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Lisa Tomlinson

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*By: Lisa Tomlinson**

I. Introduction

Over the last several years, urban agriculture has seen an explosion in creativity and innovation as urbanites become more inclined to change the unfavorable realities of living in an urban setting. City living is popular for its cultural immersions, access to attractions and nightlife, and educational institutions. However, cities tend to have one major obstacle—they lack access to locally grown fresh foods.[1] The lack of access to fresh foods creates food deserts, which lead to public nutrition and health concerns.[2] One way to solve the problem of food deserts is to encourage the creation of aquaponics farms, an agricultural system that combines the practices of aquaculture and hydroponics within abandoned factory buildings.[3] The factory-based farms use less land than traditional agriculture models, while still providing the needed access to food.[4]

Aquaponics is a creative way of raising fish and growing fresh vegetables for local consumption.[5] This method, like all urban agriculture models, has a variety of benefits and potential implementation concerns. However, for the scope of this Article, it will be assumed that the benefits of aquaponics outweigh the implementation concerns, making it a viable option for urban agriculture. Unfortunately, aquaponics is not a true potential solution to food deserts until local governments update zoning and building codes to reflect current agricultural practices. Local governments created zoning and building code regulations to promote public health and the welfare of the community.[6] As public health concerns evolve, it is important that these regulations continue to evolve to include urban agriculture. Thus far, a regulatory evolution of this nature has not occurred. The lack of access to fresh food and the existence of food deserts is a major public health problem for the majority of urban residents.[7] Aquaponics can be used to alleviate this issue, thus local zoning commissions and municipalities should update zoning ordinances and building codes to allow for this form of urban progress.

This Article will discuss the major hurdles that local governments must overcome to make aquaponics a viable urban agriculture option to combat food deserts. Part II will provide an overview of aquaponics. It will explain what an aquaponics farming system entails, the benefits and potential concerns for implementing an aquaponics system, and a case study of one of the few commercially scaled aquaponics systems currently operational in the United States. Part III discusses general zoning codes, the current state of zoning codes relating to urban agriculture, and what questions need to be asked in order to create a zoning code that allows for aquaponics in urban settings. Part IV takes a similar approach in structure to the zoning section, and discusses the current state of building codes and what local governments should consider when creating a code that allows for indoor aquaponics farms. Part V concludes with recommendations for municipalities moving forward in their urban agriculture efforts.

II. Aquaponics

A. What is Aquaponics?

Urban agriculture can take many forms, but one of the most creative is aquaponics.[8] Aquaponics combines the practices of aquaculture, the process of breeding and raising fish for consumption in controlled water environments,[9] and hydroponics, the process of growing plants in nutrient fortified water instead of soil.[10] Combining these two techniques creates a closed-loop food production system, which creates very little, if any, waste.[11] Closed-loop food production means that the waste of one process becomes an input to another and vice versa.[12] Aquaponics achieves minimal waste levels by taking advantage of the naturally occurring nitrification cycle.[13]

Put simply, "aquaponics is a system of aquaculture in which the waste produced by the farmed fish . . . supplies nutrients for plants grown hydroponically, which in turn purify the water" for the fish.[14] The process begins by connecting a number of fish tanks, a settling tank, grow beds, a sump tank, and water pumps with a piping system.[15] The fish raised in the fish tanks are fed just like any normal aquaculture system.[16] The fish excrete their waste into the water, including ammonia ("NH_3") that is toxic to the fish at high levels, while also containing nitrogen that is a beneficial input to plant growth.[17] Because the system is connected through piping, the water from the fish tanks flows to the next tank in the system, the settling tank.[18] In the settling tank, the solid waste sinks to the bottom while the NH_3, which is dissolved in the water, is broken down by microorganisms.[19] This is the point in the system where the nitrification cycle truly comes into play. Nitrosomonas bacteria convert the NH_3 into nitrite ("NO_2") and then nitrobacter bacteria convert the NO_2 into nitrate ("NO_3"), which plants can easily absorb.[20] The water, including the nitrates, next flows into the grow bed where the plants absorb the nutrients through their roots, while simultaneously cleaning the water and balancing the system.[21] The water

* Lisa Tomlinson is an Attorney specializing in environmental law and policy. She is a graduate of American University, Washington College of Law, receiving her Juris Doctorate in 2015. Ms. Tomlinson was previously a Legal Extern for the United States Department of Justice Environment and Natural Resources Division, and a Law and Policy Extern at the Center for Biological Diversity.

then flows back through the sump tank and water pump to the fish tanks where the process continuously repeats itself.[22]

By following this process, the only input to the system by the farmer is the fish food.[23] Most importantly, the plants growing in this system do not require fertilizer.[24] The plants are fertilized naturally through the nitrates in the water, and the water cleaned by the plants ensure the fish are in a constantly balanced environment.[25] Because the process is flexible in terms of the number of fish tanks and grow beds, an aquaponics farming system can come in a variety of forms and be used in both a personal small-scale farm and commercial growing system.[26]

The history of modern day aquaponics farming systems is based on variations created in the late 1970s and early 1980s, which used underground fish tanks or floating grow beds.[27] Since then, aquaponics farmers have become more innovative with their system setups and the locations in which they choose to farm. The most recent movement is an effort to combat urban food deserts by converting abandoned industrial facilities into working indoor aquaponics farms.[28] Aquaponics systems do not require a large plot of land like traditional agricultural practices because the system does not require soil.[29] Instead, aquaponics farmers can integrate vertical farming techniques to grow indoors. Vertical farming is farming done on multiple stories of a building, or in tiers to maximize grow space.[30] Combining aquaponics and vertical farming makes the use of an abandoned industrial site the ideal location, because the site is already constructed and can be easily converted into growing facilities.

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Millions of abandoned industrial facilities are scattered throughout the United States, most located in urban areas.[31] These buildings have become a blight on society and a major public health concern. The structures are not maintained, do not have identified owners, and are left forgotten.[32] These properties become hotbeds of crime, havens for squatters, and an eyesore for the community.[33] The structures are susceptible to increased structural damage and arson, which is concerning from a health standpoint.[34] Additionally, these industrial facilities are often located in food deserts, where the residents in the immediate area lack access to food.[35] When aquaponics farmers purchase these buildings, they are converting the buildings from a dangerous public health risk to a public health benefit.

B. Benefits and Concerns of Aquaponics

The benefits of the overall concept of using an aquaponics system are numerous, but there are also specific benefits for converting abandoned industrial facilities into aquaponics farms. Aquaponics produces healthy and environmentally friendly food that can feed an underserved community. These benefits, however, do not come without implementation risk. Certain factors make aquaponics an expensive and limiting farming option at this time. However, while this Article acknowledges the concerns with implementing an aquaponics system, it assumes that aquaponics farmers can overcome and reduce these concerns through technological advances and creative approaches, to make commercial-scale aquaponics a viable farming option.

