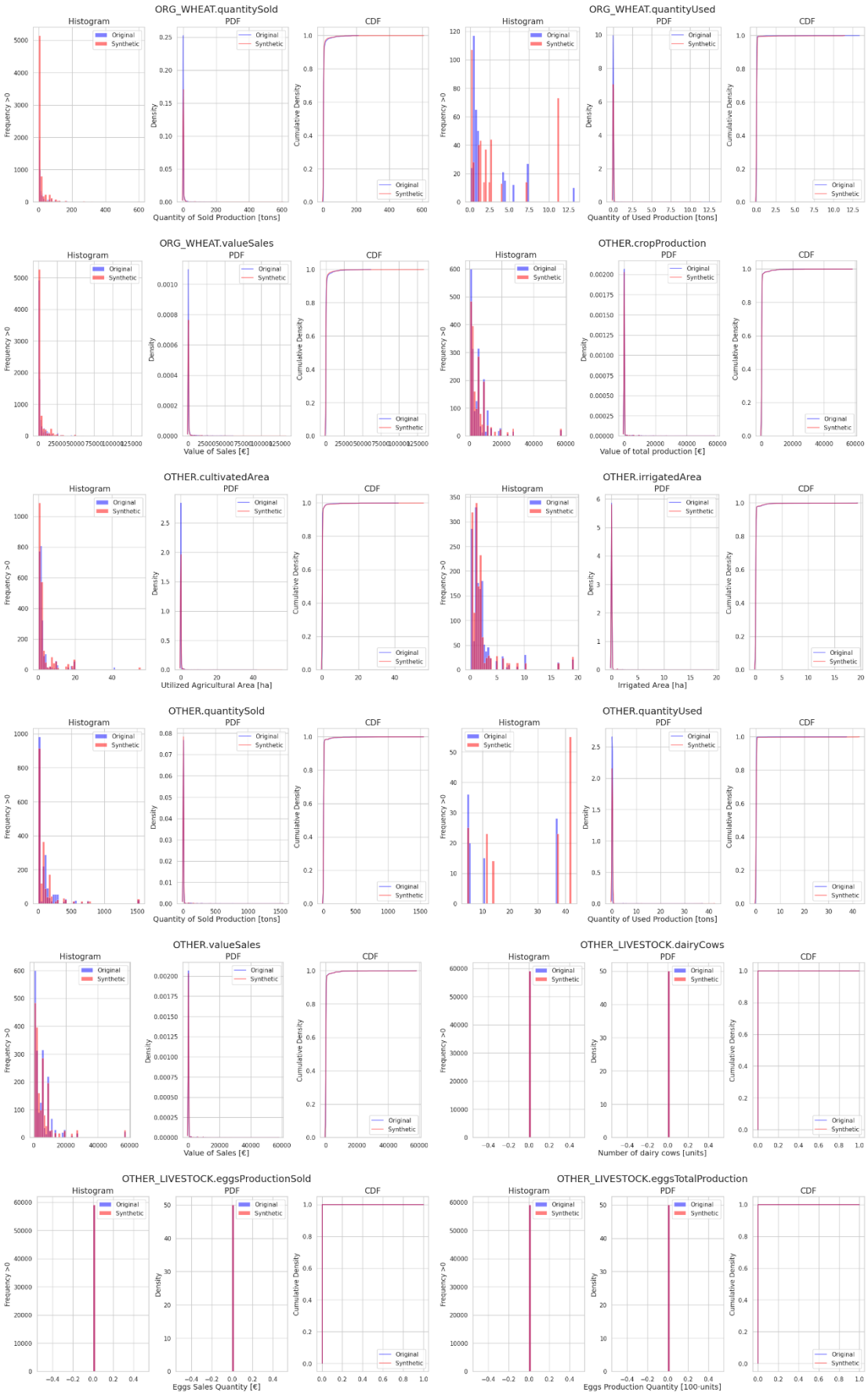

Figure 86. Statistical results: Greece 2014 (sheet 9)

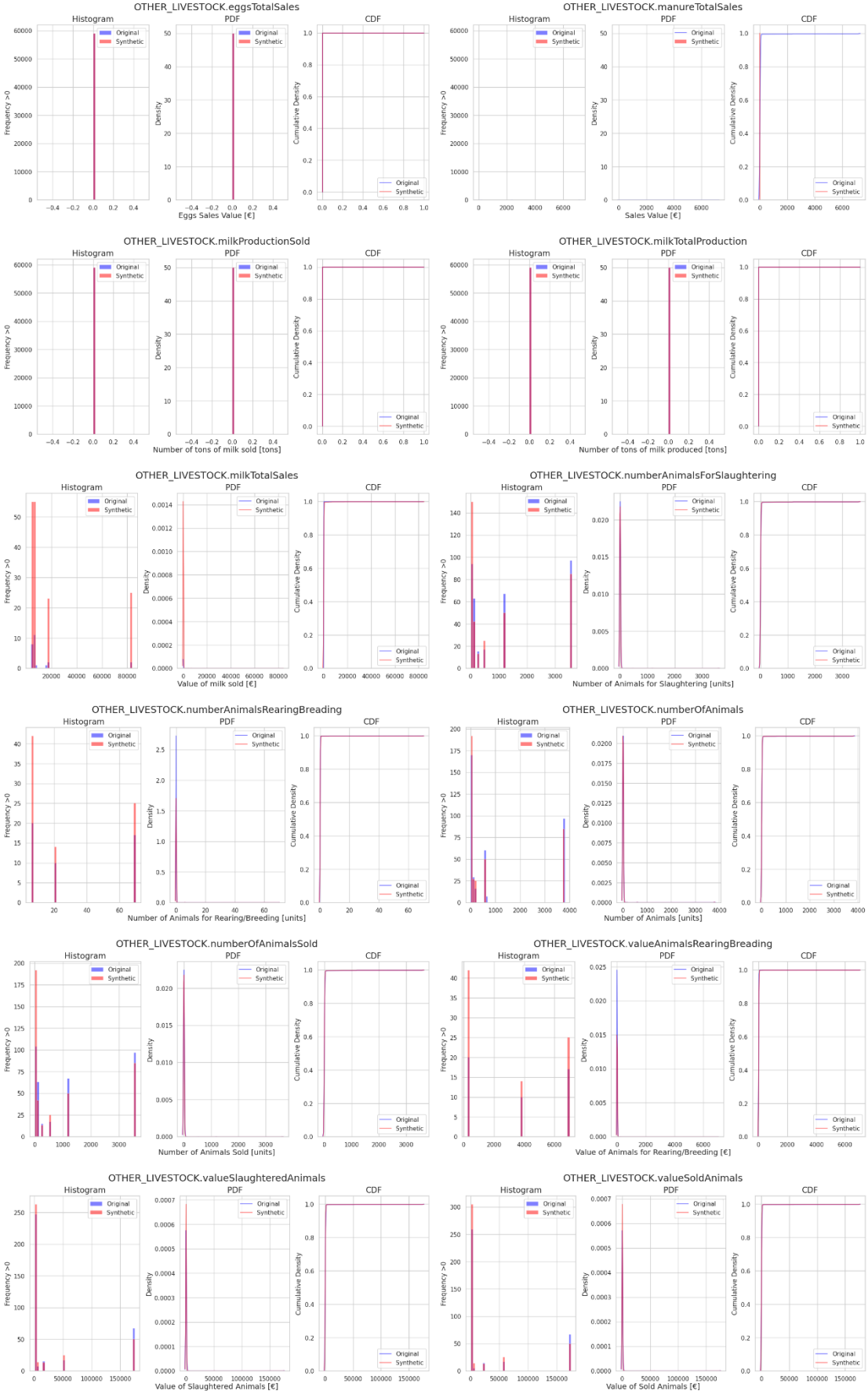

Figure 87. Statistical results: Greece 2014 (sheet 10)

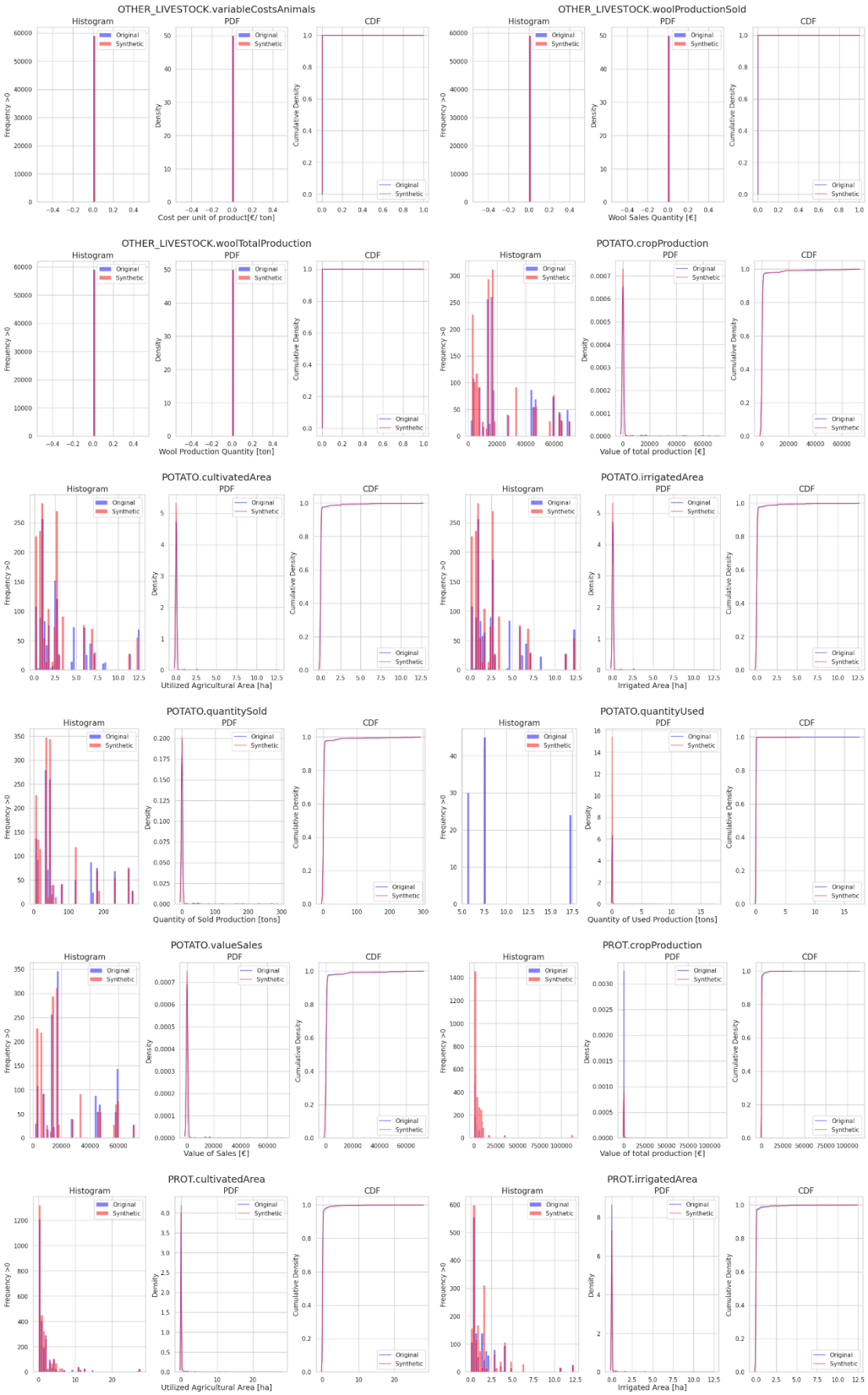

Figure 88. Statistical results: Greece 2014 (sheet 11)

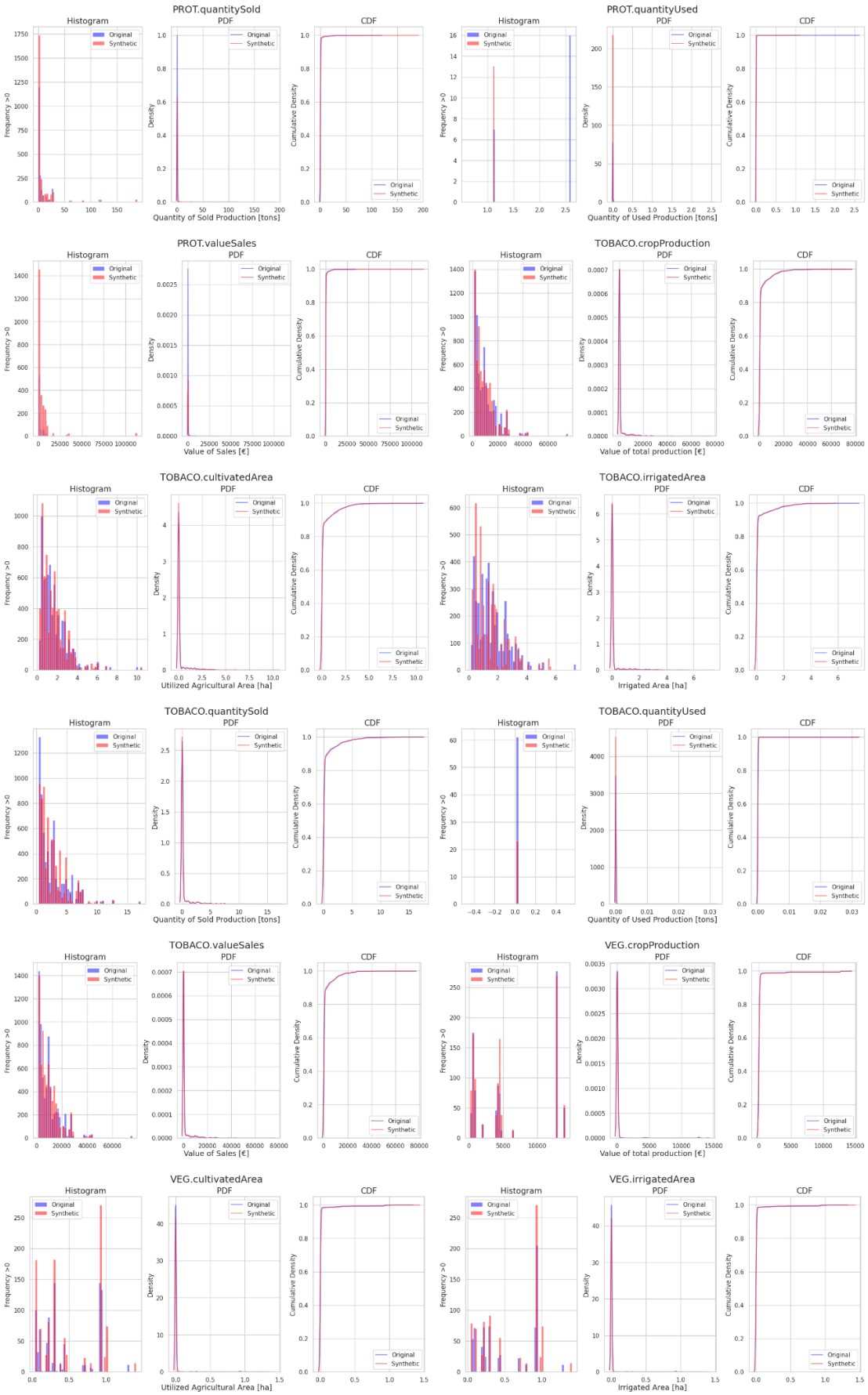

Figure 89. Statistical results: Greece 2014 (sheet 12)

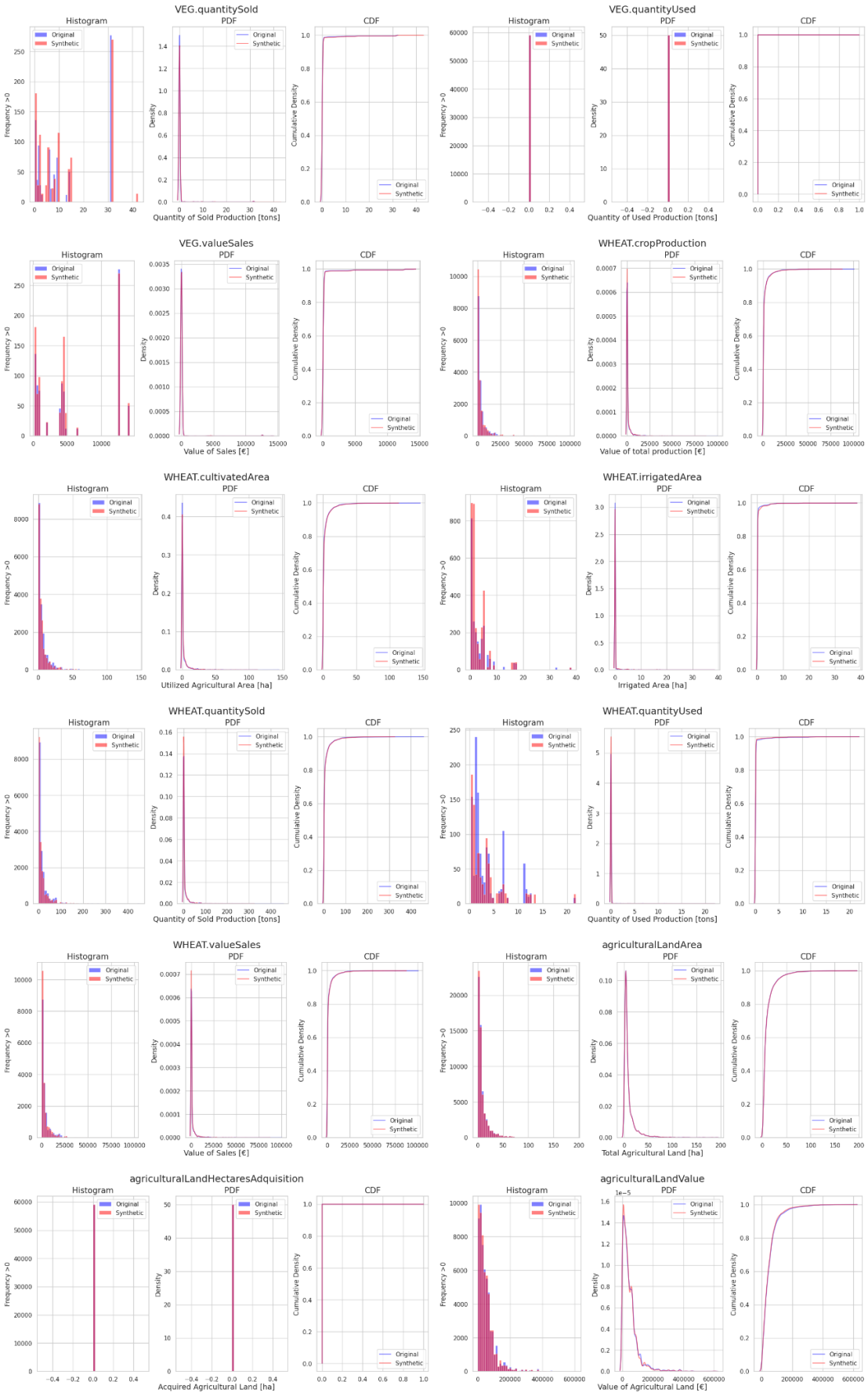

Figure 90. Statistical results: Greece 2014 (sheet 13)

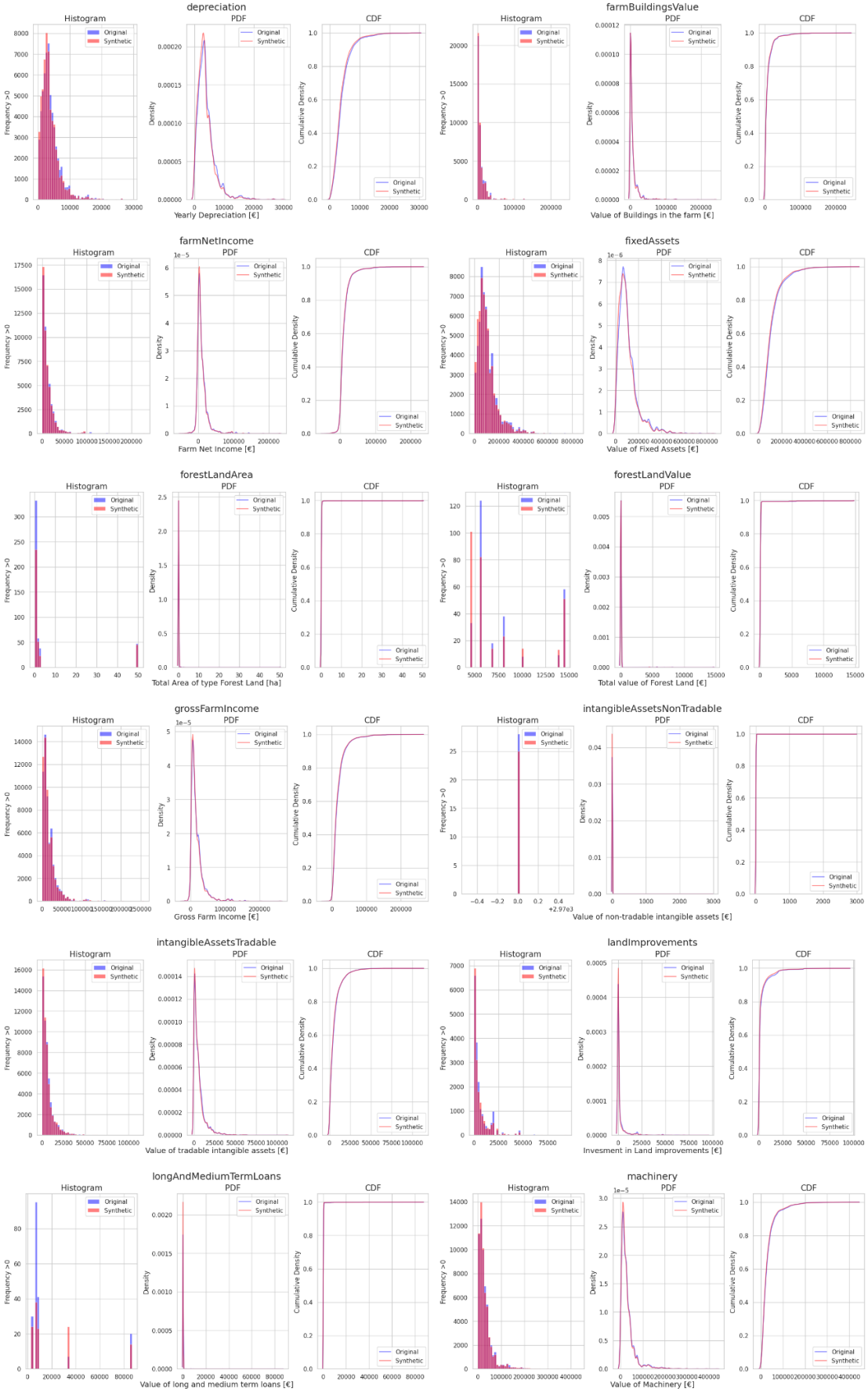

Figure 91. Statistical results: Greece 2014 (sheet 14)

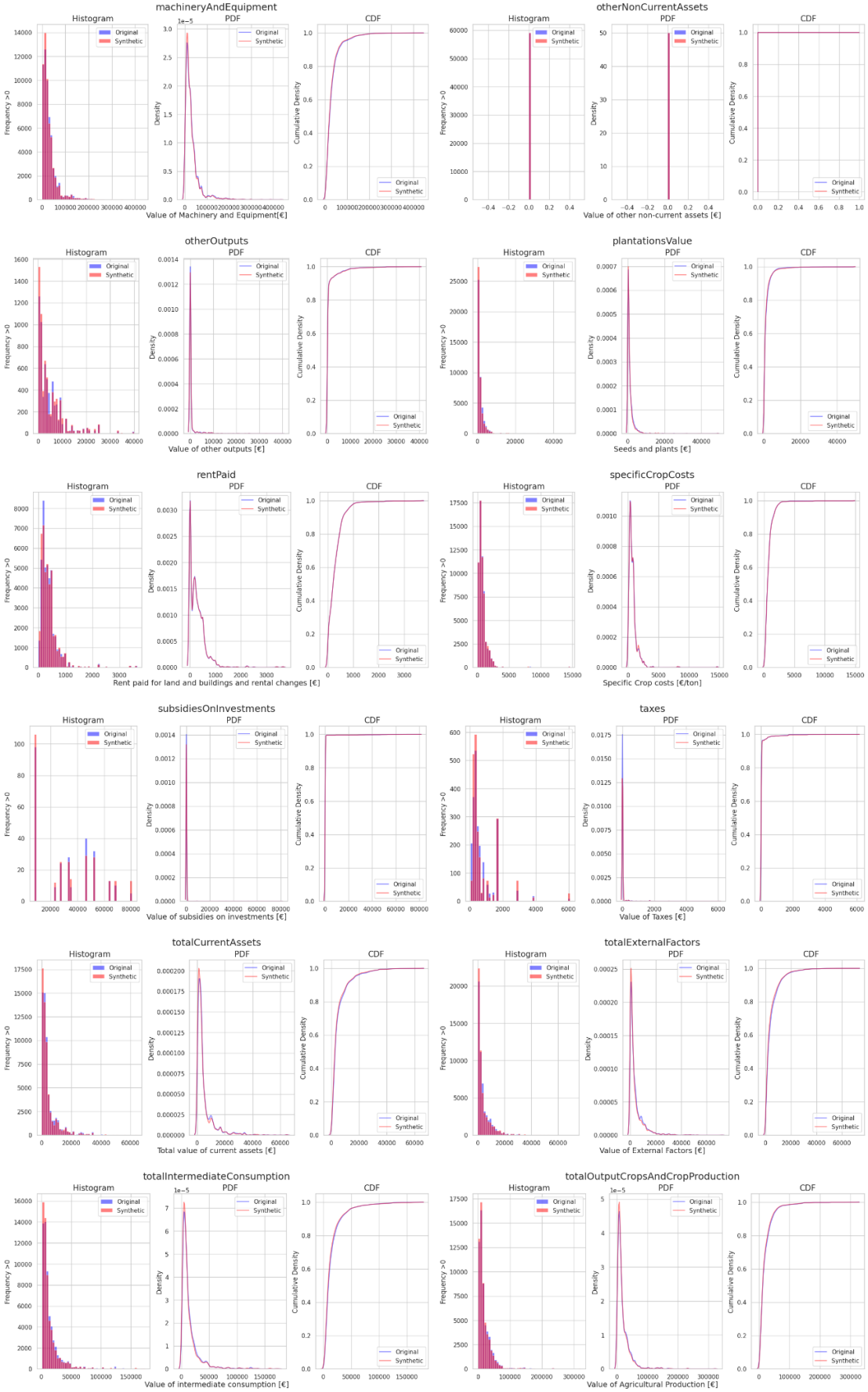

Figure 92. Statistical results: Greece 2014 (sheet 15)

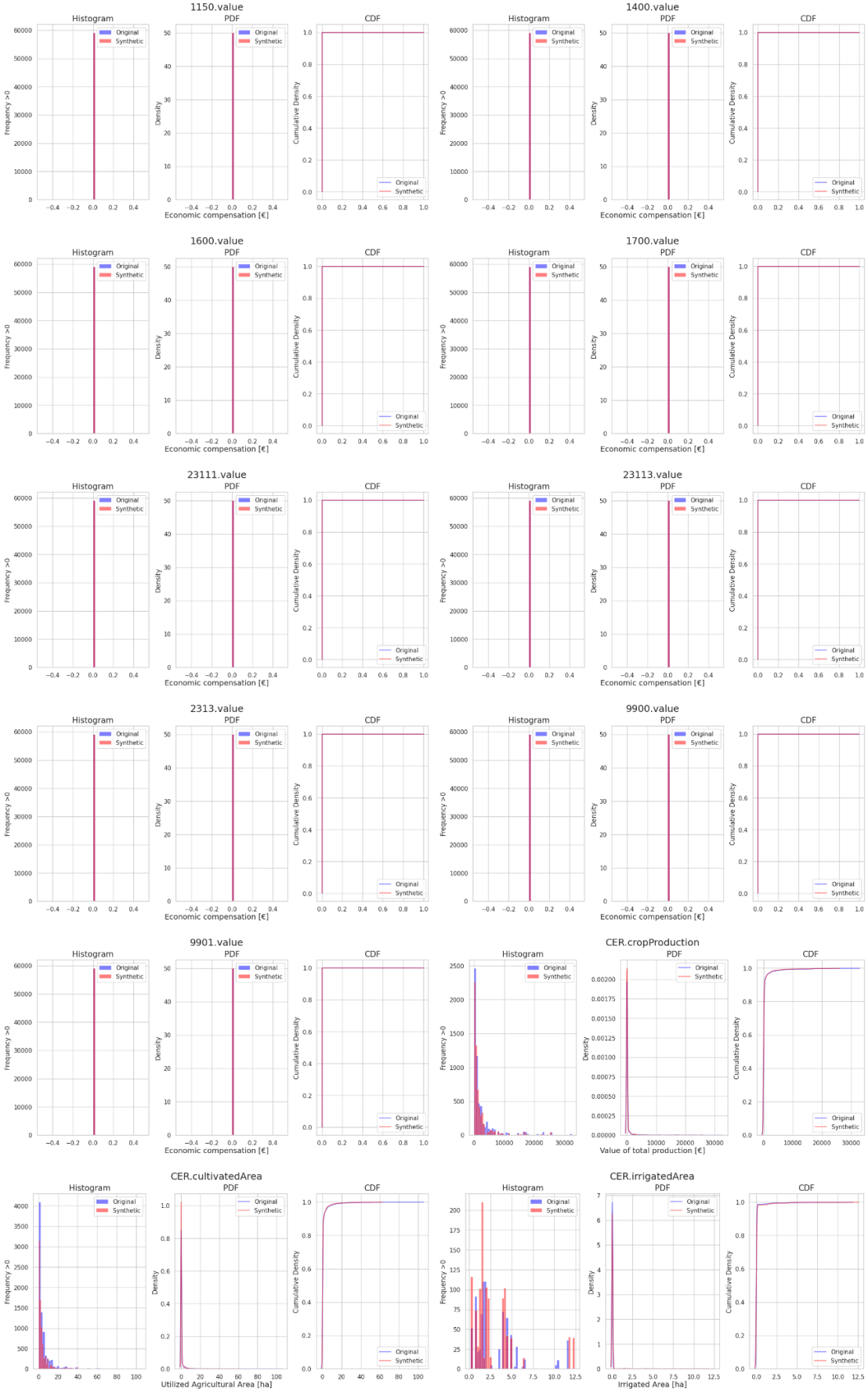

Figure 93. Statistical results: Greece 2014 (sheet 16)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
WHEAT	118120	109848	0.93
ORG_WHEAT	39710	50332	1.267
CER	34604	38385	1.109
MAIZE	33827	36625	1.083
ORG_CER	14882	9981	0.671
ORG_MAIZE	12851	11223	0.873
TOBACO	11686	11645	0.996
OTHER	7769	6742	0.868
PROT	5107	4797	0.939
POTATO	4212	4326	1.027
ORG_TOBACO	3265	3330	1.02
GRAZING	2690	2033	0.756
ORG_OTHER	2029	2775	1.368
ORG_PROT	1677	1656	0.987
FRUITS	1360	1266	0.931
ORG_GRAZING	584	1366	2.339
ORG_POTATO	581	610	1.05
VEG	533	417	0.782
ORG_FRUITS	139	247	1.777
ORG_VEG	37	132	3.568

Table 24. Greece use case, 2014: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
WHEAT	67107230	62257514	0.928
TOBACO	66520614	66320680	0.997
MAIZE	63727819	67309272	1.056
POTATO	34832207	36292791	1.042
ORG_WHEAT	25335134	30973716	1.223
ORG_MAIZE	22419465	20809588	0.928
ORG_TOBACO	18202040	18839452	1.035
CER	13074516	14824856	1.134
PROT	11602154	7168257	0.618
FRUITS	11376868	11356940	0.998
OTHER	10488785	10089292	0.962
VEG	6027110	5477445	0.909
ORG_CER	5495692	3524472	0.641
ORG_POTATO	4748163	3653227	0.769
ORG_OTHER	3358523	3392008	1.01
ORG_PROT	2569557	6133064	2.387
ORG_FRUITS	1240022	1930788	1.557
ORG_VEG	436900	808080	1.85
GRAZING	0	0	1.0
ORG_GRAZING	0	0	1.0

Table 25. Greece use case, 2018: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
MAIZE	724980	759116	1.047
WHEAT	302166	284556	0.942
ORG_MAIZE	204379	195499	0.957
OTHER	200194	201063	1.004
POTATO	114849	114615	0.998
ORG_WHEAT	113036	138109	1.222
CER	74274	82070	1.105
ORG_OTHER	73880	73231	0.991
FRUITS	29777	29939	1.005
ORG_CER	28181	19711	0.699
PROT	22247	15515	0.697
TOBACO	18578	18166	0.978
VEG	13636	11728	0.86
ORG_POTATO	12531	14291	1.14
ORG_TOBACO	4890	5392	1.103
ORG_PROT	3023	9051	2.994
ORG_FRUITS	2968	4647	1.566
ORG_VEG	2414	3983	1.65
GRAZING	0	0	1.0
ORG_GRAZING	0	0	1.0

