# Informing the Debate

## Michigan Applied Public Policy Brief

# Urban Livestock Adoption in Detroit, Michigan


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# Informing the Debate

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The IPPSR program, Michigan Applied Public Policy Research Program or MAPPR, generates research on current issues held in urban communities with special attention to Michigan. Policy researchers author summary briefs of their research outcomes and their implications. The funded research projects and related policy briefs focus on main headings of discussion being held in the policy arena.

When developing the paper series initiative in 1992, the topics of the papers were submitted following a two-day meeting with leaders from the business sector, nonprofit agencies, foundations, and university faculty and staff. That group evolved into the Urban Research Interest Group.

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# Informing the Debate

MAPPR Policy Research Brief

## Urban Livestock Adoption in Detroit, Michigan

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## Executive Summary

The City of Detroit is currently developing an Urban Livestock ordinance which would permit small animal farming within city limits. Urban communities around Michigan and the Midwest are considering similar ordinances, and Detroit's example could provide a model for other cities. A Detroit City Planner, city staff and community groups are committed to drafting livestock ordinances in a thoughtful way that incorporates research on the potential benefits and challenges of urban livestock farming, and responds to community interest and concern.

Researchers from Michigan State University partnered with Food Plus Detroit to ask, 'What are the likely trajectories of urban livestock adoption in Detroit if an urban livestock ordinance is passed, and how might urban livestock keeping affect both environmental qualities of the city and community support for urban agriculture?'

To answer this question, we collected qualitative data around community support for, and concerns about, urban livestock though interviews and 'Listen and Learn' community sessions. We then developed a system dynamics model incorporating these perspectives to generate scenarios of urban livestock adoption over a ten-year period in Detroit. System dynamics (SD) is a simulation modeling tool used in a wide variety of fields to examine the behavior of complex systems over time. Its main features are the ability to represent feedback (circular causal relationships) and stock-and-flow dynamics. SD has commonly been used to represent adoption of technology, as we did in this study. Particularly, we modeled scenarios of urban households adopting chicken-keeping over ten years in Detroit.

Chickens were chosen as a representative livestock type which is likely to be more popular with potential urban farmers than e.g. rabbits or goats, due to their relatively modest needs for space and their egg production. The motivations behind adoption decisions, disadoption decisions, and social opposition to urban livestock-keeping as coded into the model were taken directly from the interviews and community sessions.

Model results indicate that a small, but significant, minority of Detroit households could adopt chicken-keeping over a ten year period (between 1000 and 3000 households, out of 256,000 total households—approximately 1%). According to the interview and community session data, these potential adopters are motivated by food security and environmental concerns, as well as the educational opportunities afforded by urban livestock keeping (i.e. 'teaching the community/children where their food comes from').

In the SD simulation, if urban livestock adopters receive adequate support and training, both disadoption and social opposition dwindle to minimal levels after an initial adjustment period, and the number of households adopting urban livestock climbs continuously over the ten-year simulation. If training and support fail to keep up with the growth in urban livestock adoption, disadoption rates climb rapidly, causing the total number of adopters to peak after only five years. Social opposition also increases, which further diminishes adoption rates and encourages disadoption. According to interview and community session data, social opposition to urban livestock is primarily motivated by concerns about noise, smell, and containment of animals, animal welfare, and the ability of the city to enforce regulations around animal keeping.

Based on these results, we offer the following policy insights for the development of the urban livestock ordinance in Detroit:

- Urban livestock guilds could help to ensure training and compliance of potential operators, which in turn would reduce social opposition to urban livestock farming

- Reducing the time it takes for a livestock farmer to become experienced (through training and support) is the best way to ensure compliance with best practices, increase the number of urban livestock farmers, and reduce social opposition to urban livestock
- Open communication with neighbors is critical to building support for urban livestock practices
- More research is needed on the spatial dynamics of urban livestock farming, and on its economic benefits.