As a closed-loop system, the only input required for an aquaponics farm is the food that feeds the fish.[36] This food provides the stimulant for the plant growth, the fish's waste.[37] Since fish food is the only input, an aquaponics system, unlike most traditional agricultural practices, requires no chemical-based pesticides or fertilizers in order to facilitate plant growth.[38] Instead, the growth is entirely dependent on the nitrate that is broken down from the fish excrement.[39] The lack of pesticides and fertilizers applied to the plants means that every plant harvested from an aquaponics system is completely organic.[40] This is a significant benefit to farmers because they can apply for recognition as a United States Department of Agriculture Certified Organic farm, and sell their produce for a higher return.[41]

The lack of pesticides and fertilizers is also beneficial from an environmental standpoint. Pesticides and fertilizers help increase the yield of crops and restrict pests, but simultaneously present significant environmental risk.[42] Their use produces disastrous effects on the landscape and surrounding waterways through runoff.[43] Another environmental benefit stemming from the lack of chemical pesticides and fertilizers is the reduced amount of water required in an aquaponics system compared to traditional soil-based agriculture.[44] In fact, aquaponics farms use ninety percent less water than traditional soil based agriculture, which is ironic considering the entire aquaponics system revolves around the use and reuse of water.[45]

Indoor aquaponics systems provide unique benefits not available in traditional agricultural practices or outdoor aquaponics systems. Traditional outdoor farms are limited to growing certain crops during certain seasons because of temperature and climate related obstacles. Aquaponics farmers have complete control over the climate the crops are subject to since the farms are located indoors.[46] This controlled environment allows farmers to extend growing seasons beyond traditional ones.[47] Aquaponics farmers have had success in growing a variety of crops year-round.[48] This includes crops such as lettuce, tomatoes, cucumbers, leafy greens, herbs, and spinach.[49] The controlled environment also means the crops are not at risk of weather-related crop catastrophes, caused by phenomena like droughts or natural disasters.[50] When the

farms are located in abandoned industrial buildings in food deserts, the extended no-risk growing season means continued access to vegetables for areas that would otherwise have limited fresh food options.

Aquaponics systems are not without their faults, however, because the aquaponics system is more expensive than traditional farming operations and are not likely to replace the need for traditional agricultural practices. By far the largest obstacle facing aquaponics is the costs associated with constructing and maintaining an aquaponics farm.[51] Aquaponics farms can cost millions of dollars to become and remain operational.[52] Constructing a new indoor facility can cost anywhere between seventy and eighty-five dollars per square foot in urban areas, not including the cost of production equipment such as the tanks and grow beds.[53] Also added into the cost equation is the actual fish and produce that farmers grow and eventually hope to bring to market. Finally, in order for the plants to grow to their full potential, indoor aquaponics systems require prolonged exposure to light.[54] Plants require between sixteen and eighteen hours of intense lighting to grow when they are not exposed to natural sunlight.[55] The prolonged lighting leads to significantly expensive energy costs throughout the production cycle.

Adding to the potential drawbacks of aquaponics farming, a debate has arisen as to whether indoor aquaponics systems are as environmentally friendly as they claim.[56] It has been called into question whether the environmental benefit of eliminating pesticides and fertilizers is outweighed by the environmental cost of the overwhelming amount of energy that the farms require for operation.[57] However, indoor aquaponics farmers have found ways to combat both the implementation and operation cost argument, and the environmental cost argument. By using existing abandoned structures, farmers cut down on the cost of construction and reuse materials found within the structure or donated from other organizations.[58] They are also retrofitting the structures with renewable energy systems to mitigate the environmental damage caused by the required energy use.[59]

"Only a handful of zoning ordinances recognize aquaponics as a form of urban agriculture."

While there is clearly still debate as to whether the cost can be significantly decreased and renewable energy can be relied upon to power the building, for the purposes of this Article it will be assumed that the benefits outweigh the potential faults of indoor aquaponics systems. Indoor aquaponics farms have proven to provide year-round food access to food deserts by replacing what otherwise was useless dangerous space to a useful community treasure. The Plant in Chicago, Illinois, is an example of the success that these indoor commercial aquaponics farms can achieve.

C. Case Study – The Plant

In July 2010, John Edel, owner of Bubbly Dynamics, LLC, purchased the Peer Foods factory, a 93,000-square-foot abandoned meat packing building located in the Southside of Chicago.[60] Edel purchased the industrial building "for $525,000, which was the estimated value of the metal inside."[61] Edel had a vision of creating a "net-zero energy food business incubator" which would house permanent tenants who were committed to sustainable food production.[62] The Plant currently lists two tenants who practice aquaponics, one of which is Plant Chicago, a non-profit that operates an aquaponics farm in the basement of the building as a demonstration and educational farm.[63]

Plant Chicago created its fish tanks and settling tanks from the food grade materials Peer Foods left when it abandoned the building.[64] The grow beds were constructed from scrap lumber.[65] The Plant estimates that during its renovation of the abandoned facility into a food production facility, it will be able to use about eighty percent of the existing materials in some form.[66] The reuse of materials is key to significantly decreasing their costs. By undergoing what it termed a deconstruction process, the Plant claims the facility costs about half as much as it would have to construct an entirely new building.[67]

The Plant also plans to decrease the operational cost by installing renewable energy systems and an anaerobic digester.[68] An anaerobic digester breaks down biowaste and converts the captured biogas into electricity.[69] Biowaste includes wastes like left-over plant root waste, or other waste building tenants, such as the brewery or the kombucha tea brewery, will produce.[70] By implementing renewables and using an anaerobic digester, the Plant hopes to become a net-zero energy facility, meaning it will produce all the electricity and heat the building and its tenants will use.[71] While the building is connected to the grid as a backup power source in case of emergencies, the Plant is able to sell any surplus electricity that they create back to the grid.[72]

The estimated cost of development for the entire facility was approximately six million dollars.[73] This figure includes the renovation cost, the renewable energy system cost, and the anaerobic digester system cost.[74] The project is funded in part by grants awarded at the state and federal level, as well as a loan from the Chicago Community Development Fund.[75] Bubbly Dynamic, LLC and other investors provided additional funding.[76] Edel initially estimated a gross annual revenue of $500,000 over four years.[77] While the project is not fully completed, the vegetables and fish grown in the Plant at the two aquaponics farms are already being sold in the community at local markets and to local restaurants.[78]

One of the largest obstacles facing the Plant was obtaining all of the necessary permits required for food production in an industrial building that was not zoned for agricultural use.[79] Luckily, Chicago has been proactive in updating its zoning codes and permitting systems to reflect the growing popularity of urban agriculture.[80] Other cities have not been as strategic, creating a major obstacle for farmers who want to implement facilities like the Plant in their selected cities.