Table 26. Andalusia use case, 2014: quantity sold ratio comparison

Year 2018

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
1150.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1400.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1600.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
1700.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
23111.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
23113.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
2313.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
9900.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
9901.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
CER.cropProduction	0.0	0.0	248.81	208.0	52632.0	52632.0	1603.452	1504.951	0.894	0.896	0.0	Different	0.346	Similar	0.0128	0.0161
CER.cultivatedArea	0.0	0.0	0.48	0.45	60.0	60.1	2.372	2.35	0.876	0.881	0.001	Different	0.11	Similar	0.0082	0.0168
CER.irrigatedArea	0.0	0.0	0.03	0.02	10.5	10.5	0.436	0.238	0.989	0.988	0.996	Similar	1.0	Similar	0.0224	0.0225
CER.quantitySold	0.0	0.0	1.45	1.21	306.0	306.0	9.11	8.616	0.894	0.896	0.0	Different	0.297	Similar	0.0085	0.0161
CER.quantityUsed	0.0	0.0	0.01	0.01	7.0	7.0	0.257	0.206	0.996	0.996	1.0	Similar	1.0	Similar	0.0482	0.0222
CER.sellingPrice	0.0	0.0	17.73	17.17	322.4	322.4	51.909	50.994	0.894	0.896	0.023	Different	0.468	Similar	0.0044	0.019
CER.valueSales	0.0	0.0	246.79	202.72	52632.0	52632.0	1601.429	1494.061	0.894	0.896	0.0	Different	0.289	Similar	0.0128	0.016
DAIRY.dairyCows	0.0	0.0	0.01	0.01	16.0	16.0	0.352	0.349	0.999	0.999	1.0	Similar	1.0	Similar	0.0	0.0006
DAIRY.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.manureTotalSales	0.0	0.0	0.0	0.34	0.0	88.5	0.0	3.542	1.0	0.986	0.0	Different	0.0	Different	8.0903	0.4377
DAIRY.milkProductionSold	0.0	0.0	0.99	0.02	531.1	23.1	18.619	0.597	0.995	0.999	0.748	Similar	0.218	Similar	0.0589	0.0209
DAIRY.milkTotalProduction	0.0	0.0	1.0	0.02	532.9	23.1	18.684	0.608	0.995	0.999	0.539	Similar	0.118	Similar	0.0589	0.0209
DAIRY.milkTotalSales	0.0	0.0	368.82	5.84	196507.0	7648.0	6927.704	208.582	0.995	0.999	0.748	Similar	0.218	Similar	0.0367	0.0208
DAIRY.numberAnimalsForSlaughtering	0.0	0.0	0.07	0.05	34.0	23.0	1.144	0.843	0.991	0.991	1.0	Similar	1.0	Similar	0.0656	0.0331
DAIRY.numberAnimalsRearingBreading	0.0	0.0	0.05	0.06	17.0	17.0	0.736	0.775	0.993	0.993	1.0	Similar	1.0	Similar	0.0002	0.0033
DAIRY.numberOfAnimals	0.0	0.0	0.31	0.31	88.0	88.5	3.391	3.316	0.986	0.986	1.0	Similar	1.0	Similar	0.0005	0.0064
DAIRY.numberOfAnimalsSold	0.0	0.0	0.14	0.12	34.0	33.0	1.596	1.379	0.988	0.988	1.0	Similar	1.0	Similar	0.0276	0.021
DAIRY.valueAnimalsRearingBreading	0.0	0.0	19.75	23.17	11900.0	11900.0	306.745	359.125	0.993	0.993	1.0	Similar	1.0	Similar	0.0002	0.0034
DAIRY.valueSlaughteredAnimals	0.0	0.0	50.8	42.07	16070.0	14000.0	756.204	665.77	0.991	0.991	1.0	Similar	1.0	Similar	0.0405	0.0286
DAIRY.valueSoldAnimals	0.0	0.0	74.04	67.76	16200.0	16200.0	894.334	828.29	0.988	0.988	1.0	Similar	1.0	Similar	0.0004	0.0048
DAIRY.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
FRUITS.cropProduction	0.0	0.0	176.14	254.59	40744.0	95700.0	2136.664	3117.221	0.979	0.978	0.968	Similar	0.996	Similar	0.0252	0.0292
FRUITS.cultivatedArea	0.0	0.0	0.02	0.02	3.8	6.8	0.203	0.248	0.977	0.978	1.0	Similar	1.0	Similar	0.117	0.0392
FRUITS.irrigatedArea	0.0	0.0	0.02	0.02	3.8	6.7	0.203	0.247	0.98	0.98	1.0	Similar	1.0	Similar	0.1176	0.0395
FRUITS.quantitySold	0.0	0.0	0.39	0.59	83.0	265.8	4.534	7.653	0.979	0.978	0.952	Similar	0.995	Similar	0.0635	0.0311
FRUITS.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
FRUITS.sellingPrice	0.0	0.0	10.39	9.97	1000.0	1000.0	79.918	72.84	0.979	0.978	1.0	Similar	0.998	Similar	0.0034	0.0137
FRUITS.valueSales	0.0	0.0	175.36	253.87	40500.0	95700.0	2128.049	3111.051	0.979	0.978	0.968	Similar	0.996	Similar	0.0286	0.032
GRAZING.cropProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.cultivatedArea	0.0	0.0	0.05	0.05	26.1	26.3	0.788	0.781	0.992	0.992	1.0	Similar	1.0	Similar	0.0181	0.0196
GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	1.5	1.5	0.025	0.03	1.0	1.0	1.0	Similar	1.0	Similar	0.0001	0.0036
GRAZING.quantitySold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.sellingPrice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
GRAZING.valueSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
MAIZE.cropProduction	0.0	0.0	988.21	803.98	133000.0	127500.0	5953.404	4090.667	0.877	0.87	0.044	Different	0.023	Different	0.0064	0.016
MAIZE.cultivatedArea	0.0	0.0	0.37	0.36	27.7	27.7	1.485	1.405	0.876	0.86	0.0	Different	0.0	Different	0.0057	0.0131
MAIZE.irrigatedArea	0.0	0.0	0.36	0.35	27.7	27.7	1.481	1.396	0.883	0.87	0.0	Different	0.0	Different	0.0059	0.0135
MAIZE.quantitySold	0.0	0.0	9.09	7.99	1423.8	958.1	52.495	43.448	0.877	0.87	0.159	Similar	0.027	Different	0.0128	0.0291
MAIZE.quantityUsed	0.0	0.0	0.03	0.02	14.9	18.7	0.594	0.493	0.995	0.998	0.989	Similar	0.593	Similar	0.0509	0.0208
MAIZE.sellingPrice	0.0	0.0	18.45	19.58	1700.0	1700.0	58.972	60.936	0.877	0.87	0.0	Different	0.007	Different	0.0132	0.0159
MAIZE.valueSales	0.0	0.0	804.67	739.71	58246.0	58246.0	3231.121	2973.456	0.877	0.87	0.044	Different	0.023	Different	0.0096	0.0226
ORG_CER.cropProduction	0.0	0.0	76.32	116.41	30157.0	30157.0	782.276	1069.478	0.955	0.952	0.001	Different	0.245	Similar	0.0154	0.0239
ORG_CER.cultivatedArea	0.0	0.0	0.17	0.2	40.4	43.1	1.429	1.57	0.947	0.943	0.008	Different	0.123	Similar	0.0281	0.0262
ORG_CER.irrigatedArea	0.0	0.0	0.0	0.02	6.0	10.5	0.114	0.369	0.996	0.995	0.937	Similar	0.997	Similar	0.0207	0.0226
ORG_CER.quantitySold	0.0	0.0	0.44	0.65	142.9	152.0	4.416	5.759	0.955	0.952	0.02	Different	0.416	Similar	0.0114	0.0231
ORG_CER.quantityUsed	0.0	0.0	0.0	0.01	7.0	6.0	0.152	0.218	0.998	0.997	1.0	Similar	1.0	Similar	0.0163	0.0137
ORG_CER.sellingPrice	0.0	0.0	7.04	8.03	300.0	212.4	33.007	35.988	0.955	0.952	0.0	Different	0.123	Similar	0.6578	0.0932
ORG_CER.valueSales	0.0	0.0	71.7	115.14	30157.0	30157.0	758.624	1068.04	0.955	0.952	0.0	Different	0.229	Similar	0.0168	0.0255
ORG_FRUITS.cropProduction	0.0	0.0	71.39	2.2	95700.0	6250.0	2091.167	99.604	0.996	0.998	0.771	Similar	0.922	Similar	0.0235	0.0177
ORG_FRUITS.cultivatedArea	0.0	0.0	0.01	0.0	6.7	1.7	0.152	0.081	0.996	0.995	1.0	Similar	0.998	Similar	0.0223	0.0189
ORG_FRUITS.irrigatedArea	0.0	0.0	0.01	0.0	6.7	1.7	0.152	0.081	0.996	0.997	1.0	Similar	0.945	Similar	0.0633	0.0224
ORG_FRUITS.quantitySold	0.0	0.0	0.19	0.01	265.8	25.0	5.747	0.379	0.996	0.998	0.771	Similar	0.922	Similar	0.0367	0.0165
ORG_FRUITS.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_FRUITS.sellingPrice	0.0	0.0	1.83	1.9	521.7	1000.0	28.601	40.611	0.996	0.998	1.0	Similar	0.924	Similar	0.0288	0.0176
ORG_FRUITS.valueSales	0.0	0.0	71.35	2.13	95700.0	6250.0	2090.943	99.452	0.996	0.998	0.771	Similar	0.922	Similar	0.0235	0.0177
ORG_GRAZING.cropProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.cultivatedArea	0.0	0.0	0.01	0.01	19.4	20.2	0.426	0.342	0.997	0.998	1.0	Similar	1.0	Similar	0.0433	0.0223
ORG_GRAZING.irrigatedArea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0

Table 27. Statistical results: Greece 2018 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_GRAZING.quantitySold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.sellingPrice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_GRAZING.valueSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_MAIZE.cropProduction	0.0	0.0	257.98	260.44	85800.0	85800.0	1920.824	2082.248	0.934	0.947	0.0	Different	0.0	Different	0.0029	0.0123
ORG_MAIZE.cultivatedArea	0.0	0.0	0.13	0.13	44.0	44.0	0.907	1.042	0.931	0.944	0.0	Different	0.0	Different	0.0069	0.0169
ORG_MAIZE.irrigatedArea	0.0	0.0	0.12	0.13	44.0	44.0	0.906	1.04	0.938	0.946	0.0	Different	0.004	Different	0.0069	0.0169
ORG_MAIZE.quantitySold	0.0	0.0	3.04	2.84	2200.0	2200.0	37.925	38.661	0.934	0.947	0.0	Different	0.0	Different	0.0089	0.0113
ORG_MAIZE.quantityUsed	0.0	0.0	0.01	0.01	4.7	14.9	0.152	0.318	0.999	0.998	1.0	Similar	1.0	Similar	0.0058	0.0143
ORG_MAIZE.sellingPrice	0.0	0.0	10.26	8.13	250.0	279.0	41.123	36.444	0.934	0.947	0.0	Different	0.0	Different	0.1656	0.0678
ORG_MAIZE.valueSales	0.0	0.0	257.31	259.34	85800.0	85800.0	1920.505	2081.441	0.934	0.947	0.0	Different	0.0	Different	0.0029	0.0123
ORG_OTHER.cropProduction	0.0	0.0	23.11	13.96	19110.0	9802.0	395.964	264.459	0.99	0.995	0.321	Similar	0.083	Similar	0.0332	0.0277
ORG_OTHER.cultivatedArea	0.0	0.0	0.04	0.03	10.2	16.1	0.446	0.514	0.986	0.993	0.059	Similar	0.01	Different	0.1235	0.036
ORG_OTHER.irrigatedArea	0.0	0.0	0.01	0.0	10.2	4.7	0.232	0.085	0.996	0.999	0.978	Similar	0.531	Similar	0.0462	0.018
ORG_OTHER.quantitySold	0.0	0.0	0.32	0.17	546.0	257.9	9.516	4.911	0.989	0.995	0.201	Similar	0.044	Different	0.0042	0.0108
ORG_OTHER.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_OTHER.sellingPrice	0.0	0.0	1.88	0.83	625.0	500.0	24.629	15.001	0.99	0.995	0.397	Similar	0.083	Similar	0.0534	0.0282
ORG_OTHER.valueSales	0.0	0.0	23.11	13.96	19110.0	9802.0	395.964	264.459	0.99	0.995	0.321	Similar	0.083	Similar	0.0332	0.0277
ORG_POTATO.cropProduction	0.0	0.0	44.35	22.51	28080.0	33666.0	677.6	647.432	0.995	0.998	0.842	Similar	0.351	Similar	0.0412	0.0239
ORG_POTATO.cultivatedArea	0.0	0.0	0.0	0.0	2.3	3.7	0.064	0.064	0.995	0.998	0.898	Similar	0.351	Similar	0.0793	0.0235
ORG_POTATO.irrigatedArea	0.0	0.0	0.0	0.0	2.3	3.6	0.064	0.064	0.995	0.998	0.898	Similar	0.351	Similar	0.0794	0.0235
ORG_POTATO.quantitySold	0.0	0.0	0.11	0.06	68.7	111.6	1.635	1.937	0.995	0.998	0.842	Similar	0.351	Similar	0.072	0.0257
ORG_POTATO.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_POTATO.sellingPrice	0.0	0.0	2.06	0.65	500.0	500.0	29.161	16.163	0.995	0.998	0.694	Similar	0.35	Similar	0.0104	0.0189
ORG_POTATO.valueSales	0.0	0.0	43.61	21.96	27480.0	33480.0	666.44	639.301	0.995	0.998	0.842	Similar	0.351	Similar	0.0263	0.0202
ORG_PROT.cropProduction	0.0	0.0	59.91	72.39	45695.0	39000.0	777.322	887.809	0.986	0.977	0.01	Different	0.001	Different	0.0044	0.017
ORG_PROT.cultivatedArea	0.0	0.0	0.09	0.11	190.0	118.2	2.079	1.79	0.977	0.973	0.065	Similar	0.299	Similar	0.0204	0.0195
ORG_PROT.irrigatedArea	0.0	0.0	0.01	0.02	15.8	20.2	0.345	0.446	0.994	0.989	0.235	Similar	0.084	Similar	0.0063	0.0118
ORG_PROT.quantitySold	0.0	0.0	0.13	0.15	247.0	118.0	2.923	2.08	0.986	0.977	0.005	Different	0.001	Different	0.0021	0.0128
ORG_PROT.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.999	1.0	Similar	1.0	Similar	30.4444	0.4419
ORG_PROT.sellingPrice	0.0	0.0	16.32	21.16	2750.0	2500.0	169.854	195.15	0.986	0.977	0.015	Different	0.001	Different	0.0299	0.0374
ORG_PROT.valueSales	0.0	0.0	59.54	71.32	45695.0	39000.0	776.282	884.077	0.986	0.977	0.01	Different	0.001	Different	0.0043	0.017
ORG_TOBACCO.cropProduction	0.0	0.0	225.65	289.11	40050.0	33750.0	1807.178	1877.674	0.971	0.958	0.0	Different	0.0	Different	0.0242	0.0351
ORG_TOBACCO.cultivatedArea	0.0	0.0	0.04	0.05	8.0	8.0	0.325	0.339	0.971	0.958	0.0	Different	0.0	Different	0.0574	0.0411
ORG_TOBACCO.irrigatedArea	0.0	0.0	0.02	0.02	3.4	4.0	0.21	0.186	0.978	0.971	0.016	Different	0.012	Different	0.0791	0.0501
ORG_TOBACCO.quantitySold	0.0	0.0	0.06	0.07	9.0	7.5	0.467	0.427	0.971	0.958	0.0	Different	0.0	Different	0.0597	0.0479
ORG_TOBACCO.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_TOBACCO.sellingPrice	0.0	0.0	127.44	186.6	4750.8	4800.0	741.699	892.563	0.971	0.958	0.0	Different	0.0	Different	0.0192	0.0289
ORG_TOBACCO.valueSales	0.0	0.0	225.65	289.08	40050.0	33750.0	1807.178	1877.583	0.971	0.958	0.0	Different	0.0	Different	0.0242	0.0351
ORG_VEG.cropProduction	0.0	0.0	9.52	6.0	2800.0	4500.0	139.827	157.272	0.994	0.997	0.443	Similar	0.437	Similar	0.028	0.0219
ORG_VEG.cultivatedArea	0.0	0.0	0.0	0.0	0.2	0.5	0.011	0.019	0.996	0.997	0.974	Similar	1.0	Similar	0.0674	0.0245
ORG_VEG.irrigatedArea	0.0	0.0	0.0	0.0	0.2	0.2	0.007	0.003	0.998	0.999	0.999	Similar	0.993	Similar	0.0287	0.0164
ORG_VEG.quantitySold	0.0	0.0	0.01	0.02	3.8	15.0	0.177	0.524	0.994	0.997	0.728	Similar	0.438	Similar	0.0725	0.0211
ORG_VEG.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_VEG.sellingPrice	0.0	0.0	8.33	4.16	4000.0	4000.0	143.974	117.589	0.994	0.997	0.846	Similar	0.438	Similar	0.0368	0.0183
ORG_VEG.valueSales	0.0	0.0	9.52	5.98	2800.0	4500.0	139.827	157.176	0.994	0.997	0.443	Similar	0.437	Similar	0.028	0.0219
ORG_WHEAT.cropProduction	0.0	0.0	197.11	266.26	28886.0	36505.0	1275.899	1510.052	0.902	0.884	0.0	Different	0.0	Different	0.0273	0.0301
ORG_WHEAT.cultivatedArea	0.0	0.0	0.44	0.55	108.2	69.8	3.052	2.977	0.89	0.876	0.0	Different	0.0	Different	0.0129	0.0323
ORG_WHEAT.irrigatedArea	0.0	0.0	0.03	0.04	10.5	20.7	0.329	0.653	0.977	0.984	0.049	Different	0.004	Different	0.0738	0.0334
ORG_WHEAT.quantitySold	0.0	0.0	1.11	1.53	160.5	208.6	7.044	8.562	0.902	0.884	0.0	Different	0.0	Different	0.026	0.0297
ORG_WHEAT.quantityUsed	0.0	0.0	0.01	0.01	9.2	5.5	0.276	0.2	0.995	0.995	1.0	Similar	1.0	Similar	0.0472	0.0248
ORG_WHEAT.sellingPrice	0.0	0.0	16.77	19.62	250.0	220.0	51.386	54.582	0.902	0.884	0.0	Different	0.0	Different	0.1073	0.0686
ORG_WHEAT.valueSales	0.0	0.0	195.08	263.37	28886.0	36505.0	1271.765	1500.303	0.902	0.884	0.0	Different	0.0	Different	0.0276	0.0303
OTHER.cropProduction	0.0	0.0	56.0	69.21	34036.0	34036.0	772.232	901.898	0.983	0.98	0.833	Similar	0.412	Similar	0.0051	0.0125
OTHER.cultivatedArea	0.0	0.0	0.12	0.13	64.8	64.9	1.502	1.551	0.977	0.97	0.095	Similar	0.01	Different	0.0029	0.0062
OTHER.irrigatedArea	0.0	0.0	0.01	0.02	11.9	11.9	0.241	0.352	0.994	0.99	0.616	Similar	0.149	Similar	0.0091	0.0189
OTHER.quantitySold	0.0	0.0	0.6	0.82	318.0	546.0	8.763	12.797	0.983	0.98	0.704	Similar	0.273	Similar	0.0212	0.017
OTHER.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER.sellingPrice	0.0	0.0	3.12	3.94	937.5	937.5	36.456	42.254	0.983	0.98	0.803	Similar	0.409	Similar	0.0074	0.0134
OTHER.valueSales	0.0	0.0	55.19	68.81	34036.0	34036.0	770.595	901.311	0.983	0.98	0.833	Similar	0.411	Similar	0.0051	0.0125
OTHER_LIVESTOCK.dairyCows	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.manureTotalSales	0.0	0.0	0.0	0.88	0.0	4628.0	0.0	60.44	1.0	0.997	0.911	Similar	0.369	Similar	17.9872	0.4203
OTHER_LIVESTOCK.milkProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.numberAnimalsForSlaughtering	0.0	0.0	0.41	0.41	2314.0	2314.0	30.21	30.211	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0002
OTHER_LIVESTOCK.numberAnimalsRearingBreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.numberOfAnimals	0.0	0.0	0.17	0.17	554.0	555.3	7.411	7.427	0.997	0.997	1.0	Similar	1.0	Similar	0.0	0.0003
OTHER_LIVESTOCK.numberOfAnimalsSold	0.0	0.0	0.41	0.41	2314.0	2314.0	30.21	30.211	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0002
OTHER_LIVESTOCK.valueAnimalsRearingBreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0

Table 28. Statistical results: Greece 2018 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
OTHER_LIVESTOCK.valueSlaughteredAnimals	0.0	0.0	55.02	55.09	319100.0	319100.0	4163.975	4164.014	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.valueSoldAnimals	0.0	0.0	55.02	55.09	319100.0	319100.0	4163.975	4164.014	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.variableCostsAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
POTATO.cropProduction	0.0	0.0	269.2	289.16	75265.1	75265.1	2941.728	2882.356	0.983	0.979	0.884	Similar	0.366	Similar	0.0057	0.018
POTATO.cultivatedArea	0.0	0.0	0.03	0.03	6.0	6.0	0.308	0.303	0.982	0.979	0.506	Similar	0.256	Similar	0.0161	0.0236
POTATO.irrigatedArea	0.0	0.0	0.03	0.03	6.0	6.0	0.306	0.301	0.983	0.98	0.789	Similar	0.25	Similar	0.0143	0.0207
POTATO.quantitySold	0.0	0.0	0.72	0.76	172.0	172.0	7.727	7.49	0.983	0.979	0.891	Similar	0.366	Similar	0.0112	0.0196
POTATO.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
POTATO.sellingPrice	0.0	0.0	7.38	8.8	700.0	700.0	58.097	62.934	0.983	0.979	0.631	Similar	0.36	Similar	0.0037	0.0108
POTATO.valueSales	0.0	0.0	265.42	286.43	74400.0	74400.0	2909.296	2855.914	0.983	0.979	0.884	Similar	0.366	Similar	0.0061	0.0195
PROT.cropProduction	0.0	0.0	223.7	221.47	39000.0	45695.0	1427.815	1425.98	0.94	0.946	0.078	Similar	0.018	Different	0.0259	0.0273
PROT.cultivatedArea	0.0	0.0	0.32	0.28	120.0	190.0	3.515	3.179	0.932	0.938	0.01	Different	0.031	Different	0.0205	0.0198
PROT.irrigatedArea	0.0	0.0	0.05	0.05	20.2	15.8	0.469	0.407	0.965	0.969	0.1	Similar	0.149	Similar	0.0128	0.03
PROT.quantitySold	0.0	0.0	0.44	0.4	217.0	247.0	4.967	4.957	0.94	0.946	0.052	Similar	0.016	Different	0.0138	0.0195
PROT.quantityUsed	0.0	0.0	0.0	0.0	1.3	1.3	0.021	0.016	0.998	1.0	1.0	Similar	0.99	Similar	0.0001	0.0022
PROT.sellingPrice	0.0	0.0	72.19	69.86	3000.0	3000.0	369.509	365.643	0.94	0.946	0.111	Similar	0.018	Different	0.0212	0.0273
PROT.valueSales	0.0	0.0	222.76	222.33	40900.0	45695.0	1500.274	1506.651	0.94	0.946	0.078	Similar	0.018	Different	0.0162	0.0237
TOBACO.cropProduction	0.0	0.0	893.99	810.78	89620.0	89620.0	3459.821	3313.826	0.898	0.913	0.0	Different	0.0	Different	0.0078	0.0191
TOBACO.cultivatedArea	0.0	0.0	0.15	0.13	11.1	11.1	0.535	0.502	0.898	0.913	0.0	Different	0.0	Different	0.0284	0.0222
TOBACO.irrigatedArea	0.0	0.0	0.08	0.08	11.1	11.1	0.378	0.369	0.938	0.946	0.017	Different	0.004	Different	0.0104	0.0176
TOBACO.quantitySold	0.0	0.0	0.21	0.19	20.8	20.8	0.793	0.778	0.898	0.913	0.0	Different	0.0	Different	0.0065	0.0199
TOBACO.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
TOBACO.sellingPrice	0.0	0.0	441.28	374.42	4950.4	4950.4	1310.519	1214.016	0.898	0.913	0.0	Different	0.0	Different	0.0032	0.0152
TOBACO.valueSales	0.0	0.0	893.99	809.67	89620.0	89620.0	3459.821	3311.744	0.898	0.913	0.0	Different	0.0	Different	0.0078	0.0191
VEG.cropProduction	0.0	0.0	52.18	35.18	20000.0	13500.0	763.924	518.145	0.99	0.99	0.999	Similar	1.0	Similar	0.0657	0.0366
VEG.cultivatedArea	0.0	0.0	0.0	0.0	1.8	1.6	0.067	0.066	0.991	0.99	1.0	Similar	1.0	Similar	0.0871	0.0335
VEG.irrigatedArea	0.0	0.0	0.0	0.0	1.6	1.6	0.062	0.062	0.992	0.991	1.0	Similar	1.0	Similar	0.0034	0.0171
VEG.quantitySold	0.0	0.0	0.12	0.1	45.0	45.0	1.766	1.662	0.99	0.99	0.998	Similar	1.0	Similar	0.02	0.0192
VEG.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
VEG.sellingPrice	0.0	0.0	4.82	7.75	1000.0	4000.0	53.876	130.677	0.99	0.99	1.0	Similar	1.0	Similar	0.1114	0.0439
VEG.valueSales	0.0	0.0	52.14	35.16	20000.0	13500.0	763.879	518.111	0.99	0.99	0.999	Similar	1.0	Similar	0.0657	0.0366
WHEAT.cropProduction	0.0	0.0	667.99	640.26	42429.0	42429.0	2491.647	2462.841	0.716	0.722	0.0	Different	0.001	Different	0.0077	0.0163
WHEAT.cultivatedArea	0.0	0.0	1.46	1.4	98.0	108.3	5.162	5.336	0.697	0.704	0.0	Different	0.0	Different	0.0297	0.0265
WHEAT.irrigatedArea	0.0	0.0	0.1	0.09	26.0	26.0	0.979	0.799	0.971	0.955	0.0	Different	0.0	Different	0.0368	0.0255
WHEAT.quantitySold	0.0	0.0	3.86	3.66	242.4	242.4	14.353	14.035	0.715	0.722	0.0	Different	0.001	Different	0.008	0.0142
WHEAT.quantityUsed	0.0	0.0	0.04	0.04	17.0	17.0	0.45	0.561	0.981	0.986	0.529	Similar	0.116	Similar	0.032	0.0218
WHEAT.sellingPrice	0.0	0.0	48.57	47.72	495.0	495.0	78.152	77.863	0.716	0.722	0.0	Different	0.043	Different	0.0062	0.0206
WHEAT.valueSales	0.0	0.0	660.74	632.28	42429.0	42429.0	2471.704	2438.728	0.716	0.722	0.0	Different	0.001	Different	0.0075	0.0163
agriculturalLandArea	0.0	0.0	9.31	9.37	207.2	207.2	13.666	13.898	0.02	0.02	0.0	Different	0.082	Similar	0.0003	0.005
agriculturalLandHectaresAdquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
agriculturalLandValue	0.0	0.0	43049.39	45170.34	609000.0	609000.0	50690.565	53209.71	0.109	0.12	0.0	Different	0.0	Different	0.0048	0.0177
depreciation	0.0	0.0	2949.11	3016.19	28599.0	28599.0	2585.735	2610.406	0.029	0.026	0.0	Different	0.0	Different	0.0029	0.0135
farmBuildingsValue	0.0	0.0	5332.42	5699.37	110000.0	110000.0	10113.541	10754.094	0.314	0.297	0.0	Different	0.0	Different	0.0058	0.0189
farmNetIncome	-30251.0	-30251.0	8929.83	9362.95	500600.0	500600.0	13371.625	13225.358	0.0	0.0	0.0	Different	0.0	Different	0.0015	0.0098
fixedAssets	589.0	589.0	84239.8	87942.33	937362.0	937362.0	74616.097	77231.94	0.0	0.0	0.0	Different	0.0	Different	0.0025	0.0127
forestLandArea	0.0	0.0	0.01	0.01	4.1	4.1	0.106	0.106	0.989	0.99	1.0	Similar	0.998	Similar	0.0018	0.0098
forestLandValue	0.0	0.0	64.05	66.87	30000.0	30000.0	850.692	898.58	0.99	0.99	1.0	Similar	1.0	Similar	0.0004	0.0046
grossFarmIncome	-2012.3	-2012.3	15253.58	15794.16	567531.0	567531.0	17746.934	17834.13	0.0	0.0	0.0	Different	0.0	Different	0.0009	0.0075
intangibleAssetsNonTradable	0.0	0.0	1.74	5.76	1650.0	1650.0	53.584	97.316	0.999	0.997	0.995	Similar	0.652	Similar	0.0012	0.0094
intangibleAssetsTradable	0.0	0.0	2849.86	2848.47	71832.0	71832.0	3621.612	3770.229	0.086	0.111	0.0	Different	0.0	Different	0.0012	0.0088
landImprovements	0.0	0.0	1229.73	1163.41	74007.0	74007.0	4056.592	4040.783	0.723	0.724	0.0	Different	0.12	Similar	0.0046	0.0161
longAndMediumTermLoans	0.0	0.0	3.88	5.28	9368.0	9368.0	164.525	214.628	0.999	0.999	1.0	Similar	1.0	Similar	0.0003	0.0039
machinery	0.0	0.0	23928.02	24316.59	426237.0	426237.0	31953.47	32470.741	0.046	0.046	0.0	Different	0.0	Different	0.0037	0.0153
machineryAndEquipment	0.0	0.0	23928.02	24318.45	426237.0	426237.0	31953.47	32471.077	0.046	0.046	0.0	Different	0.0	Different	0.0037	0.0153
otherNonCurrentAssets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
otherOutputs	0.0	0.0	260.0	225.97	56000.0	56000.0	2483.244	2278.991	0.913	0.927	0.0	Different	0.0	Different	0.0003	0.0044
plantationsValue	0.0	0.0	881.13	1084.53	33280.0	33280.0	1707.826	2065.256	0.139	0.144	0.0	Different	0.0	Different	0.0153	0.0318
rentPaid	0.0	0.0	243.19	243.03	2982.5	2988.5	248.646	249.728	0.252	0.252	0.0	Different	0.065	Similar	0.0015	0.0099
specificCropCosts	0.0	0.0	701.65	699.87	6200.0	6200.0	673.751	680.013	0.027	0.028	0.0	Different	0.0	Different	0.0075	0.0213
subsidiesOnInvestments	0.0	0.0	30.99	34.19	47000.0	47000.0	825.188	762.53	0.993	0.993	1.0	Similar	1.0	Similar	0.0003	0.0045
taxes	0.0	0.0	17.12	14.94	2500.0	2500.0	145.852	137.438	0.978	0.981	0.949	Similar	0.443	Similar	0.0008	0.0069
totalCurrentAssets	180.0	180.0	4869.21	5798.57	100200.0	100200.0	7534.668	10013.956	0.0	0.0	0.0	Different	0.0	Different	0.0089	0.0249
totalExternalFactors	0.0	0.0	3405.63	3804.56	141500.0	141500.0	5649.648	5844.805	0.089	0.081	0.0	Different	0.0	Different	0.0057	0.0192
totalIntermediateConsumption	1000.0	1000.0	11874.41	12335.79	342352.0	342352.0	14508.168	15526.801	0.0	0.0	0.0	Different	0.0	Different	0.001	0.0079
totalOutputCropsAndCropProduction	0.0	0.0	17466.82	17658.16	700000.0	700000.0	21571.572	21247.08	0.026	0.026	0.0	Different	0.001	Different	0.0003	0.004
totalOutputLivestockAndLivestockProduction	-2436.5	-2436.5	2711.1	3504.7	309569.7	309569.7	12960.555	15241.348	0.896	0.866	0.0	Different	0.0	Different	0.0048	0.0178
vatBalanceExcludingInvestments	-38926.4	-38926.4	-100.17	-104.48	0.0	0.0	524.201	646.617	0.903	0.907	0.233	Similar	0.291	Similar	0.0008	0.0073
vatBalanceOnInvestments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0

Table 29. Statistical results: Greece 2018 (sheet 3)

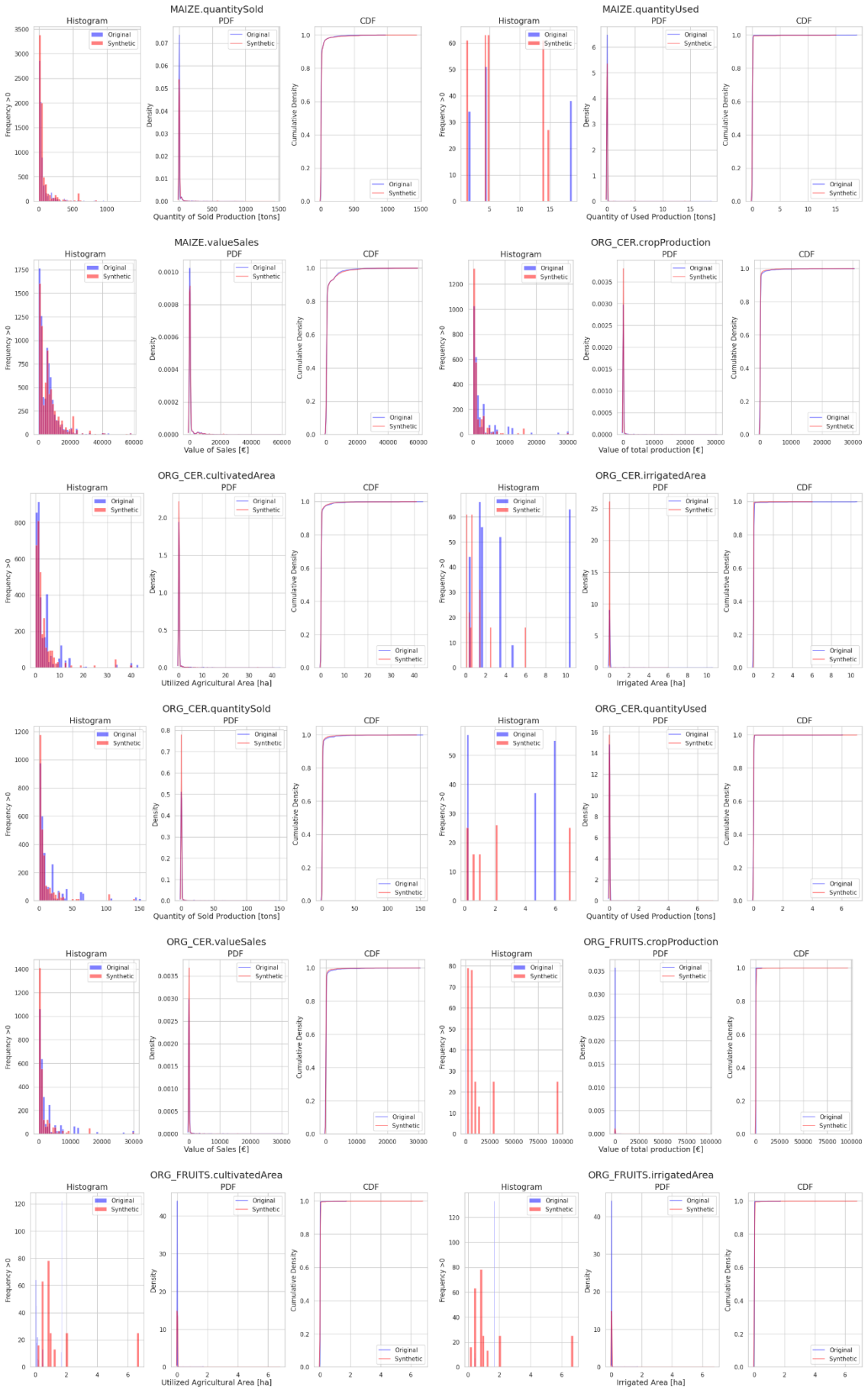

Figure 94. Statistical results: Greece 2018 (sheet 1)

