Geographical indications and sustainable food systems

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Abstract:

Geographical indications (GIs) have been used globally to denote quality of a product related to geography, raw materials, particular skills, or other processing techniques. In recent years, agencies such as FAO have been encouraging further development of GIs around food and agricultural products to support sustainable development. Considering the pressing need for more sustainable food systems, we ask: Are current GI schemes working to promote sustainability in food systems, and if so, how? We examine this question with analysis of current GIs for agricultural crops in Italy. We developed a Java-based application to compile, read, index, and search the corpus of files retrieved from the eAmbrosia database, which houses GI applications and registrations for agricultural products. We find several examples of GIs mandating and protecting sustainable modes of production. We conclude with a discussion of this geographic scheme in Italy, implications for sustainable development, and considerations for U.S. food systems.

1. Introduction

Geographic indication protections (GIs) have been used globally to indicate quality of a product related to geography, local raw materials, particular skills in use, or other processing techniques. GI labels are also intended to increase the economic value of goods and protect local economies, however, they are not solely commercial or legal vehicles (Giovanucci et al. 2009). In addition, they can provide transparency and assure consumers about certain features of the goods they are purchasing, and support local culture and tradition. While GIs for food or drink may be those that first come to mind, GIs currently exist for thousands of products, protecting not only ingestibles and potables but also handcrafted products such as glass (e.g., Murano glass in Italy) or fabrics (e.g. Mysore silk in India). In terms of success of these GIs in accomplishing economic and developmental goals, results are not uniform, though the studies that have been conducted tend to find more success than failure (Giovanucci et al. 2009). In recent years, agencies such as FAO have been encouraging further development of GIs specifically around food and agricultural products to improve rural development and promote food diversity, and to ultimately support sustainable development (Vandecandelaere et al. 2009).

Linking the establishment of GIs to processes of sustainable development creates scope for harnessing GI frameworks to actively promote and enforce sustainable activity in food and agricultural production. Taken further, GIs could work toward achieving broader impacts, such

as those linked to the Sustainable Development Goals. Considering such goals and the pressing need for more sustainable food systems, we ask the following questions: Are current GI schemes working to promote sustainability in food systems, and if so, how? We examine this question with an analysis of all current GIs for foods in Italy. We chose a nation within the European Union's GI program because the protection of GIs is the most developed here (O'Connor 2004), data were comprehensive and readily available for the EU, as opposed to the United States, and focusing on Italy is part of a broader project around sustainable food production currently underway by the authors. Following our analysis of Italian GIs on agricultural commodities, we conclude with a discussion of how this economic scheme may support sustainable food systems broadly in the U.S. and globally.

2. Background

2.1 Geographic indications in Europe

The widest known GI labeling scheme may be that which is currently supported by the European Commission and was instituted in 1992. Prior to this, rules around protecting the origin of products had existed in some form in places like France since the 14th century (Becker 2009) or Yugoslavia since the 13th century (O'Connor 2004). GIs identify goods as "originating in a delimited territory or region where a noted quality, reputation or other characteristic of the good is essentially attributable to its geographical origin and/or the human or natural factors there" (Giovanucci et al. 2009).

The function and definition of GIs in Europe relate to the larger context of the European Union's (EU) Common Agricultural Policy (CAP). The CAP was established in 1962, aiming primarily at that time to support the production of affordable food for the EU and provide income support for farmers (European Commission 2021a). Since then, the goals and mechanisms of the CAP have been revised multiple times, including in 1992 when GI legislation was first established. In 1992, the CAP shifted from focusing on price support and production quantity to rural development and food quality, while also explicitly encouraging farmers to be more environmentally friendly (Becker 2009; Cantore et al. 2011). Also around this time, the EU established legislation on organic production ((E.C.) No. 2092/91), and the 1992 Rio Earth Summit took place, during which Agenda 21, a global plan for sustainable development (United Nations 1993), was laid out. Legislators have recently outlined the objectives and foci of the CAP after 2020, which will include more climate and environmental objectives in addition to aspects of fair competition, farmer income, food quality, and rural development (European Commission 2021b).

GIs in the EU are expected to perform in a number of ways. These include maintaining fair competition among farmers, adding value to foods produced, providing relatable product information for consumers so they can make informed choices, protecting intellectual property, ensuring integrity of the internal market, and supporting rural development (Albuquerque et al. 2018). In addition, GI protection should be thought of as a form of collective action in which producers define the rules of production, product characteristics, and applicable geographic boundaries (Barjolle and Chappuis 2000; Ruiz et al. 2018). Producers collectively manage the reputation of their products, and they adapt when conditions (technological, environmental, socio-cultural, within industry, or within the market or food system) change by utilizing an amendment system for these GIs. Amendments can be made to any of a number of sections within the product specification, such as the product description, methods of production, or geographic area (Ruiz et al. 2018).

The three most frequently used GIs in the EU are Protected Designation of Origin (PDO), Protected Geographical Indication (PGI), and Traditional Specialties Guaranteed (TSG), established by regulations (E.C.) No. 2081/92 (for PDO/PGI) and (E.C.) No. 2082/92 (TSG). These EU-level GIs were "inspired by" national-level designation of origin schemes such as the French *appellation d'origine contrôlée* (Allaire and Sylvander 2011: 115) or the Italian *denominazione d'origine controllata*. The rules surrounding these three GIs were repealed and replaced by updated legislation in 2006 ((E.C.) Nos. 510/2006 and 509/2006 respectively), and in 2012, two additional GIs were added: Mountain Products and Product of Island Farming.

