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Effects of Technical, Socio-Economic, and Environmental Changes on the Richness of Fruit Germplasm in Northern Sicily, Italy

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Abstract: This study examines the changes that have occurred in the specific and varietal composition of fruit trees in one of the world's most famous agricultural areas, the Conca d'Oro, a plain surrounding Palermo (Sicily, Italy). Changes in specific and varietal composition over the centuries are the result of endogenous changes to the orchards (e.g., the spread of cultivation techniques such as irrigation or the introduction of new species and varieties), social and economic changes (e.g., the development of citrus farming in response to the demand from citrus markets). The disappearance of traditional germplasm is a complex phenomenon due to the changes occurring since the middle of the last century in the agricultural system. The more recent changes occur, unfortunately, mainly due to the expansion of the city, which has erased many orchards and vegetable gardens, but also due to the loss of the emotional, economic, and social value of orchards. The protection of this germplasm becomes indispensable in a period of climate change that, among other things, reduces the effectiveness of agrochemicals. Some germplasm protection and product enhancement initiatives are currently in place in this area and can be applied in other fruit-growing areas as well.

Keywords: Conca d'Oro history; irrigation; Monreale; landscape transformation; urban expansion

Academic Editors: Luc Legal, Ipek Kurtboke, Bert W. Hoeksema, Michael Wink and Mario A. Pagnotta

Received: 20 February 2025
Revised: 8 April 2025
Accepted: 8 April 2025
Published: 12 April 2025

Citation: Autovino, D.; La Mantia, T. Effects of Technical, Socio-Economic, and Environmental Changes on the Richness of Fruit Germplasm in Northern Sicily, Italy. *Diversity* **2025**, *17*, 273. https://doi.org/10.3390/d17040273

1. Introduction

The loss of crop diversity is a globally known problem, driven by multiple factors [1,2]. It has become particularly dramatic when different processes overlap, such as the abandonment of traditional agriculture, the spread of modern fruit varieties, and/or changes in crops [3]. In the past, variations occurred mainly as a result of new introductions and changes in cultivation techniques that generally did not lead to the disappearance of species/varieties, as evidenced by the permanence of varietal names for centuries [4]. The great historian Braudel [5] defines non-irrigated crops (wheat, olive, and vine) as a "trinity" for the Mediterranean region. While dry crops, are really prevalent in Mediterranea area, it is also true that the island has developed an exceptional capacity to use water along the coasts. In the Conca d'Oro, this resource was widely available, albeit at great expense and through the use of technological innovations [6]. Along the coasts, sugarcane, which was an irrigated crop, was cultivated from the twelfth century onward; its disappearance is essentially followed by citrus groves.

Unfortunately, these coastal areas have been affected by widespread urban expansion that lead to the obliteration of vast areas. This happened to the Conca d'Oro as well, with the consequent loss of landscape and biodiversity.

The case study presented in this article focuses on the territory of Monreale and the adjacent Conca d'Oro, the plain surrounding Palermo (Sicily, Italy). This area has been known since antiquity for its diverse cultivated species, creating an agricultural landscape described as pleasant by various writers who visited it over the years, such as Goethe in 1787 [7] or Guy de Maupassant in 1885 [8]. Maupassant wrote, "Palermo. The city is surrounded by the immense orange grove called the Conca d'Oro: this dark green forest. . .". In 1900 Oscar Wilde wrote "Palermo. . . was delightful. The most beautiful city in the world dreams its life in the Conca d'Oro, the exquisite valley that lies between two seas. The lemon and orange groves were of a perfection. . ." [9].

The attractiveness of these gardens was also the result of the multitude of species and varieties of fruit trees historically found in these soils. Those trees were selected for their ability to thrive in the soil and climatic conditions of this area. The gardens evolved over the centuries due to various endogenous factors, including irrigation, or exogenous factors, such as the discovery of new continents.

The urban expansion, which has been occurring since the middle of the last century, has drastically reduced farmland [10], but today's socioeconomic changes are also contributing to the loss of diversity. Although, from an administrative point of view, the areas fall in two different municipalities (Palermo and Monreale), from an environmental point of view they are very similar. However, their anthropogenic history is different: the plain surrounding Palermo, the Conca d'Oro, after the disappearance of sugarcane and dry crops (vine, olive, etc.), has been characterized by the presence of traditional multilayered orchards, in which the dominant tree species in the area were Citrus spp. and loquat (*Eriobotrya japonica*), and in the upper layer they were Mediterranean hackberry (*Celtis australis*) and walnut (*Juglans regia*) [11].

Many other species of fruit (peach, apricot, pear, etc.) coexist with the citrus fruits, and are used for household consumption.

Monreale, after the decline of vines, saw the spread of citrus trees. Those trees were then often replaced by plum trees, which are more resistant to prolonged conditions of the unfavorable water–air regime in clay soils during the wet periods.

This article seeks not merely to report on the lists of species and varieties of fruit grown in the Conca d'Oro, but also to analyze how the changes in agricultural diversity have been shaped by the technical advancements and socioeconomic transformations over time.

2. Materials and Methods

2.1. Study Area

The plain of Palermo (called Conca d'Oro) covers about 140 km^2, parallel to the coast in a NW–SE direction, and with an average slope of 10–15%, between the mountains and the Tyrrhenian Sea (Figure 1). The mountains surrounding Palermo, with the exception of the Oreto valley, reach an average height of 900 m above sea level, with slopes being very steep limestones [12,13]. The soils are Typic Rhodoxeralfs [14].

Climatologically, Palermo is characterized by a temperate-warm climate, influenced by its proximity to the Tyrrhenian Sea. The average annual temperatures are around 19 °C, with hot summers reaching average August monthly temperature of 31.5 °C and mild winters, rarely below 10 °C [15]. The average annual rainfall (50° percentile) is 843 mm, concentrated mainly in the autumn and winter months, while the summer period is generally dry.