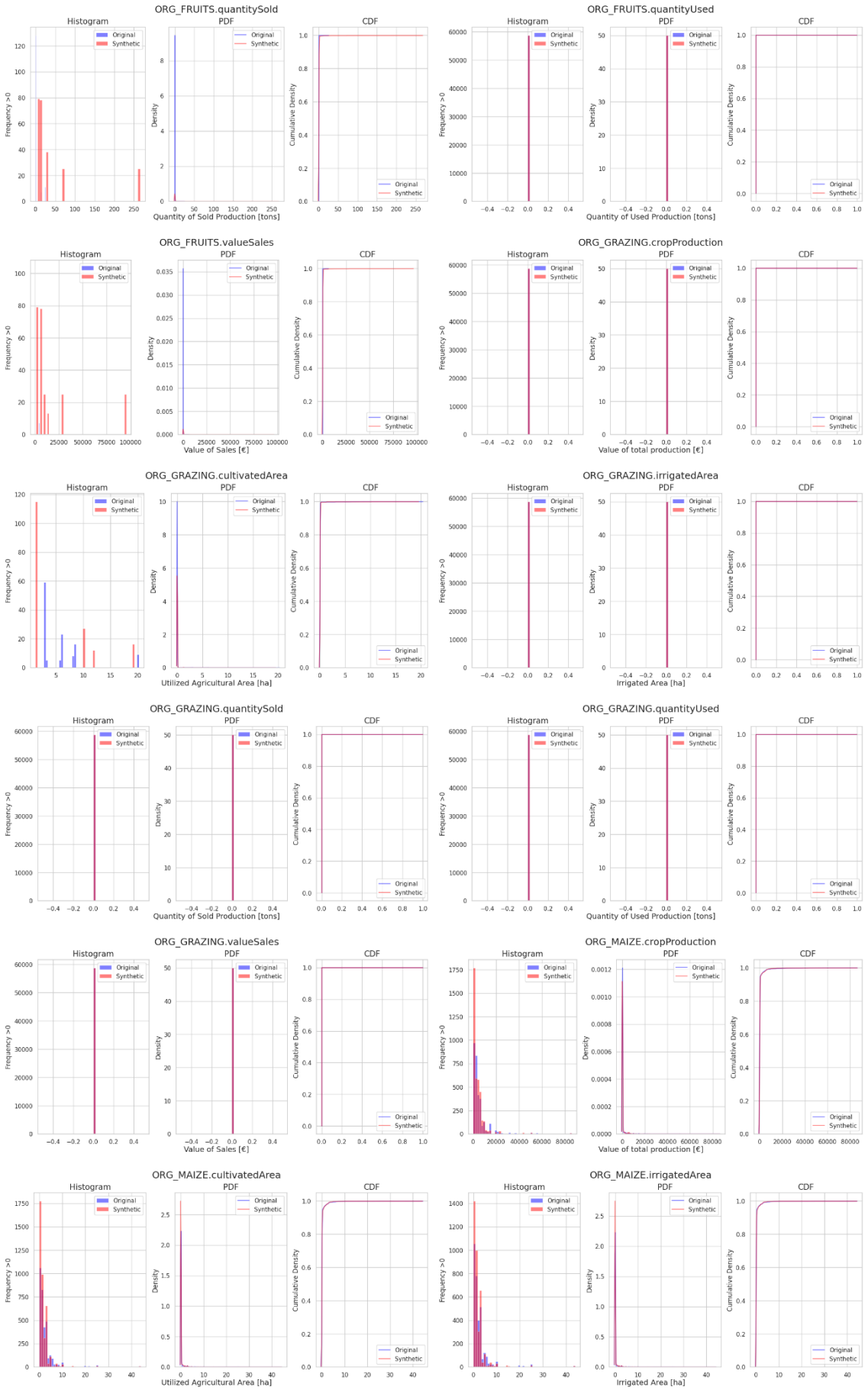

Figure 95. Statistical results: Greece 2018 (sheet 2)

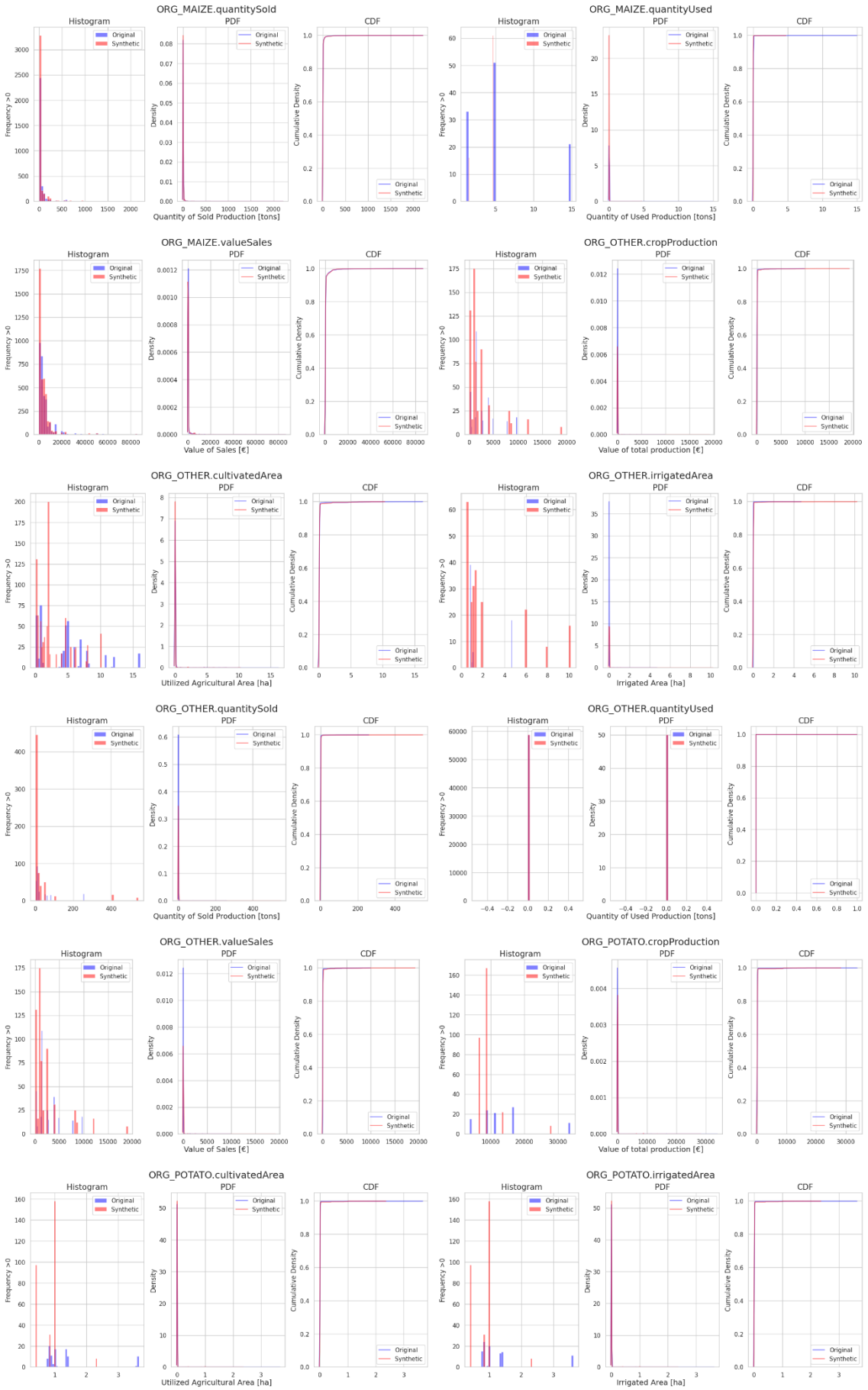

Figure 96. Statistical results: Greece 2018 (sheet 3)

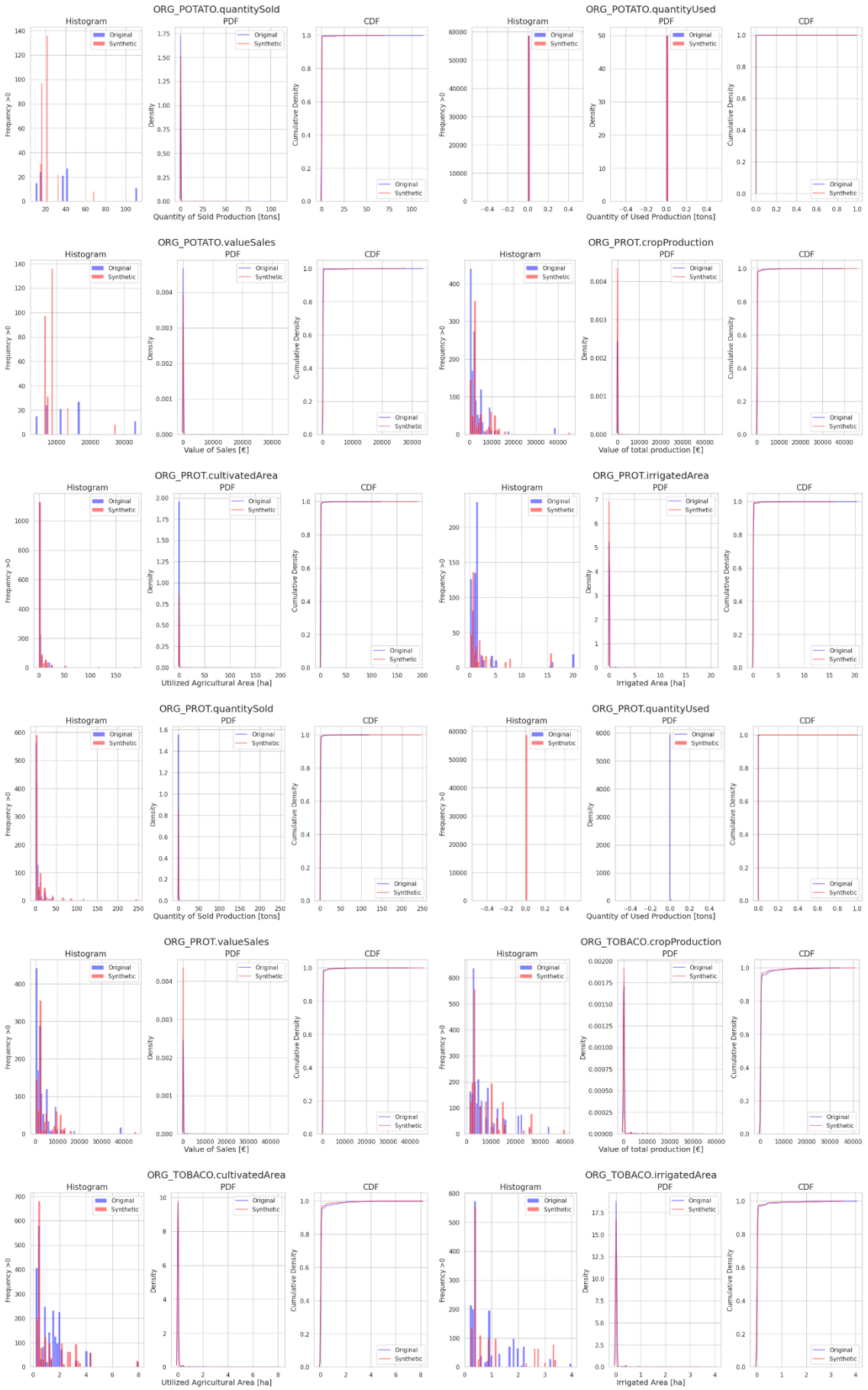

Figure 97. Statistical results: Greece 2018 (sheet 4)

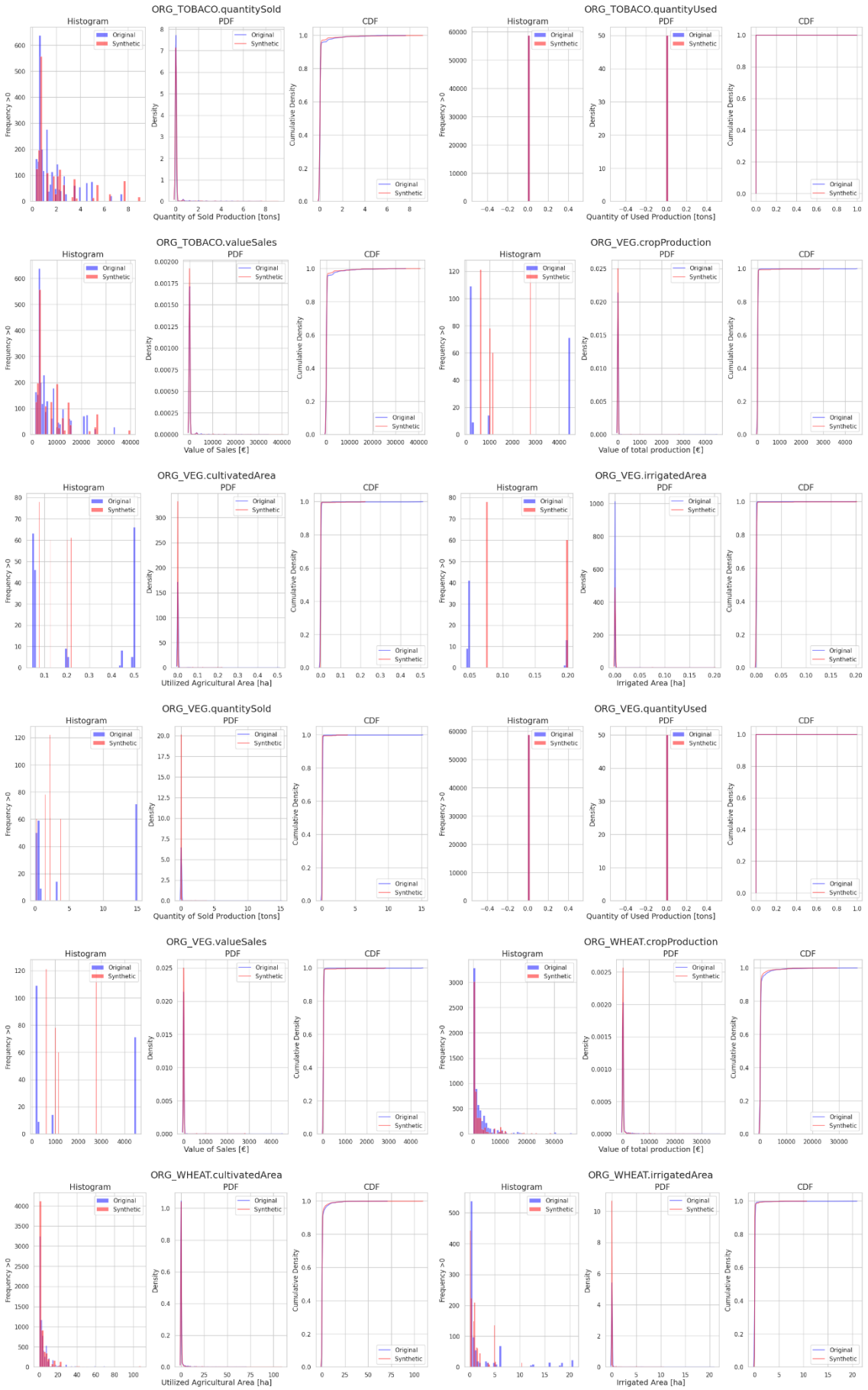

Figure 98. Statistical results: Greece 2018 (sheet 5)

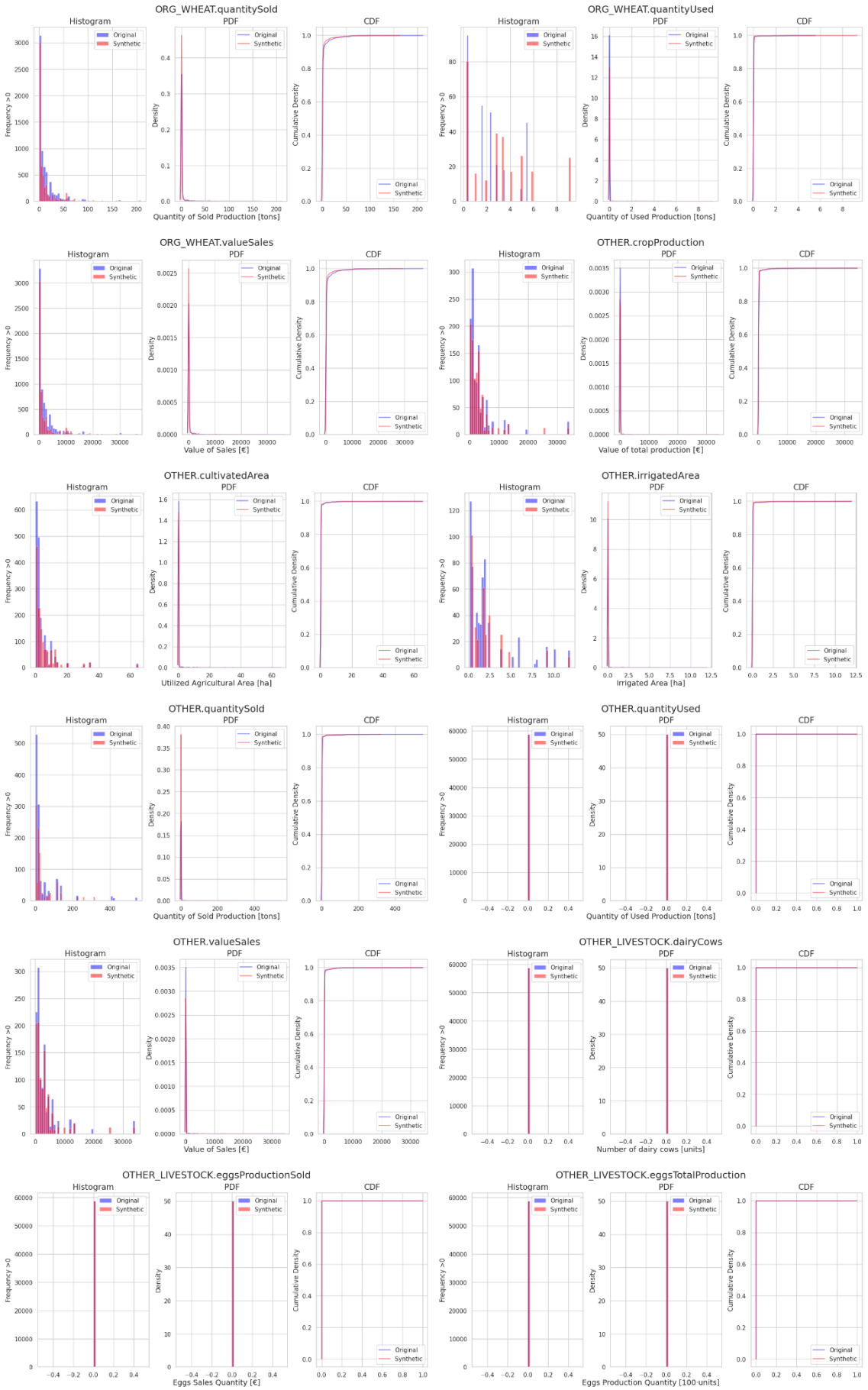

Figure 99. Statistical results: Greece 2018 (sheet 6)

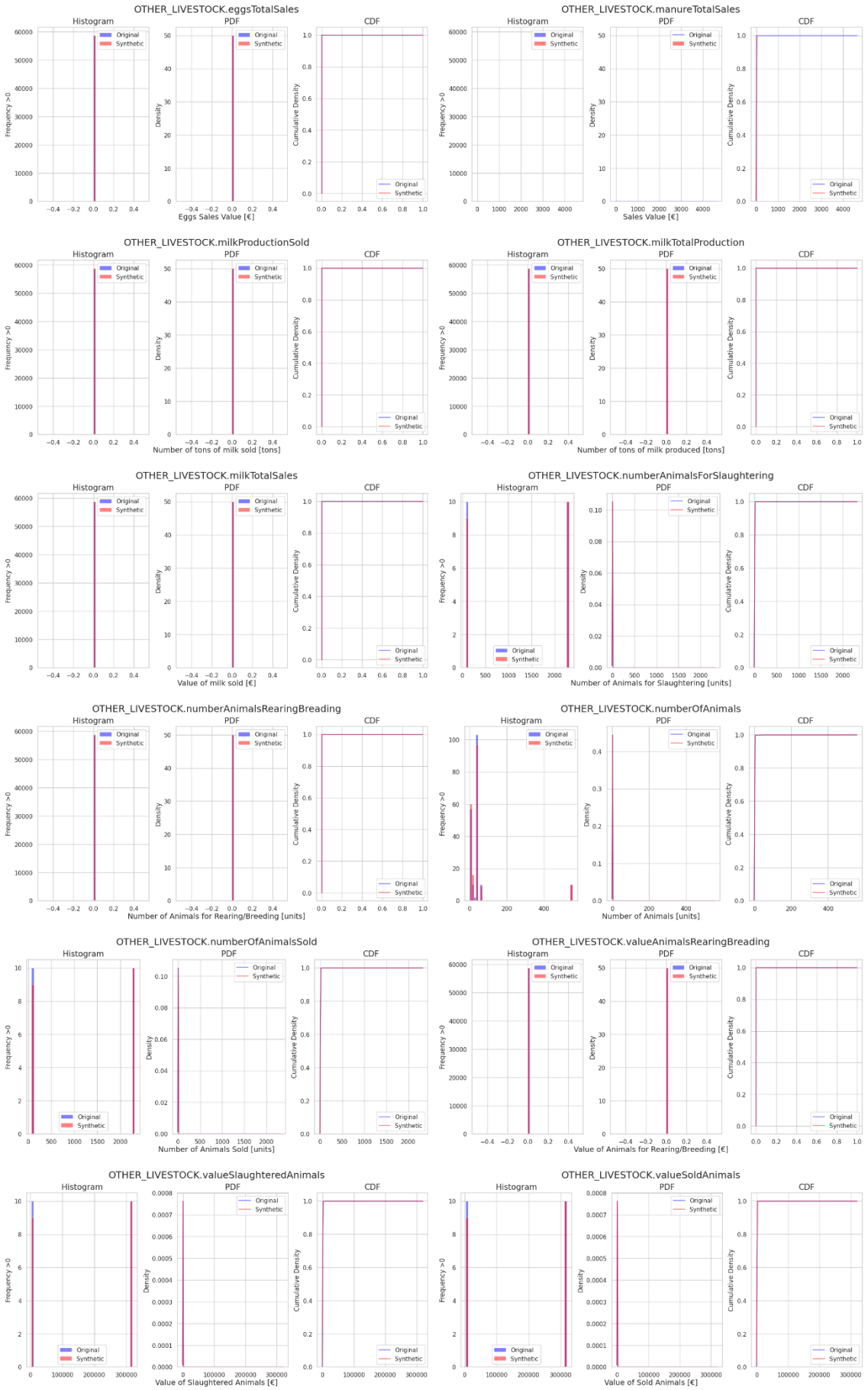

Figure 100. Statistical results: Greece 2018 (sheet 7)

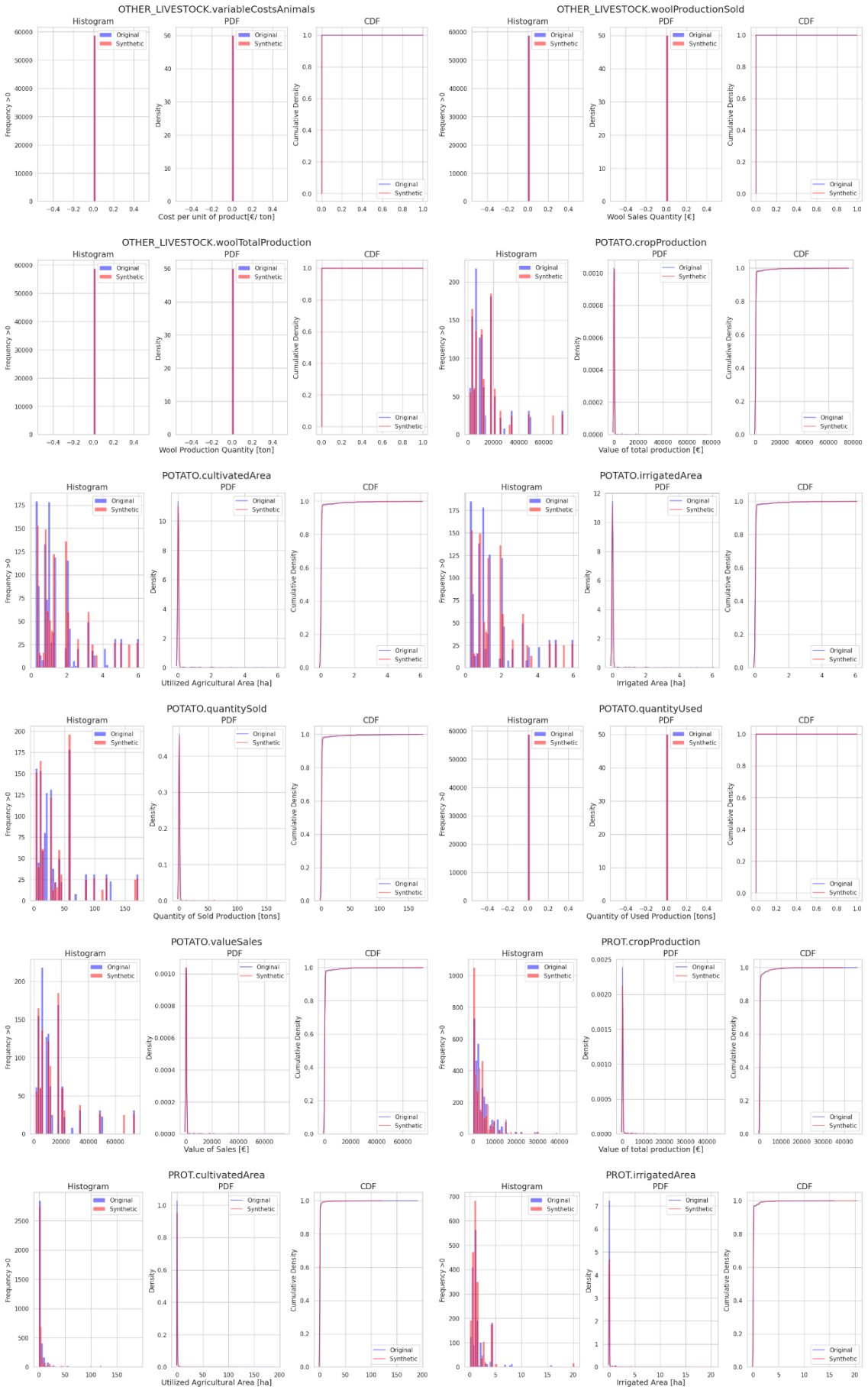

Figure 101. Statistical results: Greece 2018 (sheet 8)

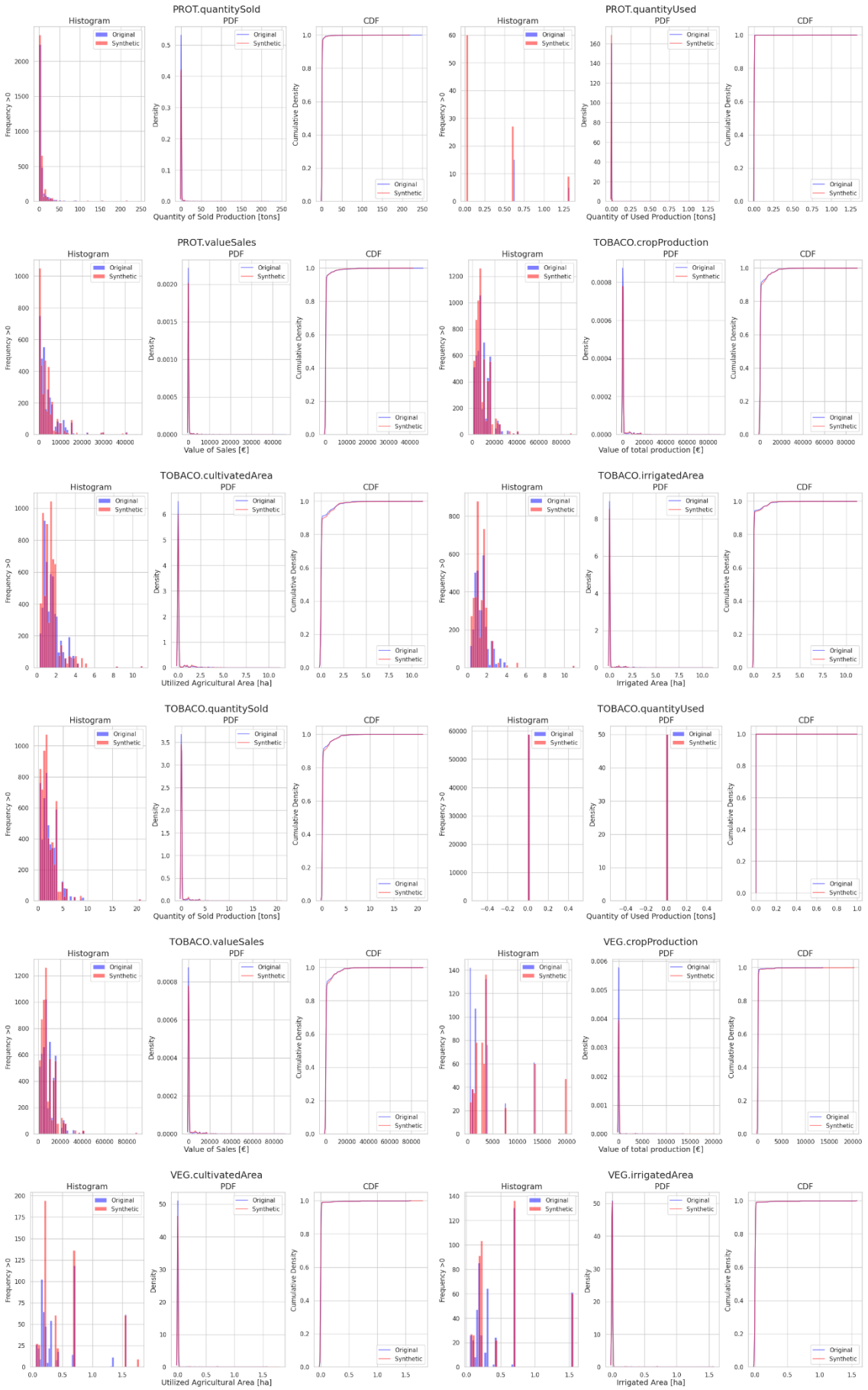

Figure 102. Statistical results: Greece 2018 (sheet 9)

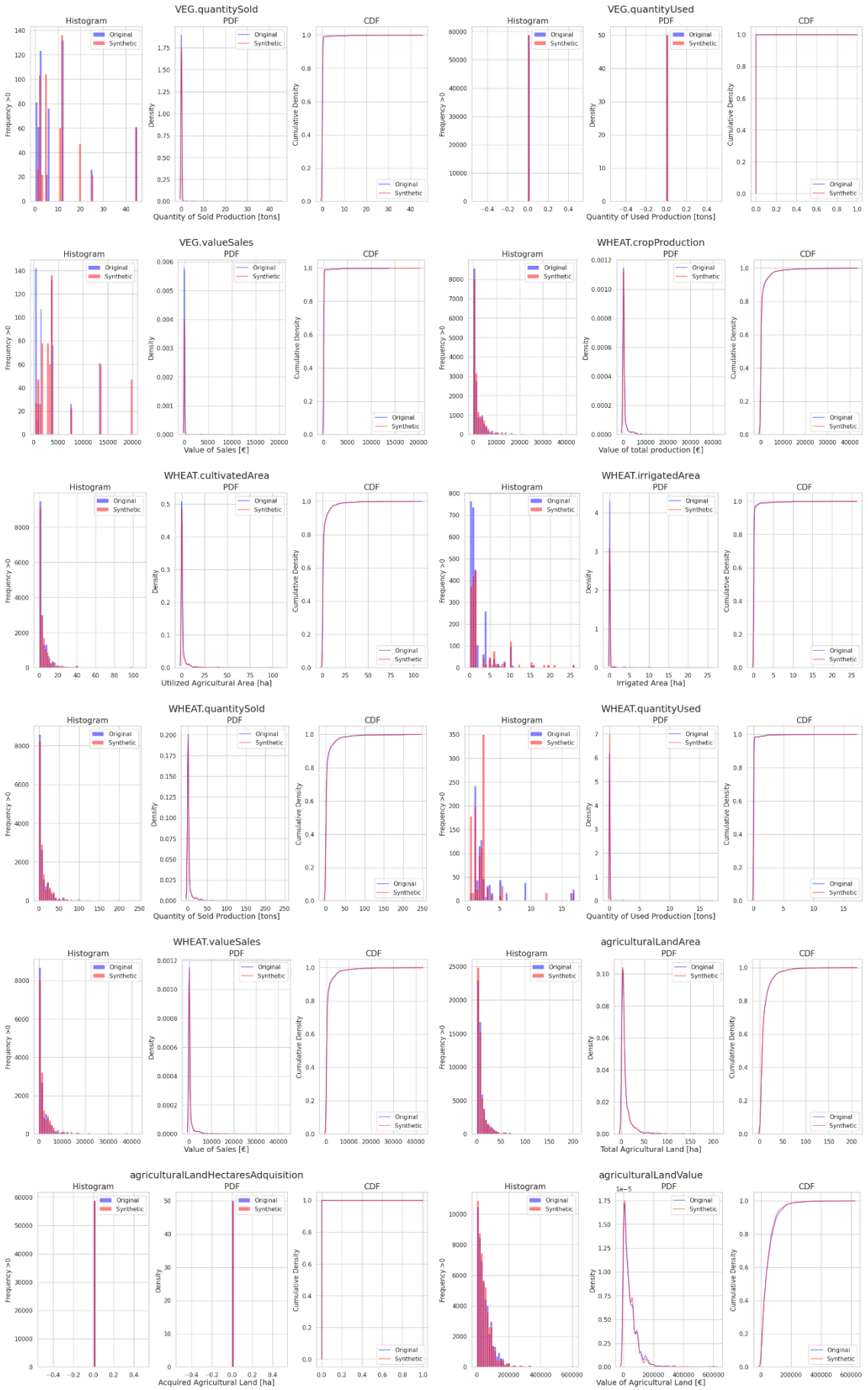

Figure 103. Statistical results: Greece 2018 (sheet 10)