# INTRODUCTION

## Historical Development/Context of the situation in Detroit

In the spring of 2013 the City of Detroit drafted its Urban Agriculture Ordinance which originally included an amendment that allowed for small animal livestock farming. The inclusion of language sparked community discussion but, due to public discomfort, the language pertaining to livestock was removed with stated plans to revisit the issue (Battagilia, 2013).

Detroit's Senior City Planner, Kathryn Lynch Underwood, and community partner Renee Wallace with Food Plus Detroit, are currently working with various stakeholders, which includes Michigan State University, to develop Detroit's Urban Livestock ordinance. They are interested in incorporating research and modeling to support the decision-making required to set standards and codes for permitting livestock agriculture in the City of Detroit. Expected benefits of solutions informed by research and modeling include a reduction in stakeholder conflicts, minimized impacts to environmental quality, and avoiding public health risks.

We used a participatory system dynamics approach to capture and reflect the public's perspective (pros and cons) related to urban livestock agriculture and utilize their input to model the potential impacts to water quality, air quality, land use, public health and waste generation, over time. This community engagement project has generated knowledge on appropriate conditions in urban cities and identified potential systems and infrastructure needed to encourage healthy urban livestock practices. The project has encouraged new research connections between Michigan State University Faculty and the practitioner community, while creating a framework for reciprocal learning about urban livestock agriculture.

Raising livestock in an urban environment raises serious concerns regarding environmental quality, public health, and neighborhood character (Mogk, Wiatkowski, &Weindorf, 2010). As part of a multi-stakeholder effort, the knowledge generated from this research and modeling will help to inform and affect policies on a multitude of levels—from the development of statewide urban agricultural management practices, to serving as a framework for similar developments in cities and urban areas across the state and region. (Pollock & al., 2012)

In April 2014, the Commission of Agriculture and Rural Development approved the 2014 Generally Accepted Agricultural and Management Practices for Site Selection and Odor Control for New and Expanding Livestock Facilities (GAAMPs). Though not directly affecting the City of Detroit (due to population size), Category 4 in the Site Selection GAAMPs identifies locations that are primarily residential and do not allow agricultural uses by right. This new category, which defaults regulation of urban agriculture to local zoning, is facilitating dialogue with communities about how they can support their local food systems. The findings of the project serve to inform and strengthen the productivity of these community dialogs by illustrating scenarios and key policy features and practices that may minimize environmental & public health impacts, and avoid neighborhood nuisance complaints.

To further review and expand understanding of the issues pertaining to urban livestock, the Michigan Department of Agriculture and Resource Development (MDARD) announced, in the

summer of 2014, the formation of a workgroup to support the expansion of agriculture in a way that "reduces potential neighborhood conflicts and allows for the community to be involved. (Michigan Good Food, 2012) The workgroup included 21 representatives with contributors from across the food system, including Detroit Senior City Planner, Kathryn Lynch Underwood. The workgroup's charge was to "formulate recommendations to stimulate and support local efforts to address the increased interest in raising livestock in urban/suburban areas" (Urban Livestock Workgroup Report). Their work resulted in a guidelines document geared at policy makers and potential urban livestock producers that outlined best management practices, local control and ordinances. The research team utilized these guidelines as a rough starting point for what regulatory compliance would look like and worked closely with stakeholders and community partners to identify other areas of concern, barriers for producers, and how these factors change over time.

# METHODOLOGY

## Interviews

To gain understanding of how *urban livestock agriculture* (ULA) fits into the larger local food movement, the research team interviewed key stakeholders in the Detroit food system. The semi-structured interview process was focused on barriers to food security, but included questions about urban livestock as a food system strategy. The team interviewed 15 stakeholders and analyzed the results to identify system behavior, potential benefits of ULA adoption, and likely sources of conflict in the community (Appendix A).