III. Zoning Codes

Zoning ordinances allow local governments to protect and promote the welfare and public health of their community.[81] Prior to the creation and implementation of zoning ordinances, citizens were restricted to using public nuisance as a means to protect their public rights.[82] However, this tool was more of an after-effect remedy instead of ex-ante.[83] As the limitations of public nuisance became evident, zoning regulations began to form "out of the concept of public nuisance . . . ."[84]

In the early 1920s, the Department of Commerce ("Department") approved the Standard State Zoning Enabling Act ("Act"), which facilitated state delegation of state power to municipal zoning commissions. The act states,

> For the purpose of promoting health, safety, morals, or the general welfare of the community the legislative body of cities and incorporated villages is hereby empowered to regulate and restrict the height, number of stories, and size of buildings and other structures, the percentage of lot that may be occupied, . . . and the location and use of buildings, structures, and land for trade, industry, residence, or other purposes.[85]

The Department intentionally included "other purposes" to act as a catchall for all land use.[86] This catchall gives the legislative body the ability to essentially regulate all land use that occurs within its borders, including agriculture. The Act instructed legislative bodies to create regulations "in accordance with a comprehensive plan" in order to create a cohesive zoning ordinance.[87] When creating the comprehensive plan and zoning regulations, the legislative body is instructed to consider factors such as "the character of the district and its peculiar suitability for particular uses, and with a view to conserving the value of buildings and encouraging the most appropriate use of land throughout such municipality."[88]

The Act further instructs legislative bodies on the appropriate method of implementing their zoning regulations, including a provision for a public hearing to allow interested persons to share their opinions.[89] It also recognizes that as time progresses conditions may change, which would require a change in the zoning code.[90] The Department explains, "it is obvious that provision must be made for changing the regulations as conditions change or new conditions arise, otherwise zoning would be a 'straight-jacket' and a detriment to a community instead of an asset."[91] Under the Act, an amendment to zoning regulations requires three-fourths approval from the members of a legislative body, as well as public hearings on the matter.[92] At this point in time, all "states have adopted enabling acts that are substantially patterned after the Standard State Zoning Enabling Act . . . ."[93]

Early zoning ordinances were often challenged on Fourteenth Amendment grounds for deprivation of property without proper due process.[94] However, the Supreme Court in *Village of Euclid v. Ambler Realty* ultimately dismissed these claims.[95] In 1922, the Village of Euclid created a comprehensive zoning plan that divided the village into six districts, which restricted the use of properties located within each district.[96] Ambler Realty owned a tract of land and wanted to sell it for industrial uses, which was not allowed in the designated district.[97] Ambler Realty argued that this designation reduced the value of its property and deprived it of due process under the Fourteenth Amendment.[98] The Court explained that zoning ordinances will vary based on municipalities, because in order to be effective, zoning ordinances must consider the individual characteristics of the locality.[99] Ultimately, the Court ruled that ordinances must be arbitrary, unreasonable, and substantially unrelated to public health, safety, morals, or the general welfare to be unconstitutional. [100] Therefore, unless the zoning regulation relates back to a community benefit, the zoning regulation will not be upheld.[101] This requirement remains for any proposed amendment to a zoning ordinance.

A. Current Zoning Codes

Zoning ordinances specified agricultural zones to reflect the concerns that were associated with traditional agricultural practices.[102] These are concerns that livestock, agricultural runoff, and farm equipment would be a detriment to the public health if it was permitted in residential or industrial areas.[103] As urban agriculture becomes more prevalent, more cities are updating their zoning ordinances to reduce their restrictions on agricultural use in areas where the practices were otherwise restricted.[104] While urban agriculture is a popular topic amongst zoning commissions, the amendments being incorporated do little to help the indoor aquaponics movements.

Only a handful of zoning ordinances recognize aquaponics as a form of urban agriculture.[105] The majority of zoning ordinances merely reference community gardens that replace vacant lots in cities and do not reference indoor farming or the process of aquaponics.[106] The minority of zoning ordinances that do mention aquaponics only reference the definition of urban agriculture.[107] For example, Cleveland, Ohio updated its Zoning Codes to allow urban agriculture by creating an Urban Garden District.[108] Within an Urban Garden District, residents can participate in two different types of urban agriculture–community gardens and market gardens.[109] Neither the definition of community garden or market garden mentions any form of aquaculture, hydroponics, or aquaponics.[110] Conversely, Chicago's zoning ordinance defines urban farms as three different operations – indoor operations, outdoor operations, and rooftop operations.[111] To qualify as an indoor operation, all activities must be conducted within completely enclosed buildings. Typical operations include greenhouses, vertical farming, hydroponic systems and aquaponic systems."[112]

Chicago updated its zoning ordinance in 2011 to support urban farms.[113] Mayor Rahm Emanuel specifically linked the growth of urban agriculture to the elimination of food deserts. He has been quoted as saying that

> [The revised] ordinance is an important component of a comprehensive strategy to eliminate food deserts in Chicago while creating jobs. . . . By making it easier for communities to turn vacant lots into urban farms, we can transform eyesores into engines of local economic activity that will supply fresh fruits and vegetables to the neighborhood.[114]

As more cities attempt to combat food deserts, they will likely come to the same conclusions as Mayor Emanuel and allow for an expanded version of urban agriculture within their zoning ordinances.

B. Questions Facing Zoning Reform

Questions facing zoning reform revolve around the possible effects on the community. Allowing for urban agriculture in any form affects the tenants that currently inhabit the surrounding areas.[115] Specific questions like what needs to be included in a definition of urban agriculture, and what type of area would benefit from agricultural use require further discussion. Local governments should consider environmental concerns when determining whether a particular area is suitable for urban agriculture development.

"However, as the indoor agriculture movement grows, cities are beginning to recognize the need for change."

Local governments' first task will be to define urban agriculture. Urban agriculture encompasses a broad spectrum of agricultural practices, including but not limited to community gardens, greenhouses, and aquaponics.[116] The definition of urban agriculture needs to specify all different types of agriculture that a city will permit and should not merely include a broad definition. When the definition is broad and does not specifically state which forms of urban agriculture are permitted, residents assume the practices are not permitted.[117] This can become an issue particularly with aquaponics. Since only a handful of zoning ordinances specifically list aquaponics as an included activity in urban agriculture,[118] the growth of aquaponics has been limited to small-scale production.

Legislative bodies should clarify zoning ordinances regarding the indoor aspect of aquaponics systems, such as the building and designated use of the building. Factors to consider include the types of buildings allowed, the size of the buildings, and the location. The majority of urban agriculture ordinances consider buildings in the sense of accessory unit, such as greenhouses and sheds, but are silent concerning larger industrialized facilities.[119] Creating specific guidelines for these buildings will likely require combining zoning regulations and building codes. Additionally, determining the right zoning code is more than just designating an agricultural use to the area, since many indoor aquaponics farms follow the model of the Plant, by both selling and growing their products.[120] A mixed-use area for agriculture and commercial activity may need to be designated,[121] but how the mixed-use designation will impact local shops and residents should be considered.