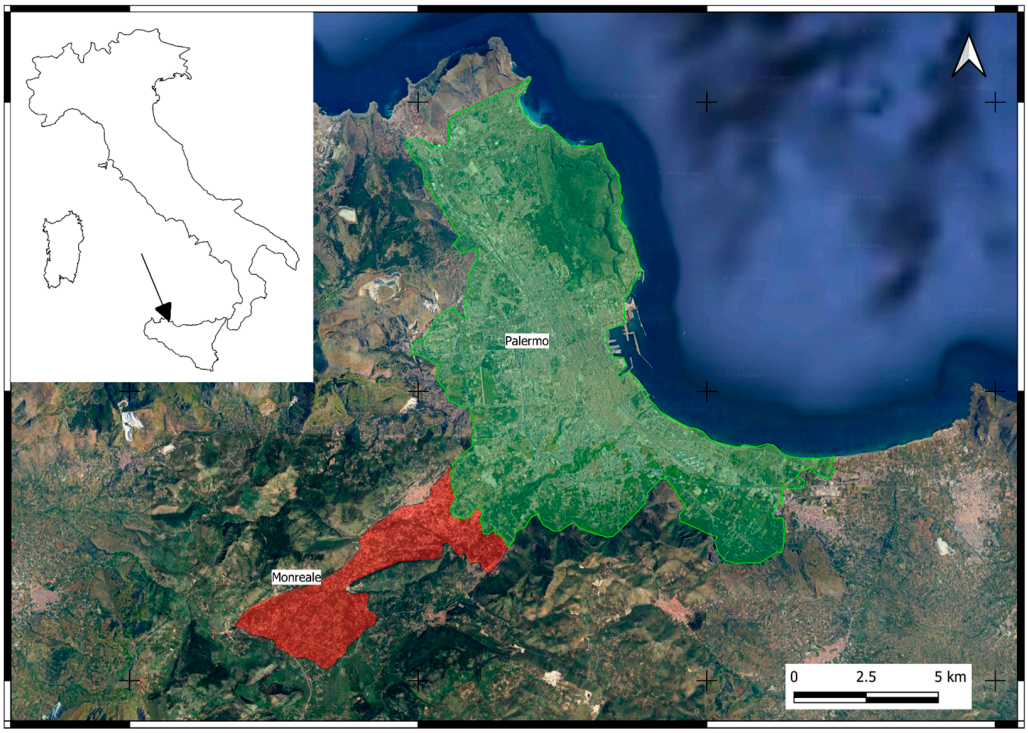

Figure 1. The figure shows the study area. In green is the part of Conca d'Oro in the municipality of Palermo, in red is the part in the municipality of Monreale. The area of Monreale analyzed in this study is part of the municipal territory, adjacent to the Conca d'Oro, which lies entirely within the hydrographic basin of the Oreto river. It extends over a surface area of approximately 19 km^2 and, unlike the plain of Palermo, is predominantly characterized by a hilly environment with a maximum height of 600 m above the sea level. The soils are classified as Calcixerollic Xerochrepts [14].

The analysis of the historical series recorded by the thermo-pluviometric station of Monreale indicates average winter temperatures of around 17 °C. The higher altitude means that the climate in Monreale is slightly more humid, with annual rainfall of 843 mm. The precipitation follows a similar regime than Palermo.

In both locations, summer is characterized by drought and heat, while winter is mild and rainy.

Analysis of the time series of the temperatures recorded by the Palermo Astronomical Observatory in the period from 1793 to 2003 shows a clear trend of increasing average air temperatures [16]. In particular, these authors calculated an average increase in temperatures of about 0.05 °C per decade over the entire observation period of 200 years. However, this increase has become much more pronounced in the last 100 years, reaching a rate of 0.18 °C per decade, and even 0.4 °C per decade in the last 25 years. The same study revealed a seasonal behavior, with greater increasing trends in the winter months and smaller ones in spring and autumn. Recently, on 24 July 2023, Palermo recorded a temperature of 47.0 °C, the highest ever recorded in the city since 1865, confirming the intensification of global warming and other extreme phenomena [17].

2.2. Archival Data

A rigorous review of the literature was conducted, encompassing not only the scientific studies on fruit cultivation, but especially those referring to the historical and social descriptions of the area. The survey work carried out in the past years in the Conca d'Oro has resulted in the publication of numerous articles on germplasm in the area, but while the agriculture and germplasm of the Conca d'Oro have been investigated in numerous articles (see [6] and bibliography cited therein) no specific studies are known for the Monreale

area, except those for plum varieties [18–20] and apricot [21]; moreover, a comprehensive assessment of the evolution of this heritage has never been made. However, some studies on the characteristics of fruit in Monreale have been conducted [22–25] (Table 1).

2.3. Field Survey

The field survey was conducted according to the methodologies applied in similar studies (see [26,27]) during winter 2023–2024.

For the Conca d'Oro, previously collected interviews were supplemented with ten additional interviews collected in the present study. In Monreale, 13 interviews were conducted with elderly farmers who recounted the current situation, and, more importantly, the condition and changes that occurred during their lifetime. Unfortunately, there are few elderly farmers left, which makes it difficult to find witnesses; therefore, a selection was not made, but elderly farmers who were over sixty years of age were chosen for the interviews. In some cases, the interviews were conducted on their farm in order to identify the fruit varieties.

The interviews with the elderly farmers were aimed at learning about the species and varieties grown in the area. The questions were structured as follows: (1) What species and varieties of fruits do you know that are grown in your area? (2) Do you have them in your orchard? (3) If you do not have them in your orchard, how do you know them? Have you seen them in other orchards? (4) How do you distinguish between the different varieties? (specific questions depending on the varieties listed) (5) Are there any modern varieties that were not there before? If so, do you know where they came from? (6) Are there any varieties that have disappeared? (7) If yes, why have they disappeared?

An important source of information was the members of the Slow Food Presidium of "Susine Bianche di Monreale" (https://www.fondazioneslowfood.com/it/presidi-slow-food/susine-bianche-di-monreale/Last accessed on 7 April 2025).

The word "sciorta", which in the Sicilian dialect means "varietes", is often encountered in Tables 1 and 2; for example, "sciorta di Palermo" means "variety of Palermo".

We have excluded vines from the analysis, due to their complexity. Regarding citrus, the literature is extensive, especially from the 1800s and early 1900s, and in some cases specific to the Conca d'Oro. These studies often describe varieties based on a single plant; moreover, the systematics of these species are, even today, very complex. Only the citrus trees, reported in the articles cited in Tables 1 and 3, are shown.

3. Results

3.1. Conca D'oro

Among the environmental factors that make the Conca outstanding for agriculture is first and foremost the climate, which offers good potential for growing species of tropical origin, such as citrus. Historian Bevilacqua [28] calls the Conca d'Oro "an area of ancient and almost mythical tree dominance".