Each of the three most used GIs are defined in the legislation, which also defines specific terms such as "raw materials" and "traditional." Albuquerque and colleagues (2018: 2484) lay out the three definitions drawn from 2012 legislative documentation (E.C. No. 1151/2012):
PDO: "identifies a product: (a) originating in a specific place, region or, in exceptional cases a country; (b) whose quality characteristics are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors; and (c) the production steps of which all take place in the defined geographical area"
PGI: "identifies a product: (a) originating in a specific place, region or country; (b) whose given quality, reputation or other characteristic is essentially attributable to its geographical origin; and (c) at least one of the production steps of which take place in the defined geographical area"
TSG (used far less frequently): "describes a specific product or foodstuff that: (a) results from a mode of production, processing or composition corresponding to traditional practice for that product or foodstuff; or (b) is produced from raw materials or ingredients that are those traditionally used"

2.2 Geographic indications in the United States

The U.S. has shown interest in legally protecting GIs of foods since the second half of the nineteenth century. Efforts at this time were closely intertwined with concerns of assuring food safety more generally. In addition, as broader transportation networks evolved, producers faced increasing competition, and thus commercial concerns were also central at this time. At the federal level, major legislation in 1902 and 1906 provided widespread mechanisms for protecting food. The 1902 Act, sometimes characterized as the misbranding act, was designed to protect geographical indications. It was soon subsumed by the 1906 Act, however, which was driven by concerns for food safety and protecting local businesses from unfair competition. Four decades later, the Lanham Act provided protection for products specifically via certification and collective marks, and in the 1990s, the U.S. saw state-level statutes, similar to the PGI scheme of the EU, put in place to protect items such as Vidalia onions, Idaho potatoes, and Florida oranges (Melkonian 2005).

The underlying intentions and associated legal framework for GIs in the U.S. are fundamentally different from those governing food and drink in the EU. While appellations of origin to designate viticultural areas in the US exist, the majority of GIs are legally viewed and regulated as a form of intellectual property, as brands and trademarks (Harvey 2017; Johnson 2017), while in the EU, GIs function as food quality standards and assurances. That is to say, the U.S. takes a private law approach while the EU takes a public law approach, and while the two approaches differ in terms of conditions and scope of protection, they both establish rights for collective use as long as producers are in compliance with defined standards (Johnson 2017). Treating GIs as intellectual property is not unique, with well over 150 other countries protecting GIs in this manner (Giovanucci et al. 2009). One way to summarize the difference in the way GIs are viewed in the EU and U.S. is by then-USDA Secretary Vilsack's explanation of how the EU system of protections for GIs "doesn't fit well into our trademark system because U.S. law seeks to protect the end agricultural product, not the process through which it is made" (Marshall 2014).

The U.S. Patent and Trade Office (PTO) defines GIs as "indications that identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographic origin." The PTO registers GIs as trademarks, certification marks, and collective marks, described by Johnson (2017: 12) as the following:

> Trademarks "protect words, names, symbols, sounds, or colors that distinguish goods and services from those manufactured or sold by others and to indicate the source of

> the goods. Trademarks, unlike patents, can be renewed forever as long as they are being used in commerce."41 Trademarks registrations are renewable for 10 year terms. Trademarks are distinctive signs that are used by a company to identify itself and its products or services to consumers and can take the form of a name, word, phrase, logo, symbol, design or image, or a combination of these elements. Trademarks do not refer to generic terms, nor do they refer exclusively to geographical terms.42 Trademarks may refer to a geographical name to indicate the specific qualities of goods as either certification marks or collective marks.
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> Certification marks refer to "any word, name, symbol, device, or any combination, used, or intended to be used, in commerce by someone other than its owner, to certify regional or other origin, material, mode of manufacture, quality, accuracy, or other characteristics of such person's goods or services, or that the work or labor on the goods or services was performed by members of a union or other organization."
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> Collective marks refer to "a trademark or service mark used, or intended to be used, in commerce, by the members of a cooperative, an association, or other collective group or organization, including a mark that indicates membership in a union, an association, or other organization"44 and "may include a mark which indicates membership in a union, and association, or other organization."

Products registered as one of these marks are not designated by further descriptive fields such as "geographical indication", and therefore it is not possible to easily compile a complete list of registered GIs in the United States (Johnson 2017).

2.3 Sustainable food systems

According to the Food and Agriculture Organization of the United Nations (FAO), sustainable food systems "(deliver) food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised" (2018). FAO specifies further that sustainable food systems are profitable, have a social benefit, and impact the environment in a neutral or positive way (ibid.). After gradually emerging in the 1980s, this three-pillar paradigm has become a ubiquitous, if not rigorously analyzed, conceptualization of sustainable development (Purvis et al. 2019). This paradigm generally defines sustainability as constituted by social, ecological and economic aspects, with all three pillars necessary to the process of sustainable development. In the words of Viederman (1994), sustainable food systems support economic security, ecological integrity, and social democracy.

In practice, it may seem that GIs have been designed principally for economic ends. However, the scope for GI protections to help achieve sustainable development across these three pillars is in fact broad. Within the context of rural development, GIs and other quality schemes can not only support economies but can highlight and promote local values and culture, including environmental stewardship and preservation of biodiversity, indigenous knowledge and skills, quality of life, reduction of poverty, and collective action and local decision making (Albuquerque et al. 2018; Vandecandelaere et al. 2009).