Analysis of the interviews reveals that stakeholders are hesitant about ULA as a food security strategy. Many report being concerned with public nuisances caused by ULA including unsightly structures, offensive odors, and property damage committed by loose animals. Others question whether the activity is in line with the look and feel of an urban space, suggesting that the activity be relegated to less densely populated areas of the city. Noise from animals, effects on property values, public health concerns, and attracting vermin and insects also emerged as concerns, but to a lesser extent than the others. Many also cited the lack of infrastructure and veterinary services as barriers to a successful ULA in Detroit. Those who viewed ULA as an effective food system strategy reported that it has the potential to create jobs and produce raw materials for other cottage industries.

| Category | Comments |
|---|---|
| Concern | 26 |
| Enforcement | 4 |
| Public Health | 3 |
| Animal Welfare | 4 |
| Research Need | 5 |
| Negative Externality | 10 |
| Reason to Support | 38 |
| Economic Development | 5 |
| Ecosystem | 6 |
| Education | 8 |
| Food Security | 6 |
| Social Capital | 3 |
| Waste | 1 |
| Age Benefit | 9 |
| Barrier to Adopt | 10 |
| Ecosystem | 1 |
| Enforcement | 2 |
| Animal Welfare | 1 |
| Skill Attainment | 3 |
| Infrastructure | 3 |
| Research | 21 |
| Enforcement | 5 |
| Public Health | 1 |
| Waste | 1 |
| Animal Welfare | 3 |
| Research Need | 8 |
| Infrastructure | 3 |
| **Total Comments** | **95** |

## Livestock Workshops

In November of 2015 The Detroit City Planning Commission hosted two community 'Listen and Learn' sessions inviting stakeholder discussion on the proposed urban livestock ordinance. The sessions provided an opportunity for community members to voice their concerns, opinions, and general feelings about ULA before the City policy was developed. In conjunction with the hosts of the sessions, the research team attended both sessions to capture perceived barriers to 'trying/adopting' ULA, reasons for public opposition, and a general understanding of how the system is currently operating. Participants were then asked to place an anonymous 'dot' sticker with a unique identifier on a poster indicating their support for, or opposition to, ULA. The research team took observation notes on public comments and recorded dot survey data. These data were then used to inform the modeling).

The notes from the public comment sessions were coded for major themes utilizing a simplified version of the constant comparison method developed by Glaser and Strauss for qualitative analysis. The method uses "three major stages" to "characterize the constant comparison analysis". The first stage, open coding, breaks the data into smaller units by content using descriptor codes for each data point. The second stage is used to group the data into categories. In the third and final stage the researchers develop "themes to express the content of each of the categories".

The research team identified four major categories that emerged from analyzing both of the sessions independently. The major categories were coded as Areas of Needed Research, Reasons to Support ULA, Public Concerns about ULA, and Barriers to Adoption of ULA. Then the comments were coded for themes within these categories.

Figure 1.x illustrates the major categories and themes identified from this processes. In total, 102 public comments dealing with ULA in the City of Detroit were documented. Of these, 26 were grouped as *Public Concerns About ULA*, 38 were coded as *Reasons to Support ULA*, 10 were coded as *Barriers to Adoption of ULA,* and 21 as *Areas of Needed Research*. Ten more comments were general best practice solutions, or ULA tips from experienced farmers.

## Public Concerns

ULA concerns are summarized in Table 1. Of the 26 documented public comments coded as concerns, four were in regards to animal welfare, ten dealt with public nuisance, and four concerned rule enforcement. Many of the public comments deal with the spill-over impacts, or externalities that may be caused by ULA activities by neighboring households. These concerns are intertwined with one of the most significant concerns which were questions dealing with the city's capacity to enforce any rule or ordinance that may be adopted to mitigate these spill-over effects. It is important to note that the city of Detroit's administrative capacity for other infrastructure and zoning related duties may be unknown due to the city's 2014 Chapter 9, Title 11 bankruptcy claim.