More significant than the instrumental data are biological facts, such as the re-flowering of holm oak (Quercus ilex), a species that has retained its tropical atavism [29]. But it is through the wise use of irrigation that the Conca d'Oro became a "paradise", as Braudel [5] defined it: "The paradisiacal Conca d'Oro surrounding Palermo, a garden of orange trees and vineyards, is a miracle produced by the conditioning of water". Water and its exceptional use in agriculture determines the formation of an exclusive material culture [6] and allows the succession of crops in different periods that only rarely disappear altogether, as happened to sugarcane. More often, what happens instead is what La Mantia [30] wrote, "The succession of crops in the Conca d'Oro is determined by market facts... and by the adversities that selectively affect the different species. The sweet orange is partly replaced

by the lemon, which in turn is severely decimated by the Dry Mal that cyclically returns to strike the lemon groves".

Dead plants were replaced by others, not necessarily citrus, without preparing any rational replacement plan. The loquat, which today is a typical plant in the promiscuous gardens of the Conca d'Oro, spread strongly around the 1930s, when the citrus crisis reached its peak. For the same reason, the tangerine, which has been present since the early 19th century, also spread in those years. The end result of these continuous inputs is an extraordinary richness of a "structural" type, which makes the old orchards of the Conca resemble an agroforestry system or a forest [31]. Trasselli [32] wrote about the genesis of this system by reporting documents dating back to the mid-400s AD: "Between the vineyards were inserted gardens, which were not yet citrus forests, as it would be poetic to consider them".

The creation of gardens with more species and with unevenly aged plants, which is the characteristic feature and the beauty of the gardens of the Conca d'Oro, must be understood in the context of the processes that took place over at least two centuries.

The richness of the mixed orchards of the Conca d'Oro is evident both structurally (different levels of vegetation), but also in terms of species and varieties (see [6] and bibliography cited herein). The latter is the result of exchanges and genetic mutations that have occurred in the Conca d'Oro, as in the case of mandarins [33]. Biological diversity and structural richness occurred due to the multifunctional use of many species, such as walnuts and blackberries, which were mentioned in the studies in this area as early as in the 12th century by Falcando, where they were used for both fruit and wood, and they are present in all documents that discuss the Conca agriculture [6].

The loquat, although of recent introduction, in addition to having assumed an important role in Palermo's gardens, has enriched fruit diversity from a structural point of view [34] and provided new niches suitable for the permanence, for example, of various xylophagous insects [35]. Other tree species besides walnut were also planted for the quality and multiple uses of their wood [36], but also for cynegetic reasons, as the Mediterranean hackberry (*Celtis australis*). In this regard, La Mantia [11] writes, "The hackberry was used for making whips in particular, while the berries, during the war and post-war period, were sold in the city (then a separate body from the countryside) along with portions of *Arundo donax*, so that boys, after eating the pulp, could throw seeds through the portions of Arundo used as blowpipes". Trees were deliberately planted at the borders of the gardens and then, at the felling, the owners divided the money resulting from the sale. The versatility of the wood allowed for multiple uses (see [31,36]).

The hackberry trees, laden with berries, were also excellent for hunting birds, as was the laurel (*Laurus nobilis*), which was also cultivated for culinary reasons (the leaves are widely used in traditional Sicilian cooking) (see [11,36] for a more detailed discussion). However, it would be wrong to think that the entire Conca d'Oro plain was irrigated; it was in fact the use of machines for water extraction from the subsoil that allowed, especially in the eastern and northern parts of the city (Piana dei Colli), the development of irrigated agriculture and citrus farming. These machines changed the landscape of the Conca d'Oro in the second half of the 1800s. Not surprisingly, the list of species and varieties reported by Lo Piccolo [37] comprised those of dry arboriculture (Manna ash, almond, pistachio, etc.) (Table 1). Regarding the destruction of the gardens of the eighteenth-century villas of the Plain of the Hills, Alfonso-Spagna [38] writes, "the landscape groves and symmetrical gardens that adorned the mansions of the ancient barons, are nowadays sacrificed to citrus groves without any hesitation, putting the reason of profit before aesthetics". It is precisely the great economic value of citrus fruits that accelerates their spread and the changes the landscape of Conca d'Oro. The most "impressive" description of this process is provided by

an agronomist of the 1800s, Alfonso-Spagna [39]: "In the horticultural lands that surround the greatest number of villages (. . .) the vegetable gardens, in most cases, are converted into citrus groves and the dry seeded fields are provided with irrigating. The vast plains immediate to the suburbs (. . .) the Citrus trees, which now align everywhere occupying most of them. The Vines, the Prickly Pears and the Sumac (. . .) and even the Ash and Olive trees have sacrificed themselves there". This is the reason why dry arboriculture species were either present for a long time (i.e., almond trees) but disappeared.

Some species (chestnut, hazelnut) were introduced during the Bourbon period (1816–1861) but, in fact, have never spread, also due to the unsuitable characteristics of the Conca d'Oro environment. Other species are known to Conca farmers because they are found in mountainous areas (Common medlar, Mediterranean Hawthorn), or are components of the bush, but are not really cultivated (Jujube, Common myrtle, Strawberry tree).

In Table 1 we report on the changes in the varietal stock in the Conca. Of course, this also reflects the periods of introduction of the different species in Sicily.

Table 1. Species and varieties of fruit grown in the Conca d'Oro and the evolution of the varietal heritage (the hyphen (-) indicates that the species is mentioned even though no specific varieties are reported).

Species	15th Century [40,41]	Early 18th Century [42] *	Late 18th Century, First Half of the 1800s [37] **	Germplasm Present (Dialect Name in Italics and/or in Brackets) [6]	Current Trends (Data Collected During This Study)
CITRUS					
Citrus *Citrus* sp.	arbores citrorum et arangiorum, lumie, citranguli, arangiis dulcibus		Agrume bianco (citrus white) (?)		
Bergamot fruit *Citrus bergamia*			(-)		-
Bitter orange *C. aurantium*			(-)	*Arancio cartasu o Arancio amaru*	Stable
Citron *C. medica*				*Citru*	Declining.
Citron lemon (Limone cedrato) *C. medica*		*Piretti maggiuri* (Pa?)	Pirittone; limone cedrato di Firenze; Cedro arancio della Cina (?); cedri di sciorta (cedars of different varieties)	Limone cedrato di Trabia (*Pirittuni*)	Declining (susceptible to the fungus *D. tracheiphila*).
Grapefruit *C. paradisi*				Duncan (*Rapprifrutti*) (deformation of the English name grapefruit)	Stable.
Lemon *C. limon*		Limone Palermitano acido (Lemon of Palermo "sour")	Limoni di sciorta (lemons of different varieties)	Dolce (*Limiuni 'ruci*) §	Disappeared (susceptible to the fungus *Deuterophoma tracheiphila*).