Motivated by the global crises of climate change and the COVID-19 pandemic as well as damaging trends of corporate consolidation, pollution, erosion, and biodiversity loss in the global food system, this research investigates the potential role of GIs in the development of more sustainable food systems along the lines of the three pillars. More specifically, we ask what GIs can do to provide economic security for farmers, social benefits to communities, while also protecting agricultural landscapes from pollution, erosion and further biodiversity loss. Using data from GI registrations in Italy, we consider a range of actions that would support sustainable food systems, ranging from crop and farm management techniques to fair labor practices. We investigate the extent to which any actions have been enshrined and protected as part of any GI registrations for agricultural crops. Where we find this to have occurred, it tends to be action related to environmental sustainability, in contrast to action related to social sustainability, where we find very few examples. We

3. Methods

We chose one European country, Italy, on which to focus analysis and inquiry as to the potential of GI schemes to protect and promote sustainable food systems across economic, environmental, and social sustainability. As of May 2020 when we pursued this research, Italy had the most GI registrations (PDO, PGI, and TSG) of any EU country, with 135 of those for agricultural crops, 57 for livestock, and 149 for value-added products. The European Commission compiles geographical indication registrations and applications for registration for foods and agricultural products in the eAmbrosia database (formerly the Database of Origin and Registration, or DOOR). Focusing on the Italian agricultural crop registrations in this database, we built a search application (described below) to search each file for the occurrence of a set of words associated with sustainability. The set of terms was developed through consultation with Italian and American colleagues in the field of food systems (see table 1 for full list).

We developed a Java-based application that uses Apache Lucene and Apache PDFBox APIs to compile, read, index, and search the corpus of files retrieved from the database based on any user-specified query. The application was initially built, packaged and deployed using IntelliJ

IDEA IDE. The search then returns a list of the relevant PDF documents, in descending order of TF-IDF score. The TF-IDF is a product of term frequency and inverse document frequency. Term frequency is the frequency of a word in a document, and inverse document frequency is a measure of the significance of a term in the body of texts in question, in this case, the 135 registrations for Italian agricultural crops. The TF-IDF score then gave us an indication of both which texts to review, and the degree to which we could expect each text to be relevant to the search at hand. Each search was created by grouping the search terms into categories with respect to the three sustainability pillars (economic, social, environmental) and then aspects of each pillar as they relate to points in the commodity chain (e.g., crop/land management, fertilization, harvest/processing; see table 1 in the Results section for the classification of pillars by categories and their associated query terms). We did not simply dump all search terms together in a single search across the documents.

We utilized this search application as the first step in analysis to help focus the task of manually reviewing the documents for pertinent sustainability text, which would have required a small army of coders if we wished to code by hand for the lengthy list of search terms that we developed. We then reviewed the pertinent documents by hand to examine the contexts in which different search terms were found, how they were used, and whether they helped indicate or point to anything actionable in the registrations that could be leveraged to promote or ensure economic, social, or environmental sustainability.

4. Results

We found the following terms used in 112 of the total 135 petitions for agricultural crops.

Table 1. Sustainability Terminology Found in Geographical Indications

Sustainability Pillar	Category	Query Terms	# Crops
Environment	Crop/Land Management	**crop rotation** \ **rotat*** \ cover crop \ no till \ low till \ **till*** \ monoculture \ intercrop \ riparian buffer \ riparian \ nutrient runoff \ **erosion** \ **pollut*** \ **conserv***	29
	Fertilization	**pollinat*** \ **manual** \ **mechanical** \ **chemical** \ **manure** \ **compost*** \ **synthetic**	15
	Harvest/Processing	**mechanical \ manual \ plastic** \ crate \ no waste \ low waste \ **waste \ chemical \ synthetic \ machin***	66
	Disease/Pests	**Pesticide** \ **herbicide** \ fungicide \ **integrated pest management** \ **weed*** \ **chemical** \ **synthetic** \ **machin***	18

	Crop Sustainability	genetic diversity \ heirloom \ perennial \ biodivers* \ **indigenous \ heritage** GMO \ **chemical**	38
	Models/Paradigms	**organic** \ biodynamic \ permaculture \ agroecolog* **sustain*** \ agroforestry	43
Social	Social Justice	fair wage \ fair working conditions \ racial equity \ ethnic equity \ gender equity \ **work*** \ labor \ **safe***	48
	Cultural	**Celebration \ celebrat* \ festival \ tradition* \ fair**	89
Economic	Economic development	**local \ regional \ economic \ resource \ trade ** monetary **\ market \ income \ competition \ compet* \ rural \ development \ develop***	106

*Emboldened terms were found in at least one GI document

Overall: Most of the search terms are used out of the context we anticipated. Many are used to justify the GI but not necessarily maintain or protect any particular mode of production. Still, several examples exist of GIs supporting sustainable methods. Additionally, amendments are often used to shift modes of production with changing climate, labor, and the availability and affordability of inputs.

Crop/Land Management: Most common to this query we find terms like “conservation”, “conserving” and “conservability”. The GI petitions for 16 crops mention some form of the term conserve. Most often the petition is describing the qualities of the geographic landscape or the current agricultural/processing methods that contribute to the quality of conservability. This simply indicates that the crop can maintain its high quality over a long period of time in storage. A couple petitions - Patata della Sila and Aceto Balsamico tradizionale di Reggio Emilia - explicitly refer to conserving the organoleptic properties of the crop, while another petition - Mela Val di Non - simply mentions that local festivals help to conserve local traditions associated with the crop. Overall, the use of conservation terms in these GI petitions are stating why conservability merits GI protection, rather than mandating conservation techniques.