The treatment of fish is an additional obstacle for aquaponics. In an aquaponics system, fish are grown and harvested at a commercial scale, making them similar to livestock in traditional agriculture.[122] Most cities have stringent zoning ordinances that prohibit the raising of livestock in urban areas because of the potential health effects that animals may carry.[123] However, traditional livestock, refers to animals such as cows and chickens, not fish.[124] Fish need a relatively small area and do not possess the same health risks as traditional livestock. Livestock is typically prohibited because animal waste can impact drinking water and the environment of surrounding residents.[125] In aquaponics, there is no concern over fish waste since it has the specific purpose of fertilizing plants.

Environmental concerns, such as soil and water contamination, create the majority of arguments against incorporating urban agriculture into zoning ordinances.[126] For example, soil contamination concerns stem from the use of chemicals applied to crops, which are subsequently absorbed into the soil or groundwater.[127] The concerns also stem from the treatment of livestock manure, which is unregulated and has the potential to contaminate farming soil.[128] These arguments are not as successful against indoor aquaponics farms as they are against community gardens because aquaponics systems do not require soil, chemicals, or untreated livestock manure.[129] When it comes to water use there is also a concern that allowing agriculture in an urban area will increase the demand for clean water, creating a competitor to the supply of drinking water for city residents.[130] However, aquaponics systems require less water than traditional agricultural practices, alleviating the consumption concern.[131]

Zoning codes differ for every community because each local government has different opinions on various public health issues. Since there are differences between various communities, it is impractical to create a model zoning code that reflects the incorporation of urban agriculture. Instead, local governments should carefully consider the questions and issues surrounding urban agriculture to best determine how it should be reflected within their city.

IV. Building Codes

Similar to zoning ordinances, local jurisdictions adopt building codes to promote health and welfare within the community.[132] All major states and cities within the United States have adopted building codes, many of which are a version of the model International Building Code ("IBC").[133] The International Code Council created the IBC, which it periodically updates to protect public health and communities as building design and installment advances.[134] These codes provide proscriptive and prescriptive requirements for construction.[135] The majority of the code discusses requirements for building materials, size restrictions, and use and occupancy. [136]

The IBC designates agricultural buildings as U classified buildings.[137] This classification requires buildings to be constructed in accordance with the fire and life hazard requirements of the IBC.[138] The U classified buildings designation is specifically for accessory buildings and lists agricultural buildings, greenhouses, and sheds as examples.[139] The IBC defines agricultural buildings as structures for housing agricultural tools and products, and specifically excluding structures where processing, treating, and packaging of agricultural products occur.[140]

While the IBC is primarily focused on new construction, it also includes requirements for existing infrastructure.[141] It requires owners of existing structures to maintain their buildings' safety and sanitation.[142] It also requires the buildings to comply with a variety of other building codes, such as the International Fire Code, the International Property Maintenance Code, and the International Energy Conservation Code when the designated occupancy of the existing structure changes.[143]

"Indoor aquaponics farms have proven to be a successful way to increase access to food and promote the revitalization of an abandoned structure."

Most states have adopted the IBC and continue to update their own building codes by adopting the IBC's revised versions as they are updated.[144] States and municipalities do amend the IBC in order to reflect the special circumstances within their jurisdictions.[145] These amendments, however, tend to be minor.[146] In order to change a community's building codes to reflect updates like indoor urban agriculture, there are two options—either advocate for a change incorporated into the most recent edition of the IBC, or create an amendment to an adopted IBC that the local government can incorporate.

A. Current Building Codes

Most discussion about updating building codes refers to updating the codes to incorporate green building standards.[147] These discussions focus on how to promote sustainability within construction[148] by focusing on concepts like energy efficiency measures in order to reduce consumption.[149] There has been little discussion on how to update building codes to reflect the indoor agriculture movement. While the IBC references buildings for agricultural purposes, it only focuses on buildings created as accessory buildings and not large commercial agricultural facilities.[150] Originally, there was no concern about agriculture's effect on building codes since traditional agriculture took place outdoors and outside the scope of building codes. However, as the indoor agriculture movement grows, cities are beginning to recognize the need for change.[151]

Phoenix, Arizona, which has adopted the IBC, acknowledged that current building codes do not accurately reflect emerging agricultural practices.[152] While agricultural buildings are specifically listed in the Group U examples, Phoenix has recognized commercial scale indoor agriculture to differ from the accessory buildings intended for this category.[153] Group U classified agriculture buildings also contain limitations on habitation, employment, and public use located in the definition of an agricultural building.[154]

The Phoenix Planning & Development Department has released an interpretation of indoor agriculture classifications,[155] and its interpretation extends beyond the U classification designated to accessory buildings under the IBC.[156] Phoenix designates the classification based on the function of the building, creating different classifications and requirements for buildings housing growing, processing, and retail areas.[157] Buildings designated as growing areas require either a U classification or an F-1 classification for "Factory industrial uses which are . . . Moderate Hazard. . . ."[158] Indoor farms that participate in processing, packaging, or infusion must be classified as F-1 buildings.[159] Finally, those that participate in retail sales require an M classification, for Mercantile.[160] According to the IBC, facilities that are mixed-use facilities will need to comply with all designated classifications.[161]

B. Questions Facing Building Code Reform

As Phoenix demonstrates, clarifying indoor agriculture's designation under the IBC can be as simple as releasing an interpretation of the code.[162] However, even Phoenix's interpretation leaves something to be desired, and additional questions remain when it comes to indoor aquaponics systems in abandoned factory buildings.

Under Phoenix's interpretation, a facility like the Plant, which engages in growing, packing, and retail, would require a mixed-use classification of U, F-1, and M.[163] A mixed-use classification means the facility would be overburdened with the

amount of permits and construction requirements the building would have to obtain and meet.[164] Even ignoring this burden, the classifications seem to address the issues of growing crops indoors, but it does not answer questions about how to deal with the fish or what energy requirements may be required.

Aquaponics includes raising fish as a form of livestock.[165] In the IBC, livestock is mentioned, but like zoning codes, it appears to refer to more traditional forms of livestock such as farm animals.[166] According to the IBC, livestock are housed in agricultural buildings, which still have the habitation, employment, and public use limitation.[167] To effectively incorporate aquaponics into a city's building codes, the agricultural building definition will need to be amended. The new definition should emphasize that there are circumstances where employment and public use are appropriate even when livestock is present. If municipalities are concerned about public health issues associated with traditional forms of livestock, they can create a specific exemption to the habitation, employment, and public use limitation for fish regarded as livestock. For example, in the current definition, poultry is explicitly separated from livestock.[168]

Municipalities may also want to consider the energy needs that are required for indoor aquaponics facilities when they update their building codes.[169] While most indoor aquaponics farms are installing renewable energy already, local governments cannot assume that all will be able to incorporate net-zero energy operations.[170] In the event that they are unable to depend on renewable energy, there may be a concern that the facility will require a large amount of energy from the grid.[171] In an attempt to control this energy need, local governments may want to consider implementing off-grid requirements for indoor aquaponics, or at least energy efficiency measures.