## Reasons to Support ULA

It is important to understand the reasons residents are supportive of ULA, and what potential they see for it within their neighborhoods and lives. Thirty-eight of the public comments were reasons why the City and community members should support ULA. Of these, five comments cited opportunities for economic and workforce development. Six pointed to the development of local food systems, food security, or food sovereignty issues. Six viewed it as an opportunity for the environment, green space management or the development of ecosystem services. Nine comments dealt with benefits to the current urban agriculture movement, citing the natural coupling of livestock with produce-based agriculture, and the use of livestock manure as compost. Eleven comments pointed to opportunities for community building, social capital creation, or educational opportunities for youth and adults to better understand the food system, agriculture and biological systems.

## Barriers to Adoption

Upon request of the research team, the session facilitator prompted the group at both sessions with a question to those who were potentially interested in practicing ULA themselves. The question was "if you are interested, what are the barriers you see to you doing this activity?" The response generally dealt with skill attainment and access to resources and infrastructure. More information was requested on how to learn the proper techniques to insure animal welfare, public safety, and proper management of animal waste. Of the ten comments coded as Barriers to Adoption, three dealt with infrastructure access, two with the rules of enforcement, three with attainment of the proper skills, one cited the unknown quality of the environment, and another about animal welfare.

## Areas of Research/ Unknowns

The sessions also brought to light issues in which more information would be necessary to make an opinion. These comments were coded as "Areas for future research" or "Unknowns". These comments dealt with issues such as the effect on public health, allergies, what to do with abandoned animals, the current livestock veterinary services, and the specific neighborhoods where ULA would take place. Many of these comments were double coded as they overlapped with the other three major themes.

## System Dynamics Model of Urban Livestock Adoption and Public Opposition

The primary objective of this study was to conduct an assessment of adoption and diffusion of ULA by residents in the city of Detroit. The underlying principal for this model comes from the Bass diffusion of innovations model, which primarily deals with adopters of new technology (Rogers 2010). In the Bass model, early adopters communicate their experience with the technology to the general public who, more frequently adopt the technology if their encounter's experience is a positive one.

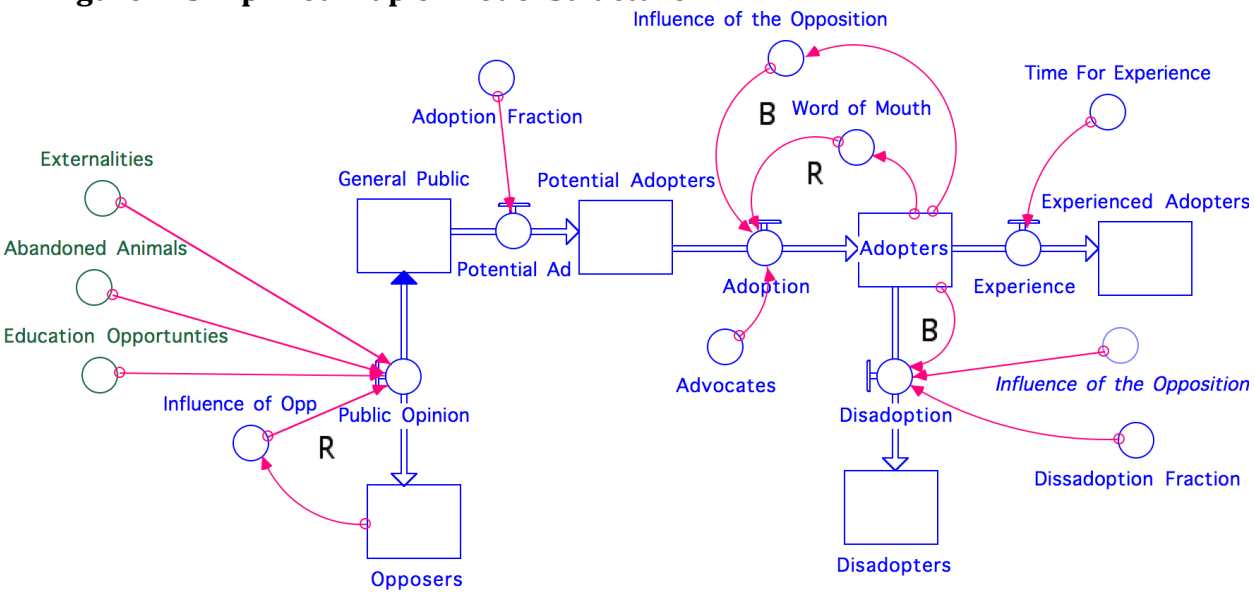
The system dynamics model utilized for this analysis is based on the diffusion of innovations theory in sociology. This perspective details how the rate of adoption (and disadoption) of new technology is shaped by the communication from those who have experience with the technology. This creates a feedback loop which reinforces the adoption rate.