The second most common term in this query, found in seven GI petitions, was “crop rotation”. Unlike the use of the conservation terms, crop rotation is often listed as a method to be protected. As in, producers must practice crop rotation in order to qualify for the GI label on their product. One exception to this is the Radicchio di Chioggia petition, wherein radicchio is simply described as a rotation crop in its historical review. Another exception - Aglio di Voghiera - states that crop rotation is allowed but not required. Otherwise, five GI crops are to be

rotated at least annually, and the GI label is doing work to mandate and protect this technique of sustainable agriculture.

The three other terms found in this query were: erosion, pollution, and tilling. Mentioned in three GI petitions, “erosion” is only mentioned as a historical event that led to the current landscape where the crop is produced. “Pollution” is mentioned in four petitions, and always in the context of describing the geographic area as ideal for producing this crop because pollution is absent. Perhaps most interestingly, “tilling”/”tillage” is mentioned in three petitions. Twice it is used to describe this conventional agricultural method, but one instance in particular - Patata dell’Alto Viterbese - reveals why the GI petition was amended: “The period during which tillage (ploughing and subsoiling) can take place has been extended to meet tillage needs linked to the climate changes observed in recent years." Here is one example of how GIs are amended in response to climate change.

Fertilization: Our fertilization query generated 53 results, yet after close review of these GIs, we find only 17 that refer to fertilization. By far, the most common term was “chemical”, found in the GI documentation for 38 different crops. Of these, 26 GIs simply mentioned the chemical properties of the crop itself or of the surrounding land and soil, justifying why the crop should be grown in a particular geography. Two GIs state that chemical fertilizers are permissible, while 1 amendment simply changes the word “chemical” to “phytosanitary”. Promisingly, 2 GIs state that chemical inputs should be limited, and five petitions ban chemical treatments during production/ processing altogether. Overall the use of this term “chemical” is most often used to describe the crop and/or geography of its production; so we return to this search term and context in our discussion of the crop sustainability query. More specific to this query around fertilization, seven GIs encourage organic production by banning or limiting chemical inputs, and in so doing demonstrate how GIs can promote sustainable food systems.

The second and third most commonly found terms in this query were “manual”, found in 14 petitions, and “mechanical”, found in 12 petitions. After close review, however, none of these GIs are using these terms to reference fertilization explicitly. We will return to these terms in the discussion of harvesting/processing and social sustainability.

Three petitions mention pollinators or pollination and in three different ways. Whereas the GI for La Bella della Daunia states that the crop naturally has good pollinators, the GI for Marrone di Caprese Michelangelo sets a production requirement, “A maximum of 10 % of plants may come from other varieties for pollination purposes". And finally, we see another example of an amendment in reaction to changes in the agricultural landscape with the Marrone del Mugello,

which reduces the required amount of cultivated chestnut trees in response to a rise in wild varieties providing pollination.

Similar to pollinat*, the term “manure” was found in three GIs and used in three different ways. Whereas the GI for Patata del Fucino simply states that farmers have historically used manure for fertilization, the GI for Asparago verde del Altado requires that chemical fertilizers are used in conjunction with manure and also the “compost of animal horn and nail, etc.” (this is the one and only time we found the term “compost”). The third use of the term manure was found in the GI for Arancia del Gargano, in which the term was actually removed with an amendment that states, “Replacing the words ‘generally still with goat and sheep manure’ reflects the need to specify the use of organic fertiliser, but without further specifying its nature. The gradual reduction in the number of sheep and goat farms since the specification was drawn up means it is difficult to find sheep and goat manure". Here they continue protecting a mandate for organic fertilizer, but remove the specificity of “manure” given the changing agricultural landscape.

Finally, we find one use of the term “synthetic” with respect to fertilization, and it is used to promote sustainable agriculture. In particular, the GI for Castagna Cuneo prohibits the use of synthetic fertilizers and other synthetic plant health care products.

Disease/Pests

This query first returned 52 results, and after analysis, 18 remain. As with the previous category of fertilization, the term “chemical” dominated this query with references to the chemical characteristics of particular crops and/or the soil in which they are grown. Seven GI documents still contain the word “chemical” in reference to disease/pest management. Of these, 3 explicitly prohibit chemical pesticides, while 2 mandate chemical pesticides. One GI states, “The crop must be maintained in optimum condition by carrying out regular mechanical or chemical pest and weed control" and the other states, “Farro della Garfagnana production must be carried out with the use of chemical fertilizers, pesticides or herbicides". Two others mention chemical pesticides without placing explicit restrictions on production practices. In particular, one GI states that chemical pesticides are unnecessary given the crop’s organoleptic properties, while another states that the final product should be free of chemical additives. The latter does not specify what methods should be used to guarantee a chemical-free final product.

Thirteen GI petitions include the term “weed” or “weeding”. Six of these GIs state that weeding or control of weeds is required, yet rarely indicate how to perform the removal of weeds. One GI - Castagna Cuneo - specifies that grass must be cut annually, and bushes and ferns removed

before harvest in order to control weed growth. Another five GIs mention weeds/weeding in their explanation for an amendment. Most often with these five GIs, spacing of plants has changed with the amendment and is justified by an enhancement of weed control. With some crops, spacing has increased to allow more weed control, and with others, spacing has decreased. For instance, the Nocciola del Piemonte GI amendment increases planting density because of newly available equipment for weeding that takes up less space between rows. Finally, one instance of the term “weeding” is found in a description of the Fagioli Bianchi di Rotonda’s cultural history, and there is one instance of the term “weeds” found to specify the prohibition of “chemical weed killers” in the production of Zafferano dell’ Aquila.