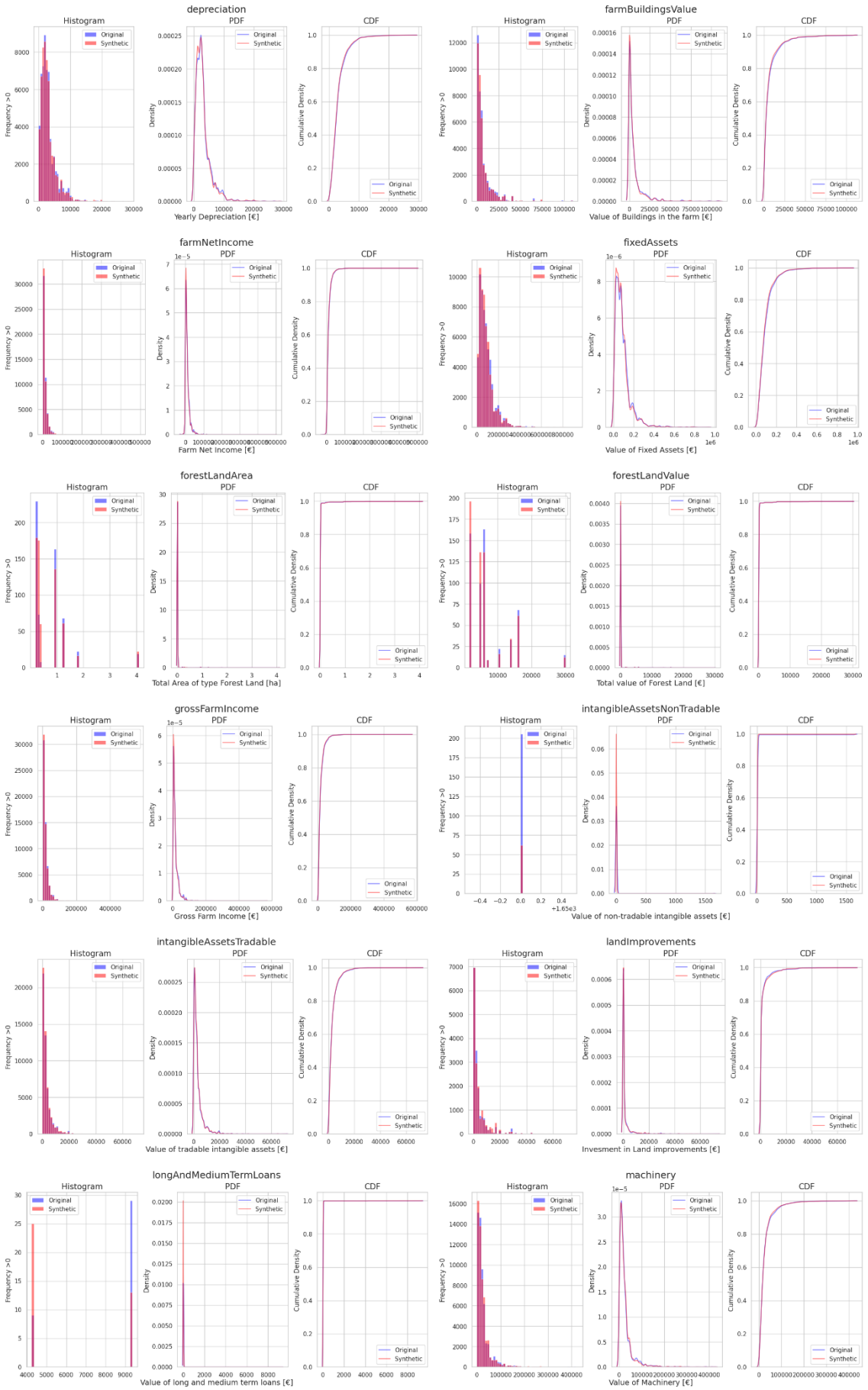

Figure 104. Statistical results: Greece 2018 (sheet 11)

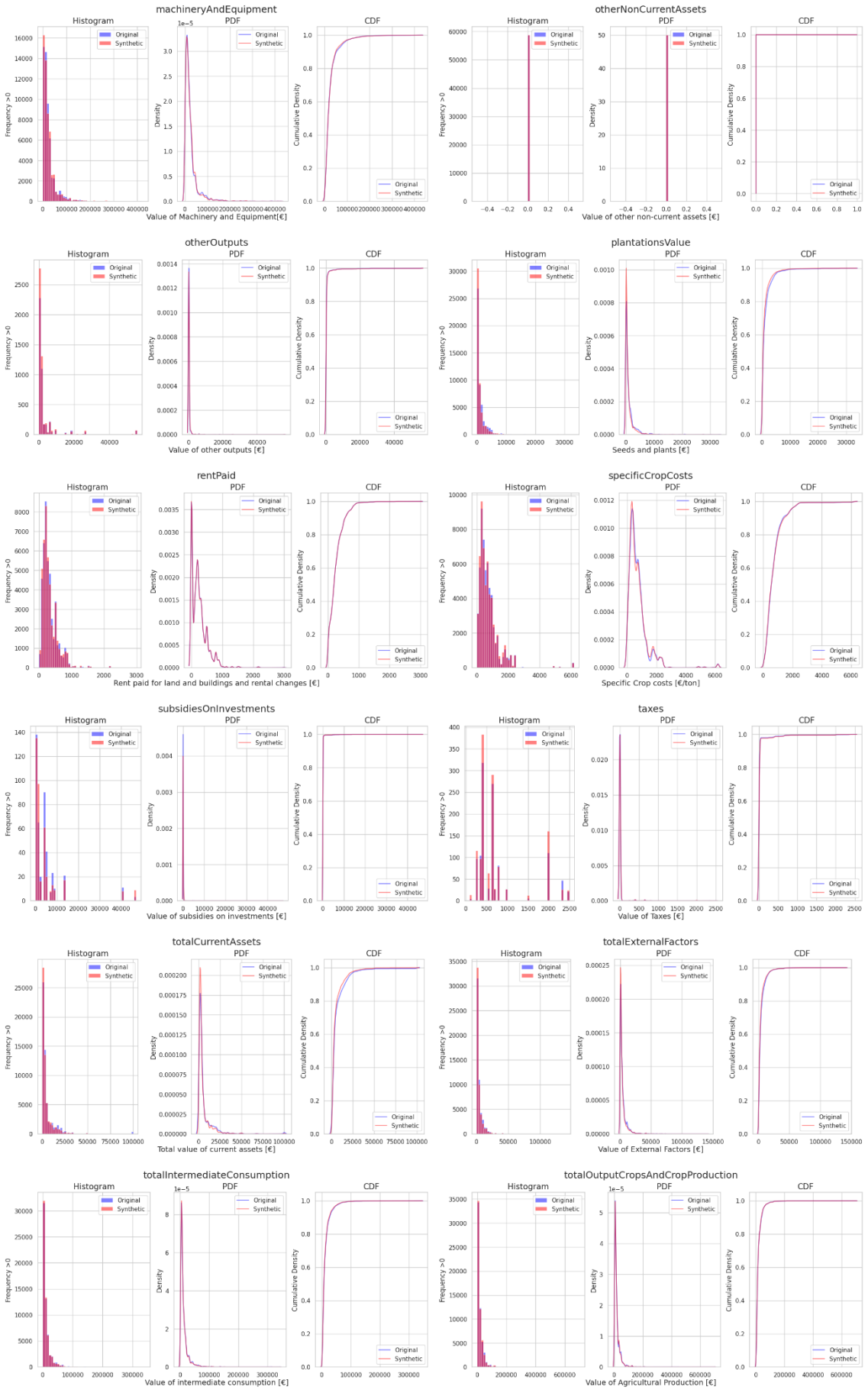

Figure 105. Statistical results: Greece 2018 (sheet 12)

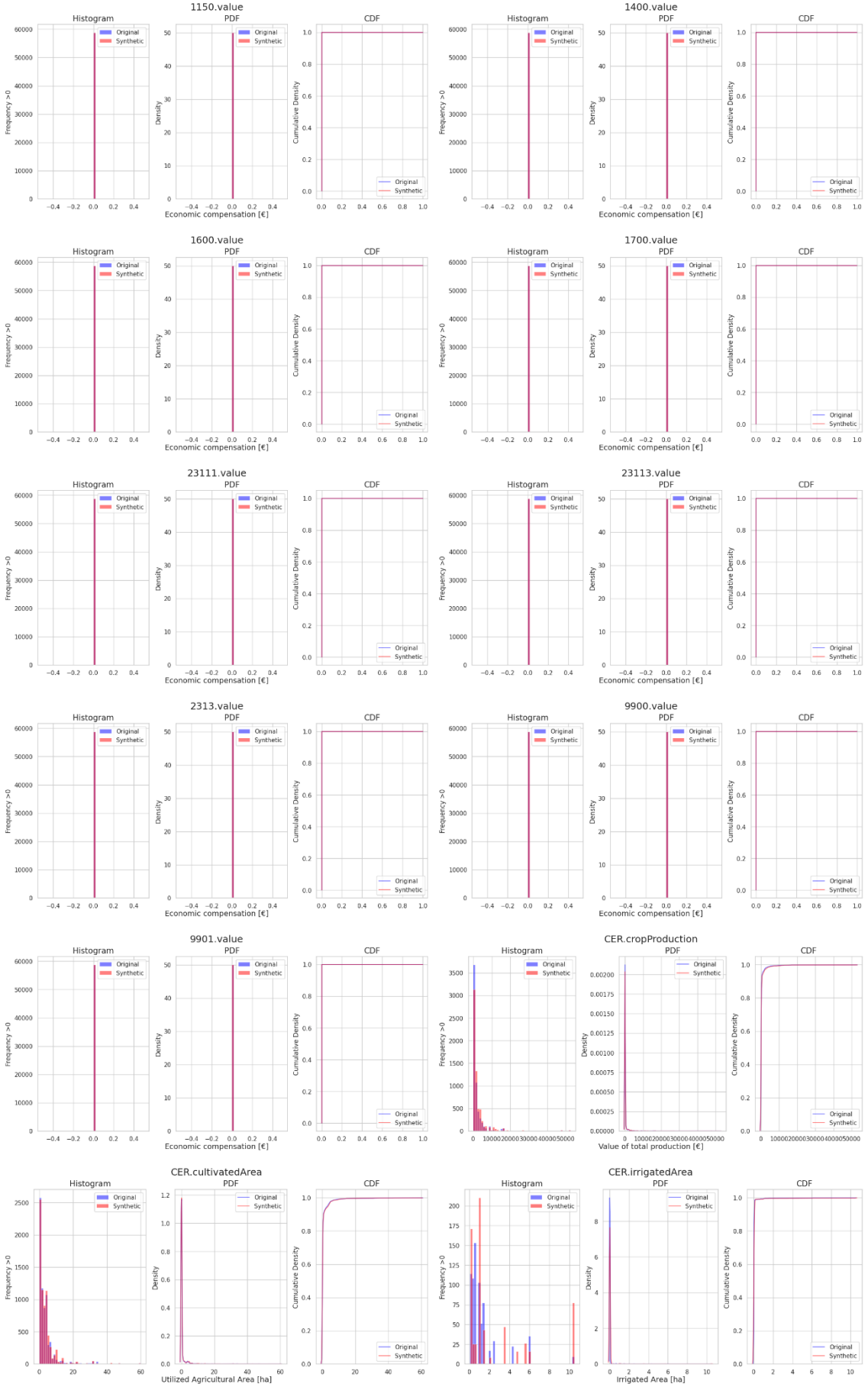

Figure 106. Statistical results: Greece 2018 (sheet 13)

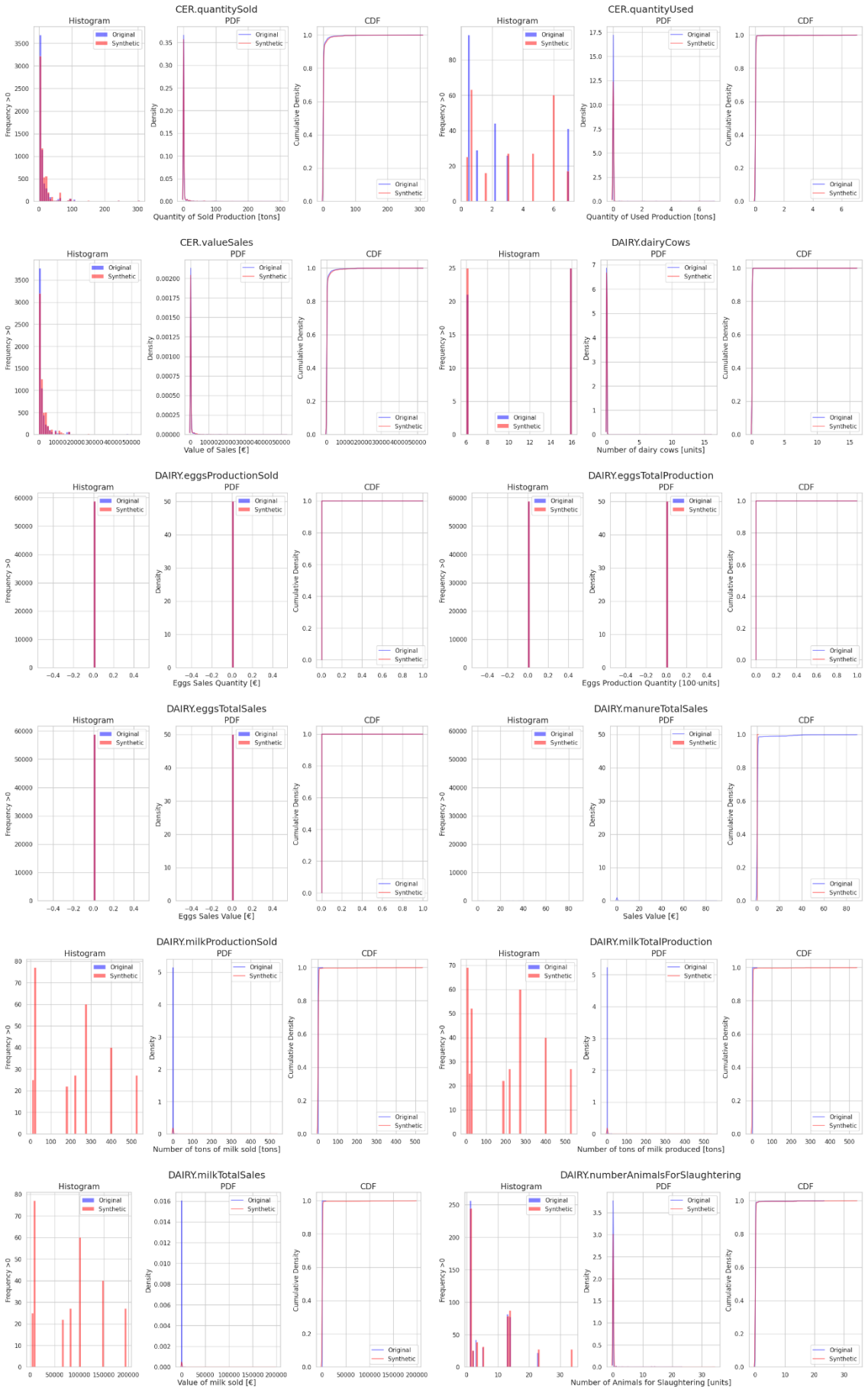

Figure 107. Statistical results: Greece 2018 (sheet 14)

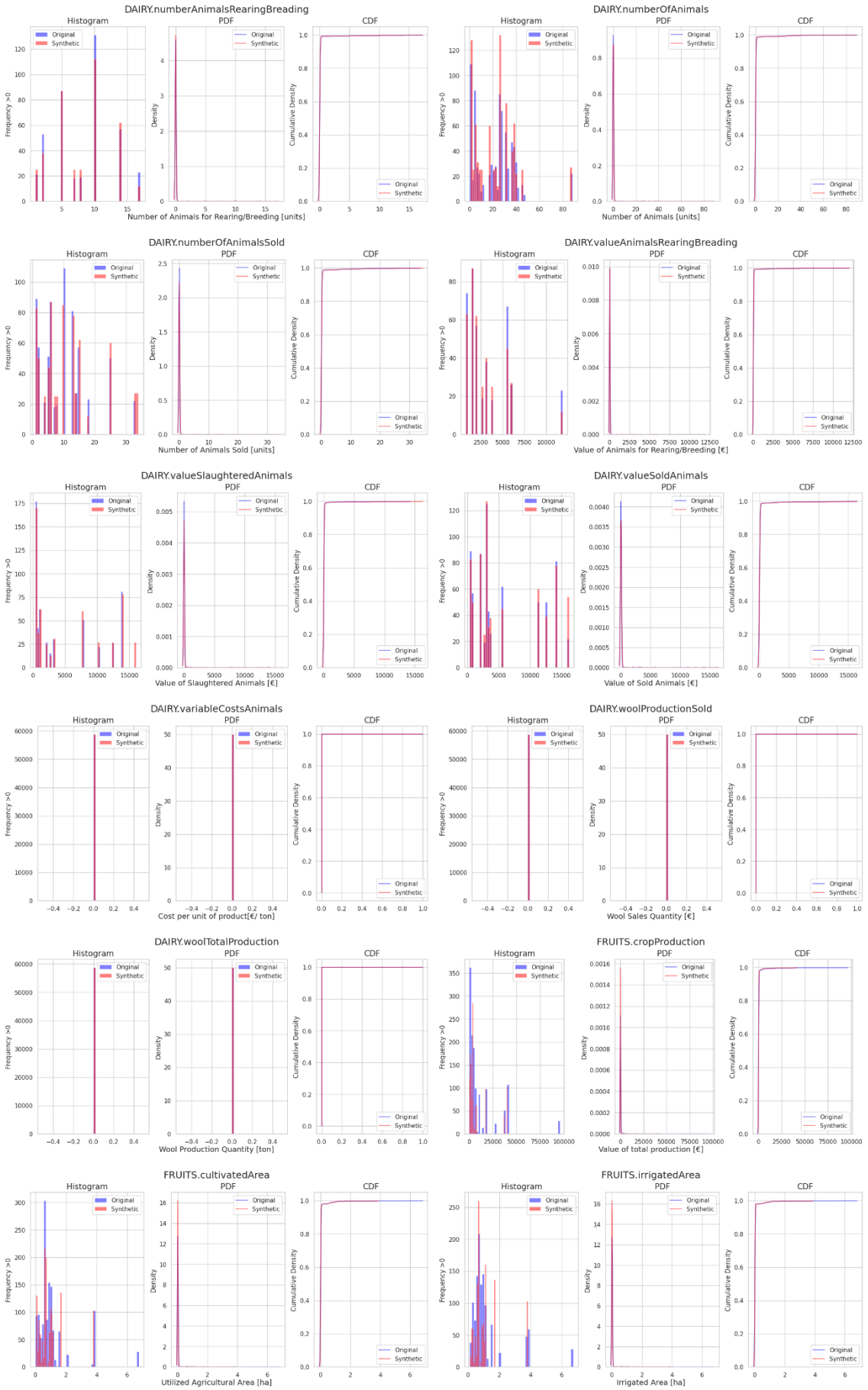

Figure 108. Statistical results: Greece 2018 (sheet 15)

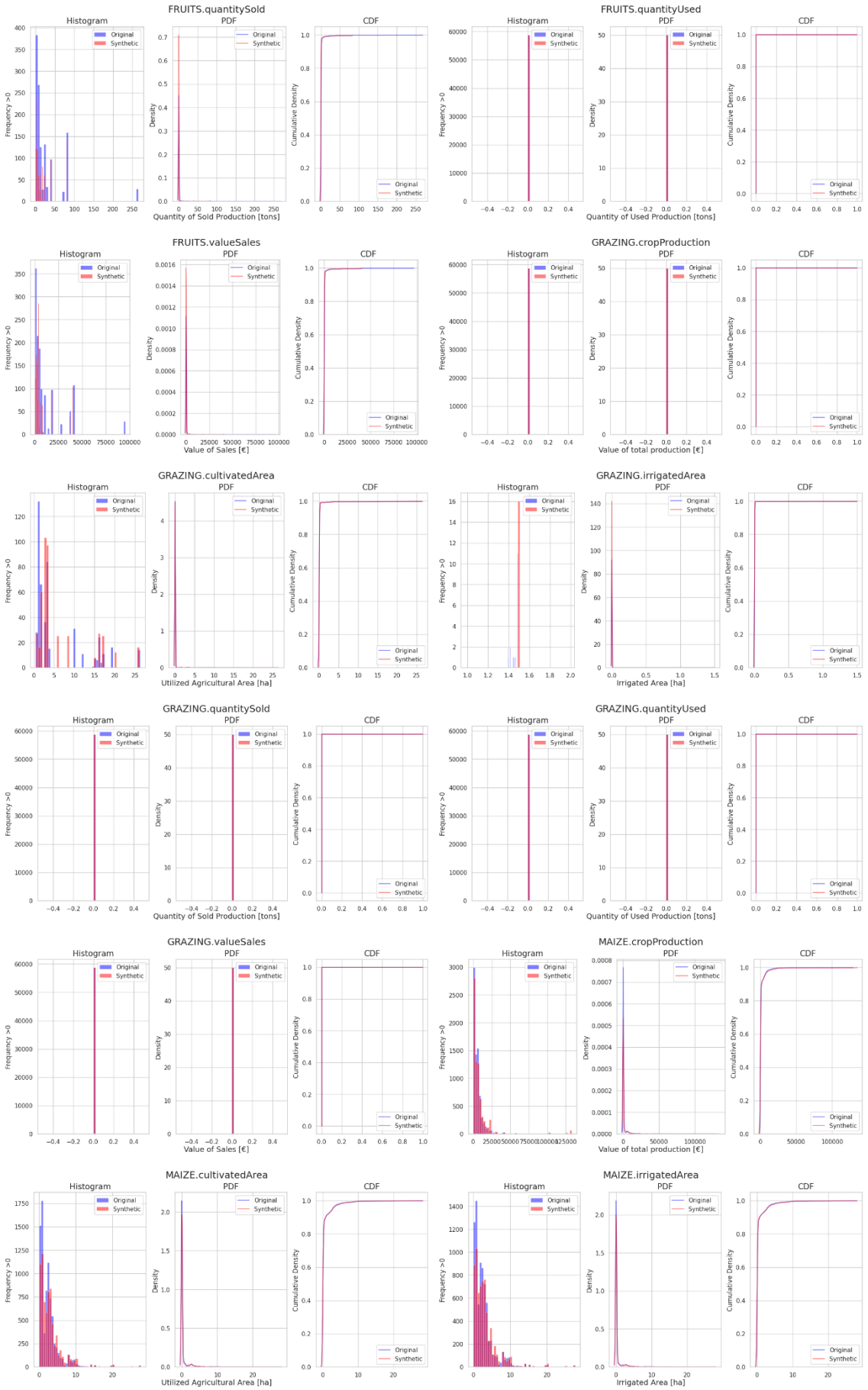

Figure 109. Statistical results: Greece 2018 (sheet 16)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
WHEAT	85925	82197	0.957
CER	28391	26542	0.935
ORG_WHEAT	26018	32052	1.232
MAIZE	21896	21316	0.974
PROT	18703	16160	0.864
ORG_CER	9972	11805	1.184
TOBACO	8663	7659	0.884
ORG_MAIZE	7471	7801	1.044
OTHER	7135	7430	1.041
ORG_PROT	5494	6284	1.144
GRAZING	2771	2714	0.979
ORG_OTHER	2248	1960	0.872
ORG_TOBACO	2185	3011	1.378
POTATO	1867	1969	1.055
FRUITS	1319	1444	1.095
ORG_GRAZING	874	742	0.849
ORG_FRUITS	354	244	0.689
VEG	282	282	1.0
ORG_POTATO	242	130	0.537
ORG_VEG	38	48	1.263

Table 30. Greece use case, 2018: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
MAIZE	58034523	47215346	0.814
TOBACO	52501551	47614620	0.907
WHEAT	39229090	37600544	0.958
POTATO	15809136	16981528	1.074
ORG_MAIZE	15150442	15295047	1.01
CER	14611822	12214938	0.836
ORG_TOBACO	13251882	16978407	1.281
PROT	13137012	13006353	0.99
ORG_WHEAT	11575971	15636658	1.351
FRUITS	10344248	14951247	1.445
ORG_CER	4482023	6836694	1.525
ORG_FRUITS	4192393	128970	0.031
ORG_PROT	3518386	4250995	1.208
OTHER	3288603	4064448	1.236
VEG	3064189	2066073	0.674
ORG_POTATO	2604520	1321866	0.508
ORG_OTHER	1357456	820066	0.604
ORG_VEG	559334	352299	0.63
GRAZING	0	0	1.0
ORG_GRAZING	0	0	1.0

Table 31. Greece use case, 2018: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
MAIZE	533733	469060	0.879
WHEAT	226946	215118	0.948
ORG_MAIZE	178357	166650	0.934
CER	84885	71129	0.838
ORG_WHEAT	65180	89880	1.379
POTATO	42425	44802	1.056
OTHER	35516	48364	1.362
PROT	25938	23567	0.909
ORG_CER	25885	38362	1.482
FRUITS	22799	34921	1.532
ORG_OTHER	18915	10008	0.529
TOBACO	12156	11172	0.919
ORG_FRUITS	10906	406	0.037
ORG_PROT	7510	8637	1.15
VEG	7276	5926	0.814
ORG_POTATO	6253	3650	0.584
ORG_TOBACO	3241	3859	1.191
ORG_VEG	741	1149	1.551
GRAZING	0	0	1.0
ORG_GRAZING	0	0	1.0

Table 32. Greece use case, 2018: quantity sold ratio comparison

5.5 Definition of the simulation scenario:

5.5.1 Policies scenario: Greece

To depict the basic subsidies scenario, the Greek use case has followed an approach similar to the ones described in section 3.5.1Policies scenario in Andalusia. Accordingly the following table shows al the subsidies considered for this use case as well as the parameters related, including the economic compensations and product groups affected for the cases of coupled subsides.

	Description	Subsidy_Code	Coupled	Aggregated_product	Economic_compensation	StartYear	EndYear	Label
0	Basic payment scheme	1150	N		4987.09	2015	2030	Basic
1	Payment for agricultural practices beneficial ...	1400	N		2596.99	2015	2030	Greening
2	Payment for young farmers	1600	N		797.35	2015	2030	
3	Small farmers scheme	1700	N		923.66	2018	2030	
4	Cereals	23111	Y	WHEAT	49.30	2015	2030	
5	Cereals	23111	Y	CER	49.30	2015	2030	
6	Cereals	23111	Y	MAIZE	49.30	2015	2030	
7	Cereals	23111	Y	ORG_WHEAT	49.30	2015	2030	
8	Cereals	23111	Y	ORG_CER	49.30	2015	2030	
9	Cereals	23111	Y	ORG_MAIZE	49.30	2015	2030	
10	Protein crops	23113	Y	LEGUMES	134.66	2015	2030	
11	Protein crops	23113	Y	ORG_LEGUMES	134.66	2015	2030	
12	Potatoes	2313	Y	POTATO	1884.77	2015	2030	
13	Potatoes	2313	Y	ORG_POTATO	1884.77	2015	2030	
14	Organic conversion of crops	9900	Y	ORG_FRUIT	3.11	2015	2020	
15	Organic conversion of crops	9900	Y	ORG_CITRUS	3.11	2015	2020	
16	Organic conversion of crops	9900	Y	ORG_GRAZ	1.81	2015	2020	
17	Organic olive conversion	9901	Y	ORG_OLIVE	2.73	2015	2020	
18	Organic conversion of crops	9900	Y	ORG_FRUIT	311.25	2015	2020	
19	Organic conversion of crops	9900	Y	ORG_CITRUS	311.25	2015	2020	
20	Organic conversion of crops	9900	Y	ORG_GRAZ	180.73	2015	2020	
21	Organic olive conversion	9901	Y	ORG_OLIVE	272.69	2015	2020	

Table 33. Greece use case: subsidies

6 UC4: An additional use case for the Agricore project: use case Italy

The last use case presented in this report corresponds to the Italian use case. This use case was not originally projected but it was born as an initiative to UNIPR and their possibility to access to farms microdata (RICA database). The goal of this use case is to test and validate the short-term period model and to assess the impact of introducing different levels of CO2 taxation on GHG emissions produced by the livestock activity. As a general consideration, this use case focuses on a specific region in the north of Italy, Emilia-Romagna.

6.1 Presentation of the data used for the generation of the synthetic population (Data Sources Analysis)

6.1.1 Used data sources

The construction of the Italian use case is based on the use of the FADN (Rete di Informazione Contabile Agricola) dataset as the main source of information. The FADN database is a comprehensive data source expressing the economic performance of agricultural holdings. It is an essential dataset for the mission at hand, as it constitutes a comprehensive resource aligned with the purposes of the project, and allows to understand the possible repercussions and effects of specific agricultural policies and environments on multiple dimensions of the Italian agricultural sector. This credibility is supported by a reliable source and a standardized approach to data covering economic, social and environmental factors.

The alignment of this dataset with the project not only relies on the information contained, but also in the guidelines established to create it. These guidelines are marked by the EU-wide Farm Accountancy Data Network, and hence RICA operates under the same harmonized rules (Council Regulation (EC) No 1217/2009 of November 30, 2009). Thus, the accounting principles and methodologies followed in the compilation of the FADN database are common to the compilation of other comparable databases produced by other EU countries. This valuable feature facilitates comparisons of data between different countries and the integration with European datasets in a single form. In this case, FADN, RECAN and RICA have followed a straightforward integration process by just overcoming minor differences in variables naming and datasets structure that Synthetic Population Generation module easily manages in an automated way. The module directly maps the different variables useful for the agents initialization and makes the appropriate conversion by just knowing the use case to be processed and the year of analysis.

The data presented in the RICA dataset comes from surveys conducted on a representative sample of real agricultural holdings. Like other survey-based datasets referenced in this project, RICA follows a specific and rigorous selection plan that is reviewed and updated annually. This approach ensures a comprehensive coverage and representativeness across a diverse range of agricultural sectors, providing a reliable reflection of the economic and operational realities of Italian farms.

Likewise in other mentioned databases, information is presented as an anonymized structured tabular dataset. Sensible information is omitted or removed, and the selection methods ensure that potentially identifiable farms are not included in the data to safeguard personal and sensitive information. In this way privacy and confidentiality are guaranteed, and thus the dataset can be utilized in a broad set of usages, including research, policy evaluation and other purposes.

In figures, originally the sample composing dataset contains 11.000 farms which represent a total of 566.338 farms in the field of observation, covering a wide ratio of total agricultural land (93% ~ 11.678 thousands of hectares). Its wider cover compared to other EC databases allows for carrying out agricultural at heterogeneous levels.

6.1.2 How the data sources were acquired (public / private nature)

RICA data acquisition was facilitated through UNIPR. This organization requested datasets for different accountancy years covering the entirety of Italy.

As an academic and research organization, UNIPR is categorized as an eligible entity, particularly considering that the data is being used for agricultural research and policy analysis. They followed the formal procedure, submitting a request that included detailed information about the organization, the intended use of the data, and the procedures in place to ensure the protection of any personal or sensitive data.

Eventually, the data was provided, granting access to download the requested datasets. In this case, the datasets covered the years 2018, 2019, and 2020.

6.1.3 Data sources limitations (what is missing)

The Italian use case benefited from the advantage of being supported by the RICA dataset. Unlike other use cases, the broad diversity of agriculture-related variables contained within this dataset helped to cover all the fields required to define the agent parameters. Indeed, the conceptual framework of the model required the definition of several agent parameters, despite uncertainty about the availability of relevant data. The analysis of the RICA dataset confirmed that these parameters could be populated with reliable information.

This advantage is the result of a meticulous data-gathering campaign, which included detailed information about agricultural holdings and captured various aspects of agricultural activity, economic performance, and the structure of the farms. Unlike other datasets, this one specifically included crop costs, which were readily available in the original dataset.

Due to these reasons, no significant limitations in the data sources used for the Italian use case were encountered, and therefore, there was no need to merge different datasets.

6.2 Crop grouping analysis

The crop grouping analysis for the Italian use case has been made following strict objective representativeness and crop affinity reasons. For this use case no outstanding crops have been considered.

6.2.1 Distribution of crops in the regions of interest (produced quantity, used area, organic vs non-organic, ...)

Before taking the decisions that definitively conduct to a specific crop grouping, a crop representativeness study has been conducted. This analysis aims to drive the crop grouping in an objective way based on different crop indicators. Then with this information and considering the crops affinity the final decisions about crop grouping are taken.

The indicator reported in the analysis consider an extrapolation of the sample data to get a better understanding of how each crop is spreading across the studied region. This consideration is crucial considering that weights on the data sample are highly diverse, and hence they can strongly influence on the marco-indicators when computing the totals.

This use case considers 244 different crop species. Among the use cases studied is by far the most complex use case considering this aspect. If the use case would be developed by considering this initial number of crops, the complexity of the simulation and the model would scale up to be able to manage a number of variables close to 2500 variables. For this reason crop grouping for this use case is critical according to this context. Taking into account this figure, it is foreseeable that the product groups generated will be very extensive as they have to include a higher number of individual crops.

The first results displayed are the representativeness according to the total area of each crop:

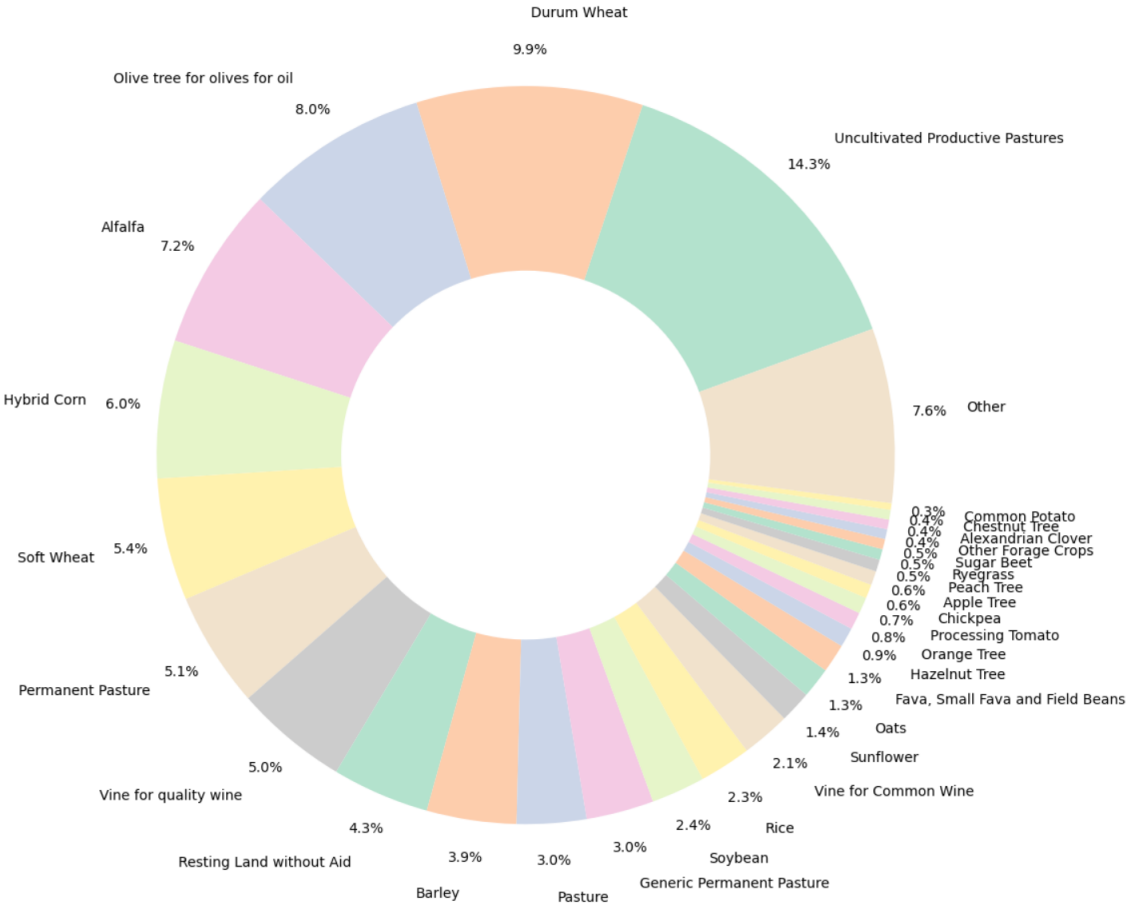

Figure 110. Italian crops by cultivated area

The five original crops with higher overall cultivated area are Uncultivated productive pastures, Durum wheat, Olive tree for olives for oil, Alfalfa and Hybrid corn. In this case, other is not a crop or a product group but it is a representation of many minor crops to through light to the graph and facilitate its comprehensibility. All the mentioned crops amount a total of 52,6% of the total cultivated are in the studied region. This figure is significative considering the original number of individual crops managed at the start of the study. In addition, it helps to create an idea about the potential product groups that must be created following crop similarity criteria.