## Model Overview

Our model simulates Detroit households deciding to participate in ULA, and the general public's opinion of the practice over time. Specifically, we focused on households choosing to raise chickens, likely the most commonly adopted type of ULA, but the model could easily be adapted to other livestock types (rabbits, goats, ducks) with similar adoption dynamics but different space and housing requirements. The rates of change for these stocks are based on public perception of performance, benefits, and other external impacts of ULA. We utilized the qualitative analysis from both the interviews and the aforementioned 'Listen and Learn' sessions to inform the model's structure and parameters.

Figure 1 represents a simplified illustration of the model structure. The sociological literature on technology adoption stresses the importance of communication among early adopters and potential adopters regarding performance of the technology (Lin 2003). The literature on diffusion of innovations also stresses the importance of peer-to-peer learning, and gives theoretical justifications for the reinforcing feedback loops for both adoption and disadoption (Rogers 2010). We also modeled potential changes in public opinion with a similar reinforcing feedback mechanism.

**Figure 1: Simplified Map of Model Structure**




The model follows a simple stock and flow structure, with the majority of households beginning the simulation in the general population, which is the population that is neutral to the idea of ULA. From this stock, some households flow into the Potential ULA Adopters stock. This fraction is based on an estimate of single family households with enough land and setback from other properties to acceptably practice urban livestock. Potential Adopters may choose to adopt ULA based on the word of mouth of current adopters and the influence of advocates in the ULA community. As the stock of ULA Adopters increases, so does the effect of word of mouth. This represents a reinforcing feedback loop (labeled 'R' in the diagram above), meaning that it is a circular cause-and-effect structure that builds on itself. The strength of this effect is modulated by the influence of the opposition, which represents a balancing feedback loop (labeled 'B'). Balancing loops tend to dampen growth of a stock, and move the system towards equilibrium. If the influence of the opposition is stronger than the word of mouth effect, the household remains a potential adopter. If the Word of Mouth Effect is stronger, the household becomes an adopter. At every time-step (one month as simulated in our model), adopters have the opportunity to disadopt from ULA. It is assumed that 1% of adopters will decide to give up the practice each time-step, and more if the influence of the opposition is strong. The disadoption process therefore represents a third feedback loop which is balancing—the more adopters there are, the more

potential disadopters, which in turn brings down the number of adopters. The green connectors on the left side of Figure 1 are in fact not exogenous factors, but are driven by the behavior of ULA adopters as described below.

## Adopter to Disadopter

As with any new activity, some ULA adopters may find that the practice of raising animals isn't for them, that it doesn't fulfill their expectations of benefits, or it causes too many problems with their neighbors. Households leaving ULA are simulated in the model as disadoption and is a function of the Influence of the Opposition and the Disadoption Fraction. The Disadoption fraction is an estimated percentage of households that will disadopt every month. Disadopting households also affect the model in that their animals flow into the abandoned animal stock.

## Adopter to Experienced Adopter

It is assumed that over a length of time, new ULA adopters will gain significant skill and experience in the practice of raising animals. This experience allows them to be stronger advocates and share their knowledge with other new adopters. It is assumed that once an adopter has gained this experience they will continue to farm animals and will no longer disadopt the practice.