Integrated pest management (IPM) is mentioned twice. Once with the Pistacchio verde di Bronte as optional. The other instance is the Patata dell’Alto Viterbese, which mentions IPM as an existing practice in the region and a reason why a sentence about disinfestation is removed with an amendment to this GI. There are no examples of integrated pest management being required for GI protection.

The term “pesticides” is found explicitly in 3 petitions, and the term “herbicides” exists in 2 GIs, with one overlap. The GI for Cipollotto Nocerino mandates the use of pre-emergence herbicides, and the GI for Farro della Garfagnana mandates the use of chemical pesticides and herbicides. The GI for Ciliegia di Vignola requires that the final product is free of *visible* pesticide residues, but does not include requirements regarding production or processing practices. On the other hand, the GI for Marrone di Castel del Rio prohibits any use of pesticides whatsoever.

Lastly, the GI for Castagna Cuneo emerges again in this query as an example of sustainability and how GIs protect sustainable agricultural practices. As previously mentioned in the results of the fertilization query, this GI prohibits the use of all synthetic plant health care products. This is the only instance of the term “synthetic” relevant to the management of diseases and pests.

Harvest/Processing:

A total 66 GIs included terms from our Harvest/Processing query. Of these, the most popular term is “plastic”, located in 39 GIs. Most often, plastic is mentioned in reference to packaging/labeling to describe current methods of production. A couple GIs explicitly mandate the use of plastic film (Ciliegia dell'Etna) / single-use plastic (Oliva di Gaeta). At the same time, three notable GIs promote sustainability by mandating "non-toxic" (Ciliegia di Marostica) / “recyclable” (Melanzana Rossa di Rotonda) / "reusable" (Mela di Valtellina) plastic for packaging; One exceptional example of a plastic ban is found in the GI for Zafferano del’Aquila,

which “must be sold in paper envelopes or glass jars…. [and] may not be marketed in plastic containers.”

The terms “manual” and “mechanical” are found 15 and 14 times, respectively. These are often used together to state that both manual and mechanical methods are permitted, and regularly they are found in the historical section of the petition describing why the crop should have a GI protection. Yet again, there are several important exceptions. For instance, the GIs for Carciofo Brindisino and Marrone di Caprese Michelangelo both mandate manual harvesting, but with the Pistacchio Verde di Bronte, an amendment was filed to allow mechanical harvesting, where manual harvesting was previously required. It is unclear whether these rules on manual/mechanical harvesting are protecting fair labor practices and promoting social sustainability; more research is needed to understand this relationship. Related to these, “machine*” is found in 14 GIs, and always in reference to current methods of production. The use of machines is never mandated and simply mentioned as typical to producing the crop. Two GIs --Farro della Garfagnana and Aglio di Voghiera-- include “machines” in an amendment, indicating that relevant machinery has become available or has changed substantially.

The term “chemical” emerges in 10 GIs in this query. Six are still simple references to chemical characteristics of the product, and two are doing work to support sustainability: 1. Castagna Cuneo bans the use of chemically-treated wood, and 2. Pomodorino del Piennolo del Vesuvio prohibits chemical treatments during the storage phase. On the other hand, Asparago Verde di Altedo and Farro della Garfagnana mandate the use of chemical inputs. Similar to “chemical”, “synthetic” is found in 2 GIs. The packaging for Radicchio di Verona can be made with synthetic material, while “synthetic plant health care products” are still prohibited from growing Castagna Cuneo. Finally, the term “waste” is located in 3 GIs, always in reference to historical methods and never in terms of requiring sustainable methods of waste reduction.

Crop Sustainability: This query first returned 10 documents, eight of which use the term “heritage”. Of these, 3 GIs reference heritage knowledge and expertise that support the crop’s production. Another 3 GIs point to cultural heritage and heritage customs associated with the crop. One GI mentions the heritage diet supported by the crop, and one last use of “heritage” is in reference to woodlands and mushroom heritage. Altogether, these eight GIs reveal how social, environmental, and economic sustainability are intertwined and interdependent.

Only one GI uses the term “indigenous” to state, the “Brovada turnip... [is] listed on the Regional Register for the protection of indigenous genetic resources of agrarian and forestry interest". Similarly, only one GI mentions “perennial”, indicating that the Carciofo Spinoso di Sardegna is a perennial crop, though the GI petition states that it can be grown as either a

perennial or an annual. And one last GI, for the Ciliegia di Marostica, uses the term "Biodiversity", which is mentioned to explain the selection of cultivars. The amendment reads: "Broadening of the varietal range: the list of permitted varieties has been updated to include varieties that perform better and are better tuned to the current market in terms of production and, above all, quality (larger, tastier and better keeping fruit). The aim is to promote the replacement of cultivars that no longer meet market demand while maintaining local biodiversity as much as possible."