The different pasture characterisations amount a total of 25,4% including Uncultivated productive pastures, Permanent pastures, Pasture, and Generic permanent pasture. Setting aside the pastures and meadows, it is possible to observer a high predominance of cereals. Durum wheat, Hybrid corn, Soft wheat, Barely, Rice, Oats are some examples of this family of crops represented in the graph. The observed cultivated area destined to cereals is at

least of 28,8% of the available cultivated area, which is a meaningful figure. Alfalfa is a crop which occupies the fourth position in top cultivated area, although no similar crops are observed in this representation. The same happens with Olive tree for olives for oil. It covers the 8% of the total cultivated area and no other crops of its family are identified within the top vegetal species.

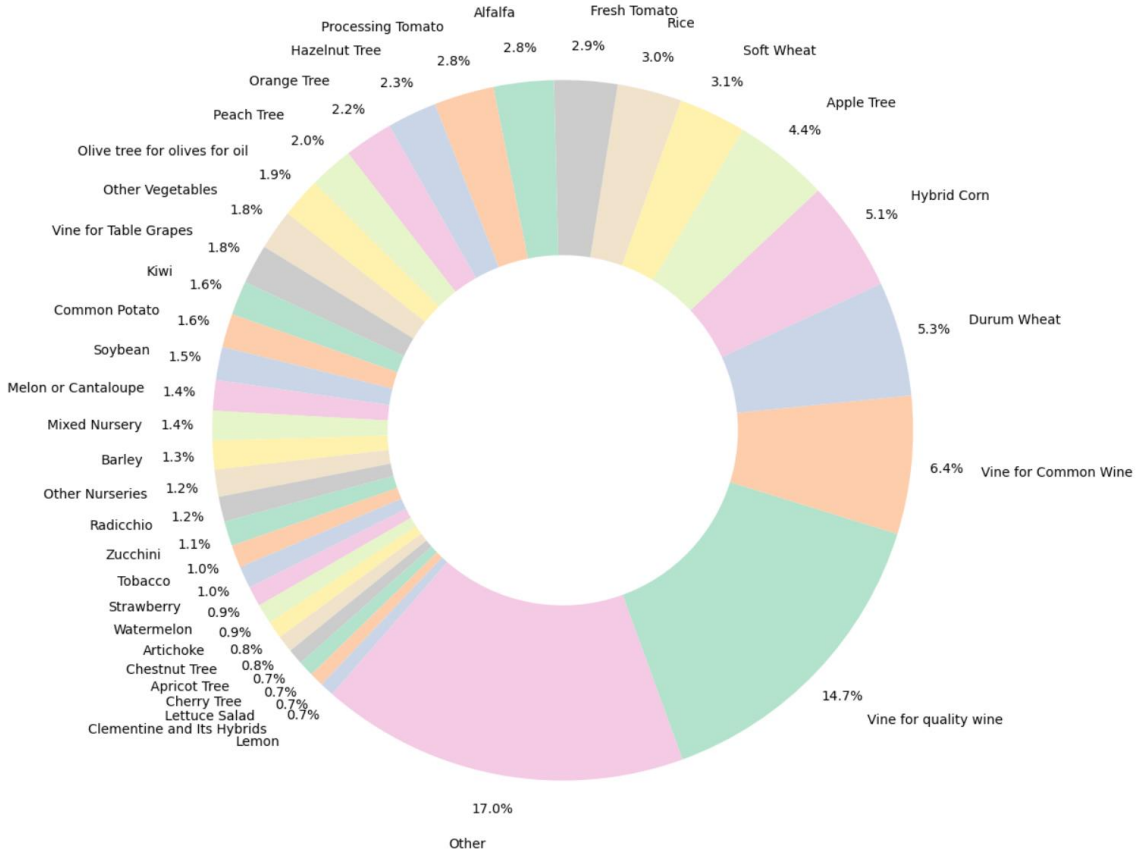

Figure 111. Italian crops by sales quantity

With regard to the economic indicators of the crops included in the use case, it is remarkable that the first two positions in the ranking are occupied by vine, a permanent crop, both for quality wine and for common wine. Following these are cereal crops, which as in the case of cultivated area, demonstrate a cross-cutting presence across several indicators. Next, it is possible to see the presence of some vegetables, including tomato, and with a representative figure, alfalfa. In general, the economic parameter show a more balanced distribution across all the available crops. In contrast to the previous graph, pastures and meadows do not have a predominant representation. This may be due to the linkages between the use of these crops and the techno-economic orientation of farms that include them. The primary revenue from these crops comes from their use as livestock feed, so their economic contribution is not reflected in agricultural output but rather in the livestock sector's economic balance and output.

Considering the purpose of this use case, factors related to interactions between crops and livestock must be taken into account. According to this reason, cultivated area parameters must be predominant over other indicators, so the presence of a specific product group to feed livestock is ensured.

	FADN Code	Description	Frequency	Frequency Rel	Total Area	Production Quantity	Sales Quantity	Sales Value	average_area	Share Area	# Crops Combination	product_code
0	214	Pascoli incolti produttivi	56721	0.0942	1364045	71629787	3998031	8536228	126.36	23.662	3.86	Uncultivated Productive Pastures
1	3	Frumento duro	90649	0.1506	945118	961878662	3605099	947030286	87.55	6.902	4.86	Durum Wheat
2	327	Olivo per olive da olio	271008	0.4503	763003	1185113789	2291215	334602936	70.68	16.031	3.77	Olive tree for olives for oil
3	175	Erba medica	78450	0.1304	684074	701939232	6413317	497318995	63.37	8.223	4.56	Alfalfa
4	6	Mais ibrido	68094	0.1131	575638	1021861921	6131801	918401610	53.32	9.876	4.19	Hybrid Corn
5	4	Frumento tenero	74031	0.1230	511429	582102829	2755122	560278258	47.38	9.392	4.75	Soft Wheat
6	215	Prato pascolo permanente	51316	0.0853	483156	227859158	2262427	74441553	44.76	22.729	3.38	Permanent Pasture
7	325	Vite per vino di qualità	122552	0.2036	472996	3514671451	4791474	2625032747	43.82	12.593	2.87	Vine for quality wine
8	346	Terreni a riposo senza aiuto	108436	0.1802	405842	0	0	0	37.60	3.961	4.40	Resting Land without Aid
9	9	Orzo	70873	0.1178	374021	285450846	1496587	238219578	34.65	5.289	5.14	Barley
10	212	Pascolo	13638	0.0227	290150	18734874	1014916	1799120	26.88	9.973	3.87	Pasture
11	213	Prato pascolo generico non avvicendato	21236	0.0353	281873	75375077	774002	38216805	26.11	2.820	3.82	Generic Permanent Pasture
12	26	Soja	32807	0.0545	224247	275863170	801525	273230764	20.77	3.497	4.25	Soybean
13	11	Riso	4414	0.0073	215874	530750868	1460333	530448755	20.00	0.496	2.74	Rice
14	326	Vite per vino comune	100059	0.1663	203070	1234893849	2947652	1139942803	18.81	3.169	4.16	Vine for Common Wine
15	39	Girasole	15513	0.0258	132472	99487048	314465	99319242	12.27	1.562	5.38	Sunflower
16	1	Avena	27162	0.0451	127898	75701116	348459	58158868	11.85	1.150	5.27	Oats
17	21	Fava, favino e favetta	22277	0.0370	119854	62341217	231180	56003908	11.10	0.954	5.46	Fava, Small Fava and Field Beans
18	272	Nocciolo	18156	0.0302	81612	414337268	132283	410821230	7.56	2.445	2.68	Hazelnut Tree
19	313	Arancio	26122	0.0434	72175	402302255	1193820	402302255	6.69	0.995	3.48	Orange Tree
20	156	Pomodoro da industria	9295	0.0154	67705	495706515	4624333	495388646	6.27	0.558	5.40	Processing Tomato
21	18	Cece	11944	0.0198	58531	45074747	87716	44390065	5.42	0.804	6.20	Chickpea
22	286	Melo	25257	0.0420	58400	786826613	2179524	786133708	5.41	2.193	3.76	Apple Tree
23	294	Pesco	22138	0.0368	49843	363873001	822065	362417217	4.62	0.870	4.64	Peach Tree
24	177	Loietto	7859	0.0131	44905	37388133	333169	19003586	4.16	0.529	4.77	Ryegrass
25	46	Barbabietola da zucchero	5849	0.0097	43301	100829756	2459177	100713359	4.01	0.217	6.02	Sugar Beet
26	407	Altre foraggere	10231	0.0170	41138	21627922	240187	13837902	3.81	1.115	4.12	Other Forage Crops
27	452	Trifoglio alessandrino	3970	0.0066	40410	21710578	118718	20664917	3.74	0.217	5.73	Alexandrian Clover
28	270	Castagno	13050	0.0217	40082	145782416	89220	145647362	3.71	0.717	3.48	Chestnut Tree
29	149	Patata comune	16422	0.0273	28557	277674535	999354	277545056	2.65	0.536	5.57	Common Potato
30	29	Altre leguminose da granella	5349	0.0089	28072	14341885	37974	13435586	2.60	1.354	5.52	Other Grain Legumes
31	25	Pisello secco	4851	0.0081	26767	19549279	72938	18133913	2.48	0.367	6.36	Dry Pea
32	301	Actinidia (Kiwi)	9086	0.0151	26322	282227853	388504	282227853	2.44	0.404	4.78	Kiwi
33	324	Vite per uva da tavola	8861	0.0147	26023	327620848	560278	326395465	2.41	0.369	4.31	Vine for Table Grapes
34	147	Melone o popone	6955	0.0116	24253	251878907	548520	251878907	2.25	0.231	6.32	Melon or Cantaloupe

Table 34. Crop representativeness results for Italy

This table illustrates the results obtained by sorting the individual crops following a total cultivated area criterion. Other metrics related to each individual crops are also available, including the total productions in tons expressed through the variable Sales Quantity, the average percentage of the total cultivated area of a holding when the crop is present, expressed with average area, or how many crops are typically combined by farmers when they cultivate a given crop.

6.2.2 Crop grouping decisions for Italian use case

With the results shown for individual crops, a specific crop grouping plan for the Italian use case has been designed.

Cereals product groups have been created to encompass all similar cereal crops due to their high representativeness, similar features, and comparable production methods and agricultural practices. The product group began with wheat, but all other cereals (excluding maize) have been included to build up this group.

Olive has its own product group. Its unique features considering that it is a permanent crop and its high presence linked to a high economic indicators support the creation of a specific product group for olive related crops.

Protein crops group is a distinct product group characterized by nitrogen-fixing crops. It is essential to create at least one product group with this feature for each use case because the simulation engine needs to recognize it in order to run the models. Therefore, this decision is not based on macro indicators but rather on the requirement for proper execution. Soybean, sunflower, beans, chickpeas flax or lentils are some of the examples of crops included.

Maize accounts with its own product group. The total cultivated area destined linked to the multiple usages that this crop may have (production of grain or silage) poses a feature for its distinction from other cereals.

Grazing is the product group that encompasses pastures in all their various forms. Their main purposes of the individual crops composing the group is to serve as livestock feed.

Alfalfa is an individual crop similar to maize considering the general features that characterize a product group in Agricore, but with the addition of being a nitrogen-fixing crop. Although it is linked to a single induvial crop, it has no negligible cultivated area and economic indicators.

Industrial is a product group that encompasses crops that are primarily cultivated for their industrial applications rather than for direct human consumption. They are mainly cultivated for their material properties, which make them suitable to be transformed into food or industrial products through complex and specialized industrial processes. Processing tomato, sugar beet or potatoes are some of the crops included.

Forage product group comprises crops specifically cultivated to provide feed for livestock. These crops are distinguished by their exceptional nutritional value and play a crucial role in enhancing animal productivity, creating a direct relationship with livestock production. The crops within this group share common processing techniques, primarily aimed at preserving them for longer periods. Additionally, some forage crops can be incorporated into rotation agriculture, allowing farmers to combine them with other arable crops.

Other group encompasses all minority, low-presence or no aligned with the use case purposes crops. In this crops, low-representative crops are predominant, although the aggregated figures overcome other main product groups. Here, it highlights the presence of vine crops due their strong weight on the economic development of the agricultural sector in the region. Although the conditions of Emilia-Romagna are particularly suitable for the cultivation of vine due to mediterranean climatic conditions, the soil quality and other circumstances, it is not a crop aligned with the purposes of this use case despite the impressive figures shown regarding economic indicators. For this reason, vine related crops have been included within the other product group.

This is the final composition of the product groups for the Italian use case:

#	Product group	Abbreviation	Description
1	Olive	OLIV	Olive tree and all its varieties and derived products
2	Cereals	CER	All kind of cereals, including maize, wheat, rice, rye, barley…
3	Maize	MAIZE	Maize crop for different purposes, including the production of grain and livestock food as fodder
4	Grazing	GRAZ	All crops that can be used as fodder or as feed for livestock, including pasture, meadows, rough grazing, green maize and plants harvested green.
5	Alfalfa	ALFA	Alfalfa crop, which is commonly used as high-quality feed for livestock due to its high protein content.
6	Industrial	INDUSTRIAL	Crops grown for industrial uses.
7	Protein crops	PROT	Agricultural plants that are cultivated for their high protein content including lentils, chickpeas, beans… Crops that serve as nitrogen-fixing.
8	Forage	FRG	Crops grown specifically for grazing by livestock or for harvesting as hay or silage to feed animals

9	Other	OTHER	Group of crops with low representativeness or without a relevant impact on the use case study. Grapes, wooded area, flowers,

Table 35. Italy crops grouping

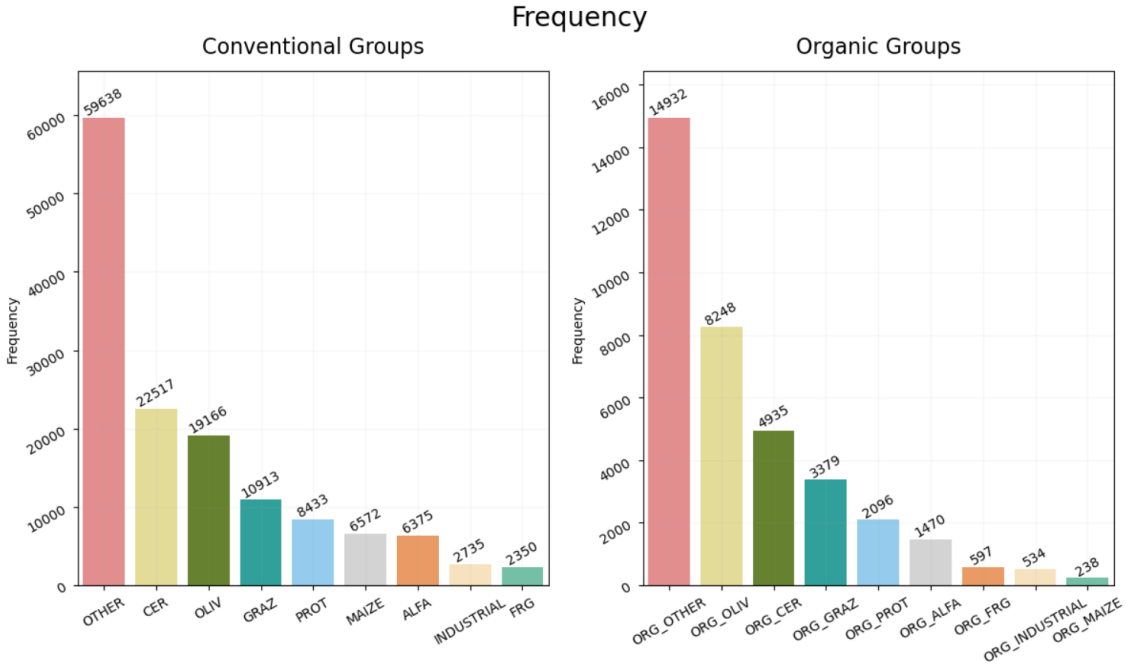

Figure 112. Italy crop grouping result: frequency

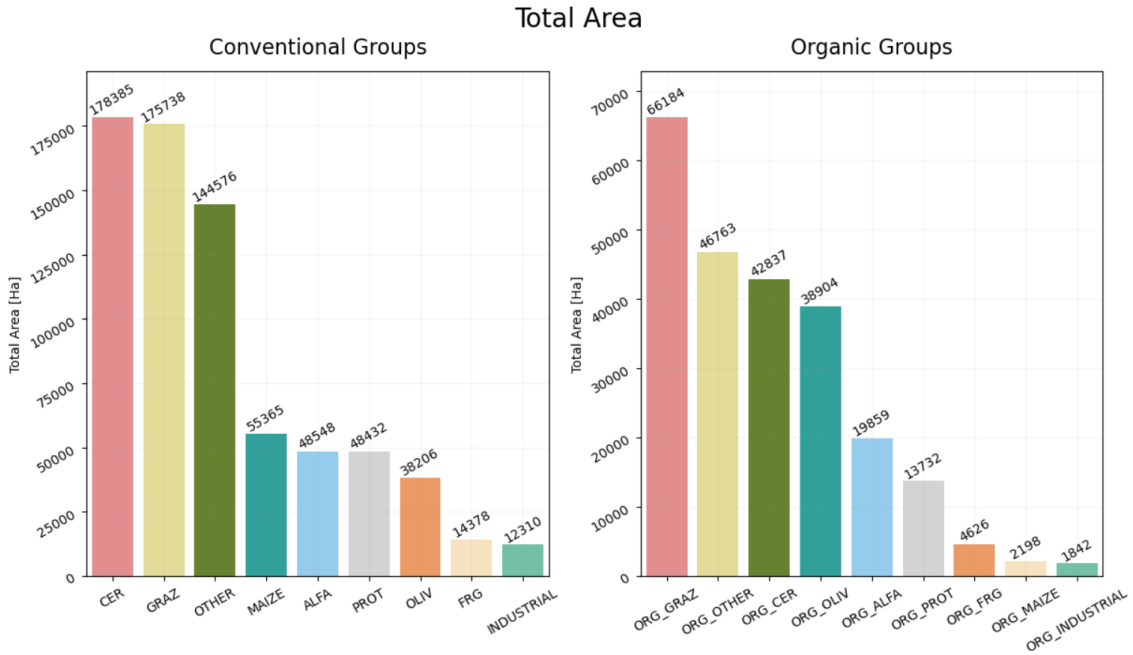

Figure 113. Italy crop grouping result: total area

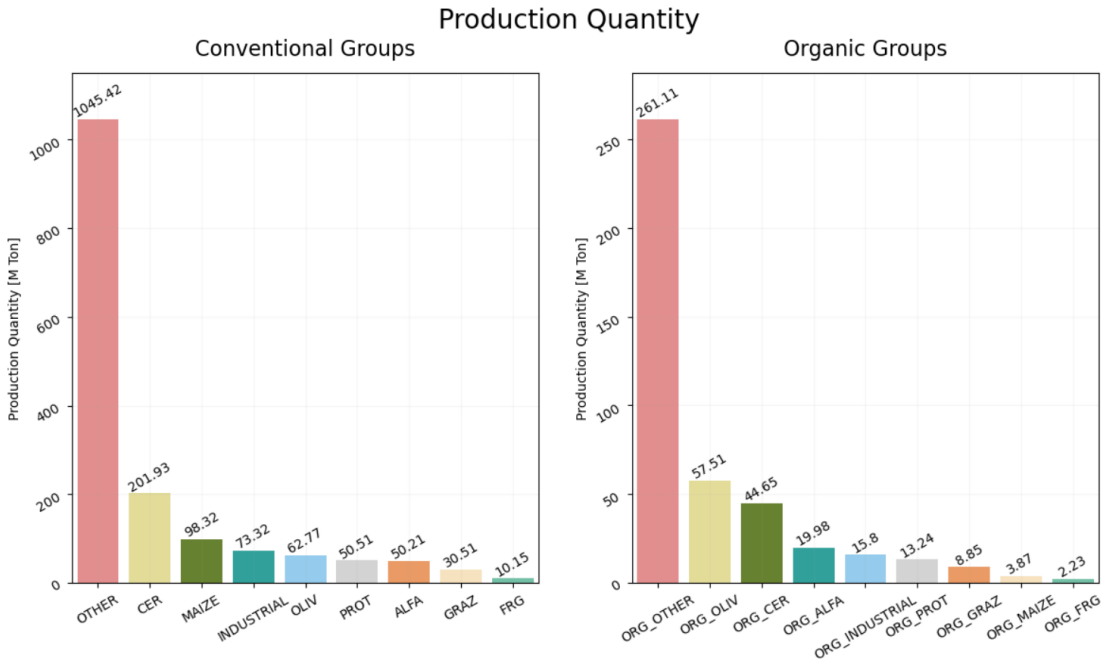

Figure 114. Italy crop grouping result: production quantity

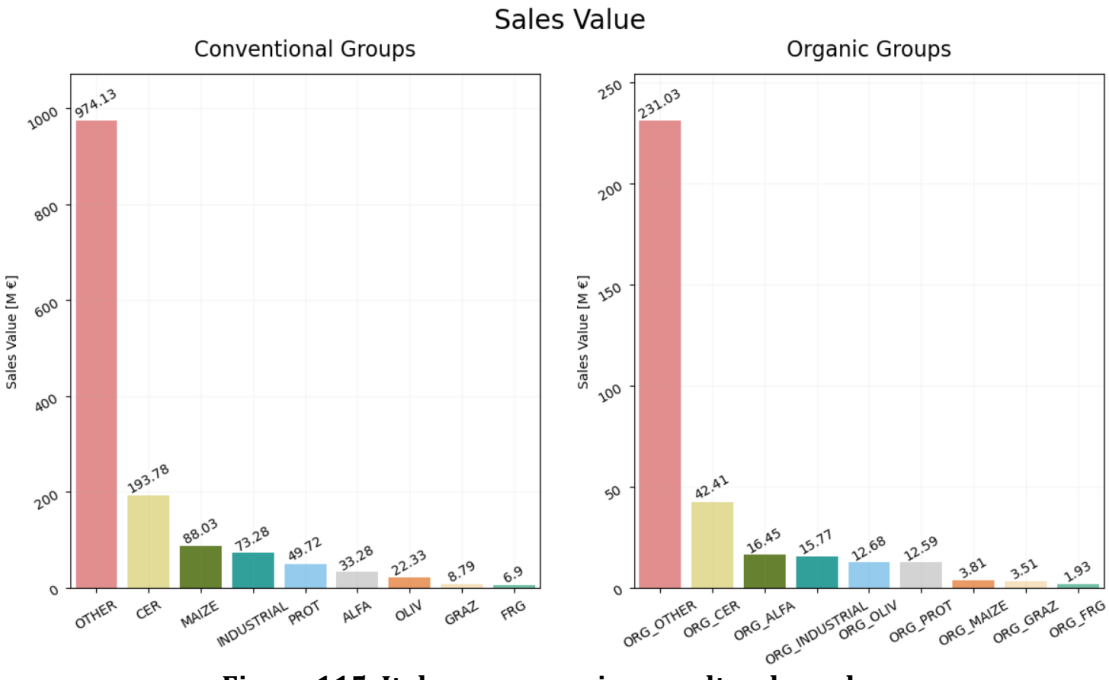

Figure 115. Italy crop grouping result: sales value

This is the result of the crops grouping for the Italian use case. Overall, the group other occupies the first position for all the indicators. Although when speaking about cultivated area or frequency of appearance the difference with other crops is not exacerbated, what refers to productions and economic indicators do: in this case, it is about one order of magnitude higher. Basically this is due to the large number of individual crops aggregated under the product group other. Specifically 136 individual crops have been included for this denomination, among which, the vine related crops. This is specially important considering the high contribution to economic indicators of these kind of crops.

Setting aside this group, the remaining product groups are quite balanced, considering the diversity arising from the range of crop species. This trend is hold also for organic

production, which reflect a similar structure than conventional production but with a lower scale.

According to these results, the following tables summarizes the linkage between individual crops and the product group assigned.

	RICA Code	Description	Group
0	175	Alfalfa	ALFA
1	1	Oats	CER
2	11	Rice	CER
3	13	Rye / Rye Wheat	CER
4	17	Other Grain Cereals	CER
5	2	Spelt	CER
6	3	Durum Wheat	CER
7	4	Soft Wheat	CER
8	9	Barley	CER
9	177	Ryegrass	FRG
10	178	Sainfoin	FRG
11	180	Young Corn	FRG
12	181	Hedysarum	FRG
13	182	Ladino Clover	FRG
14	183	Red Clover	FRG
15	23	Lupin	FRG
16	407	Other Forage Crops	FRG
17	452	Alexandrian Clover	FRG
18	212	Pasture	GRAZ
19	213	Generic Permanent Pasture	GRAZ
20	214	Uncultivated Productive Pastures	GRAZ
21	215	Permanent Pasture	GRAZ
22	112	Sweet Potato	INDUSTRIAL
23	149	Common Potato	INDUSTRIAL
24	156	Processing Tomato	INDUSTRIAL
25	46	Sugar Beet	INDUSTRIAL
26	6	Hybrid Corn	MAIZE
27	327	Olive tree for olives for oil	OLIV
28	328	Olive Tree for Table Olives	OLIV
29	102	Thyme	OTHER
30	104	Saffron	OTHER
31	105	Other Aromatic, Medicinal and Herbal Plants	OTHER
32	107	Garlic	OTHER
33	110	Asparagus	OTHER
34	111	Basil	OTHER
35	113	Leafy Chard	OTHER
36	114	Beetroot Chard	OTHER
37	115	Broccoli Rabe	OTHER
38	117	Artichoke	OTHER
39	118	Thistle	OTHER
40	119	Carrot	OTHER
41	120	Cauliflower	OTHER
42	122	Broccoli	OTHER
43	123	Cabbage	OTHER
44	124	Brussels Sprout	OTHER
45	125	Kohlrabi	OTHER
46	126	Red Cabbage	OTHER
47	127	Savoy Cabbage	OTHER
48	129	Cucumber	OTHER
49	130	Chicory	OTHER
50	131	Chicory Endive	OTHER
51	132	Onion	OTHER
52	133	Watermelon	OTHER
53	138	Fennel	OTHER
54	139	Strawberry	OTHER
55	141	Smooth Endive	OTHER
56	142	Curly Endive	OTHER
57	143	Lettuce Salad	OTHER
58	144	Little Lettuce	OTHER
59	145	Sweet Corn	OTHER
60	146	Eggplant	OTHER
61	147	Melon or Cantaloupe	OTHER
62	150	Seed Potato	OTHER
63	151	Early Potato	OTHER
64	152	Chili Pepper	OTHER
65	153	Bell Pepper	OTHER
66	154	Snap Peas or Snow Peas	OTHER
67	155	Shelled Pea	OTHER
68	157	Fresh Tomato	OTHER
69	158	Leek	OTHER
70	159	Parsley	OTHER
71	160	Radicchio	OTHER
72	161	Turnip	OTHER
73	162	Radish	OTHER
74	163	Agretti (Salsola Soda)	OTHER
75	164	Shallot	OTHER
76	165	Escarole	OTHER
77	166	Arugula	OTHER
78	168	Celery	OTHER
79	170	Spinach	OTHER
80	171	Pumpkin	OTHER
81	172	Zucchini	OTHER
82	173	Other Vegetables	OTHER
83	185	Vetch	OTHER
84	230	Cyclamen	OTHER
85	231	Chrysanthemum	OTHER
86	235	Eucalyptus	OTHER
87	238	Carnations	OTHER
88	239	Geranium	OTHER
89	242	Lily	OTHER
90	243	Broom Plant	OTHER
91	244	Gladiolus	OTHER
92	249	Orchid	OTHER
93	25	Dry Pea	OTHER
94	250	Hydrangea	OTHER
95	259	Poinsettia (Christmas Star)	OTHER
96	262	Roses	OTHER
97	270	Chestnut Tree	OTHER
98	272	Hazelnut Tree	OTHER
99	273	Walnut	OTHER
100	276	Apricot Tree	OTHER
101	278	Cherry Tree	OTHER
102	280	Fig	OTHER
103	281	Fruit in General	OTHER
104	284	Raspberry	OTHER
105	285	Persimmon	OTHER
106	286	Apple Tree	OTHER
107	288	Blueberry	OTHER
108	289	Blackberry	OTHER
109	290	Common Medlar	OTHER
110	292	Nectarine	OTHER
111	294	Peach Tree	OTHER
112	295	Currant	OTHER
113	298	Plum Tree	OTHER
114	300	Sour Cherry	OTHER
115	301	Kiwi	OTHER
116	308	Prickly Pear	OTHER
117	313	Orange Tree	OTHER
118	315	Bergamot	OTHER
119	318	Clementine and Its Hybrids	OTHER

Table 36. Italy use case: crop grouping results (1)

	RICA Code	Description	Group
120	321	Lemon	OTHER
121	322	Mandarin	OTHER
122	324	Vine for Table Grapes	OTHER
123	325	Vine for quality wine	OTHER
124	326	Vine for Common Wine	OTHER
125	329	Citrus Nursery	OTHER
126	330	Flower Nursery	OTHER
127	331	Forest Nursery	OTHER
128	332	Fruit Tree Nursery	OTHER
129	333	Olive Tree Nursery	OTHER
130	334	Vegetable Nursery	OTHER
131	335	Aromatic, Medicinal, and Herbal Plant Nursery	OTHER
132	336	Vine Nursery	OTHER
133	337	Mixed Nursery	OTHER
134	338	Other Nurseries	OTHER
135	345	Other Farm Crops	OTHER
136	346	Resting Land without Aid	OTHER
137	37	Peanut	OTHER
138	398	Other Flowering Plants	OTHER
139	400	Succulents in General	OTHER
140	402	Other Ornamental Plants	OTHER
141	404	Resting Land with Aid	OTHER
142	45	Other Oil Plants	OTHER
143	457	Coriander	OTHER
144	53	Tobacco	OTHER
145	54	Other Industrial Plants	OTHER
146	58	Dill	OTHER
147	62	Wormwood	OTHER
148	66	Chamomile	OTHER
149	84	Lavender	OTHER
150	89	Mint	OTHER
151	92	Oregano	OTHER
152	93	Passionflower	OTHER
153	97	Rosemary	OTHER
154	99	Sage	OTHER
155	135	Green Beans or Snap Beans	PROT
156	136	Shelled Beans	PROT
157	137	Green Fava Bean	PROT
158	176	Fava Beans and Small Fava Beans	PROT
159	18	Chickpea	PROT
160	20	Dry Bean	PROT
161	21	Fava, Small Fava and Field Beans	PROT
162	22	Lentil	PROT
163	26	Soybean	PROT
164	29	Other Grain Legumes	PROT
165	30	Hemp	PROT
166	34	Flax	PROT
167	38	Rapeseed	PROT
168	39	Sunflower	PROT

Table 37. Italy use case: crop grouping results (2)

6.3 Building of the synthetic population

This section contains the details about the generation of the synthetic population for the Italian use case. This use case considers the accountancy year 2019. According to Eurostat information, the total number of farms contained in Emilia-Romagna for the year 2019 was close to 52000 farms. This value slightly differs from microdata indicators, as the total number of real farms represented is the sum of the weights associated to each farm in the data sample, expressing a value of 42547. The variation is due to the misrepresentation of some economic sizes in the data sample. Despite this variation, the number of farms generated will be equal to the number of farms expressed by the microdata sample, as it is not possible to generate virtual farms that mimic real unrepresented entities. Essentially, the features that characterize this kind of farms and unknown, so generation module is not able to learn the data insights and variables interrelationships.

6.3.1 Generation of synthetic data to solve data unavailability

For this use case, data unavailability was a minor issue. In this case, all the agent features were available in microdata. The RICA dataset, being both extensive and granular, provided a diverse set of high-resolution farming attributes, offering a detailed and comprehensive representation of agricultural practices. Consequently, these unique features serve to map the information that would be useful when defining the agent parameters. As example, unlike FADN dataset, RICA dataset did contain a higher geospatial resolution level, so all agent geospatial variables were known beforehand without the necessity of performing merge operations.

6.3.2 Use-case's population-specific assumptions

The primary assumption in this use case relates to the farms represented in the main data source and, consequently, their economic sizes. It is assumed that some farms are not included in the synthetic population generated. Nevertheless, the economic, crop production, and livestock indicators closely align with the totals published by official sources [16]. This suggests that the missing farms primarily affect the total farm count in the population, while their influence on other agricultural indicators is minimal or negligible. Therefore, the decision to rely solely on known farming structures based on available data is expected to produce more accurate results. Attempting to artificially inflate the population by inventing additional farm structures could introduce unrealistic behaviors, leading to poor simulation performance and unreliable outcomes.

This use case as the other use cases composing the project also accounts with some assumptions related to the greening area. As in other examples, a variable portion of land amounting to 5% or less is accounted for greening practices if the holding qualifies for the greening subsidy. This area destined to greening practices is only taken from the crops characterized as Nitrogen fixing.

6.4 Analysis and verification of the synthetic population

This section contains the synthetic population evaluation performed for the Italian use case. Here, results are presented to provide an objective indicator about the goodness of shape of the synthetic population generated. Methods and tools applied to perform such labor are described in section Techniques to compare and assess synthetic population fidelity. The complete synthetic population evaluation is composed of three different outcomes well-differentiated alongside this section.