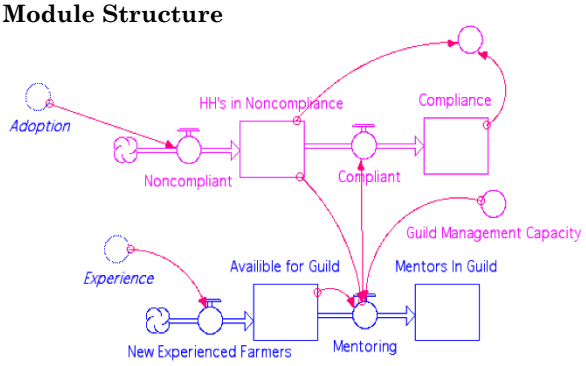
## Public Opinion – BiFlow

The flow to opposition from the general public (or vice versa) is determined by three areas of public concern gleaned from the participatory process; the Externalities Effect, Abandoned Animal Effect and the Educational Opportunities Effect. Each of these effects are modeled to have a tolerance threshold that determines if the influence is positive (increasing the flow to Opposition) or negative (returning Opposers to the neutral General Public). The more households in the Opposition stock, the stronger the Influence of the Opposition is, slowing the flow of adoption, increasing the rate of Disadoption, and creating a reinforcing feedback loop drawing in more opposition.

If the system is operating below the thresholds for any of the categories, the strength of the opposition dissipates; for instance, if there are systems in place to avoid abandoned animals, many educational opportunities exist, and most ULA adopters are in 'compliance' the influence of the opposition will be low, and may reverse direction, reducing the stock of Opposition households, and returning the households to the General Public.

## Non-Compliant Households to Compliant Households

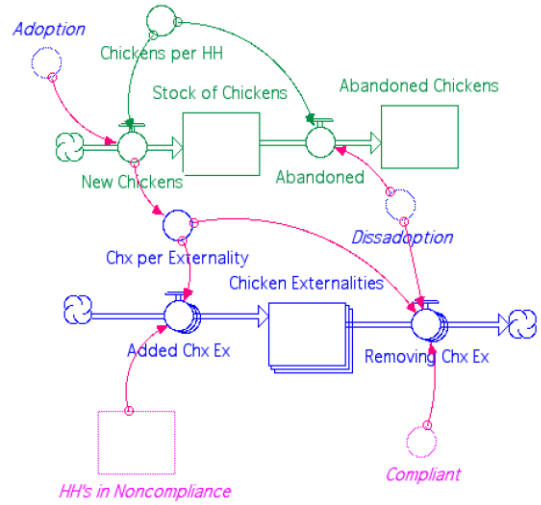
**Figure 2 Detailed Map of Compliance Module Structure**




Compliant Households are modeled as those who are fully in line with the Urban Livestock Workgroup's recommendations. These recommendations cover aspects of ULA that ensure minimal public nuisance, public health disturbances, and welfare for all involved. The guidelines describe best practices for health, housing, waste management, slaughter and pest control. Many of these guidelines will require institutional support and experienced ULA farmers to accomplish. To simulate this process, our model assumes that new adopters, who are inexperienced with the realities of livestock farming, will undoubtedly face troubles while getting started. The model assumes that part of this startup feature will create opportunities for neighbor complaints and other non-compliant practices that may lead to ecological, public health, and animal welfare concerns.

Overtime, ULA adopters may move into compliance by receiving input and citations from compliance staff, through personal experience, and the word of mouth assistance offered by more experienced farmers. One of the options recommended by the Urban Livestock Workgroup is to institute livestock guilds, responsible for policing and correcting ULA practices that are not deemed in compliance[1]. The mentorship capacity of the Guild is based on the quantity of experienced ULA farmers in the system. Over time, as this number increases, the capacity increases as well, bringing more ULA farmers into compliance.

**Figure 3 Detailed Map of Externalities Module Structure**




The compliance/noncompliance ratio determines the level of negative externalities experienced in the system. It is assumed that non-compliant households create more nuisance complaints, have more difficulty containing their livestock to their property, and overall strengthen the influence of those opposed to ULA.