There is no need to create a separate agricultural designation in building codes to complete their purpose of promoting public health and welfare within communities when it comes to indoor aquaponics farms. Indoor aquaponics farms do not pose the same risk as traditional agriculture because of the lack of chemical pesticides and fertilizers, as well as the lack of traditional livestock.[172] Keeping these facilities as U classified buildings where they must meet fire and hazard requirements thus ensuring the safety of the building to the public suffices to maintain public health. By simply amending the definition of agricultural building to reflect the differences of aquaponics from traditional agriculture, building codes can help promote the growth of commercial indoor aquaponics farms and help decrease the prevalence of food deserts in urban areas.

V. Conclusion

As food deserts become more prevalent in urban areas, it becomes increasingly important to update existing zoning ordinances and building codes. The purpose of both zoning ordinances and building codes are to promote public health and welfare for the community. Indoor aquaponics farms have proven to be a successful way to increase access to food and promote the revitalization of an abandoned structure. Current zoning ordinances and building codes are obstacles to aquaponics farmers who wish to provide this public health benefit. While every state or municipality may differ on their ultimate regulations for incorporating aquaponics into their ordinances, local governments should update their regulations to promote aquaponics and reduce food deserts to reflect the needs of their community.

Endnotes: Indoor Aquaponics in Abandoned Buildings: A Potential Solution to Food Deserts

1 *See Food Access Research Atlas*, USDA, http://www.ers.usda.gov/data-products/food-access-research-atlas/go-to-the-atlas.aspx (last visited Nov. 23, 2015) (showing the prevalence of food deserts across the country).

2 *See* Mari Gallagher, *USDA Defines Food Deserts*, Nutrition Digest, American Nutrition Association, (2010), http://americannutritionassociation.org/newsletter/usda-defines-food-deserts (last visited Nov. 23, 2015) (noting that the USDA defines food deserts "as parts of the country vapid of fresh fruit, vegetables, and other healthful whole foods, usually found in impoverished areas.").

3 *See* John Sedey, *New Ordinance Encourages More Urban Farming*, Sustainable Chi., Sept. 28, 2011, http://www.sustainable-chicago.com/2011/09/28/new-ordinance-encourages-more-urban-farming/ (stating that urban farming will help to eliminate food deserts in disadvantaged neighborhoods).

4 Jeff Wells, *Indoor Farming: Future Takes Root In Abandoned Buildings, Warehouses, Empty Lots & High Rises*, Int'l Bus. Times (Aug. 9, 2014), http://www.ibtimes.com/indoor-farming-future-takes-root-abandoned-buildings-warehouses-empty-lots-high-rises-1653412; Rachel Tinker-Kulberg, *Aquaponics: A New Breed of Sustainable Farmers + Social Justice Activists*, Abundance N.C. (Oct. 14, 2014), http://abundancenc.org/aquaponics-a-new-breed-of-farmers-promoting-environmental-sustainability-and-social-justice/.

5 Wells, *supra* note 5.

6 Standard State Zoning Enabling Act § 1 (Dep't of Commerce 1926) [hereinafter SZEA], https://www.planning.org/growingsmart/pdf/SZEnablingAct1926.pdf; *Preface*, International Building Code (2012) [hereinafter IBC], http://publicecodes.cyberregs.com/icod/ibc/2012/icod_ibc_2012_intro.htm.

7 *See Food Access Research Atlas*, *supra* note 2.

8 The practice of urban agriculture has described many practices, from community gardens to CSAs, as well as hydroponics and aquaponics. It is an all-encompassing phrase. While zoning ordinances should be altered to reflect a variety urban agriculture practices, this Article will focus on aquaponics.

9 *What is Aquaculture?*, NOAA, http://www.nmfs.noaa.gov/aquaculture/what_is_aquaculture.html (last visited Nov. 23, 2015).

10 Merle Jensen, *What is Hydroponics?*, Controlled Env't Agric. Ctr., Univ. of Ariz., http://ag.arizona.edu/ceac/what-hydroponics (last visited Nov. 23, 2015).

11 *Aquaponics*, The Plant, http://www.plantchicago.com/non-profit/farms/aquaponics/ (last visited Nov. 23, 2015).

12 *See id*.

13 *See id*.

14 Tinker-Kulberg, *supra* note 5.

15 *See Aquaponics*, *supra* note 12 (referring to the video included on the website).

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[163] *See* David Porter, *Hurricane Sandy Was Second Costliest in U.S. History, Report Shows*, Huffington Post, (Feb. 12, 2013), http://www.huffingtonpost.com/2013/02/12/hurricane-sandy-second-costliest_n_2669686.html.
[164] *See* Chris Francescani, *Chris Christie: Hurricane Sandy New Jersey Damage Will Cost At Least $29.4 Billion,* Huffington Post (Nov. 23, 2012), http://www.huffingtonpost.com/2012/11/23/chris-christie-hurricane-sandy-new-jersey_n_2179909.html.
[165] *See* Andrew Freedman, *Hurricane Irene Ranked Most Coslty Category 1 Storm*, Climate Central (May 10, 2012), http://www.climatecentral.org/news/hurricane-irene-ranked-most-costly-category-1-storm.
[166] *See* Gurian & O'Dea, *supra* note 125.
[167] *See id.*
[168] *See id.*
[169] *See* Jonathan Douglas Witten, *Carrying Capacity and the Comprehensive Plan: Establishing and Defending Limits to Growth*, 28 B.C. Envtl. Aff. L. Rev. 583, 586 (2001).
[170] Reiu-Clarke, *supra* note 44, at 650.
[171] Klein, *supra* note 125, at 1165-66; Naomi Klein, *Capitalism vs. the Climate*, The Nation, Nov. 9, 2011 ("A 2007 Harris poll found that 71 percent of Americans believed that the continued burning of fossil fuels would cause the climate to change. By 2009 the figure had dropped to 51 percent. In June 2011 the number of Americans who agreed was down to 44 percent").
[172] *See* N.J. Admin. Code. § 7:36-1.1.
[173] *See* N.J. Stat. Ann. § 40:55D.
[174] *See id.*
[175] *See* N.J. Stat. Ann. tit. 40.
[176] *See* Witten, *supra* note 89 at 593.
[177] *See generally*, Robin B. Valinski, *Green Brook Flood Control Project: Saving Bound Brook* (2012), *available a*t http://repository.upenn.edu/cgi/viewcontent.cgi?article=1046&context=mes_capstones.
[178] *See* Arnold, *supra* note 75 at 421 (citation omitted).
[179] *See id.* at 433 (explaining that ecological changes are "characterized by: (1) nonlinear and unpredictable change; (2) many interconnections that cross scales of time, space, natural processes, and societal dynamics and effects; (3) organization by nested scales, networks... and nonlinear transition; (4) feedback effects; and (5) phenomena that may lack analogies in past experience, data, and models").
[180] Witten, *supra* note 89 at 593.
[181] N.J. Admin. Code. § 7:36-15.1, at 49-50 (2011).
[182] *See* Lathrop, *supra* note 26.
[183] *See e.g.*, N.J. Admin. Code. § 7:36-1.1 at 3-4.
[184] *See generally* John Hasse*, Evidence of Persistent Exclusionary Effects of Land Use Policy within Historic and Projected Development Patterns in New Jersey: A Case Study of Monmouth and Somerset Counties*, Geospatial Research Laboratory, Rowan University (2011), *available at* http://gis.rowan.edu/projects/exclusionary/exclusionary_zoning_final_draft_20110610.pdf.
[185] *See* Renee Skelton & Vernice Miller, *The Environmental Justice Movement*, Natural Resources Defense Council http://www.nrdc.org/ej/history/hej.asp (last updated Oct. 12, 2006).
[186] *See* Steinberg, *supra* note 88, at 61 (providing an example of how Florida legislators racialized human-exacerbated natural disasters).
[187] *See id.* at 61.
[188] *See* id. at 61*; see also What is Environmental Justice?*, EPA, http://www3.epa.gov/environmentaljustice/ (last updated Nov. 16, 2015) http://www.epa.gov/environmentaljustice/.
[189] *See* Hasse, *supra* note 185.
[190] *See* Cavanaugh, *supra* note 14.
[191] *See About the Refuge*, Fish and Wildlife Service, http://www.fws.gov/refuge/Great_Swamp/about.html (last visited March 13, 2015).
[192] *See* Jonathan E. Cohen, *A Constitutional Safety Valve: The Variance in Zoning and Land-Use Based Environmental Controls*, 22 B.C. Envtl. Aff. L Rev. 307, 329 (1995).
[193] *Id.*
[194] *See* Ottensmann, *supra* note 13.
[195] *See* Naomi Klein, *supra* note 172.
[196] *See* Francescani, *supra* note 165 (the cost of Hurricane Sandy).
[197] *Inside the Tobacco Deal*, PBS, http://www.pbs.org/wgbh/pages/frontline/shows/settlement/timelines/fullindex.html (last visited Nov. 21, 2015).
[198] *See, e.g.*, *Lead Industries Assoc. v. EPA*, 647 F.2d 1130 (D.C. Cir. 1980).
[199] *See* Leopold, *supra* note 141.
[200] *See* Leopold, *supra* note 141.