Table 1. *Cont.*

Species	15th Century [40,41]	Early 18th Century [42] *	Late 18th Century, First Half of the 1800s [37] **	Germplasm Present (Dialect Name in Italics and/or in Brackets) [6]	Current Trends (Data Collected During This Study)
				Femminello (*Limiuni*)	Stable. New clones of Femminello are replacing other varieties.
				Interdonato (*'Ntaiddunato*)	Localized in the process of disappearing.
				Lunario comune (*Lunariu*) (in old articles Lunario is called Lunario palermitano)	Declining (susceptible to the fungus *D. tracheiphila*).
				Monachello (*Munacheddu*)	Declining. On the verge of disappearing because it is not appreciated by the market.
				Lo Porto [43]	Was a very localized variety (disappeared).
Mandarin orange *C. reticulata*			Arancio mandrino	Avana (*Mantrino primintiu*); Tardivo di Ciaculli (*Mantrino Tardiu*)	Stable. Still widespread but partly replaced by clementine (*Citrus* x *clementine*) by new hybrids.
Sweet orange *Citrus sinensis*		Nicosia wrote "3 varietes of Portogallo" but not indicate Palermo	Generic orange bat many "Portugal"; Coppola di cardinale (?)	Portogallo (*Purtuallo*) #	In the process of disappearing.
				Tarocco	Stable. Recently introduced.
				Vaniglia (*Arancio 'ruci*) and Vaniglia pigmentato (*Arancio 'ruci sanguinello*)	Stable. Scarcely widespread.
				Washington navel (*Brasilianu*)	Stable. Widespread, replacing other varieties particularly Portugal.
Sweet orange tree born from seed			Arillari di Portogallo	*Ariddaru*	In the process of disappearing (sometimes used to indicate the *Citrus aurantium*).
Sweet lime, s. lemon, s. limetta *C. lumia/limetta*		Lumincella di Tagghieri	Limoncelli dolci o limetta	Limetta (*Lumia*)	Disappeared.

Table 1. *Cont.*

Species	15th Century [40,41]	Early 18th Century [42] *	Late 18th Century, First Half of the 1800s [37] **	Germplasm Present (Dialect Name in Italics and/or in Brackets) [6]	Current Trends (Data Collected During This Study)
OTHER SPECIES					
Almond *Prunus dulcis*	millisie o Amigdalis dulcibus millisiis	Nicosia described many varietes of almond and among them *Cavalera*. . .; *Muddisa*. . .(Pa?)	*Cavaliere*; *Mollesia*	*Muddisa*; *Cavaliera*	Disappeared, were part of dry arboriculture.
Apple *Malus domestica*	Agostine; mele di Napoli; monechate	Nicosia described many varietes of peach and among them *Pumu di Napuli*, *Pumu russuliddu di Napuli* (Pa?)	(-)	Limoncella (*Lumincella*)	Disappeared.
Apricot *Prunus armeniaca*	barkoki ad ossa dulcia	*Valenziano*, *Alessandrino*	Albicocche mandolare	Bufala; Fiorentino; Maiolino (*Majulinu*); *Mussu*; Persicara; Regina (*Reggina*); Regina vaniglia (see [21])	All declining; some also disappeared due to the recrudescence of *Armillaria mellea* fungus.
Bay laurel *Laurus nobilis*		(-)	Alloro imperiale (Bay laurel imperial); Alloro nostrale (Bay laurel, the meaning of nostrale is local)		
Black mulberry *Morus nigra*		Ceusu niuru. . . (Pa?)	(-)	*Ceuso niuru*	Declining. On the verge of disappearance replaced by new varieties.
Banana *Musa* sp.		(-)		*Bananu*	The banana tree is traditionally cultivated in gardens with small plants and is a characteristic feature of the coastal areas of Sicily [44]. Today we are witnessing on the one hand its specialized cultivation precisely in the Conca d'Oro but, on the other hand, also the disappearance of plants typical of the Conca's garden.

Table 1. *Cont.*

Species	15th Century [40,41]	Early 18th Century [42] *	Late 18th Century, First Half of the 1800s [37] **	Germplasm Present (Dialect Name in Italics and/or in Brackets) [6]	Current Trends (Data Collected During This Study)
Carob *Ceratonia siliqua*		(-)	(-)	*Carrubbu*	In the Conca d'Oro plain, it is sporadically present. Declining
Cherry *Prunus avium*	Bianche; callose (i.e., duracine); amarolle (possible Sour cherry)	*Caddusa niura* e *C. russigna* (Pa?); *Cirasa cappucci nigri* (Pa?); variety of Misilmeri, a town near Palermo *Cirasa a Birriuni*	(-)	Cappuccia	Disappeared.
Chestnut *Castanea sativa*		(-)	(-); §		
Common *myrtle* *Myrtus communis*		(-)	(-)		
Common Quince *Cydonia oblonga*			(-)	*Muddisi*; *Sarbaggiu*, *Napulitani*	Disappeared due to the resurgence of the *Armillaria mellea* fungus.
Common medlar *Mespilus germanica*		Nicosia indicates varieties but the common medlar is not cultivated in the plan of Palermo	(-)		
Fig *Ficus carica*	Albe; bifare; Burgisotte; catalaniske (or catalanischi); fricazane (or Fi-cazane/ficazzane); situni (or sicuni); vernitici (winter)	*Uttatta ordinaria*; *U. vranca*; *U. lattara*; *U. cucciusa*; *U. cu la scorcia aspiredda*; *U. minuri cu la scorcia dura*, *virdi oscura* (it is not clear whether the latter is from Palermo); (*Missinisa. . .*; *Ficazzana. . .*; Biffara. . .; *Incurunata. . .*; vera; etc. (Pa?))	Burgesotti, Messinesi, Incoronate	*Bifari*; *Ficazzani*; *Fico r'austu*; *Gentili*; *Missinisi*; *Natalischi*; *Settembrini*	All declining; some also disappeared due to the resurgence of the *Armillaria mellea* fungus.
Manna *ash* or South European flowering *ash* *Fraxinus ornus*			Frascini; (-)		
Hazelnut *Corylus avellana*		(-)	(-); §	*Nuciddi*	Disappeared.
Jujube *Ziziphus jujuba*		(-)	(-)		
Lotus persimmon *Diospyros lotus*			(-)	*Lignusantu*	Declining (it was used for wood).