6.4.1 Report on the generated population probability distribution vs the sample one

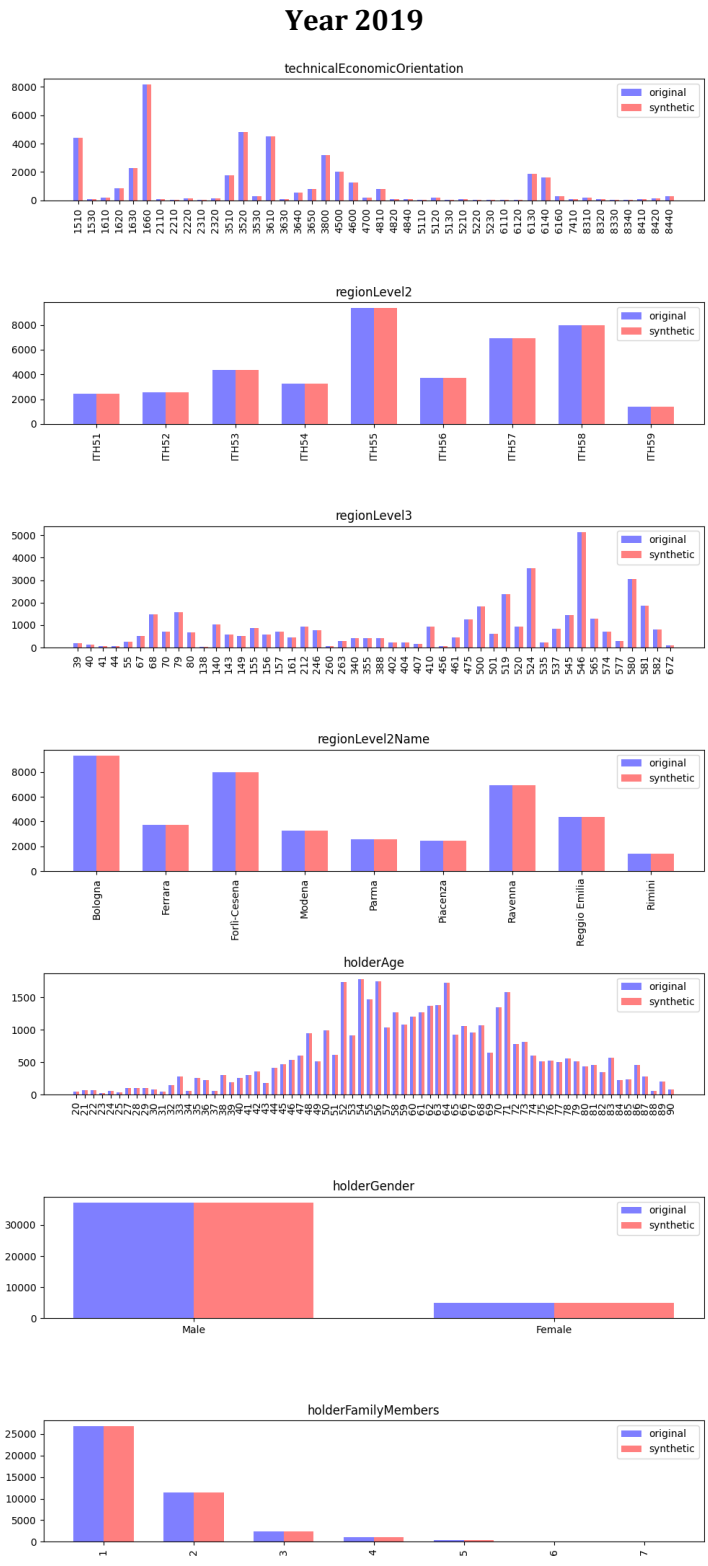

Figure 116. Comparison of Categorical Variables for the Italian Use Case 2019

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
500.value	0.0	0.0	5430.95	5540.03	432132.0	432133.0	16911.554	17331.168	0.07	0.07	0.641	Similar	0.958	Similar	0.0001	0.0025
501.value	0.0	0.0	1614.82	1591.11	45113.0	45114.3	4565.426	4506.007	0.692	0.692	0.964	Similar	1.0	Similar	0.0003	0.0041
516.value	0.0	0.0	33.64	35.1	2407.0	2407.8	178.713	186.976	0.932	0.932	0.999	Similar	1.0	Similar	0.0001	0.003
517.value	0.0	0.0	65.46	79.87	52773.0	52773.6	1474.269	1703.308	0.977	0.977	1.0	Similar	1.0	Similar	0.0001	0.0019
518.value	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
520.value	0.0	0.0	24.58	26.69	15334.0	15335.2	493.994	535.344	0.996	0.996	1.0	Similar	1.0	Similar	0.0001	0.0024
521.value	0.0	0.0	532.34	549.02	29220.0	29221.4	2353.101	2437.382	0.909	0.909	1.0	Similar	1.0	Similar	0.0002	0.0038
522.value	0.0	0.0	128.25	133.4	12552.0	12552.7	958.004	994.741	0.972	0.972	1.0	Similar	1.0	Similar	0.0002	0.0032
523.value	0.0	0.0	4.6	4.59	586.0	587.0	32.081	32.25	0.955	0.955	1.0	Similar	1.0	Similar	0.0005	0.0056
ALFA.cropProduction	0.0	0.0	5445.16	5411.8	174300.0	174300.0	15460.602	15200.401	0.662	0.662	0.505	Similar	0.963	Similar	0.0008	0.007
ALFA.cultivatedArea	0.0	0.0	4.34	4.36	233.9	234.9	12.874	12.974	0.66	0.66	0.431	Similar	0.997	Similar	0.0002	0.0038
ALFA.irrigatedArea	0.0	0.0	0.98	0.95	104.2	104.2	6.315	6.108	0.957	0.951	0.505	Similar	0.144	Similar	0.0062	0.0185
ALFA.quantitySold	-53.0	-53.0	39.52	36.51	1660.0	1660.0	120.546	115.111	0.681	0.689	0.0	Different	0.0	Different	0.0034	0.014
ALFA.quantityUsed	0.0	0.0	10.43	13.44	1321.9	1321.9	70.64	70.986	0.935	0.907	0.0	Different	0.0	Different	0.006	0.0203
ALFA.sellingPrice	0.0	0.0	36.54	36.42	464.6	465.9	56.306	55.928	0.681	0.681	0.0	Different	0.029	Different	0.0019	0.0099
ALFA.valueSales	-5370.0	-5370.0	4394.95	4029.78	174300.0	174300.0	13381.353	12795.14	0.68	0.689	0.0	Different	0.0	Different	0.0031	0.0139
CER.cropProduction	0.0	0.0	8298.73	8164.87	395260.0	395260.0	21059.702	20912.341	0.497	0.499	0.026	Different	0.262	Similar	0.0006	0.0059
CER.cultivatedArea	0.0	0.0	6.22	6.2	206.7	207.5	14.712	14.743	0.497	0.497	0.002	Different	0.492	Similar	0.0009	0.0076
CER.irrigatedArea	0.0	0.0	0.51	0.49	100.1	100.1	4.356	4.315	0.969	0.973	0.778	Similar	0.269	Similar	0.0008	0.0081
CER.quantitySold	-0.1	-0.1	36.47	35.25	1214.5	1214.5	85.708	85.073	0.503	0.522	0.0	Different	0.0	Different	0.0011	0.0084
CER.quantityUsed	0.0	0.0	0.9	1.76	202.1	202.1	8.563	12.552	0.964	0.937	0.0	Different	0.0	Different	0.0078	0.0239
CER.sellingPrice	0.0	0.0	108.62	108.56	535.0	536.5	112.806	112.793	0.503	0.503	0.009	Different	0.571	Similar	0.0026	0.0126
CER.valueSales	-20.0	-20.0	8130.64	7834.41	395260.0	395260.0	20850.6	20664.202	0.503	0.522	0.0	Different	0.0	Different	0.0005	0.0054
DAIRY.dairyCows	0.0	0.0	5.27	5.36	413.0	413.0	30.115	29.438	0.932	0.92	0.004	Different	0.0	Different	0.0009	0.0076
DAIRY.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.manureTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.milkProductionSold	0.0	0.0	24.04	24.32	2728.4	2728.4	152.182	145.856	0.932	0.92	0.004	Different	0.0	Different	0.0002	0.0036
DAIRY.milkTotalProduction	0.0	0.0	28.9	29.28	2970.0	2970.0	178.712	171.641	0.932	0.92	0.004	Different	0.0	Different	0.0003	0.0044
DAIRY.milkTotalSales	0.0	0.0	17851.53	17283.61	1983052.0	1983052.0	106491.842	102114.976	0.887	0.918	0.0	Different	0.0	Different	0.0004	0.0051
DAIRY.numberAnimalsForSlaughtering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.numberAnimalsRearingBreading	0.0	0.0	3.63	3.27	257.2	257.2	18.275	16.869	0.887	0.888	0.167	Similar	0.965	Similar	0.001	0.0078
DAIRY.numberOfAnimals	0.0	0.0	8.9	8.63	544.3	545.2	45.081	43.793	0.887	0.887	0.99	Similar	1.0	Similar	0.001	0.008
DAIRY.numberOfAnimalsSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.valueAnimalsRearingBreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.valueSlaughteredAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.valueSoldAnimals	0.0	0.0	14258.18	14145.06	1865959.0	1865959.6	91991.304	91061.574	0.924	0.924	1.0	Similar	1.0	Similar	0.0001	0.0018
DAIRY.variableCostsAnimals	0.0	0.0	18.92	21.89	3100.2	3100.2	120.134	119.75	0.932	0.919	0.002	Different	0.0	Different	0.0017	0.0107
DAIRY.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
DAIRY.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
FRG.cropProduction	0.0	0.0	790.93	799.32	147600.0	147600.0	5659.894	5625.641	0.938	0.939	0.999	Similar	1.0	Similar	0.0009	0.0077
FRG.cultivatedArea	0.0	0.0	0.54	0.55	107.8	108.1	3.753	3.782	0.938	0.938	0.988	Similar	1.0	Similar	0.0003	0.0047
FRG.irrigatedArea	0.0	0.0	0.29	0.31	107.8	107.8	3.11	3.112	0.973	0.972	0.997	Similar	0.999	Similar	0.0005	0.0055
FRG.quantitySold	0.0	0.0	11.37	10.39	2000.0	2000.0	94.523	89.783	0.95	0.954	0.859	Similar	0.492	Similar	0.0007	0.0065
FRG.quantityUsed	0.0	0.0	3.22	4.56	1690.0	1690.0	54.952	61.062	0.988	0.983	0.6	Similar	0.153	Similar	0.0012	0.0092
FRG.sellingPrice	0.0	0.0	4.11	4.14	160.0	161.1	20.176	20.249	0.95	0.95	1.0	Similar	1.0	Similar	0.0083	0.0244
FRG.valueSales	0.0	0.0	621.0	519.43	89724.0	89724.0	4386.875	4071.851	0.946	0.954	0.175	Similar	0.034	Different	0.0033	0.0119
GRAZ.cropProduction	0.0	0.0	827.11	828.23	67500.0	67500.0	4176.417	4015.442	0.837	0.838	0.001	Different	0.418	Similar	0.0035	0.0148
GRAZ.cultivatedArea	0.0	0.0	0.88	0.89	59.1	60.2	3.935	3.946	0.837	0.837	0.0	Different	0.332	Similar	0.0038	0.0165
GRAZ.irrigatedArea	0.0	0.0	0.03	0.06	17.3	17.3	0.635	0.88	0.997	0.991	0.378	Similar	0.068	Similar	0.0042	0.0186
GRAZ.quantitySold	0.0	0.0	5.16	4.43	400.0	400.0	26.866	25.17	0.863	0.881	0.0	Different	0.0	Different	0.0073	0.0205
GRAZ.quantityUsed	0.0	0.0	3.56	4.74	750.0	750.0	29.327	32.388	0.956	0.942	0.001	Different	0.0	Different	0.0026	0.0133
GRAZ.sellingPrice	0.0	0.0	12.67	12.7	228.9	230.2	33.204	33.349	0.863	0.863	0.03	Different	0.909	Similar	0.008	0.0213
GRAZ.valueSales	0.0	0.0	522.8	436.03	34105.0	34105.0	2949.686	2586.916	0.863	0.881	0.0	Different	0.0	Different	0.0081	0.0214
INDUSTRIAL.cropProduction	0.0	0.0	6098.86	6212.47	363440.0	363440.0	29792.254	30235.994	0.873	0.874	0.959	Similar	1.0	Similar	0.001	0.0079
INDUSTRIAL.cultivatedArea	0.0	0.0	1.47	1.49	67.5	68.8	6.332	6.404	0.873	0.873	0.789	Similar	1.0	Similar	0.0066	0.0225
INDUSTRIAL.irrigatedArea	0.0	0.0	1.13	1.14	67.0	67.0	5.865	5.896	0.916	0.913	0.577	Similar	0.533	Similar	0.0013	0.01
INDUSTRIAL.quantitySold	0.0	0.0	82.53	83.44	4980.0	4980.0	377.727	381.633	0.874	0.874	0.985	Similar	1.0	Similar	0.0004	0.0052
INDUSTRIAL.quantityUsed	0.0	0.0	0.06	0.04	236.6	236.6	3.645	3.26	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0006
INDUSTRIAL.sellingPrice	0.0	0.0	14.55	14.2	1564.3	1565.5	75.705	73.133	0.874	0.874	0.977	Similar	1.0	Similar	0.0001	0.0024
INDUSTRIAL.valueSales	0.0	0.0	6097.12	6202.35	363440.0	363440.0	29792.116	30231.418	0.873	0.874	0.92	Similar	1.0	Similar	0.001	0.0078
MAIZE.cropProduction	0.0	0.0	3598.85	3599.79	262640.0	262640.0	14003.062	13780.562	0.819	0.821	0.794	Similar	0.99	Similar	0.0009	0.0075
MAIZE.cultivatedArea	0.0	0.0	2.14	2.13	156.0	156.6	8.306	8.155	0.819	0.819	0.778	Similar	1.0	Similar	0.0006	0.0061
MAIZE.irrigatedArea	0.0	0.0	1.62	1.61	133.0	133.0	6.938	6.92	0.872	0.876	0.369	Similar	0.51	Similar	0.0007	0.0064
MAIZE.quantitySold	0.0	0.0	19.61	19.07	1500.8	1500.8	78.017	76.726	0.824	0.831	0.118	Similar	0.047	Different	0.0005	0.0054
MAIZE.quantityUsed	0.0	0.0	0.94	1.5	245.3	245.3	12.573	15.64	0.991	0.984	0.252	Similar	0.037	Different	0.0023	0.0129
MAIZE.sellingPrice	0.0	0.0	31.82	31.81	401.5	402.6	69.647	69.605	0.824	0.824	0.001	Different	0.664	Similar	0.0004	0.0051
MAIZE.valueSales	0.0	0.0	3461.91	3369.67	262640.0	262640.0	13677.146	13436.507	0.824	0.831	0.118	Similar	0.046	Different	0.0006	0.006
OLIV.cropProduction	0.0	0.0	79.78	97.48	10200.0	10200.0	521.043	606.74	0.94	0.941	0.442	Similar	0.988	Similar	0.0034	0.015
OLIV.cultivatedArea	0.0	0.0	0.05	0.05	4.8	5.6	0.294	0.309	0.939	0.939	0.143	Similar	0.989	Similar	0.0158	0.0337
OLIV.irrigatedArea	0.0	0.0	0.0	0.0	0.3	0.3	0.013	0.016	0.998	0.997	1.0	Similar	1.0	Similar	0.0003	0.0043
OLIV.quantitySold	0.0	0.0	0.07	0.08	8.8	8.8	0.516	0.617	0.954	0.955	0.84	Similar	1.0	Similar	0.0049	0.018
OLIV.quantityUsed	0.0	0.0	0.05	0.05	13.6	13.6	0.547	0.608	0.986	0.986	1.0	Similar	1.0	Similar	0.0011	0.008
OLIV.sellingPrice	0.0	0.0	33.66	33.85	1090.0	1091.2	158.104	158.882	0.954	0.954	0.997	Similar	1.0	Similar	0.0054	0.0214
OLIV.valueSales	0.0	0.0	49.6	61.23	6688.0	6688.0	368.761	442.89	0.954	0.955	0.789	Similar	1.0	Similar	0.0046	0.0176

Table 38. Statistical results: Italy 2019 (sheet 1)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
ORG_ALFA.cropProduction	0.0	0.0	3942.69	3832.63	2792008.0	2792008.0	77899.183	75539.346	0.921	0.921	1.0	Similar	1.0	Similar	0.0	0.0008
ORG_ALFA.cultivatedArea	0.0	0.0	3.05	2.97	1754.0	1755.2	49.575	48.134	0.921	0.921	1.0	Similar	1.0	Similar	0.0	0.0011
ORG_ALFA.irrigatedArea	0.0	0.0	0.12	0.12	50.5	50.5	2.144	2.052	0.995	0.995	1.0	Similar	1.0	Similar	0.0001	0.0021
ORG_ALFA.quantitySold	-22.4	-22.4	28.06	26.79	21040.0	21040.0	585.895	568.075	0.926	0.931	0.442	Similar	0.089	Similar	0.0	0.001
ORG_ALFA.quantityUsed	0.0	0.0	4.7	5.27	1900.0	1900.0	53.379	54.362	0.968	0.966	0.97	Similar	0.866	Similar	0.0004	0.0054
ORG_ALFA.sellingPrice	0.0	0.0	7.83	7.84	150.0	151.2	28.273	28.32	0.926	0.926	0.606	Similar	1.0	Similar	0.0029	0.0132
ORG_ALFA.valueSales	-2400.0	-2400.0	3456.99	3289.72	2792008.0	2792008.0	77650.114	75281.76	0.926	0.931	0.338	Similar	0.087	Similar	0.0	0.0007
ORG_CER.cropProduction	0.0	0.0	1579.89	1451.18	820374.0	820374.0	23819.315	21674.882	0.928	0.929	0.984	Similar	0.997	Similar	0.0	0.001
ORG_CER.cultivatedArea	0.0	0.0	1.2	1.11	517.7	519.0	15.314	13.989	0.928	0.928	0.687	Similar	1.0	Similar	0.0	0.0014
ORG_CER.irrigatedArea	0.0	0.0	0.06	0.06	22.5	22.5	1.001	0.948	0.996	0.995	1.0	Similar	1.0	Similar	0.0006	0.007
ORG_CER.quantitySold	0.0	0.0	6.72	5.98	3589.0	3589.0	104.051	94.605	0.929	0.934	0.664	Similar	0.184	Similar	0.0001	0.0024
ORG_CER.quantityUsed	0.0	0.0	0.18	0.29	56.3	56.3	2.574	3.104	0.989	0.985	0.388	Similar	0.307	Similar	0.0032	0.0157
ORG_CER.sellingPrice	0.0	0.0	16.55	16.63	404.0	405.2	61.948	62.099	0.929	0.929	0.949	Similar	1.0	Similar	0.0023	0.0134
ORG_CER.valueSales	0.0	0.0	1548.43	1389.23	820374.0	820374.0	23807.278	21650.395	0.929	0.934	0.664	Similar	0.186	Similar	0.0001	0.0022
ORG_FRG.cropProduction	0.0	0.0	416.4	374.52	298173.0	298173.0	9191.742	8982.455	0.992	0.992	1.0	Similar	1.0	Similar	0.0002	0.0033
ORG_FRG.cultivatedArea	0.0	0.0	0.3	0.29	257.4	258.5	7.506	7.474	0.992	0.992	1.0	Similar	1.0	Similar	0.0003	0.0051
ORG_FRG.irrigatedArea	0.0	0.0	0.28	0.25	257.4	257.4	7.466	7.417	0.996	0.997	1.0	Similar	1.0	Similar	0.0001	0.0022
ORG_FRG.quantitySold	-2.6	-2.6	15.15	13.94	14198.7	14198.7	410.188	408.564	0.993	0.993	1.0	Similar	1.0	Similar	0.0001	0.0025
ORG_FRG.quantityUsed	0.0	0.0	0.05	0.07	72.6	72.6	1.749	2.123	0.999	0.999	1.0	Similar	1.0	Similar	0.0001	0.0023
ORG_FRG.sellingPrice	0.0	0.0	0.62	0.62	140.1	141.2	7.882	7.975	0.993	0.993	1.0	Similar	1.0	Similar	0.0004	0.0055
ORG_FRG.valueSales	-185.0	-185.0	411.4	367.15	298173.0	298173.0	9190.388	8980.377	0.993	0.993	1.0	Similar	1.0	Similar	0.0002	0.0033
ORG_GRAZ.cropProduction	0.0	0.0	595.1	606.39	149800.0	149800.0	4913.167	4868.441	0.931	0.931	1.0	Similar	1.0	Similar	0.0009	0.008
ORG_GRAZ.cultivatedArea	0.0	0.0	0.92	0.89	270.2	271.2	7.348	7.137	0.929	0.929	0.99	Similar	1.0	Similar	0.0002	0.0037
ORG_GRAZ.irrigatedArea	0.0	0.0	0.04	0.03	10.2	10.2	0.57	0.545	0.994	0.995	1.0	Similar	1.0	Similar	0.0016	0.0117
ORG_GRAZ.quantitySold	0.0	0.0	4.34	4.24	757.7	757.7	34.476	33.779	0.943	0.945	1.0	Similar	0.965	Similar	0.0003	0.0039
ORG_GRAZ.quantityUsed	0.0	0.0	1.9	2.11	780.3	780.3	21.237	22.084	0.969	0.967	0.999	Similar	0.981	Similar	0.0014	0.0098
ORG_GRAZ.sellingPrice	0.0	0.0	4.78	4.77	150.0	152.7	20.174	20.179	0.943	0.943	0.606	Similar	1.0	Similar	0.0546	0.0538
ORG_GRAZ.valueSales	0.0	0.0	422.12	410.94	73800.0	73800.0	3501.852	3425.267	0.943	0.945	1.0	Similar	0.965	Similar	0.0003	0.0041
ORG_INDUSTRIAL.cropProduction	0.0	0.0	1023.12	967.51	630468.0	630468.0	22439.031	21813.181	0.989	0.99	1.0	Similar	1.0	Similar	0.0	0.0015
ORG_INDUSTRIAL.cultivatedArea	0.0	0.0	0.19	0.18	96.6	97.9	3.817	3.663	0.989	0.989	1.0	Similar	1.0	Similar	0.0004	0.006
ORG_INDUSTRIAL.irrigatedArea	0.0	0.0	0.19	0.17	96.6	96.6	3.817	3.654	0.995	0.995	1.0	Similar	1.0	Similar	0.0002	0.0041
ORG_INDUSTRIAL.quantitySold	0.0	0.0	12.64	11.51	8269.9	8269.9	275.431	258.409	0.989	0.99	1.0	Similar	1.0	Similar	0.0	0.0017
ORG_INDUSTRIAL.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_INDUSTRIAL.sellingPrice	0.0	0.0	1.31	1.24	460.0	460.9	16.591	15.6	0.989	0.989	1.0	Similar	1.0	Similar	0.0001	0.0029
ORG_INDUSTRIAL.valueSales	0.0	0.0	1023.12	967.51	630468.0	630468.0	22439.031	21813.181	0.989	0.99	1.0	Similar	1.0	Similar	0.0	0.0015
ORG_MAIZE.cropProduction	0.0	0.0	219.59	212.1	58058.0	58058.0	2970.815	2889.193	0.991	0.992	1.0	Similar	1.0	Similar	0.0001	0.0027
ORG_MAIZE.cultivatedArea	0.0	0.0	0.13	0.12	36.3	37.0	1.709	1.692	0.991	0.991	1.0	Similar	1.0	Similar	0.0032	0.0164
ORG_MAIZE.irrigatedArea	0.0	0.0	0.12	0.12	36.3	36.3	1.708	1.679	0.993	0.993	1.0	Similar	1.0	Similar	0.0011	0.0101
ORG_MAIZE.quantitySold	0.0	0.0	1.15	1.12	296.0	296.0	15.458	15.169	0.991	0.992	1.0	Similar	1.0	Similar	0.0001	0.0019
ORG_MAIZE.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_MAIZE.sellingPrice	0.0	0.0	1.76	1.73	290.0	290.8	19.297	18.94	0.991	0.991	1.0	Similar	1.0	Similar	0.0016	0.0118
ORG_MAIZE.valueSales	0.0	0.0	219.59	212.1	58058.0	58058.0	2970.815	2889.193	0.991	0.992	1.0	Similar	1.0	Similar	0.0001	0.0027
ORG_OLIV.cropProduction	0.0	0.0	44.92	36.53	5800.0	5800.0	377.652	304.776	0.979	0.979	0.995	Similar	1.0	Similar	0.004	0.0152
ORG_OLIV.cultivatedArea	0.0	0.0	0.02	0.02	2.4	3.4	0.172	0.181	0.979	0.979	0.968	Similar	1.0	Similar	0.0221	0.0398
ORG_OLIV.irrigatedArea	0.0	0.0	0.0	0.0	1.9	1.9	0.069	0.06	0.999	0.999	1.0	Similar	1.0	Similar	0.0002	0.0042
ORG_OLIV.quantitySold	0.0	0.0	0.04	0.03	7.5	7.5	0.388	0.328	0.984	0.984	1.0	Similar	1.0	Similar	0.0028	0.0129
ORG_OLIV.quantityUsed	0.0	0.0	0.03	0.02	10.0	10.0	0.432	0.34	0.993	0.994	1.0	Similar	1.0	Similar	0.0014	0.0081
ORG_OLIV.sellingPrice	0.0	0.0	12.95	12.88	1050.0	1051.1	102.382	101.826	0.984	0.984	1.0	Similar	1.0	Similar	0.002	0.0135
ORG_OLIV.valueSales	0.0	0.0	28.93	24.54	5250.0	5250.0	292.638	253.285	0.984	0.984	1.0	Similar	1.0	Similar	0.0028	0.0131
ORG_OTHER.cropProduction	0.0	0.0	5009.48	5105.93	791607.0	791607.0	32958.101	35285.143	0.929	0.93	1.0	Similar	0.994	Similar	0.0005	0.0058
ORG_OTHER.cultivatedArea	0.0	0.0	0.66	0.69	57.5	58.4	3.687	3.743	0.923	0.923	0.612	Similar	1.0	Similar	0.0041	0.0176
ORG_OTHER.irrigatedArea	0.0	0.0	0.2	0.2	30.5	30.5	1.78	1.794	0.971	0.973	1.0	Similar	0.942	Similar	0.0005	0.0057
ORG_OTHER.quantitySold	0.0	0.0	7.67	7.9	800.5	800.5	48.32	51.038	0.934	0.935	1.0	Similar	1.0	Similar	0.0009	0.0075
ORG_OTHER.quantityUsed	0.0	0.0	0.71	0.66	405.0	405.0	13.518	12.763	0.992	0.992	1.0	Similar	1.0	Similar	0.0003	0.0045
ORG_OTHER.sellingPrice	0.0	0.0	65.84	64.47	5141.0	5141.7	353.45	342.135	0.934	0.934	1.0	Similar	1.0	Similar	0.0002	0.0035
ORG_OTHER.valueSales	0.0	0.0	4730.71	4840.53	791607.0	791607.0	32464.579	34868.615	0.934	0.935	0.999	Similar	1.0	Similar	0.0012	0.0087
ORG_PROT.cropProduction	0.0	0.0	252.32	237.03	109648.0	109648.0	3643.097	3383.629	0.979	0.979	1.0	Similar	1.0	Similar	0.0003	0.004
ORG_PROT.cultivatedArea	0.0	0.0	0.19	0.19	66.6	67.2	2.334	2.246	0.979	0.979	1.0	Similar	1.0	Similar	0.0017	0.0115
ORG_PROT.irrigatedArea	0.0	0.0	0.06	0.06	32.5	32.5	1.255	1.286	0.996	0.997	1.0	Similar	1.0	Similar	0.0001	0.0033
ORG_PROT.quantitySold	0.0	0.0	0.66	0.64	251.6	251.6	9.022	8.706	0.979	0.979	1.0	Similar	1.0	Similar	0.0007	0.0073
ORG_PROT.quantityUsed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
ORG_PROT.sellingPrice	0.0	0.0	7.96	7.92	840.0	840.9	59.76	59.464	0.979	0.979	1.0	Similar	1.0	Similar	0.0005	0.0058
ORG_PROT.valueSales	0.0	0.0	252.32	236.89	109648.0	109648.0	3643.097	3383.585	0.979	0.979	1.0	Similar	1.0	Similar	0.0003	0.004
OTHER.cropProduction	0.0	0.0	43625.05	40350.37	1531629.0	1531629.0	108246.326	102191.338	0.339	0.352	0.0	Different	0.0	Different	0.0027	0.0128
OTHER.cultivatedArea	0.0	0.0	5.0	5.0	129.9	131.2	10.421	10.435	0.311	0.311	0.017	Different	0.268	Similar	0.0044	0.0181
OTHER.irrigatedArea	0.0	0.0	2.56	2.47	105.3	105.3	8.491	8.372	0.623	0.629	0.0	Different	0.008	Different	0.0008	0.0071
OTHER.quantitySold	0.0	0.0	85.29	81.21	3854.7	3854.7	223.772	216.097	0.352	0.369	0.0	Different	0.0	Different	0.0004	0.005
OTHER.quantityUsed	0.0	0.0	1.08	1.32	322.2	322.2	10.53	12.035	0.967	0.967	0.583	Similar	1.0	Similar	0.0052	0.018
OTHER.sellingPrice	0.0	0.0	465.87	469.22	17912.7	17914.1	894.331	893.698	0.352	0.352	0.544	Similar	0.881	Similar	0.0001	0.0024
OTHER.valueSales	0.0	0.0	43255.38	39925.43	1531629.0	1531629.0	108270.964	102266.988	0.352	0.369	0.0	Different	0.0	Different	0.0029	0.0132
OTHER_LIVESTOCK.dairyCows	0.0	0.0	2.02	1.76	699.0	699.0	30.934	28.342	0.993	0.994	1.0	Similar	1.0	Similar	0.0001	0.0022
OTHER_LIVESTOCK.eggsProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.eggsTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.manureTotalSales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.milkProductionSold	0.0	0.0	0.29	0.24	183.3	183.3	6.999	6.279	0.993	0.994	1.0	Similar	1.0	Similar	0.0	0.0014
OTHER_LIVESTOCK.milkTotalProduction	0.0	0.0	0.4	0.32	235.0	235.0	8.983	8.059	0.993	0.994	1.0	Similar	1.0	Similar	0.0001	0.0021

Table 39. Statistical results: Italy 2019 (sheet 2)

variable	min O	min S	mean O	mean S	max O	max S	std O	std S	ratio 0 O	ratio 0 S	KS p	KS result	CVM p	CVM result	KL Div	JS Div
OTHER_LIVESTOCK.milkTotalSales	0.0	0.0	10597.9	856.07	6545833.0	6545833.0	170908.122	48125.983	0.93	0.99	0.0	Different	0.0	Different	0.0147	0.0236
OTHER_LIVESTOCK.numberAnimalsForSlaughtering	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.numberAnimalsRearingBreading	0.0	0.0	5.11	4.61	2372.1	2372.1	69.789	62.611	0.936	0.936	1.0	Similar	1.0	Similar	0.0001	0.0028
OTHER_LIVESTOCK.numberOfAnimals	0.0	0.0	5.41	4.88	2372.1	2372.9	69.9	62.726	0.93	0.93	0.894	Similar	1.0	Similar	0.0001	0.003
OTHER_LIVESTOCK.numberOfAnimalsSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.valueAnimalsRearingBreading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.valueSlaughteredAnimals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.valueSoldAnimals	0.0	0.0	4288.23	2785.01	7321608.0	7321608.4	126749.027	92198.066	0.96	0.96	1.0	Similar	1.0	Similar	0.0002	0.0037
OTHER_LIVESTOCK.variableCostsAnimals	0.0	0.0	15.64	16.2	6567.6	6567.6	304.075	312.229	0.993	0.994	1.0	Similar	1.0	Similar	0.0001	0.0019
OTHER_LIVESTOCK.woolProductionSold	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
OTHER_LIVESTOCK.woolTotalProduction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
PROT.cropProduction	0.0	0.0	1762.84	1867.26	112948.0	112948.0	7399.86	7711.04	0.83	0.83	0.222	Similar	0.977	Similar	0.0006	0.0063
PROT.cultivatedArea	0.0	0.0	1.19	1.22	78.8	80.0	4.576	4.738	0.83	0.83	0.489	Similar	1.0	Similar	0.0031	0.0147
PROT.irrigatedArea	0.0	0.0	0.5	0.5	55.4	55.4	3.116	3.131	0.933	0.937	0.913	Similar	0.44	Similar	0.0014	0.0102
PROT.quantitySold	-1.6	-1.6	4.58	4.73	451.0	451.0	20.209	21.012	0.831	0.832	0.629	Similar	0.91	Similar	0.0009	0.0076
PROT.quantityUsed	0.0	0.0	0.03	0.06	25.0	25.0	0.875	1.171	0.999	0.997	1.0	Similar	1.0	Similar	0.0006	0.0062
PROT.sellingPrice	0.0	0.0	74.76	73.21	2800.0	2801.4	219.602	211.898	0.831	0.831	0.467	Similar	1.0	Similar	0.0004	0.0051
PROT.valueSales	-440.0	-440.0	1756.17	1840.71	112948.0	112948.0	7399.413	7683.08	0.831	0.832	0.467	Similar	0.942	Similar	0.0005	0.0058
agriculturalLandArea	1.0	0.0	28.55	29.13	1754.0	1755.3	70.339	76.308	0.0	0.0	0.005	Different	0.42	Similar	0.0002	0.0039
agriculturalLandHectaresAdquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
agriculturalLandValue	0.0	0.0	392420.53	417341.52	16199564.0	16199564.0	844071.015	889593.024	0.284	0.263	0.0	Different	0.0	Different	0.0021	0.0116
depreciation	0.0	0.0	6904.51	7261.64	275289.0	275289.0	14824.551	15383.028	0.055	0.056	0.0	Different	0.0	Different	0.0026	0.0126
farmBuildingsValue	0.0	0.0	29686.97	33689.48	4662990.0	4662990.0	142074.31	151395.345	0.587	0.57	0.0	Different	0.0	Different	0.0029	0.0142
farmNetIncome	-164682.0	-164682.0	68347.07	78188.87	2707695.0	2707695.0	141605.171	158490.032	0.0	0.0	0.0	Different	0.0	Different	0.0061	0.0204
fixedAssets	0.0	0.0	47010.75	50640.14	4885634.0	4885634.0	159750.686	168949.227	0.103	0.107	0.0	Different	0.0	Different	0.0026	0.0131
forestLandArea	0.0	0.0	2.48	2.42	260.0	260.0	10.722	10.232	0.777	0.77	0.062	Similar	0.065	Similar	0.0005	0.0055
forestLandValue	0.0	0.0	9972.08	10544.34	1580187.0	1580187.0	77599.057	76943.548	0.867	0.853	0.0	Different	0.0	Different	0.001	0.0081
grossFarmIncome	-213984.0	-213984.0	54617.22	62984.43	1974309.0	1974309.0	109346.131	121459.731	0.0	0.0	0.0	Different	0.0	Different	0.004	0.016
intangibleAssetsNonTradable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
intangibleAssetsTradable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
landImprovements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
longAndMediumTermLoans	0.0	0.0	2440.7	2799.8	1192824.0	1192824.0	46545.856	46479.476	0.995	0.993	1.0	Similar	0.919	Similar	0.0005	0.006
machineryAndEquipment	0.0	0.0	17323.78	16948.62	1087949.0	1087949.0	48991.562	47712.496	0.185	0.191	0.0	Different	0.0	Different	0.0018	0.0101
otherNonCurrentAssets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
otherOutputs	0.0	0.0	9834.68	10338.22	652522.0	652522.0	28277.494	30536.043	0.06	0.055	0.0	Different	0.0	Different	0.0002	0.004
plantationsValue	-111.0	-111.0	15084.85	13213.24	485979.0	485979.0	37835.801	37641.488	0.515	0.583	0.0	Different	0.0	Different	0.0112	0.0255
subsidiesOnInvestments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
taxes	0.0	0.0	1324.47	1494.33	423160.0	423160.0	10614.08	11961.668	0.005	0.005	0.0	Different	0.0	Different	0.0015	0.0096
totalCurrentAssets	0.0	0.0	89112.02	99670.71	3927717.0	3927717.0	181031.249	193853.417	0.028	0.029	0.0	Different	0.0	Different	0.0033	0.0152
totalExternalFactors	-2510.0	-2510.0	21074.95	23771.16	1380650.0	1380650.0	65619.306	74445.342	0.038	0.049	0.0	Different	0.0	Different	0.0016	0.0109
totalIntermediateConsumption	506.0	506.0	83689.87	110866.34	9306726.0	9306726.0	251365.275	422291.898	0.0	0.0	0.0	Different	0.0	Different	0.0037	0.0163
totalOutputCropsAndCropProduction	-650.0	-650.0	83080.53	81891.83	2792008.0	2792008.0	161289.344	164714.637	0.005	0.012	0.0	Different	0.0	Different	0.0036	0.0149
totalOutputLivestockAndLivestockProduction	0.0	0.0	30499.25	59989.84	7472733.0	7472733.0	220649.542	358975.286	0.846	0.811	0.0	Different	0.0	Different	0.0111	0.0289
vatBalanceExcludingInvestments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0
vatBalanceOnInvestments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	Similar	1.0	Similar	0.0	0.0