After analysis of other queries, 29 additional GIs were added that include the term "chemical". Of these, we find that 17 do not actually have to do with crop sustainability. We find 10 GIs (including one that was already captured with the term "heritage") that describe how the chemical characteristics of the soil sustain the crop's production and its chemical properties. The Patata della Sita stands out as a varietal that does not require chemical treatment: "The 'Patata della Sila' is well-known for its organoleptic qualities and its culinary properties, in particular associated with frying and long-term conservation, without the need for chemical antisprouting treatments." Lastly, two GIs - Patata dell'Alto Viterbese and Riso di Baraggia Biellese e Vercellese - indicate that the chemical properties of the soil and crop have changed over time, and amendments are filed to update their corresponding chemical characteristics. With these uses of "chemical", we see both indications of sustainability and also the inevitability of change in food systems.

Models/Paradigms: The query for models and paradigms included any form of the following terms: organic, sustainability, biodynamic, permaculture, agroecology, and agroforestry. We found only instances of organic and sustainability (including these forms: sustainable, sustained and sustaining). The latter is present in four GIs, while the term organic is much more popular, located in 40 GIs.

Regarding "sustain*", the results are varied. The GI for Carciofo Spinoso di Sardegna mentioned "pest-management sustainability" as a benefit of the areas' naturally occurring organic matter. Meanwhile, Fagiolo Cuneo cultivation is "sustained" by large markets in the region, and Marrone di Combai has a long history of "sustaining" local inhabitants. The fourth and final instance of the term "sustain" is found in the GI for Limone Costa d'Amalfi, which was amended to allow environmentally friendly non-wooden posts that are considered a "sustainable" material that will reduce fixed costs for growers and better guarantee "safety in the workplace".

Organic is queen of this query, showing up in various ways across 40 GIs. While 19 GIs mention organic in reference to an inherent characteristic of the crop or geography, another 16 GIs

describe their current production methods as organic. Meanwhile, three GIs were amended to allow or align with more organic methods, and one GI - Mela Alto Adige : Südtiroler Apfel - was amended to remove the term “organic agriculture”. Finally, one GI stands out as a recurring example of sustainable agriculture - Castagna Cuneo - which prohibits the use of fertilizer and synthetic inputs “except for those products authorized for organic farming.”

Social justice: This query returned forty eight results, of which a version of the term “work*'' was found in 42 GIs and some form of the term “safe*” was found in 12 GIs. There was no explicit mention of wages, labor protections, or social/racial/ethnic/gender equity, with one exception: The GI for Marrone della Valle di Susa mentions a history of “well-paid work”. Regardless, none of these GIs mandate any sort of labor protections for workers. Overall, the term “work” is generally used to describe the history of labor that characterizes the region and the crop’s production. These references are most often contained within the sections of the GIs that describe the crop’s link to its particular geography and it’s proof of origin. Seven GIs reference literary works that prove the crop’s origin in the geography indicated. Interestingly, two GIs - Radicchio Rosso di Treviso and Radicchio Variegato di Castelfranco - use identical language to amend methods of production, stating, “new requirements in terms of health and working conditions have resulted in all processing rooms being heated, which means that the drying period is no longer necessary” These GIs are not mandating new requirements but are reacting to external changes, to explain why production methods have changed.

The term “safe*” is found most often in the form “safeguarding” and is in reference to a history of techniques used to safeguard the quality of the product. Four GIs mention “food safety” for end consumers, and one GI mentions, “safety in the workplace.” This GI - Limone Costa d’Amalfi - was amended to allow the use of non-wooden posts because of the changing landscape of resources. This amendment was not made in order to improve safety for workers, but their safety is referenced as an additional benefit of the amendment.

Overall, the findings from the query reveal that the GIs are not doing work to support or drive social justice among workers in the value chain. It is unclear if workers are paid living wages or guaranteed decent working conditions or equitable employment. However, the quality of labor is most often celebrated as skilled, specialized, and local, and in protecting the crop economically in the global marketplace, it is implied that the GI protection does work to protect the associated source of income for local workers.

Cultural: To further investigate the role of GIs in supporting social sustainability, we ran a query with the following terms: tradition, celebration (celebrat*), festival (fest*), and fair. With this query, we primarily find the term “tradition” used in two ways: to verify the origin of the crop

and associated methods, and/or to simply describe historical production methods as "traditional". Sometimes this term is in reference to annual festivals, but most often it is in reference to agricultural methods.

The second most common term from this query is "festival"; and when "celebration/ celebrate/celebrating" is present, it is always used in reference to the GI crops' festival. Twenty-eight GIs mention an annual festival that celebrates and promotes the GI crop and helps to sustain its production. These festivals embed the crop and related foods into the local culture and also attract tourists to celebrate and purchase value-added products. In this way, festivals help sustain the local culture around GI crops and also attract customers to economically sustain the growers and manufacturers producing the crop and associated products.

The term "fair" is minimally used as a synonym for "festival". More often, "fair" shows up as a descriptor of the GI crop itself or the soil in which it's grown. For example, the GI for Zafferano di San Gimignano simply mentions "fairly permeable soil," while the GI for Arancia del Gargano describes this orange's rind as "fairly thin".

Economic: This query returned 106 GIs, more than any other query.

'Market' is most often mentioned (288 times), and this term pulls up words like marketing and marketed. Where it seems most relevant is when it describes rules around marketing/putting things on the market, e.g:
Harvested fruits must have their prickles removed so that they can be marketed as 'prickle-free' fruits. (Ficodindia di San Cono), and It may not be marketed in plastic containers. Or ...saffron is marketed as threads or processed into powder. (Zafferano dell'Aquila). Sometimes though it used very generally as part of a back story or to say something bland like 'a confirmed reputation on Italian markets.'