Table 1. *Cont.*

Species	15th Century [40,41]	Early 18th Century [42] *	Late 18th Century, First Half of the 1800s [37] **	Germplasm Present (Dialect Name in Italics and/or in Brackets) [6]	Current Trends (Data Collected During This Study)
Mediterranean hackberry *Celtis australis*			(-)	*Caccamu*	
Mediterranean Hawthorn, or Azarole *Crataegus azarolus*			Bianche e rosse	*Azzarolu*	Disappeared.
Peach *Prunus persica*	duracine, persici barkoki	*Persica di cuteddu* (*cuteddu* = knife; the peach is hard and can only be cut with a knife; can only be found at the Convent of Santa Teresa in Palermo. Nicosia described many varieties of peach and among them *Persica di Carini*. . .(Pa?)	Eggiziane (?)	Carini o Martorana (*Spaccarella*); Maiolina (*Fraulara*); Settembrina	Disappeared. Replaced by new varieties.
Pear *Pyrus communis*	Blanculilli; brancate (good for jam); muscarelli (or moscatelle); lixuni or lixini, churcameni (giaxameni di Nicosia) or churcameni (yellow with flavor reminiscent of wine)	Piru di la sciorta di Palermu. Nicosia described many varieties of pear and among them *Jazzolu rusatu*. . ., *Moscatelline minime*. . ., *Muscareddi veri*. . ., *Ciminnitu d'invernu*, *Giaxamemi minuri* (Pa?)	Pera d'inverno	Jazzolo (*Pirazzola*, *Piriddu o Carinisi*); Moscatello; Butirra estiva (*Piro butiru*)	Disappeared or Declining. Replaced by new varieties.
Pistachio *Pistacia vera*		(-)	(-)		
Plum *Prunus domestica*	pruni di li frati; blanculillli; massuci	Nicosia described many varieties of peach and among them Rapparini, Pruna occhi di Voi; Pruna di cori, Pruna di Cori janchi (at the Rocca perhaps a district of Palermo), Pruna di cori niuri lunghetti; Pruna di S. Giuvanni o Maiulini (Pa?)	(-)	*Ariddu di cuore*; *Atrigni*; Caleca; Lazarino o Rapparino (*Rapparinu*); *Occhi 'i Voi*; *Prunu Reggina*; Sanacuore (*Prunu 'i coriu*); San Giovanni (*Prunu 'i San Giuvanni*); Susino della rosa (*Santarosa*), *Zuccarinu* o Zuccarini	Declining, partly disappeared.

Table 1. *Cont.*

Species	15th Century [40,41]	Early 18th Century [42] *	Late 18th Century, First Half of the 1800s [37] **	Germplasm Present (Dialect Name in Italics and/or in Brackets) [6]	Current Trends (Data Collected During This Study)
Pomegranate *Punica granatum*	Cartasi (agri = harsh)	*Granatu duci Napulitanu*, *Granatu cartasu* (Pa?)	(-)	*Napulitanu*; *Sarvaggiu*	Disappeared. Replaced by new varieties.
Prickly pear cactus *Opuntia ficus-indica*		(-)	(-)	Bianca (*muscaredda*); Gialla (*Surfarina*); Rossa (*Sanguigna*)	Stable. They are not exclusive to the Conca where they are sporadic.
Olive *Olea europaea*	Biancolilli, Jarraffare, Ogliarole	Nicosia described many varieties of olives and, among them, *Giarraffi*, *Giarraffeddi*, *muddisa*. . .(Pa?)	Olivo di sponsa	*Aliva 'i salari*; *Aliva r'ogghiu*; *Aliva di lo signuruzzu*; *Bianculidda*; *Ogliarola*; *Sanmartinara*	Stable. Olive varieties are not exclusive to the Conca d'Oro.
Oriental persimmon *Diospyros kaki*				Farmacista Honorati; *Napulitanu*	Still cultivated. On the verge of disappearing.
Service tree *Sorbus domestica*	Maryusu	Nicosia described many varieties of the Service tree	(-)	*Zorbu*	Disappeared.
Sour cherry *Prunus cerasus*			(-)		
Strawberry tree *Arbutus unedo*		(-)	(-)		
Walnut *Juglans regia*		Nicosia described many varieties of walnut and among them *Nuci muddisa* . . . (Pa?)	(-)	*Muddisa*; *Cavaliera*; *Pizzuta*; *Romana*; *Sarvaggiu*; *Tumminara*	On the way to disappearance, some disappeared.
White mulberry, *Morus alba*		*Ceusu vrancu minuri paulinu*, *Ceusu vrancu*. . . (Pa?)	Celso paulino	*Ceuso bianco*; *Palinu*	On the way to disappearance and being replaced by new varieties.
Total number of species	16	17	17	32	Stable: 10 Declining: 10 Disappeared: 19
Total number of varieties	30	About 53	About 26	76	(about) Stable: 22 Disappeared: 30 Declining: 106

*: Nicosia [45] only a few times explicitly indicates that the name is used in Palermo, we have reported (with the exception of citrus) other names similar to those used in Palermo; the suspension points. . . are used because he expands on the characteristics of the fruit, or to say that multiple varieties are indicated; **: many species were introduced during the stay of the Bourbon kings in Palermo (see [46]), especially pistachios and hazelnuts (even chestnuts, which did not take root as no plants of this species remained). With §, we have indicated the species that have not spread to gardens. The same is true for many of the citrus species/varieties indicated by Lo Piccolo that are not traceable to any known species and varieties, and are therefore indicated with ? #: for the history of this variety see [47].

We have separately reported the loquat (Table 2) which, although only recently introduced (late nineteenth century, see [34]), has enriched the varietal heritage of the Conca d'Oro, with effects on the agroecosystem [48].

The species spread from seeds, "originating" new varieties, that, if appreciated, were multiplied by farmers; each district of the Conca d'Oro had "its" own varieties. Actually, from the beginning of the last century, numerous varieties are mentioned: Lo Priore [49] writes "it now counts, by virtue of its easy reproduction by seed, a large number of varieties". Some authors, such as Santarelli [50], Megna [51], and Guzzini [52], report some varieties, shown in Table 2; however we preferred to report the names scientifically collected by Crescimanno [46,48,53], which reflect this diversity.

Table 2. Varieties of loquat cultivated in the Conca d'Oro, and the trends of the varietal heritage.

Sprenger [54] and De Rosa [55]	Crescimanno [46,48,53] *	Varieties not Reported in the Literature [11]	Trend
They write that in Palermo, Messina, and Catania there are countless varieties, and report that in Palermo and Alcamo the following varieties exist: Palermo; Limoncello; Conca d'Oro (nespolo fragola) (strawberry medlar); Monreale; Nespolo a un seme (single-seeded loquat); Santa Rosalia.	Nespolone bianco; Nespolone di Ficarazzi; Nespolone gigante bianco; Nespolone gigante bianco lungo; Nespolone gigante bianco tondo; Nespolone Marchetto; Nespolone rosa precoce; Nespolone rosa tardivo; Nespolone rosso; Nespolone rosso precoce; Nespolone rosso da seme; Pelosella; Sciorta di Don Pietro; Virticchiara bianca; Vaniglia bianca; Vaniglia.	*A piriddu*; *Dell'Acquasanta*; *Nascuta*; *Sarvaggia bianca*; *Giganti.*	The species is disappearing not only from the study area, but from Sicily in general, and its varieties are reduced to very few. Selected Spanish varieties are also spreading but the species however is disappearing.