Table 40. Statistical results: Italy 2019 (sheet 3)

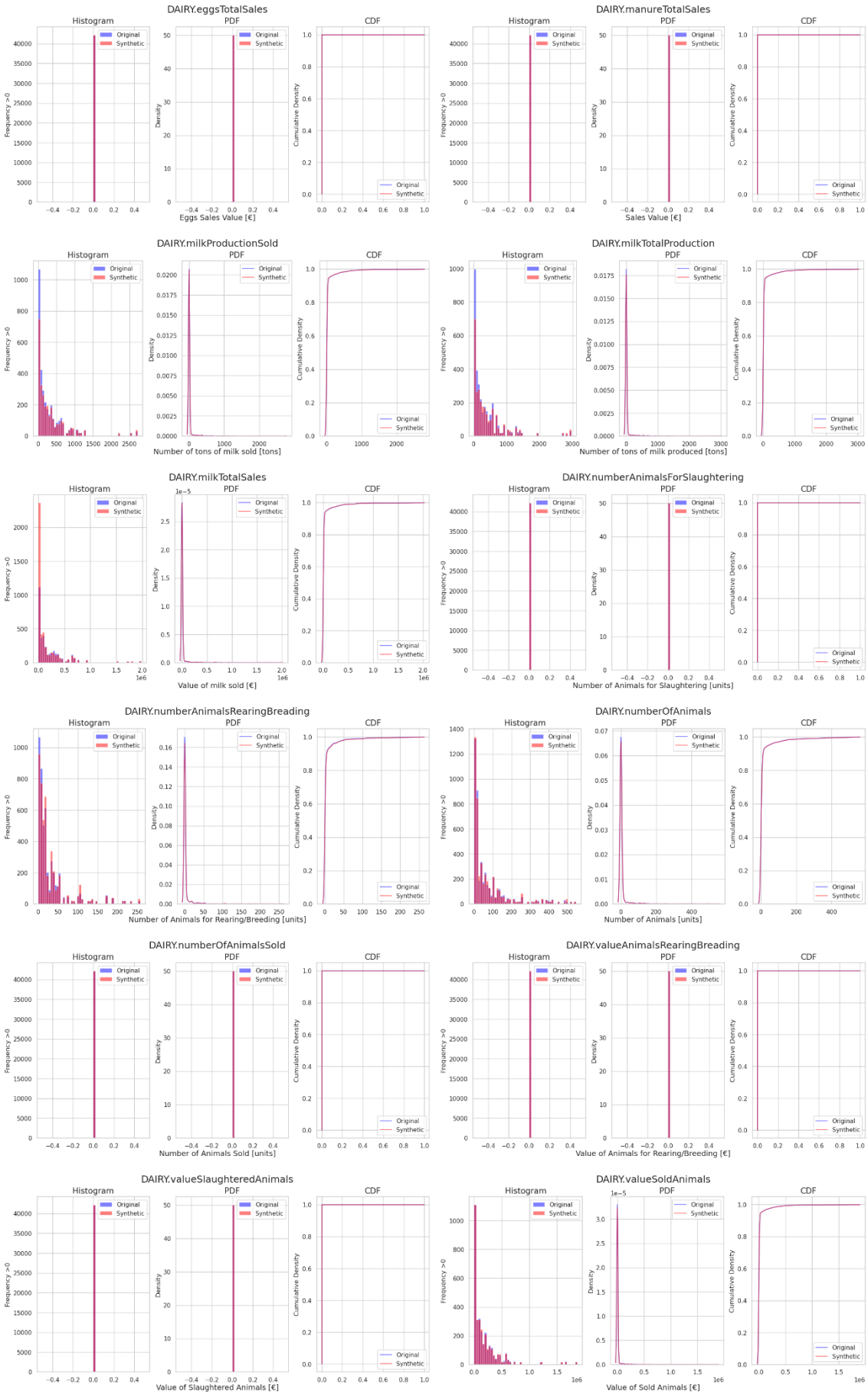

Figure 117. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 1)

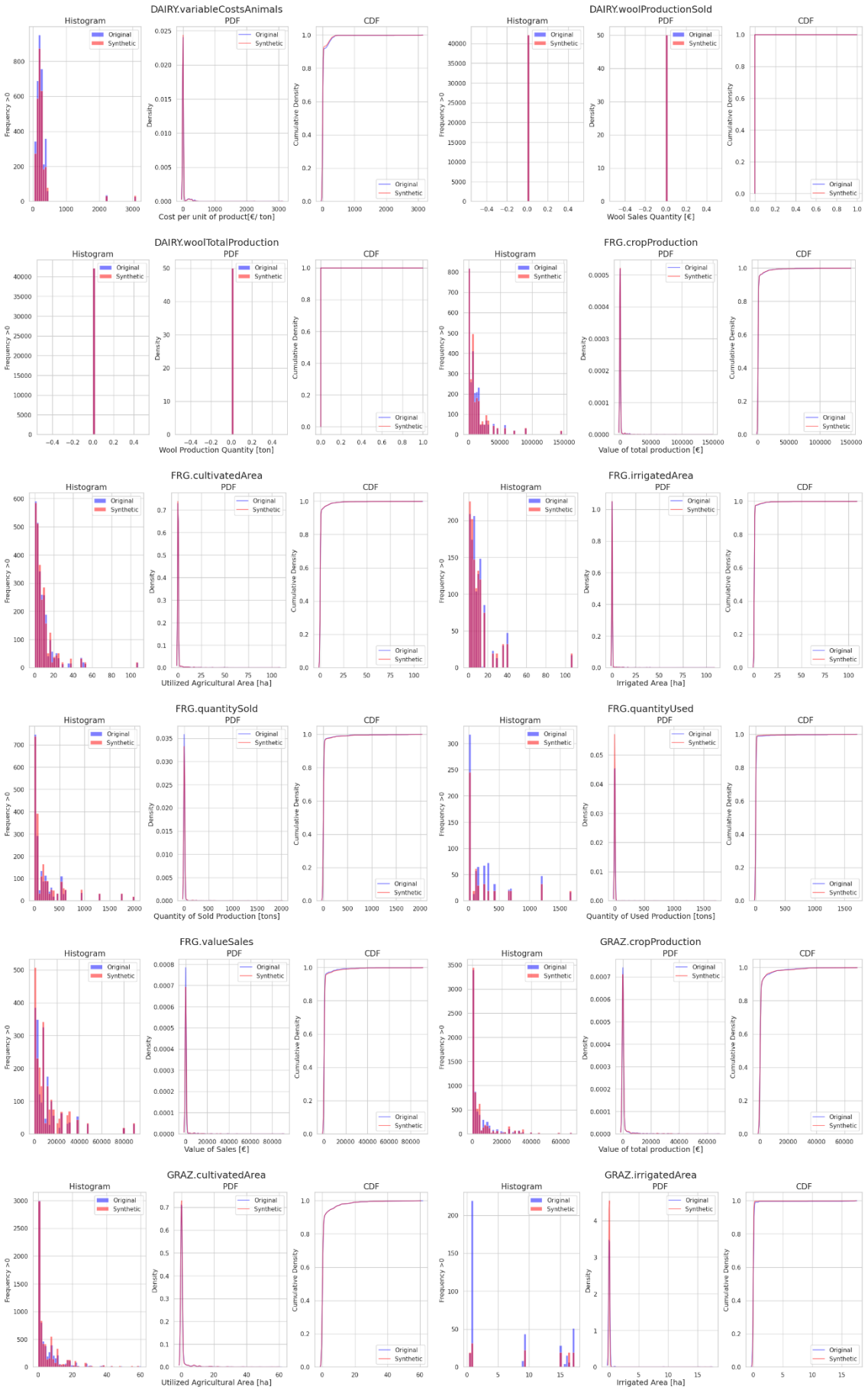

Figure 118. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 2)

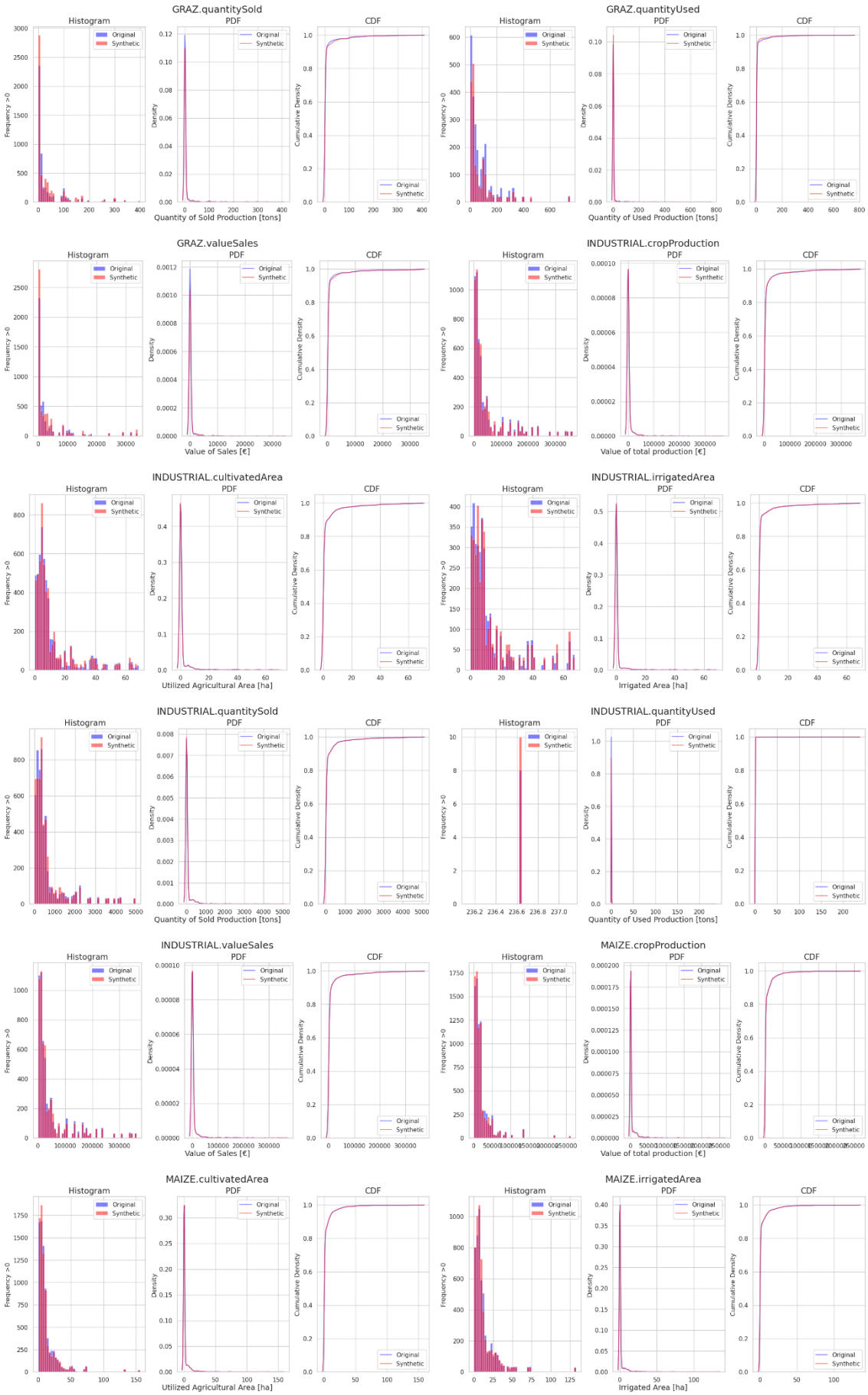

Figure 119. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 3)

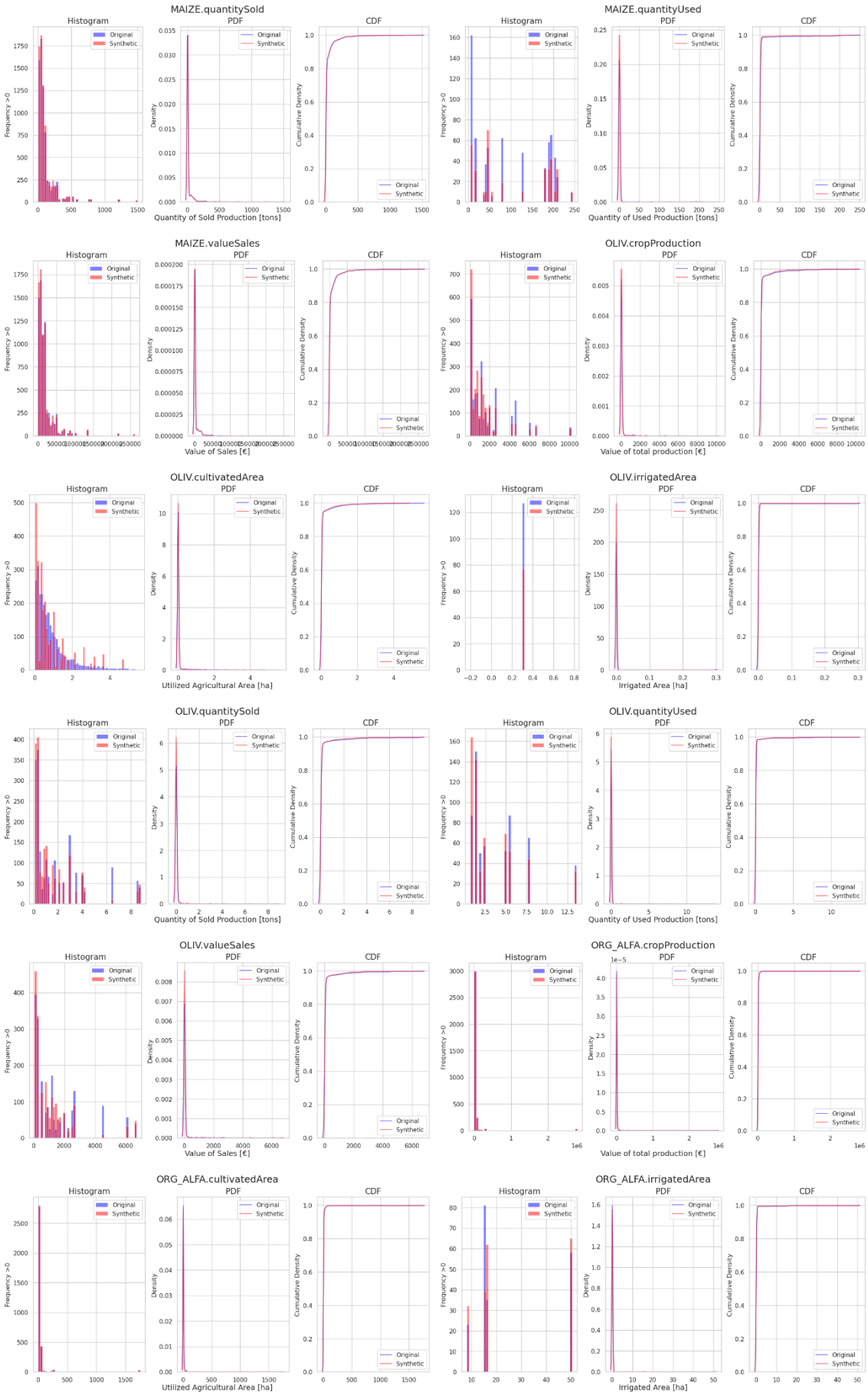

Figure 120. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 4)

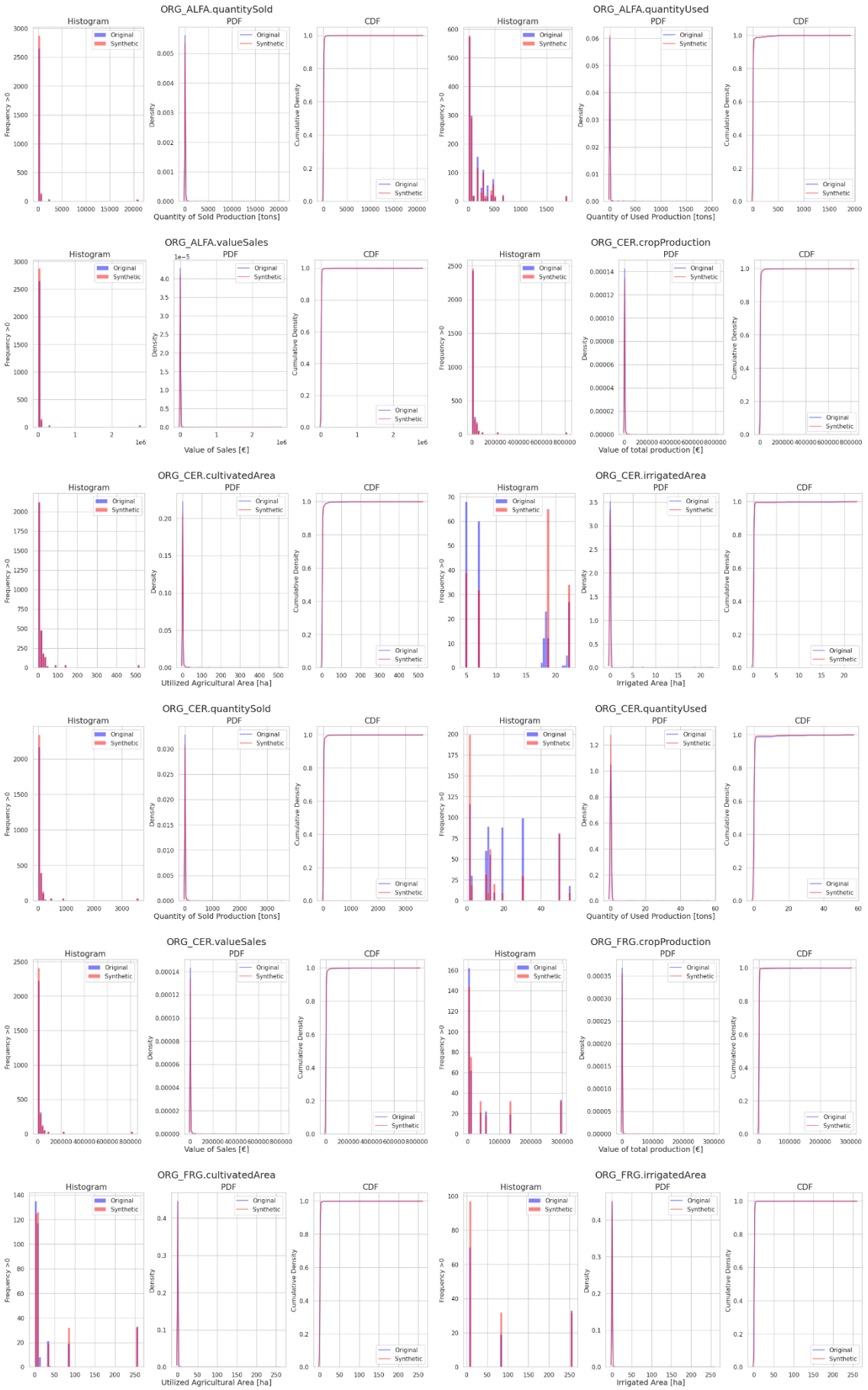

Figure 121. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 5)

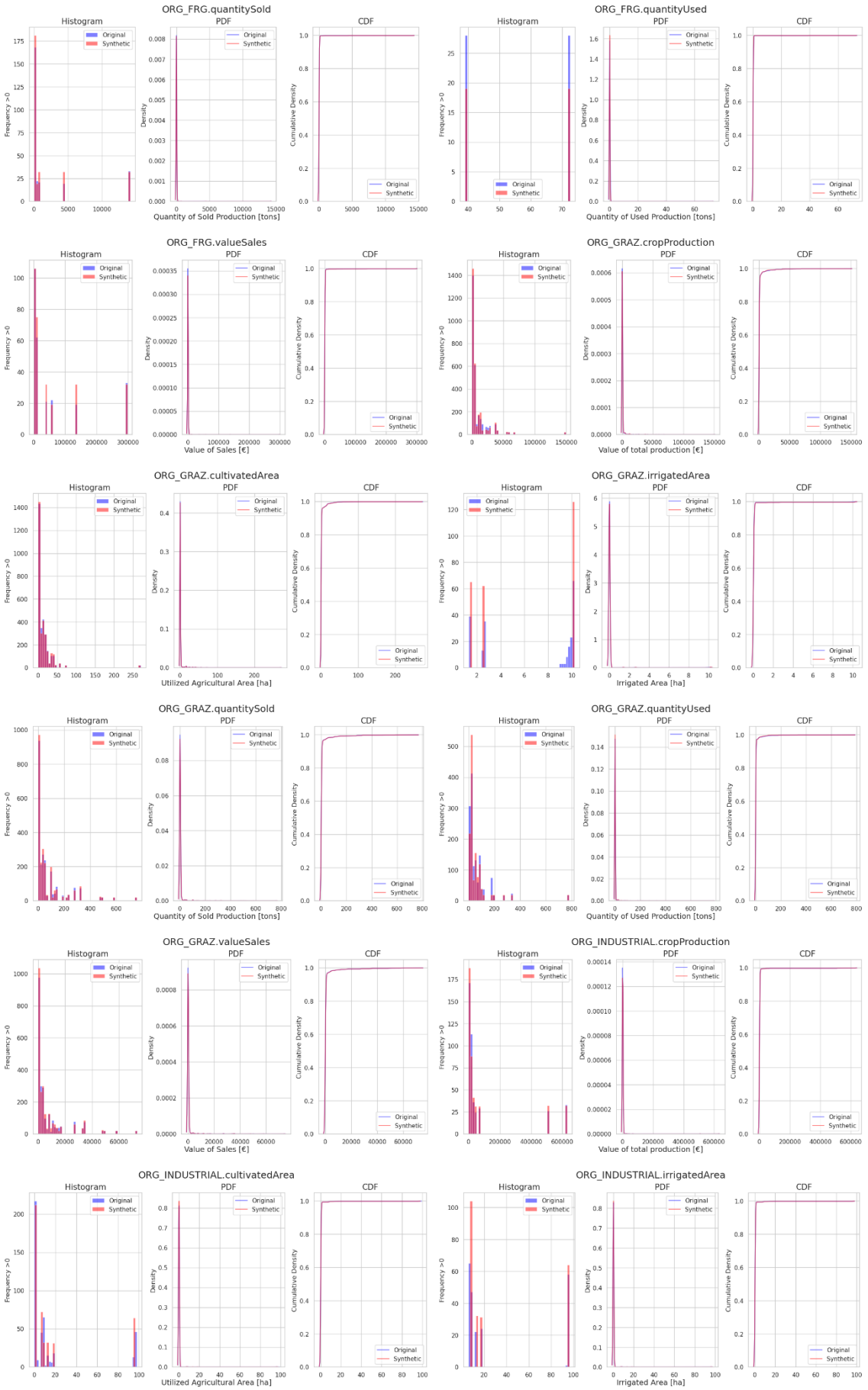

Figure 122. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 6)

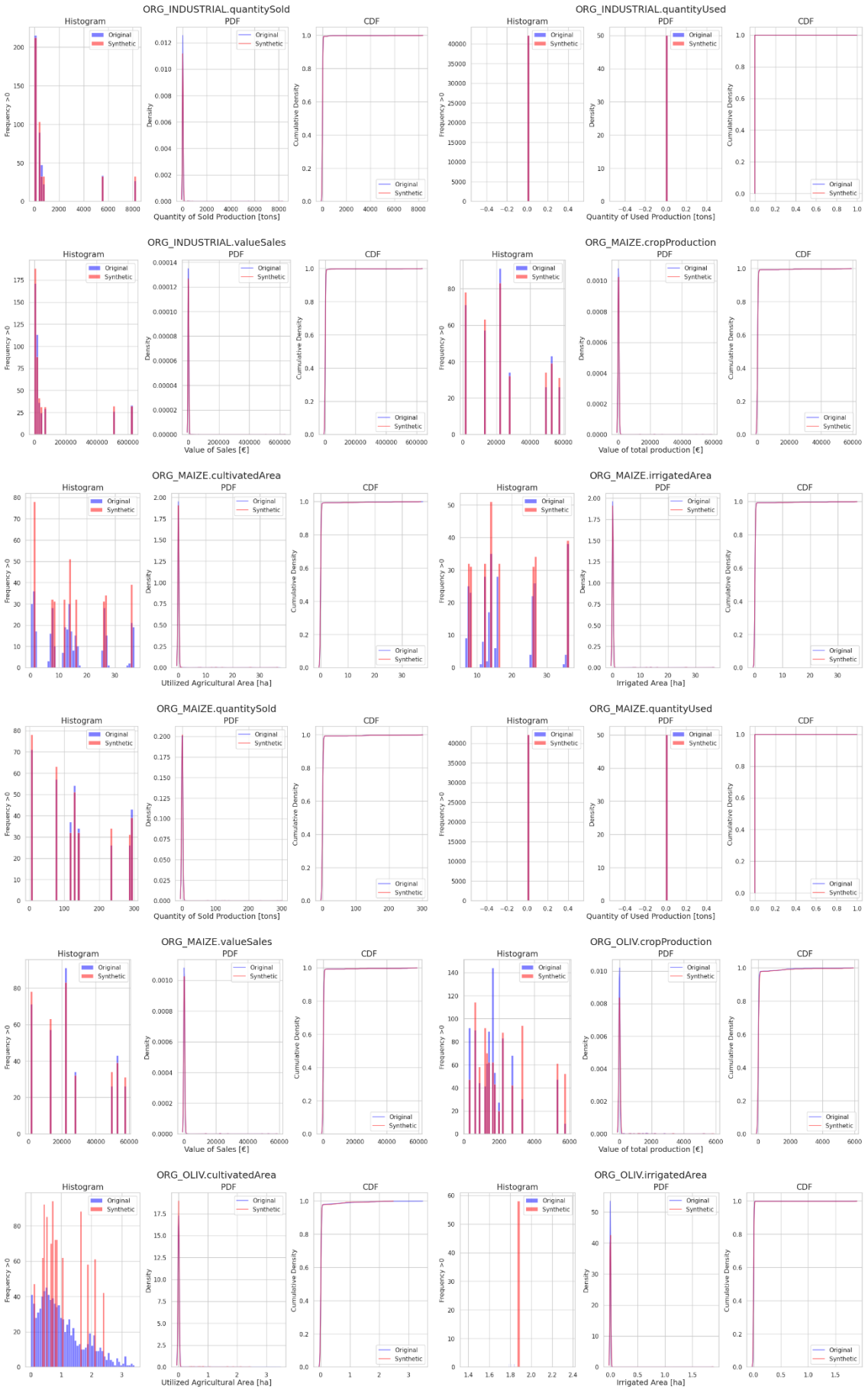

Figure 123. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 7)

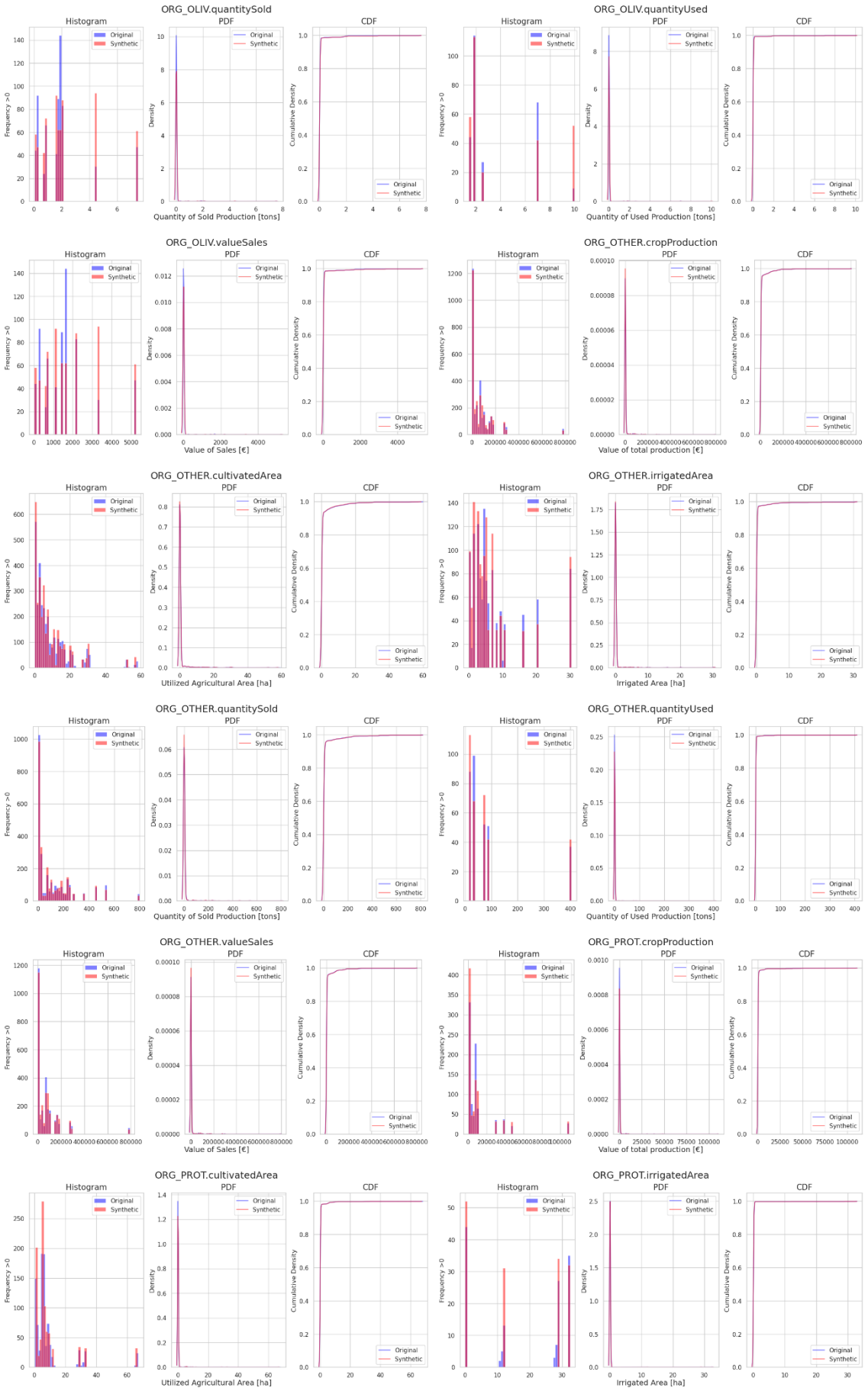

Figure 124. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 8)

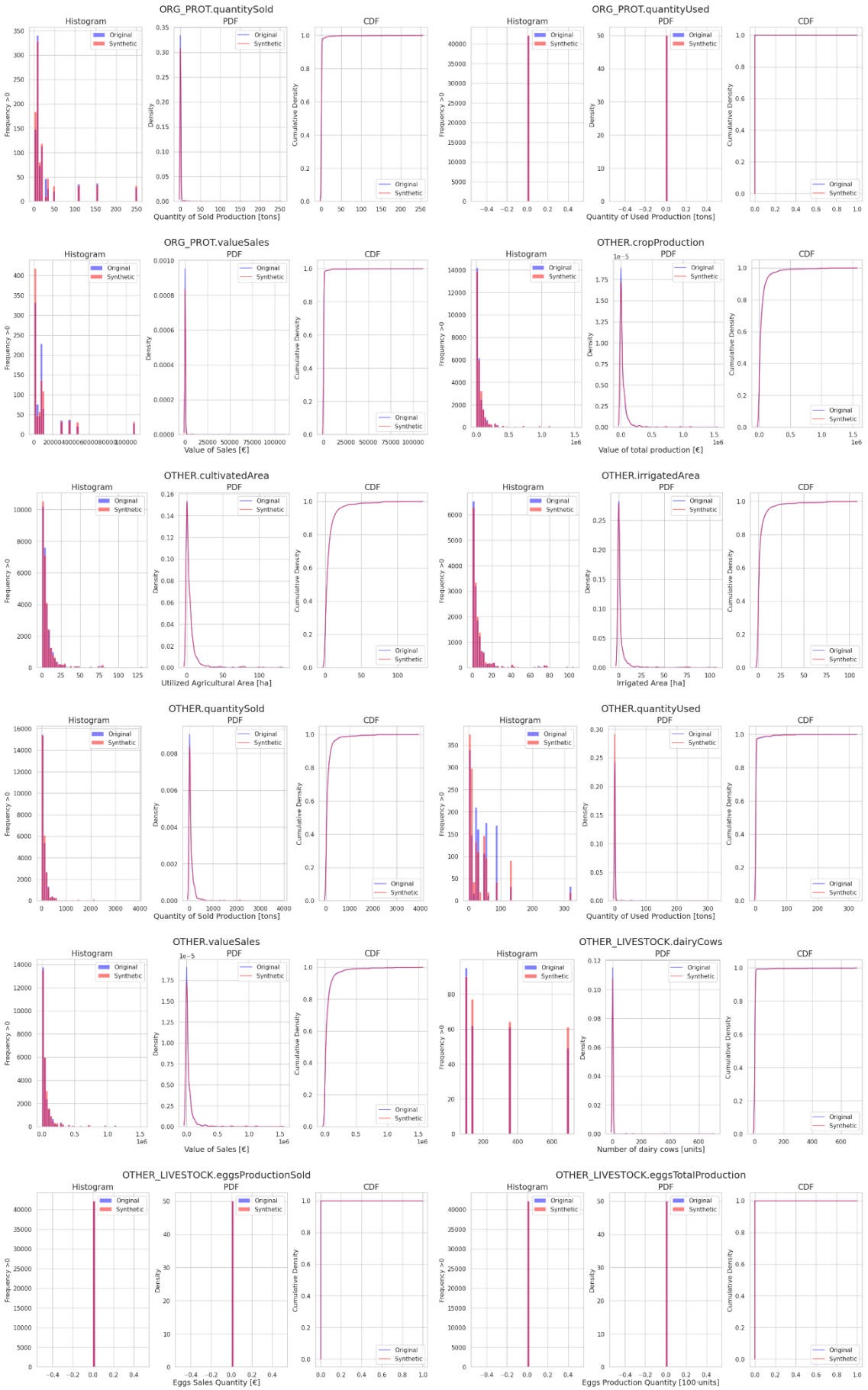

Figure 125. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 9)