"Local" is mentioned almost as often (263 times) and typically used in terms of local experience/methods/knowledge/techniques as forming the basis for how the crops are produced, in general. For example, the GI for Aceto Balsamico di Modena states, "The product is closely linked to the knowledge, traditions and skills of the local population, which has created an exclusive and distinctive local product." Less often, "local" is referring particularly to how local growers have the knowledge to make decisions about crop management, e.g., for Ficodindia di San Cono, "the experience of the local farmers enables them to manage the plant's water requirements appropriately by taking account of the weather as well as factors linked to the age of the plant, the quantity of fruit present and the altitude of the cactus pears in order to irrigate them as effectively as possible."

The term “local” is also used as a descriptive word in storytelling around the crop, e.g., “The lives of the local people [in 13th and 14th c.] were deeply marked by its [Zafferano dell’Aquila] growing economic importance and changing fortunes.” and to describe the ways that a crop connects with or is part of local identity, e.g., for Mela Rossa Cuneo, “This is where the growing of red-skinned apples began and developed, eventually becoming part of the local fabric.” Occasionally, “local” is used to describe cultivars that are allowed under the particular GI, or as more environment-related: Broadening of the varietal range: the list of permitted varieties has been updated to include varieties that perform better and are better tuned to the current market in terms of production and, above all, quality (larger, tastier and better keeping fruit). The aim is to promote the replacement of cultivars that no longer meet market demand while maintaining local biodiversity as much as possible. (Ciliegia di Marostica)

‘development/develop*’, occurring 83 and 62 times, respectively, is most often in terms of crop characteristics, like ‘development of anthocyanins’ or characteristics of the fruit’s flesh develop because of xyz, or to avoid development of parasitic disease. But occasionally as part of description of economic growth, e.g., “The establishment of the ‘Ciliegia di Vignola’ name on the market has led to the development of related commercial activities and has had a major impact on the whole sector, from the production to the marketing of the fruit. In fact, the area has seen the development of farms, processing/marketing cooperatives, and a fruit and vegetable market.” Ciliegia di Vignola. Sometimes this kind of description is historical/part of the crop back story too, like “The development of modern apple-growing in Cuneo dates back to the 1950s and 1960s,...” Mela Rossa Cuneo

‘Trade’: pops up pretty often (57 times) but almost never in the sense of trading something, more as part of the word trademark or trade name, which are typically mentioned in terms of what should be on packaging. When it does refer to trading something, it’s so far in historical context (like how trade in saffron was so important for economic development)

‘Economic’: occasionally (41 occurrences) as e.g., ‘economic resource’ to describe a crop, but more often used generally in the crop back story to talk about how it became important economically

‘Regional’ comes up 23 times, and this term often refers to some regional rules or body, but occasionally as ‘regional source of income’, and ‘Resource’ comes up 21 times. This term is not used often, and generally as ‘economic resource’ or in name of a governing body, occasionally to make note of water resources needed for growing.

'Rural' emerges 14 times:. more often used to describe things about the production and crop history/crop back story. E.g., 'deep roots of the rural population in the production area', BUT, one was relevant for sustainability, just nothing to do with economics: "The wide ranging economic, cultural and social interest in this product has made it possible to develop and improve cultivation techniques, sales and marketing strategies and, in keeping with tradition, to maintain production that provides an income whilst fostering local cooperation and protection of the rural environment." Asparago di Cantello

'Income' is mentioned 9 times, and appears in the phrases 'main source of income' or 'important source of income' to describe crops generally. 'Monetary' was not found in any of the GIs.

Lastly, 'Competition/Compet*': rarely comes up. in naming a competition held for a crop (like you might name a festival) or to describe prices in relation to competitors. Annoyingly also pulls up 'competent' and its variants, and competent is often found in the kind of boilerplate-like language at the front end of these docs.

5. Discussion

With this review of 135 Italian agricultural crops with Geographic Indications (GIs), we find 112 total documents that contain terminology associated with sustainability. Out of these, we find examples of GI protections doing work to promote sustainability, and at the same time, some GIs are mandating unsustainable methods and potentially doing additional work to sustain inequitable food systems. Overall, the majority of these terms are used in a context that simply describes the crop itself or associated methods of production, and not in a manner that mandates any particular strategy or principle. Still, this analysis reveals the opportunities for GIs to contribute to a sustainable food system in Italy and beyond.

Environmentally, there are a variety of ways that GIs are promoting this pillar of sustainability. While 5 GIs mandate crop rotation, another 7 GIs limit or ban chemical/synthetic inputs. The most notable example of this is the GI for Castagna Cuneo, which came up in 4 different queries and effectively bans the use of chemically-treated wood, fertilizers, and all synthetic inputs except those deemed organic. Also remarkable, the GI for Marrone di Castel del Rio prohibits pesticides altogether. While many allow chemical/synthetic inputs and a couple GIs even mandate them, we consider it important to focus on the examples that promote ecological resiliency. As with the use of plastic, many allow or mandate its use, but there are again some notable exceptions. Three GIs in particular specify the use of non-toxic, recyclable, or reusable plastic, in order of increasing sustainability; and one GI - Zafferano dell'Aquila - bans the use of

plastic altogether in the packaging, labeling, and marketing phases of production. This is admittedly a small proportion of the total 135 GIs reviewed, and aligns with the findings from Belletti et al. (2015) of the olive-oil sector in particular. Using six indicators, the authors similarly found that environmental concerns were rarely present in GIs for olive oil. Fortunately, they also discovered a "greening" of GIs, indicating a growing possibility for GI protections to promote environmental and even social pillars of sustainability. Considering this finding from Belletti et al., it may be fruitful to pursue a temporal analysis of the GIs reviewed in this paper to see if we find similar trends of "greening" over time.