*: Some varieties were designated for areas contiguous to the Conca d'Oro where agriculture was erased, however these were also cultivated and spread in the Conca d'Oro.

3.2. Monreale

Table 3 shows the species and varieties cultivated in the Monreale area. Although specific studies are lacking, with the exception of those reported, a great historical richness emerges from the "gray" literature. Schirò [56] reports a 16th century document; he writes that citrus (3148 trees), peach (59,071), plum (58,526), common medlar (50,210), pear (36,046), quince, fig, pomegranate, cherry, mulberry, walnut, etc., were present. Again, Schirò [56] writes that citrus farming was developed in the 1600s and increased in the 1700s, when new canals were created for irrigation and the use of springs was increased. Cassinese Abbot Michele Del Giudice in 1702 [45], referring to the landscape that can be admired from the city of Monreale, reports "a true paradise of amenity, for the near and distant prospect of fertile gardens".

Salmon Thomas [57], an 18th-century traveler, describing the town Monreale, also mentions the gardens that surround it: "It is a small town, set over a most pleasant hill all around clothed with beautiful fruit-bearing plants". Again, Salmon Thomas [57] writes the following about the Sicilian economy: "it trades in the citrus fruits which abound in the fields of Palermo and Monreale".

While lemon cultivation in the 1700s generated large revenues, Monreale gardens in the 1700s also featured other fruit crops. A more specific indication of the cultivation orientation in the first half of the 18th century is contained in an archival resource from 1735, in which the improvement works performed in a farm near Monreale are described [58]. Here, it lists the presence of 2930 trees divided into pomegranates (135), common medlar (81), walnut

(39), pear (32), citrus (42), Mediterranean hackberry (56), grapevines on pergola (52), fig (65), white mulberry (2), willows (25), myrtle (1), plums of the "*cuore*" and "*muscarelle*" varieties (2000), and "plums di *cuore atrigne*" (400) ("*atrigne*" is the name used even today for wild plums; it would seem that plants born from the seed of the "*cuoreatrigne*" variety were used as rootstocks). Speaking of the white mulberry tree, it is noteworthy that in the past there was always a tree of this species next to country houses, perhaps a legacy of when small farmers grew a few trees to allocate the leaves for silkworm breeding [59].

In the nineteenth century, agriculture was flourishing, and the descriptions, albeit generic [56], confirm the presence of all the species seen before, but also of vineyards and tree-lined vineyards, olive groves, sumac groves, reeds, almond trees, and prickly pears. This trend is confirmed by Amati [60], in which the Monreale entry reports "Its territory is very fertile in olive trees, vines, citrus fruits, orange trees, and other fruit trees whose fruits are also exported", and by a 1905 yearbook [61], which reports that the area produces "large oranges with an exquisite taste, liqueurs, wines, oils and sumacs".

Schirò [56] describes the change in agriculture taking place at the beginning of the 20th century: the vineyards were destroyed by phylloxera, the citrus fruits by fungi that attack the roots, the sumac groves were reduced, the olive trees were partly cut down to produce firewood. Interviews conducted with farmers confirm this process, with respondents in particular relying on the accounts of their parents or grandparents, recounting the debacle of grapevines due to phylloxera and their partial replacement with citrus.

A mixed orchard was therefore established, partly irrigated, and with the presence of species such as willow and canes to be used for the preparation of baskets and as fruit containers, before the advent of wooden boxes in the second half of the last century [56]. At the same time, the Monreale area also saw a return of olive groves, a reduction in lemon groves, and the predominance of mixed-fruit growing, especially plum trees [56]. As the theses [18,62] also demonstrate, until the middle of the last century there was a great diversity of species and varieties; in fact, Lo Piccolo [62] writes, "there are numerous orchards. . . with a mixture of varieties". This mixture of species and varieties found in the gardens of Monreale was the result of the farmers' need to have a source of income and/or food at all times of the year. In fact, there was no time window without the fruits of any species until December, when the fruits of varieties known as "*nataline*" (fruits that ripen for Christmas) were harvested or consumed.

In the less productive winter months, some fruits with different peculiarities were stored in order to have a substantial amount of stock. In this regard, mention should be made of pears of the "*marginelle*" or winter pear variety, described by the farmers interviewed as the tastiest pears of any other variety, which were tied to the stem with a string to form a necklace and hung in the attics of rural houses to await their ripening. Similarly, the rowan fruits (*Sorbus aucuparia*) combined with the leaves were tied to form a garland called "*curuna*" (crown), which was hung waiting for the fruits to ripen. Another case of fruit preservation techniques concerns the plums of the "*Ariddu di cori*" variety, which were wrapped in tissue paper (used for processing lemons) to form a braid which allowed their dehydration and the possibility of consuming them in winter (Figure 2).

The use of wild species such, as jujube or strawberry trees, confirms how the Monreale area maintains its "natural" characteristics that have disappeared in other areas of the Conca d'Oro. Agriculture in Monreale maintained a relationship with other agricultural and pastoral activities in the area until a few years ago, for example, or until a few decades ago, when shepherds took sheep to the orchards to graze on the grass, receiving ricotta cheese and lambs for Easter in return. In the plain of Palermo, on the other hand, animals, such as cows, were kept in stables, and grass was reaped in orchards [6].

(**A**)

(**B**)

(**C**)

(**D**)

(**E**)

(**F**)

Figure 2. Some examples of the peculiarities of the studied area: fruits of the Loquat variety "*Nascuta*" (with the nose) (**A**); apricot fruits of the "*Majulinu*" variety (which ripens in May) (**B**); orange fruits of the "Portugal" variety (**C**) and a bottle of the juice (**D**); plum fruits of the "*Sanacore*" variety (slow food presidium) (**E**); and "*I trizzi*" (fruits wrapped in soft paper) (**F**).

Table 3. Species and varieties cultivated in Monreale and their trends.