[1] The formation of an Urban Livestock Guild was recommended by City Planner Kathryn Lynch Underwood to create opportunities to gain hands-on training to learn how to deal with health and other care issues with ULA. The ULG would serve to train future and current animal keepers on proper care techniques. A component of the Guild would serve as a peer support for animal keepers; be a liaison to the city; and provide education and outreach to the broader community. Also being considered is a required training administered through the Guild as a prerequisite for City livestock permitting.

### Animals to Abandoned Animals

Another area of concern that emerged out of the participatory process was concern for the welfare of the livestock animals, in particular the question of what happens to an animal if an adopter decides to give up the practice. To capture this, our model assumes that if ULA adopters decide to discontinue ULA, their stock of animals contributes to a stock of animals deemed abandoned.

### Compliance Staff

Another option to ensure that ULA participants are in compliance with the proposed regulations/guidelines is to utilize city staff to inspect and enforce rules.

## RESULTS

### Simulated Scenarios

Working with the data collected from the stakeholder meetings and interviews, the research team constructed model scenarios to simulate possible adoption rates and public opposition to ULA. The purpose of this exercise was to generate 'what if' pictures of the future that could serve to guide policy. The model was simulated at a monthly time step for ten years (120 months), to capture both short- and medium-term dynamics of proposed livestock legalization.

### Base Model -> No compliance staff; no Guild

As this model run demonstrates, without a regulatory institution or ULA dedicated compliance staff to slow adoption, potential adopters rapidly take on ULA farming. As households adopt ULA without compliance mechanisms, they are cumulatively creating negative externalities and conflicts with neighbors and other stakeholders. Adopters are also disadopting as a result of the growing opposition towards the practice and lack of institutional support for learning proper livestock farming techniques. Over ten years the amount of ULA farmers stabilizes as some participants become more experienced and others disadopt.