Endnotes: Indoor Aquaponics in Abandoned Buildings: A Potential Solution to Food Deserts

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[16] *See id*. (referring to the video); *Basic Questions about Aquaculture*, NOAA, http://www.nmfs.noaa.gov/aquaculture/faqs/faq_aq_101.html#18whatdo (explaining the dietary regimen of farmed fish) (last visited Nov. 4, 2015).
[17] *See Aquaponics*, *supra* note 12 (referring to the video).
[18] *See id*.
[19] *See id*.
[20] *See id*.
[21] *See id*.
[22] *See id*.
[23] *See id*.
[24] *See id*.
[25] *See id*.
[26] In Australia, it has become increasing popular to have at home aquaponics systems. While in the United States, the interest in aquaponics tends to be at a larger commercial scale. *See* Michael Tortorello, *The Spotless Garden*, N.Y. Times, Feb. 17, 2010, *available at* http://www.nytimes.com/2010/02/18/garden/18aqua.html?_r=0.
[27] Modern day aquaponics systems have grown from two distinct forms. A North Carolina State University researcher, who submerged fish tanks below a greenhouse, created the first form. The water from the fish tanks was used to irrigate the hydroponic grow beds that were located in the greenhouse. As the plants in the grow beds purified the water, the water returned to the fish tanks below the green house. Researchers at the University of the Virgin Island, who developed a system using fish tanks and floating raft hydroponics, created the second form. *See* Steve Driver, *Aquaponics-Integration of Hydroponics with Aquaculture* 3-4, 7 (2010), *available at* https://attra.ncat.org/attra-pub/download.php?id=56.
[28] *See* Wells, *supra* note 5.
[29] *See id*.
[30] *See* Craig Lawson, *Vertical Farming: A Hot New Area for Investors*, CNBC (Apr. 2, 2015, 2:19 PM), http://www.cnbc.com/id/102557803.
[31] *See* Jon M. Shane, *The Problem of Abandoned Buildings and Lots*, Center For Problem-Oriented Policing, http://www.popcenter.org/problems/abandoned_buildings_and_lots (last visited Nov. 4, 2015).
[32] *See id*.
[33] *See id*.
[34] *See id*.
[35] *See* Mari Gallagher, *supra* note 3.
[36] *See Aquaponics*, *supra* note 12.
[37] *See id.*
[38] *See id*; *see also* Tinker-Kulberg, *supra* note 5.
[39] *See Aquaponics*, *supra* note 12.
[40] *See Benefits of Aquaponics*, Volcano Veggies, http://www.volcanoveggies.com/benefits-of-aquaponics/ (last visited Nov. 4, 2015).
[41] *See Organic Agriculture*, USDA, http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=organic-agriculture.html (last updated Nov. 4, 2015) (describing the process of becoming an organic farm and the benefits of going organic); *see also* Kassandra Hinrichsen, *Farmers Market Now Doubling Link Dollars*, The Plant (Aug. 19, 2015), http://www.plantchicago.com/farmers-market-now-doubling-link-dollars/ (explaining how one commercial scale aquaponics farm, the Plant, will participate in a double dollar matching program for Illinois food stamp cards, making the produce affordable to low income families).
[42] *See* Wasim Aktar, et al., *Impact of Pesticide Use in Agriculture: Their Benefits and Hazards*, 2 Interdisc. Toxicology 1, 1-12 (2009), *available at* http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2984095/.