Species	Germplasm Present (The Italian Name in Brackets)	Trend
CITRUS		
Sweet orange *Citrus sinensis*	Tarocco *Arancio 'ruci* (Vaniglia)	Declining Declining
Bitter orange *C. aurantium*	*Arancio amaru*	Stable
Lemon *C. limon*	*Limiuni 'ruci* (Dolce) *Limiuni* (Femminello) *Lunariu* (Lunario comune) *Munacheddu* (Monachello)	Declining Stable Stable Stable
Sweet lime, s. lemon, s. limetta *C. lumia/limetta*	*Lumia* (Limetta)	Declining
Mandarin orange *C. reticulata*	*Marzuddi* (Tardivo di Ciaculli)	Declining
OTHER SPECIES		
Almond *Prunus dulcis*	*Muddisa* *Cavalera*	Declining
Apple *Malus domestica*	*Puma*	Disappeared
Apricot *Prunus armeniaca*	Bufala * Fiorentino *Majulinu* (Maiolino) * Persicara * *Reggina* (Regina) (Fatta del Bosco [21] describes a "Regina vaniglia" variety present at the time with 5 specimens, we do not know if it is synonymous with the "Regina")	Disappeared Declining Disappeared Disappeared Declining
Azarole *Crataegus azarolus*	*Azzarolu bianco* *Azzarolu russu*	Declining Disappeared
Black mulberry *Morus nigra*	*Cevusa nivuri*	Stable
Carob *Ceratonia siliqua*	*Carubbu*	Stable
Cherry *Prunus avium*	*Marena cirasa*	Disappeared
Common myrtle (white) *Myrtus communis*	*Murtidda*	Disappeared
Common quince *Cydonia oblonga*	*Cutugnu*	Declining
Fig *Ficus carica*	*Bifari bianchi* *Ficazzani* *Incurunati* *Missinisi* *Natalini* *Ottate* (figs that ripen in June) *Sarbaggia*	Stable Declining Disappeared Disappeared Disappeared Stable Stable
Lotus persimmon *Diospyros lotus*	*Lignusantu*	Stable
Mediterranean hackberry *Celtis australis*	*Caccami* (declining also for the spread of alien species such as Ailanthus altissima)	Declining
Peach *Prunus persica*	The species has effectively disappeared and so has the memory of its name	Disappeared

Table 3. *Cont.*

Species	Germplasm Present (The Italian Name in Brackets)	Trend
Prickly pear cactus *Opuntia ficus-indica*	*Muscaredda* (Bianca)	Declining
	Surfarina (Gialla)	Stable
	Sanguigna (Rossa)	Stable
Oriental persimmon *Diospyros kaki*	*Cachì*	Declining
Jujube *Ziziphus jujuba*	*Nzinzula*, no varieties are known	Declining
Loquat *Eriobotrya japonica*	*Virticchiaro*	Declining
	Giagante bianco	Declining
	Gigante rosso	Declining
Olive *Olea europaea*	*Aliva salara* (Nocellara del Belice)	Stable
	Aliva r'ogghiu (Ogliarola)	Declining
	Bianculidda (Biancolilla)	Stable
	Sanmartinara	Declining
	Cirasola (Cerasuola) (in the neighboring municipality of Altofonte called Marfia)	Stable
		Declining
	Giarraffa	Disappeared
	Pateddara	Disappeared
Pear *Pyrus communis*	*Azzola*	Stable
	Azzulune **	Declining
	Butira **	Declining
	Caruseddi	Disappeared
	Cosci i ronna	Stable
	Genuine	Stable
	Gentile	Declining
	Lapo	Disappeared
	Marginelli **	Declining
	Pumiddu **	Declining
	Vardara	Disappeared
	Virdi fatti **	Disappeared
	Zuccarino **	Disappeared
Plum *Prunus domestica*	§*Ariddi i core* or *Ariddu i cori* ***	Stable
	Atrigni	Stable
	Caleca ***	Stable
	Lazzarino or Rapparino ***	Stable
	Occhi 'i Voi	Disappeared
	Pruna i vrunu	Declining
	Pruna a rosa ***	Disappeared
	§ *Sanacore* or *Prunu 'i cori* ***	Stable
	§ *Sanacore tardie*	Declining
	San Giuvanni ***	Disappeared
Pomegranate *Punica granatum*	*Denti i cavaddu*	Disappeared
	Granata	Declining
Service tree *Sorbus domestica*	*Zorbe nataline*	Declining
	Austine	
Sour cherry *Prunus cerasus*	*'Marena*	Declining
Strawberry *Arbutus unedo*	*'Mracoli*	Declining
Walnut *Juglans regia*	*Muddisa*	Declining
White mulberry *Morus alba*	*San Giuvanni*	Declining

Table 3. *Cont.*

Species	Germplasm Present (The Italian Name in Brackets)	Trend
Total number of species: 31	Total number of varieties: 79	Declining: 34 Disappeared: 22 Stable: 23

*: cited in Fatta del Bosco [21]; **: cited in Stassi [18]; ***: cited in both Fatta del Bosco [20] and Stassi [18]; § varieties protected by slow food protection and recognized as a traditional agri-food product.

4. Discussion

The Reasons for Change

The extraordinary richness of the specific and varietal heritage of this territory probably has no equal in the Sicilian territory. This is due not only to environmental factors, but also because the area has been a source of cultural exchanges and crops since the dawn of civilization, which has left both material and immaterial signs [6]. Significant, in this sense, is the presence of numerous varieties called "napulitani" (i.e., coming from Naples). The differences in the specific and varietal compositions in the two municipalities was determined to have occurred due to environmental reasons, mainly the greater presence of clay that relegated Monreale citrus to the few most suitable places. However, as the data shows, a loss of species and varieties has occurred in this area.

The disappearance of orchards causes a loss of biodiversity, as verified in other cities (see [63,64]). However, in the area we studied, irrigation plays an important role. As far as the absence of competition with animals is concerned, it should be underlined that in our study area, abandoned areas facilitate the spread of rats (*Rattus norvegicus* and *R. rattus*), leading to predation on fruits in cultivated areas. Meanwhile, in Monreale, wild boars have become a problem (*Sus scrofa*).

What is common to the two areas, however, is the decrease in species and varieties, the reasons for which are as follows: (1) urban expansion has taken away numerous agricultural surfaces and caused the abandonment of agricultural land and the use of land for other needs [10] (from 1850 to 2007, urban areas increased from 1.431 to 6.374 hectares, while agricultural areas decreased from 9.075 to 2521 hectares); (2) the difficulties in irrigation [11,65]; (3) the resurgence of some pests (*Armillaria mellea*) that have reduced, and are reducing, the numbers of the most sensitive species; (4) land fragmentation due to land being divided among heirs and due to urbanization reducing competitiveness in markets [62,66]; (5) the reduction in the agricultural component in the population [67] and the disappearance of the older generation.