GI protections appear to do the least amount of work to promote social justice explicitly, though there are indeed socially sustainable implications therein, including the safer working conditions associated with the aforementioned environmental protections. Although none of the GIs mandate fair wages or safe, equitable working conditions, they point us to crops and their value chains that have sustained communities for decades or centuries. In many cases, local labor is valued as specialized and skilled, but this labor is framed as a given, and the GIs do not mandate that the local community is hired for the crop's maintenance and harvest. Perhaps the GI petition does not need to do this work, but also, this potentially leaves the metaphorical door open for "cheaper" migrant labor to replace the local workforce. There is an opportunity here to expand GI rules to mandate local employment and also fair wages and safe, equitable working conditions. Further, our findings corroborate those of Ceccarelli & Fattibene (2020) who provide ideas for creating an ethical food label.

The social pillar of sustainability is in theory enhanced by the creation of the cooperatives that develop and maintain GI protections. By definition, the GI petitions are submitted by a cooperative or coalition of producers and processors that want to protect their crop's value chain. The formation of these cooperatives/coalitions creates a space for these producers and processors to have a collective voice in the marketplace. However, the GIs themselves do not explicitly mention nor mandate democracy or equitable representation in the crop's value chain or among the board directing the cooperative/coalition. More research is needed to understand how this process of developing GIs is an opportunity to support social democracy and ultimately the social pillar of sustainability.

Culturally, the GIs support and are supported by local festivals, or "sagras", that celebrate the protected crops and attract economic support of their production. The GI petitions and amendments are not mandating these local festivals, but referring to them as an important part of the crop's value chain. This reveals the interconnectedness of the social and economic pillars, and points us to places in the agricultural landscape where particular crops have extreme social and cultural relevance and importance. That is to say, the social supports the economic and vice

versa, and ultimately GIs are doing work to support both in this regard. Moreover, the celebration of local, skilled workers speaks to the economic pillar as well as the social, with an explicit connection found in the GI for Marrone della Valle di Susa, which references a history of "well-paid work" that supports the local community economically.

Unsurprisingly, geographic indications are prioritizing the economic pillar of sustainability. Given this was the original intention - to protect local and regional value chains in a globalized food economy - every GI is used to distinguish the economic value of producing a specific crop in a specified locale by a particular population. In so doing, we see how the environmental and social are leveraged to justify economic protection in the global marketplace, but for whom? and at what cost to the social and environmental? According to Riccheri et al. (2007), "Products protected under a GI are sometimes assumed to be more environmentally friendly than other products, due to their local reference, predominance of "low intensity" production methods (derived from small-scale, traditional processes) and their potential to mobilise and implicate local communities in the exploitation of local natural resources…. [yet] due to the different baseline conditions, the environmental effects of production are seen to differ substantially, from environmentally beneficial productions which are protected by GIs tightly linked to nature conservation objectives to GIs with a neutral to ambiguous effect on the environment" (p53). Moreover, Vandecandelaere et al. (2018) describe how producers face tradeoffs between environmental and economic sustainability, regardless of GI protections.

Another interesting finding from this research is the use of amendments to reflect changes in production methods and crop characteristics. While GIs are generally used to acknowledge and protect traditional methods and historically-significant foodstuffs, they are still reacting to changes within ecological, economic, and social systems. For instance, the GI amendment for Arancia del Gargano removes "manure" in response to the decline of sheep and goat farms that historically provided this resource. Five different GIs were amended to change planting density in response to changes in machinery and related technologies. Additionally, the GI for Patata dell'Alto Viterbese was amended to expand the tillage season in response to climate change. These examples illustrate how sustainability requires not just mitigation but also adaptation to environmental, social, and economic changes. In an analysis of GIs and their adaptive capacity, Edelmann et al. (2019) find that "Actors amended their Product Specification due to both system-internal (e.g., locally generated knowledge, negotiation processes) and external (e.g., market evolution, new breeds/varieties) pressures. In the two cases, there have been social learning processes among local producers, with diverging outcomes." Moreover, GIs are evolving systems that require democratic processes so that producers can maintain viability and sustainability while coping with a changing environment.

Conclusion

Additional possible considerations:

- concept of terroir vis a vis climate change;
- does the US have a cuisine/crop traditions as in EU/US food culture as roadblock;
- US aversion (for some people) to government-run programs (as pdo/pgi/tsg are run in EU, though in the US they are protected differently)
- Take advantage of this moment in time around covid to think about how this can transform US food system
- Is the EU providing relief to IGP/PDO/TSG producers, processors?
- Knock-on effects of these kinds of labels/legislation (thinking about Osterhoudt's recent paper https://www.sciencedirect.com/science/article/pii/S0305750X20301960?dgcid=author

Application to the US...

- Review EU mechanisms that promote ecological sustainability and social equity and their relationship to the geographic/economic labels
- Review ecological and social sustainability mechanisms in the U.S. and compare to EU/Italy (organic, fair trade, environmental regulations, labor laws, pro-equity/anti-discrimination laws)

Potential for sustainable food systems...

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