[43] *See id*. at 5-7.
[44] *See* Tinker-Kulberg*, supra* note 5.
[45] *See* Wells, *supra* note 5.
[46] *See id.*; *see also* Mike Sula, *The Four-Story Farm*, Chicago Reader (Aug. 19, 2010), http://www.chicagoreader.com/chicago/vertical-agriculture-city-farm-back-of-the-yards/Content?oid=2272850 (noting advantages to agricultural methods such as hydroponics include "a year-round growing cycle, no weather-related crop failures, no agricultural runoff, no pests").
[47] *See* Wells, *supra* note 5.
[48] *See id*; *see also* Sula, *supra* note 46 (referring to advantages of year-round growing cycle).
[49] *See Recommended Plants and Fish in Aquaponics*, Nelson Pade, http://aquaponics.com/page/recommended-plants-and-fish-in-aquaponics (last visited Apr. 25, 2015).
[50] *See* Sula, *supra* note 47.
[51] *See* Wells, *supra* note 5.
[52] *See id*.
[53] *See FAQ*, The Plant, http://www.plantchicago.com/about/faq/ (last visited Apr. 25, 2015).
[54] *See* Wells, *supra* note 5.
[55] *See id*.
[56] *See id*.
[57] *See id*.
[58] *See FAQ*, *supra* note 54 (explaining the process of deconstruction).
[59] *See id*.
[60] *See* Mark Andrew Boyer, *Inside the Meatpacking Plant Being Turned Into an Enormous Vertical Farm*, Fast Company (Aug. 5, 2013), http://www.fastcoexist.com/1682763/inside-the-chicago-meatpacking-plant-being-turned-into-an-enormous-vertical-farm#2.
[61] *Id*.
[62] About, The Plant, http://www.plantchicago.com/about/ (last visited Apr. 25, 2015).
[63] *See Current Tenants*, The Plant, http://www.plantchicago.com/businesses/current-tenants/ (last visited Dec. 6, 2015) (listing Skyygreens as tenants, in addition to the non-profit tenant the Plant Chicago).
[64] *See Aquaponics*, *supra* note 12.
[65] *See id*.
[66] *See FAQ*, *supra* note 54.
[67] *See id*.
[68] *See id*.
[69] *See id*.
[70] *See How Does the Plant Work?*, The Plant, http://www.plantchicago.com/how-does-the-plant-work/ (last visited Nov. 4, 2015) (referencing the video to explain the interconnection between the tenants and their waste).
[71] *See FAQ*, *supra* note 54.
[72] *See id*.
[73] *See* The Plant, The Plant: Farming the Future Highlights, *available at* http://www.plantchicago.com/wp-content/uploads/Groundbreaking-at-The-Plant-Press-Kit.pdf.
[74] *See id*.
[75] *See id*.
[76] *See About*, *supra* note 63 (noting that the physical building is owned by Bubbly Dynamics).
[77] *See* The Plant, *supra* note 74.
[78] *See id.* (noting that the Plant will hopefully be completed in 2016); *see also Current Tenants*, *supra* note 64 (describing the products of the aquaponics tenants and where they can be purchased); *Join us for The Back of the Yards Community Market indoor season starting October 3*, The Plant (Dec. 6, 2015), *available at* http://www.plantchicago.com/market/ (describing how the tenants of the Plant sell their produce at a farms market held in the building).
[79] *See FAQ*, *supra* note 54 (referring to the eight permits that were required prior to operation).
[80] *See Mayor Emanuel Introduces an Ordinance Supporting Urban Farms*, City of Chicago (July 28, 2011), http://www.cityofchicago.org/city/en/depts/dcd/provdrs/planning_and_policydivision/news/2011/aug/mayor_emanuel_introducesanordinancesupportingurbanfarms.html.
[81] SZEA § 1 (1926), *available at* https://www.planning.org/growingsmart/enablingacts.htm.
[82] *See* Phillip L. Fraietta, *Note: Contract and Conditional Zoning Without Romance: A Public Choice Analysis*, 81 Fordham L. Rev. 1923, 1926-27 (2013).
[83] *See id*. (discussing the failure of public nuisance to prevent the construction of large buildings in New York City, which ultimately led to the Zoning Resolution of 1916 in New York City).
[84] *Id*.
[85] SZEA § 1.
[86] *Id*. (referring to footnote 25 of the SZEA).
[87] *See id*. § 3 (discussing how the SZEA gives municipalities police power to plan a city according to the needs and to promote the wellbeing of the residents).
[88] *Id*.
[89] *See id*. § 4.
[90] *See id*. § 5.
[91] *Id*. (quoting footnote 30 of the SZEA).
[92] *See id*.
[93] Fraietta, *supra* note 83, at 1928.
[94] *Id*. at 1927 (citing Lincoln Trust Co. v. Williams Building Corp., 128 N.E. 209 (N.Y. 1920)).
[95] Euclid v. Ambler Realty Co., 272 U.S. 365 (1926).
[96] *Id*. at 379-80.
[97] *Id*. at 382.
[98] *Id*. at 384.
[99] *Id*. at 388 (stating that, "the question whether the power exists to forbid the erection of a building of a particular kind or for a particular use, like the question whether a particular thing is a nuisance, is to be determined not by an abstract consideration of the building or the thing considered apart, but by considering it in connection with the circumstances and the locality.").
[100] *Id*. at 395.
[101] *Id*.
[102] John E. Mogk, et al, *Promoting Urban Agriculture as an Alternative Land Use for Vacant Properties in the City of Detroit: Benefits, Problems and Proposals for a Regulatory Framework For Successful Land Use Integration*, 51 Wayne L. Rev. 1521, 1535 (2010) (explaining the concerns that consumers may have with the commercial sale of agricultural products).
[103] *Id* 1535-36.
[104] *Id*. at 1535 (specifically using Detroit as an example)
[105] *See generally*, United States Environmental Protection Agency, Urban Agriculture Code Audit, Milwaukee, Wisconsin 23 (2012) (describing urban agriculture reforms and noting only Chicago has specific mention of aquaponics).
[106] *Id*. at 23-24 (Cleveland, Kansas City, and San Francisco are cited as examples).
[107] *See id*.
[108] *Id*. at 23 (quoting Section 336 of the Cleveland Zoning Code).
[109] *Id*. (defining community garden as "[a]n area of land managed and maintained by a group of individuals to grow and harvest food crops and/or non-food, ornamental crops, such as flowers, for personal or group use, consumption or donation" and defining market gardens as "[a]n area of land managed and maintained by an individual or group of individuals to grow and harvest food crops and/or non-food, ornamental crops, such as flowers, to be sold for profit").
[110] *Id*. (noting the focus on land management for both definitions and the lack of inclusion of aquaculture, hydroponics, or aquaponics from the Code).
[111] *Id*. (quoting Section 17-17-0104-H of the Chicago Zoning Ordinance).
[112] *Id*.
[113] *See Mayor Emanuel Introduces an Ordinance Supporting Urban Farms, supra* note 81.
[114] *Id*.
[115] *See supra* Part II B (discussing the potential of combatting food deserts through urban agriculture); *see also supra* Part III (discussing concerns with agricultural zones).
[116] *See generally*, United States Environmental Protection Agency, *supra* note 106 (discussing the variety of urban agriculture methods).
[117] *See supra* Part II C (discussing the confusion that occurs when codes are not clear as to what is allowed).
[118] *See* United States Environmental Protection Agency, *supra* note 106, at 23 (referencing Section 17-17-0104-H of the Chicago Zoning Ordinance).
[119] *Id*. at 15-16.
[120] *See supra* Part II C.
[121] *See* Mogk, *supra* note 103, at 1549 (explaining the concerns that consumers may have with the commercial sale of agricultural products).
[122] *See* United States Environmental Protection Agency, *supra* note 106, at 15-16 (discussing housing livestock and acknowledging fish as livestock).
[123] *See* Mogk, *supra* note 102, at 1538.