These factors, causing the loss of fruit diversity, are similar to those identified in Sardinia [68]: introduction of modern varieties; new pests and disease; environment degradation and disturbance (among which desertification and decline of farming population); urbanization; market failure; and competition with domestic livestock and wild fauna.

Points 1 and 2 are closely related, and we would like to focus on them, as the connections between irrigation and the conservation of fruit diversity and biodiversity, in general, are little known. Urbanization often destroys old irrigation channels, leading to the abandonment of some agricultural areas. Small farmers, in fact, cannot cope with the bureaucratic obstacles related to the restoration of irrigation canals that now partially lie beneath urban streets.

Historically, irrigation in the Palermo plain territory required water extraction and collection systems, that, since historical times, have been performed with technologies introduced during the period of Muslim domination (see [6]). In the Monreale area, which is closer to the aquifers, there are numerous springs [69] and peculiar water collection

systems [6]. The impossibility of irrigation determines an overall reduction in the diversity of the system; less demanding species such as the olive tree are spreading, but, agronomic techniques are also changing. The technique that allowed the extraordinary flowering and irrigation by inducing stress on lemon plants is disappearing [65]. Modern irrigation systems are introduced, that allow water consumption to be reduced, but lose the ecological advantages connected to the use of the traditional systems of irrigation [6], while the water from the springs and Qanats (vertical draining wells of Persian origin) is also being lost in the sewers.

Unfortunately, an active contribution is missing from the administrations of the two cities, which should, first of all allow, the possibility of irrigation, using the water that flows in underground rivers, and also commit to guaranteeing the care and maintenance of small irrigation infrastructures. The approach, instead, is unthinkable for large distribution plants connected to large artificial lakes [67], despite the fact that more than 50 years of this approach have demonstrated its ineffectiveness. The precariousness of irrigation also has an impact on both natural diversity (see [6]) and fruit varieties; the impossibility of irrigating reduces the farmers' attention towards these aspects. Especially in a period like this when, as climate data shows, climate change reduces water availability. These changes have an impact on agriculture by enhancing the spread of some fungal diseases, but at the same time, they should push us to safeguard what remains of agriculture. Studies conducted by the writer, in fact, have confirmed the role of agricultural vegetation in Palermo in reducing the urban heat island (UHI) (i.e., the difference in temperature between urban and rural areas).

Regarding point 3, there has been an increase in the resurgence of some pests (such as *Armillaria mellea*), that have reduced, and are reducing, the most susceptible species such as *Eriobotrya japonica*; this is related to climate change [70].

Regarding point 4 (land fragmentation and reduced competitiveness in markets [62,66]) and 5 (the reduction in the agricultural component in the population [67] and the disappearance of the older generation), these two phenomena are connected; point 5 is, however, connected to point 1. In some cases, in fact, urbanization interrupts irrigation channels or makes the cultivation of residual patches of gardens further complex and expensive.

Regarding the market problems, it should be noted that if this problem occurs for crops such as vines, for which there are regulations that favor the simplification process of mixed agriculture (see [71]), then this phenomenon is secondary in the area studied. Production is, in fact, often directed towards local markets.

5. Conclusions

The protection of this germplasm becomes essential especially in the period of climate change, since many varieties have adapted to a warm climate. In addition, many of these varieties are particularly early, like the apricot variety "*Majulinu*", which manages to escape the attack of the fruit fly (*Drosophila melanogaster*)—a growing problem for fruit growing, which translates into a reduction in agrochemicals.

In response to this, the Sicilian Region has launched several initiatives, such as public collection centers for disappearing varieties, and "custodian farmers"—guardians of fruit diversity—etc. [72]

The importance of peri-urban agricultural areas is well known in the developing countries and in Mediterranean countries (although this division is not so rigid), and all agree in reporting its importance, its decrease due to the growth of cities, and the signs of revitalization [73–75]. Despite of what was reported in the previous paragraphs, there are some positive signs for agriculture in the Monreale and Palermo area.

For example, there is the Slow Food Presidium, an initiative to protect and promote unique and endangered local food products. By focusing on sustainable agriculture and traditional methods, this Presidium helps sustain biodiversity and cultural heritage. The "Monreale White Plums" Slow Food Presidium initiative was established in 2006 to preserve the "*Sanacore*" and "*Arridicore*" plum varieties, which have been cultivated for generations in the Monreale area. The Presidium has helped revitalize interest in these plums by raising awareness of the importance of preserving local biodiversity. Another example is the valorization of the Late Mandarin of Ciaculli (https://www.tardivodiciaculli.net/ last accessed on 7 April 2025), which promotes two varieties of mandarin "born" in the Conca [33].

But there are many other small and large activities, such as the valorization of the Portugal orange [47] and the right recognition of the value of lemons. Furthermore, the urban gardens spread to many parts of the city, and the mixed gardens also fulfill other social functions [76], as they have a strong symbolic value that also determines social status, work, and relaxation. The impulse from the people coming from other countries, who further value the "traditional" products of the Conca, such as the exotic but ancient *Sechium edule* [77], also helps. Thanks to all these initiatives, the surviving areas of the Conca are returning to their past economic function.

However, we cannot ignore the environmental and landscape functions of agriculture, that today perhaps prevail over the economic ones.

Author Contributions: Conceptualization, T.L.M.; methodology, T.L.M.; formal analysis, T.L.M. and D.A.; investigation, T.L.M. and D.A.; data curation, T.L.M.; writing—original draft preparation, T.L.M. and D.A.; writing—review and editing, T.L.M. and D.A.; visualization, T.L.M. and D.A. All authors have read and agreed to the published version of the manuscript.

Funding: This work was supported by the National Biodiversity Future Center Project (NBFC), identification code CN00000033, CUP B73C22000790001 (Spoke 3-Biodiversity), and the National Recovery and Resilience Plan (NRRP).

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Dataset available on request from the authors.

Acknowledgments: This work is dedicated to Marilu Monte who dedicated her short life to the protection and enhancement of agriculture in Monreale. The authors also thank the numerous farmers of Monreale and Palermo who provided us with the information and who cherish this memory and the anonymous reviewers for their valuable rereading work and suggestions. We would like to thank Daniela Patti who works in the Department of Agricultural, Food, and Forest Sciences (SAAF) library for her invaluable help in bibliographic research. We would also like to thank the anonymous reviewers of the article who contributed greatly to improving its quality.

Conflicts of Interest: The authors declare no conflicts of interest.

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