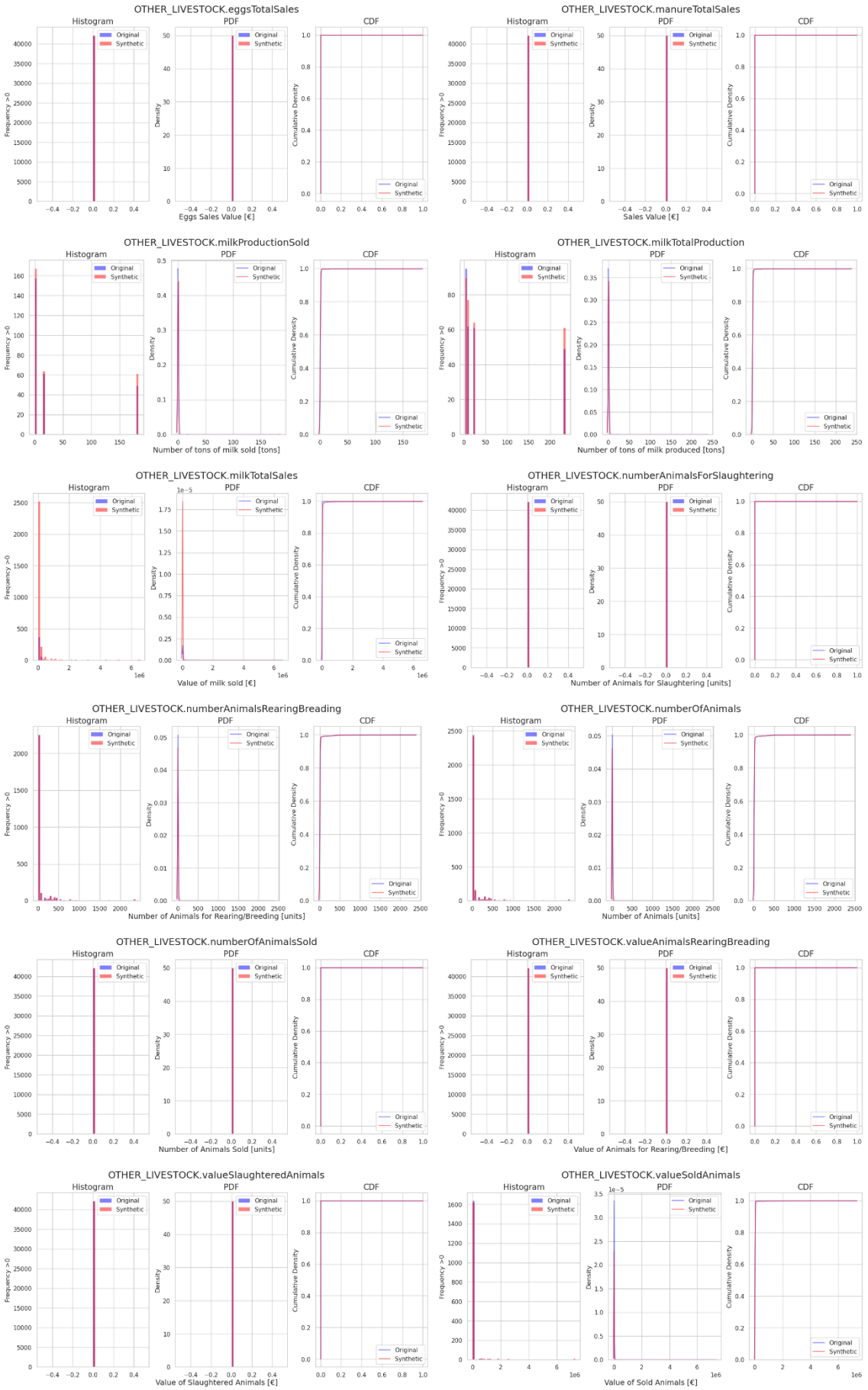

Figure 126. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 10)

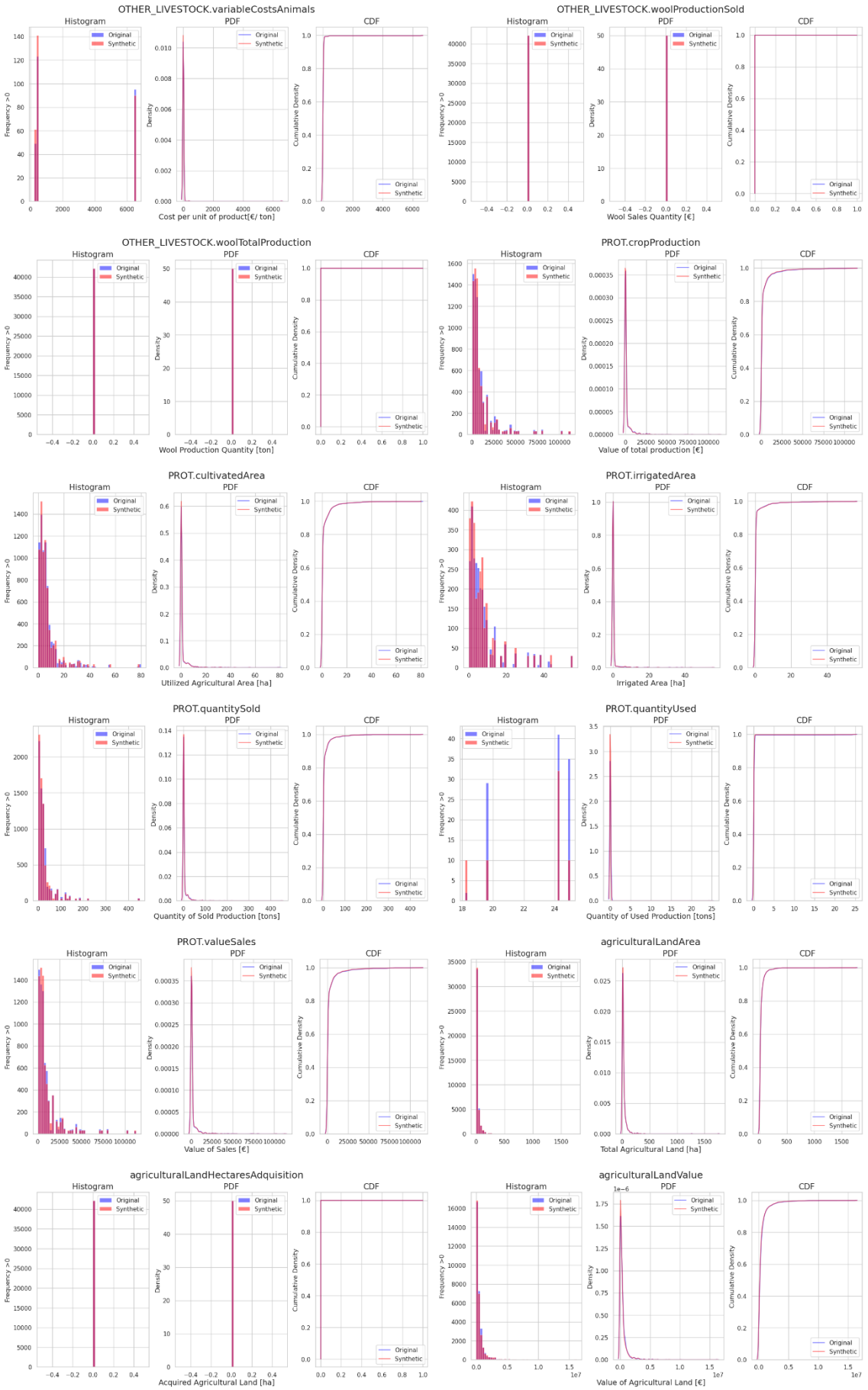

Figure 127. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 11)

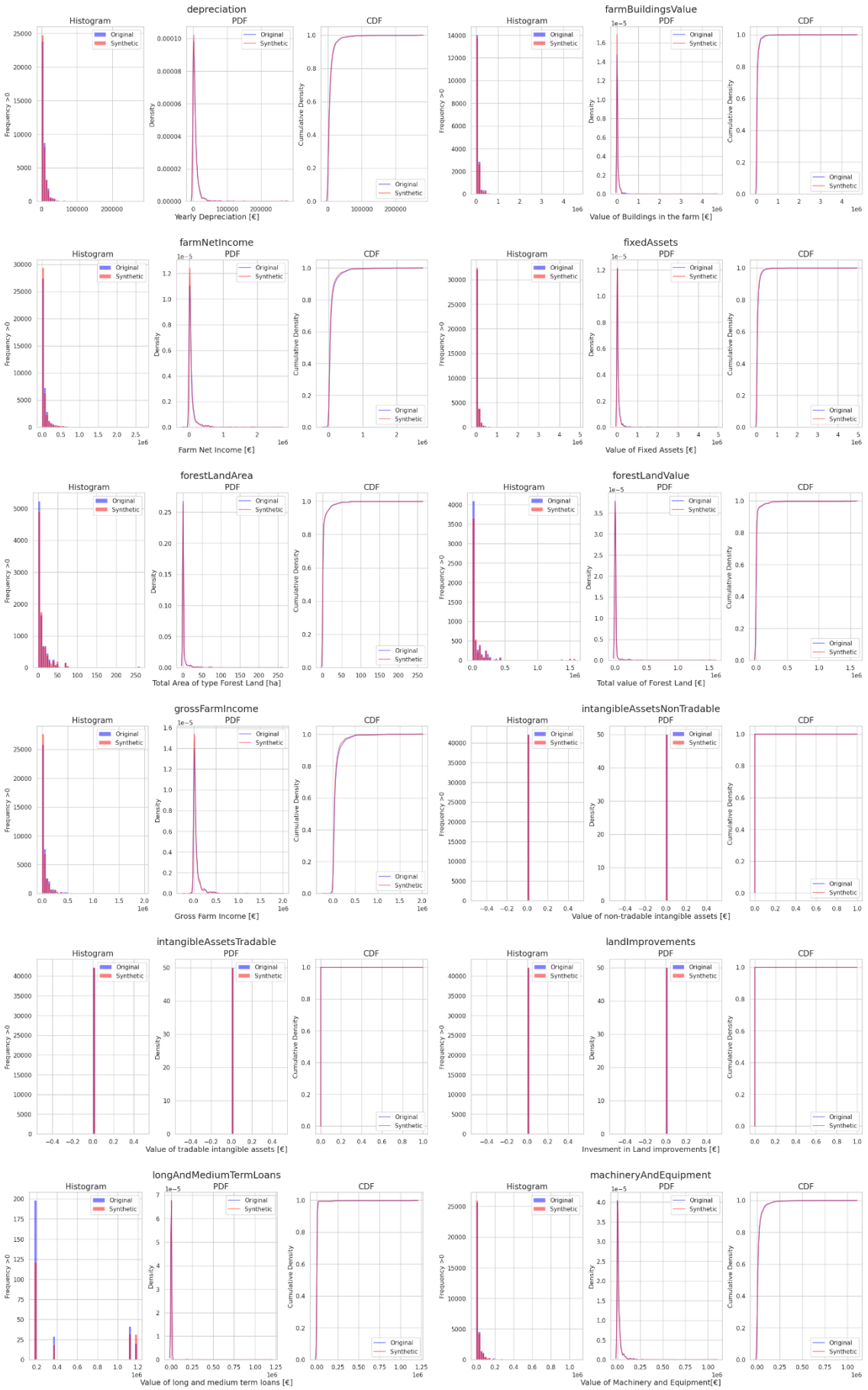

Figure 128. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 12)

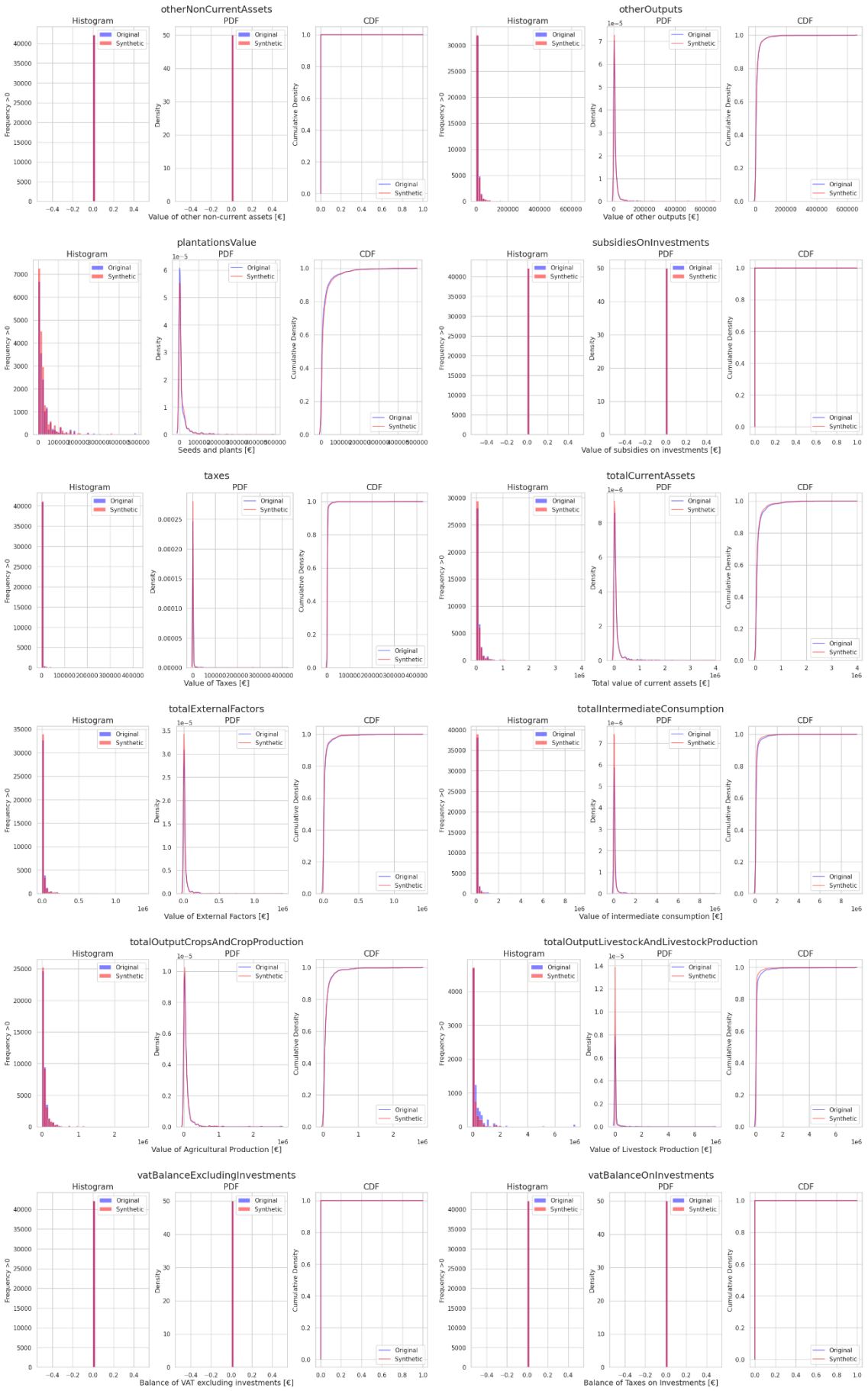

Figure 129. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 13)

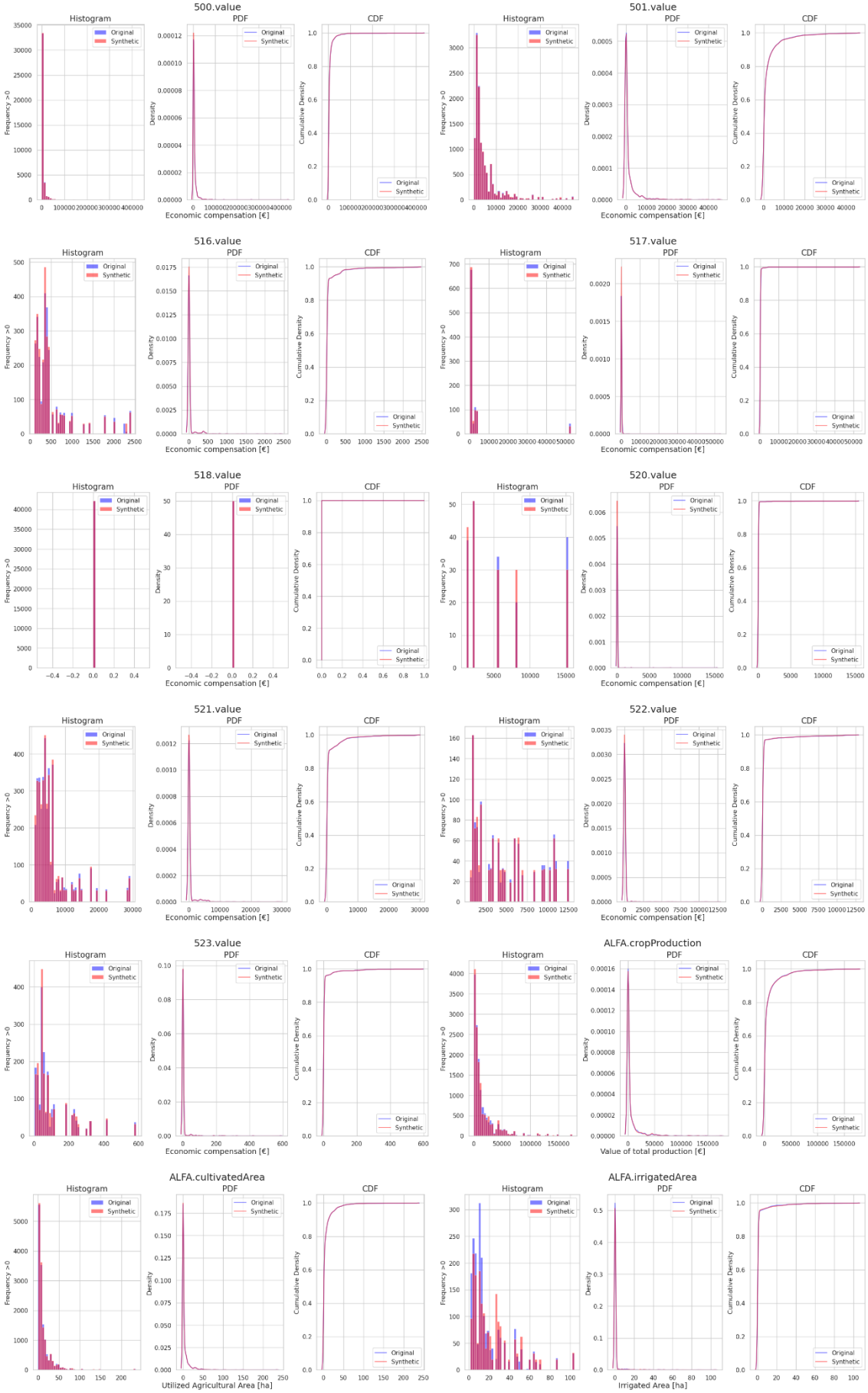

Figure 130. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 14)

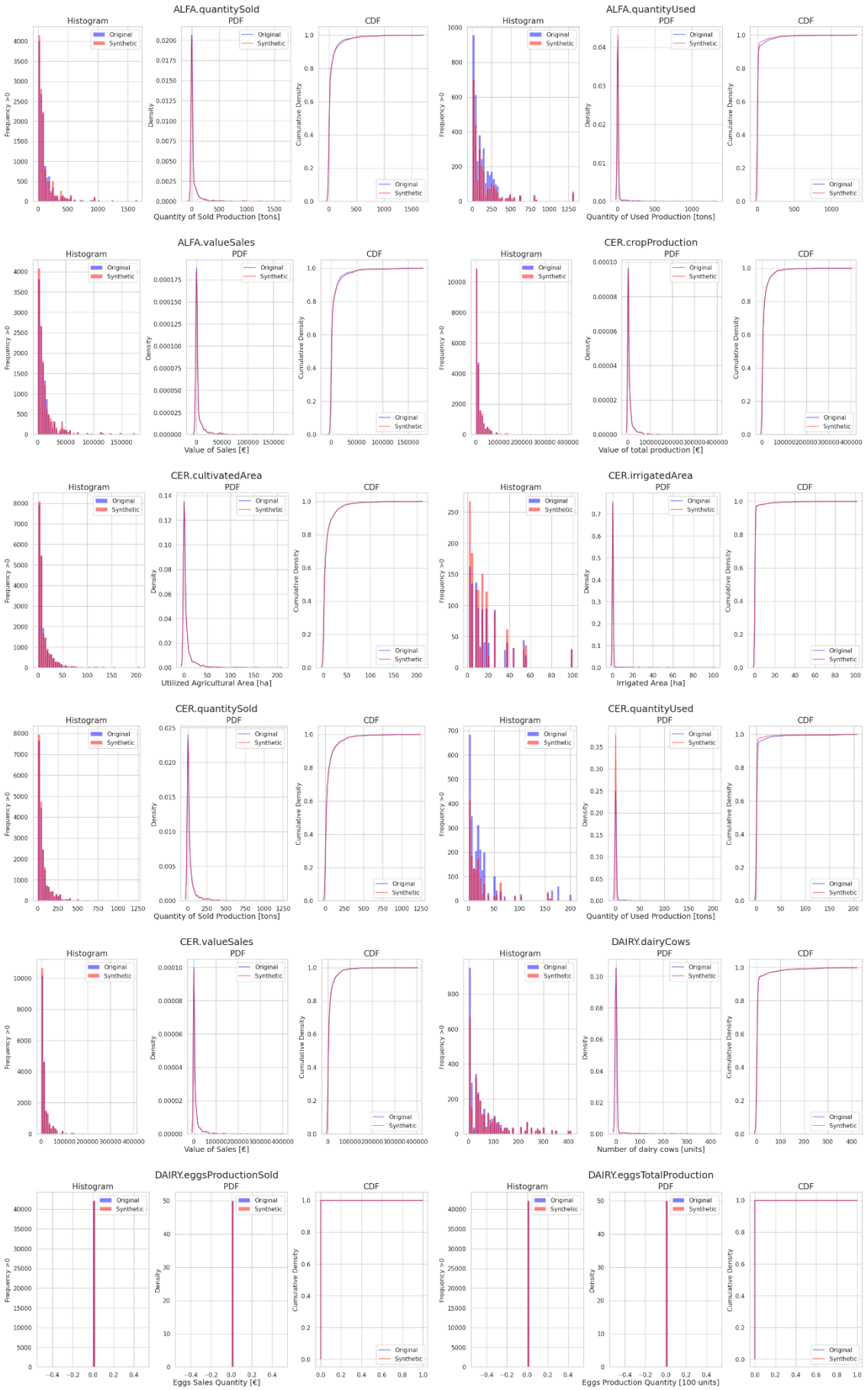

Figure 131. Comparison of Continuous Variables: Italy Use Case 2019 (Sheet 15)

	Original cultivatedArea [ha]	Synthetic cultivatedArea [ha]	Ratio cultivatedArea
CER	262198	261165	0.996
OTHER	210547	210494	1.0
ALFA	182995	183531	1.003
ORG_ALFA	128622	125061	0.972
MAIZE	90274	89927	0.996
INDUSTRIAL	61963	62623	1.011
ORG_CER	50701	46903	0.925
PROT	50097	51295	1.024
ORG_GRAZ	38829	37645	0.97
GRAZ	36944	37316	1.01
ORG_OTHER	27991	28965	1.035
FRG	22833	23335	1.022
ORG_FRG	12777	12053	0.943
ORG_PROT	8163	7958	0.975
ORG_INDUSTRIAL	8087	7489	0.926
ORG_MAIZE	5319	5212	0.98
OLIV	1986	2244	1.13
ORG_OLIV	899	907	1.009

Table 41. Italy use case, 2019: cultivated area ratio comparison

	Original cropProduction [€]	Synthetic cropProduction [€]	Ratio cropProduction
OTHER	1837923178	1699960943	0.925
CER	349625506	343985792	0.984
INDUSTRIAL	256945046	261731228	1.019
ALFA	229404485	227999229	0.994
ORG_OTHER	211049464	215112813	1.019
ORG_ALFA	166105421	161468609	0.972
MAIZE	151619483	151659263	1.0
PROT	74268360	78667777	1.059
ORG_CER	66560661	61138286	0.919
ORG_INDUSTRIAL	43104053	40761323	0.946
GRAZ	34846087	34893324	1.001
FRG	33321772	33675186	1.011
ORG_GRAZ	25071614	25547002	1.019
ORG_FRG	17543137	15778717	0.899
ORG_PROT	10630436	9986222	0.939
ORG_MAIZE	9251154	8935573	0.966
OLIV	3361250	4106644	1.222
ORG_OLIV	1892475	1538839	0.813

Table 42. Italy use case, 2019: crop production ratio comparison

	Original quantitySold [tons]	Synthetic quantitySold [tons]	Ratio quantitySold
OTHER	3593424	3421260	0.952
INDUSTRIAL	3477005	3515356	1.011
ALFA	1664982	1538084	0.924
CER	1536575	1485282	0.967
ORG_ALFA	1182058	1128815	0.955
MAIZE	826017	803428	0.973
ORG_FRG	638479	587445	0.92
ORG_INDUSTRIAL	532366	484803	0.911
FRG	479186	437645	0.913
ORG_OTHER	323274	332720	1.029
ORG_CER	282926	252089	0.891
GRAZ	217481	186426	0.857
PROT	193009	199070	1.031
ORG_GRAZ	182847	178553	0.977
ORG_MAIZE	48481	47171	0.973
ORG_PROT	27619	26832	0.972
OLIV	2892	3578	1.237
ORG_OLIV	1543	1264	0.819

Table 43. Italy use case, 2019: quantity sold ratio comparison

6.5 Definition of the simulation scenario:

6.5.1 Policies scenario:

For the Italian use case, a data analysis focused on subsidies has been performed. For this analysis, some tables from the RICA dataset have been used, and a report containing the required parameters for a proper model execution has been generated. The report or subsidies configuration contains the same fields explained in other use cases, but with the particularity than other subsidies are present and variable economic compensations can be observed.

With respect to this information, same rules as explained in Policies scenario in Andalusia have been followed, and in fact, the subsidies configuration presents the same format.

In this case, no other subsidies from the ones present in the RICA dataset were added. All of them were available in RICA microdata, as some of the farms sampled had received some economic benefits from these subsidies.

Both the synthetic population generated for the Italian use case and the table containing subsidy-related information include all the data needed to perform the simulations. These datasets were uploaded together to the data warehouse and are used on demand whenever a new simulation request arises.

In this case, just two subsidies are considered as decoupled subsidies, one as base payment and another one for greening practices. Regarding the coupled subsidies, there is a varied ranges of subsidies covering the different product groups defined.

Subsidy_Code	Description	Coupled	Aggregated_product	Economic_compensation	StartYear	EndYear	Label
501	GREENING - Diversificazione delle colture	N		85	2017	2020	Greening
500	Pagamento base (Reg. 1307/2013)	N		203	2017	2020	Basic
517	Contributo piccoli agricoltori (Reg. 1307/2013)	Y	CER	78	2017	2020	
517	Contributo piccoli agricoltori (Reg. 1307/2013)	Y	ORG_CER	78	2017	2020	
520	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Riso	Y	CER	137	2017	2020	
520	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Riso	Y	ORG_CER	111	2017	2020	
523	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Olivo	Y	OLIV	110	2017	2020	
523	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Olivo	Y	ORG_OLIV	110	2017	2020	
521	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Barbabietola da zucchero	Y	INDUSTRIAL	600	2017	2020	
521	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Barbabietola da zucchero	Y	ORG_INDUSTRIAL	600	2017	2020	
518	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Oleo proteaginose	Y	PROT	70	2017	2020	
518	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Oleo proteaginose	Y	ORG_PROT	78	2017	2020	
522	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Pomodoro da industria	Y	ORG_INDUSTRIAL	166	2017	2020	
522	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Pomodoro da industria	Y	INDUSTRIAL	160	2017	2020	
516	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Soia	Y	ORG_PROT	33	2017	2020	
516	Pagamenti accoppiati (Reg. 1307/2013) - Colture - Soia	Y	PROT	53	2017	2020	

Table 44. Subsidies result, Italy

Although these are the default subsidies managed by the model, it is possible to manually expand the list of subsidies by adding new ones during the simulation configuration process. This is done by the user during the setup phase through a user-friendly interface, allowing for quick and seamless exploration of new simulations. This flexibility enables the user to test different scenarios and incorporate evolving policies or custom subsidy schemes into the analysis with ease. In this way, the overall tool is not limited to the existing policy context but can be adapted to new regulations, emerging subsidy programs, or unique user-defined conditions, ensuring the simulations remain relevant and up to date.

7 Conclusions

This document outlines the methodology used to develop the use cases for the AGRICORE project. The creation of these use cases involves constructing synthetic populations that accurately reflect the economic, social, and agricultural characteristics of real farmers. This approach allows for the creation of a virtual ecosystem where farmer models simulate real behaviors based on the initialized parameters.

Overall, the evaluation of synthetic populations shows a strong goodness of fit across nearly all variables. The generation method developed for the AGRICORE project efficiently handles tabular data, effectively capturing both individual relationships and inter-variable patterns. The Bayesian network-based approach performs well, ensuring that the synthetic data accurately mirrors the insights from the original sample. This strong performance provides a solid foundation for further leveraging the generation module, with only minor adjustments needed when working with tabular data.

The comparison report reveals a high level of fit between original and synthetic data across all use cases and years. Statistical analysis indicates that most variables exhibit similar ranges and follow comparable probability density functions. While some tests for synthetic population goodness-of-fit suggest potential differences, these tests are stringent. Other metrics, which assess the divergence between distributions, generally show very low values. This discrepancy is more pronounced for variables with very few non-zero values, where generation relies on conditional probability distributions based on other parent variables.

Results are highly dependent on data quality, a reality that has become especially clear when working with datasets from diverse sources. Despite following FADN standards, variations in data requests and formats across different countries and organizations have markedly impacted the outcomes of synthetic population generation. These inconsistencies not only affect the results but also require the creation of intricate extraction, transformation, and loading (ETL) pipelines. These pipelines are essential for handling the unique characteristics, nomenclatures, and information gaps present in each dataset.

Datasets that included weights or farm representativeness, such as those from Andalusia and Italy, enabled a streamlined process for generating synthetic data. This facilitated efficient computation based on various farm features. Conversely, the Polish and Greek use cases, with the latter to a lesser extent, faced challenges in determining farm representativeness, necessitating the use of statistical methods. While these methods produce accurate results, they inherently carry some degree of uncertainty regarding their precision. Furthermore, validating this information against alternative solutions is not feasible, as different approaches might produce similarly adequate results.

The work undertaken has been designed with flexibility to accommodate the various modifications in data and their implications for other simulation parameters. For example, the crop grouping approach was tailored specifically for each use case and adjusted according to user preferences. This adaptability required recalculating economic compensations for coupled subsidies based on available subsidies, crop representativeness, and the specific product grouping applied. To streamline the process and minimize the potential for errors, this work has been automated, ensuring a more efficient and accurate creation of the use cases.

8 References

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For preparing this report, the following deliverables have been taken into consideration:

Deliverable Number	Deliverable Title	Lead beneficiary	Type	Dissemination Level	Due date

Annex A. Kernel Density Estimation algorithm

Kernel Density Estimation algorithm (KDE) is a non-parametric algorithm that allows for obtaining a continuous representation of data distribution[17]. This algorithm does not assume a specific data distribution but instead estimates the probability density function of the data by averaging over kernel function applied to each data point.

The flexibility that characterizes KDE method reinforces its utilization for the characterization of complex and multimodal data distribution where traditional parametric models might fail to provide an accurate fit. This feature facilitates its utilization in generative data science[18].

The function that approximates the KDE algorithm is described above:

$$\hat{f}_h(x) = \frac{1}{nh}\sum_{i=1}^{n} K\left(\frac{x - x_i}{h}\right)$$

Where:

- $\hat{f}_h(x)$: estimated density at point x for the predicted random variable.
- n: number of data points.
- h: bandwidth serving as a smoothing parameter. It determines the width of the kernel function, thus impacting the estimation fit.
- K: kernel function. Function modeling the influence of a sample point within its neighborhood. It servers to determine the shape of the curve used to generate the density estimate around each data point. Traditional kernel functions are gaussian function, uniform or top-hat kernel and Epanechnikov kernel, although the impact of this parameter is low on the final result.
- x_i: independent sample points of an observed random variable.
- x: point at which density is estimated.

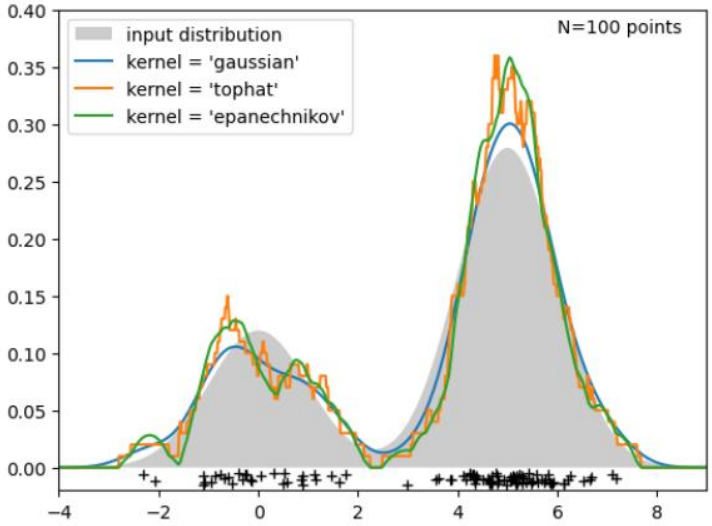

Figure 132. KDE algorithm fitting example

Annex B. Variable costs crop inference

Crop production costs data was not included in three of the four use cases of the Agricore project. To address this information gap, a mathematical formulation was developed as a linear optimization problem. The objective is to obtain the variable costs per crop in euros per ton of each of the product groups defined for each use case.

The first step when building the optimization problem is to define the objective function $of(x_i)$. In this, case, the objective function is the difference between the total costs per holding and the sum of the broken-down crop costs multiplied by the total quantity produced:

$$of = \sum_{i}^{m}\sum_{j}^{n}(y_j - A_{ij}x_i)$$

The available information contained in the FADN data is the total variable costs y_j in euros and the total amount produced A_{ij} in Tons. In this case subscript i refers to crop and subscript j refers to holding. The decision variables in this case are the variable costs per crop x_i in euros per ton. When solving the optimization problem, the solver adjusts their values, so the value of the objective function is minimal.

Variable costs crops can vary from one farmer to another. Different ways of working, or different specific conditions can produce variations in the production costs. Additionally, the only source of information to drive this approach is the FADN/RECAN datasets. Moreover, data records may contain some noise or inaccuracies, so it is quite possible that trying to fit the sum of individual costs to total variable costs is not possible.

The first mathematical formulation utilizes inequities to set the constraints or equations that determine the balance between the total costs and the aggregation of individual costs. Additionally, other constraints are set as the imposition of obtaining variable costs crops greater than zero.

$$\begin{aligned} \min \quad & of \\ \text{s.t.} \quad & A_{ij}x_i \leq y_j \\ & x_i \geq 0 \end{aligned}$$

Softening constraints method is used to undo the inequities by introducing some slack variables h_j. Now slack variables represent the difference between the total costs measured and the sum of individual production costs.

$$\begin{aligned} \min \quad & of = \sum_{j}^{n} h_j \\ \text{s.t.} \quad & A_{ij}x_i + h_j = y_j \\ & x_i \geq 0 \\ & h_j \geq 0 \end{aligned}$$

In this way the solver will try to adjust the variable costs of crops, represented by the decision variables x_i while minimizing the value of slack variables which essentially represent the mismatch in total variable costs for the crops.

A general script has been created to automatically formulate and solve the optimization problem. It simplifies the process by only requiring the user to set the use case. The script will then automatically load, process, and ingest the microdata to obtain the variable costs by crop, following the approach described above. The solver utilized for solving the optimisation problem is pulp[19].