[124] *See* United States Environmental Protection Agency, *supra* note 106, at 11 (referencing Milwaukee's zoning code Section 295-203-14, including "cows, cattle, horses, sheep, swine, goats, chickens, ducks, turkeys, [and] geese" in the definition of livestock).
[125] *See id*.
[126] *See id*. at 1535-40.
[127] *See id*. at 1535-36.
[128] *See id*. at 1538.
[129] *Supra*, Part II A (discussing how aquaponics systems work).
[130] *See* Mogk, *supra* note 103, at 1540 (stating that "agriculture in an urban setting introduces a competitor for clean water).
[131] *See supra* Part II B at 8 (discussing water needs for aquaponics system).
[132] *See* IBC, International Code Council (2012), *available at* http://publicecodes.cyberregs.com/icod/ibc/2012/icod_ibc_2012_intro.htm (referencing the Preface to the code) (last visited Nov. 20, 2015) [hereinafter IBC].
[133] *See* Nancy J. King & Brian J. King, *Creating Incentives for Sustainable Buildings: A Comparative Law Approach Featuring the United States and the European Union*, 23 Va. Envtl. L.J. 397, 409 (2005).
[134] *See* IBC, *supra* note 133, at Preface.
[135] *See id.*
[136] *See id.* at § 101.2.
[137] *See id*. at § 312.1.
[138] *See id*.
[139] *See id*.
[140] *See id*. *at* § 202*(*defining "agricultural building" as "[a] structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products. This structure shall not be a place of human habitation or a place of employment where agricultural products are processed, treated or packaged, nor shall it be a place used by the public).
[141] *See id*. at § 3401.1-3401.6.
[142] *See id*. at § 3401.2.
[143] *See id*. at § 3401.3.
[144] *See* King, *supra* note 134, at 409.
[145] *See, e.g.*, Phoenix, Ariz., 2012 Phoenix Building Construction Code Amendments (2012), *available at* https://www.phoenix.gov/pdd/devcode/buildingcode (last visited Nov. 20, 2015).
[146] *Id*.
[147] *See generally*, King, *supra* note 134, at 397-402 (discussing the benefits of green building standards and how municipalities can incentivize green development).
[148] *See id*.
[149] *See id*.
[150] *See* IBC, *supra* note 133, at § 312.1.
[151] *See id*.
[152] *See* City of phoenix, Indoor Agriculture Occupancy Classifications (2013), *available at* https://www.phoenix.gov/pddsite/Documents/dsd_trt_pdf_00756.pdf (last visited Nov. 21, 2015).
[153] *See id*.
[154] *See* IBC, *supra* note 133, at § 202.
[155] *See* City of Phoenix, *supra* note 153.
[156] *See id*. (demonstrating potentially using F-1 Factory Industrial Moderate-hazard and Mercantile classifications for Indoor Agricultural Facilities).
[157] *See id*.
[158] *See* IBC, *supra* note 133, at § 306.2.
[159] *See* City of Phoenix, *supra* note 153.
[160] *See id*.
[161] *See* IBC, *supra* note 133, at § 302.1 (stating that "structures or portions of structures shall be classified with respect to occupancy in one or more of the groups listed below.").
[162] *See* City of Phoenix, *supra* note 153.
[163] *See id*.
[164] *See supra* Part IV A (discussing how current building codes function).
[165] *See supra* Part II A (giving a background on how an aquaponics farm works).
[166] *See* IBC, *supra* note 133, at § 202.
[167] *See id*.
[168] *See id*.
[169] *See supra* Part II B (referencing the cost of water and sixteen to eighteen hours of light each plant needs).
[170] *See* Wells, *supra* note 4 (discussing renewables in aquaponics farms).
[171] *See supra* Part II B (noting the energy requirements discussed earlier in the Article, and that operations will be required to connect to the grid if they are unable to produce enough renewable energy themselves).
[172] *See supra* Part II B (discussing how aquaponics farms do not require fertilizers).

Endnotes: Ridding PES Systems of the "Pay to Pollute" Principle: PES Optimization Strategies

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the UNFCCC is on stabilizing greenhouse gas (GHG) concentrations in the atmosphere to a less volatile and more sustainable level. *See Background on the UNFCCC: The International Response to Climate Change*, http://unfccc.int/essential_background/items/6031.php (last visited Nov. 13, 205) [hereinafter "*Background on the UNFCCC"*].

3 *See id*.; *see also Kyoto Protocol*, United Nations Framework Convention on Climate Change, http://unfccc.int/kyoto_protocol/items/2830.php (last visited Nov. 6, 2015) (describing the role of the Kyoto Protocol was to set internationally binding emissions reduction targets).

4 *See generally id*. (discussing hard number commitments); *Reducing Emissions from Deforestation and Forest Degradation and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries (REDD-plus)*, UNFCCC Int., http://unfccc.int/land_use_and_climate_change/redd/items/7377.php (last visited Nov. 14, 2015) (discussing the REDD program which involves other countries helping to finance and provide technical support to developing countries to abate and reverse the effects of deforestation).

5 *See generally* Richard B. Stewart et al., Climate Finance: Key Concepts and Ways Forward 1-2, *available at* http://belfercenter.ksg.harvard.edu/files/Stewart_Final_2.pdf (last visited Nov. 13, 2015).

6 PES is known by other names including Payment for Ecosystem Services and Green Growth Strategies, but each refers to the same basic type of agreement in which there is a service provider—the landowner, and there is a payor—the person, private company, non-profit, or governmental entity paying for conservation efforts. *See generally* Org. for Econ. Cooperation and Dev., Green Growth and Developing Countries: Consultation Draft, 10-11, Org. for Econ. Co-Operation and Dev., (June 2012), *available at* http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&ved=0CEwQFjAFahUKEwiY18CB143JAhVB5iYKHUP9AbE&url=http%3A%2F%2Fwww.oecd.org%2Fenvironment%2Fenvironment-development%2F50559116.pdf&usg=AFQjCNFe2PpRR14wvhO5o85MQA_RfBJ2cw [hereinafter "*Green Growth*"] ("Choosing not to bring more land under cultivation because of the high environmental costs will be difficult for a country with high levels of poverty.").

7 *See Markets and Payments for Environmental Services*, Int'l Inst. for Env't and Dev., http://www.iied.org/markets-payments-for-environmental-services (last visited Nov. 6, 2015) [hereinafter "*Markets and Payments for Environmental Services*"]. These payments are similar, incentive-wise to subsidies and taxes on land for the purposes of achieving conservation goals.

8 *See id.*; *see also* Katoomba Grp. and UNEP, Payments for Ecosystem Services Getting Started: A Primer 5, 26 (2008), *available at* http://www.unep.org/pdf/PaymentsForEcosystemServices_en.pdf [hereinafter Payments for Ecosystem Services Getting Started] (discussing how payment for watershed services currently exists in Costa Rica, Ecuador, Bolivia, India, South Africa, Mexico, and the United States).

9 Alternatively, many support the contention that PES is instead characterized by the "common but differentiated" principle because historically, developed countries fund PES projects in less developed countries to promote an identified conservation goal, thereby reducing activity responsible for producing climate change effects in exchange for a fee. Therefore, the common purpose is served: reducing climate change impacts. *See* Natural Res. Mgmt. and Env't Dep't Food and Agric. Org. of the United Nations, Payments for Environmental Services Within the Context of the Green Economy 4 (Sept. 2010),