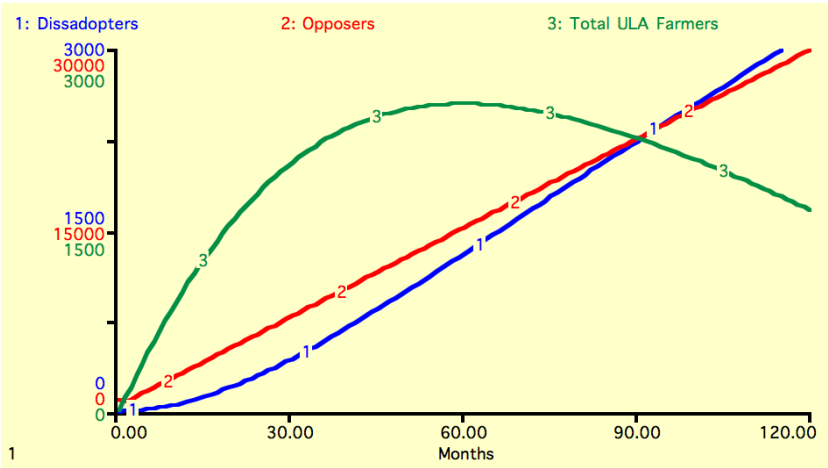


**Figure 4 Base Model Run**

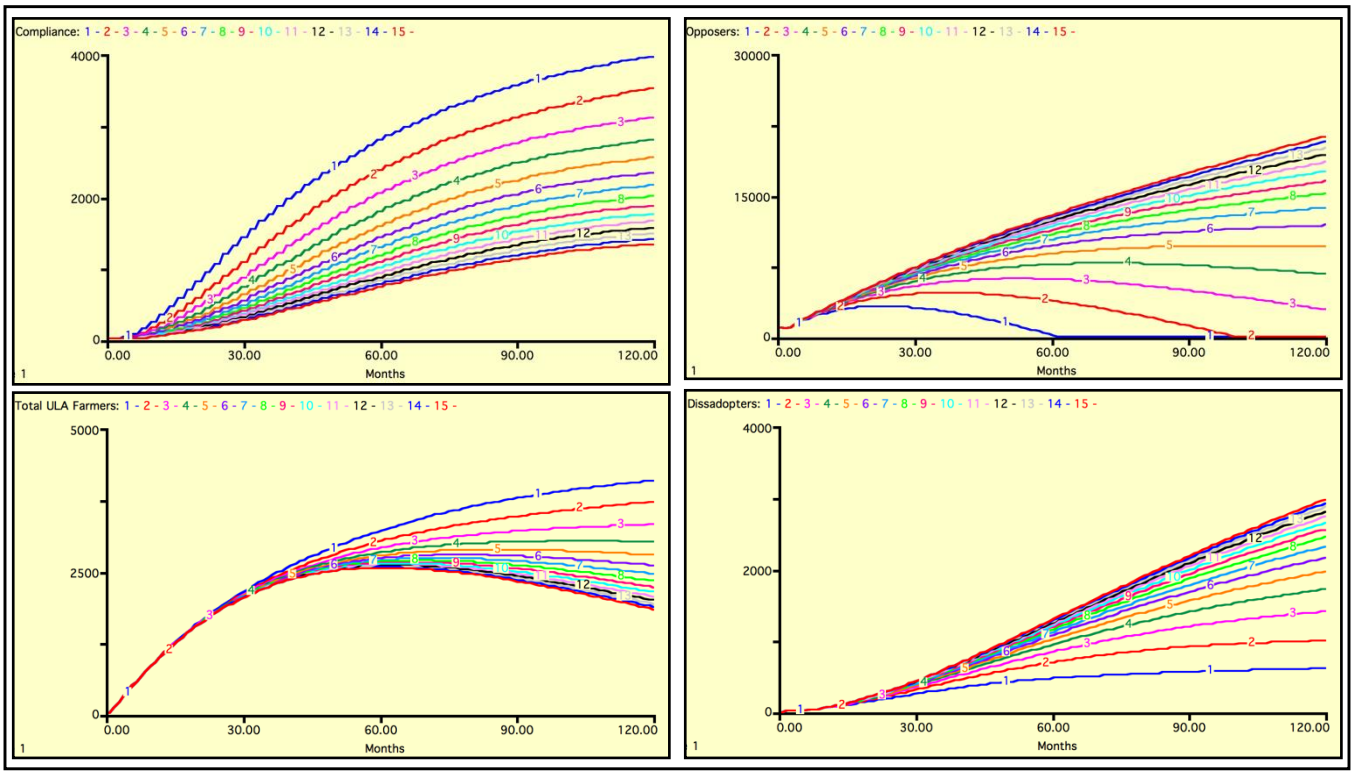
## Compliance Staff -> Delay

Without controlling the flow of permits a dynamic problem arises with the capacity of enforcement and the compliance staff. There is a delay in reacting to rising levels of ULA farmers and hiring and training compliant staff. This delay creates a problem where compliance staff are ill-equipped to deal with non-compliance, or are over staffed when ULA participation starts to decline through disadoption.

## Guild Program & Sensitivity of Time in Training

The Guild Program, which uses experienced ULA farmers to regulate practices and provide institutional support for adopters, is effective at bringing ULA farmers into compliance. As more ULA farmers become compliant and are able to offer mentorship and skill development to others, the capacity of the Guild grows. Important to this feedback loop is the length of time, in months, that it takes for a ULA farmer to become "experienced". Figure 5 demonstrates that the system's behavior is sensitive to changes in this length of time to become experienced. Each model run (labeled 1-15) in the chart has the same initial conditions and parameters, but varies incrementally in the 'length of time to experience' variable from 12 months to ten years. When the length of time variable is set at twelve months the system experiences the fastest route to compliance and the least amount of opposition. This also results in the most ULA overall and the least disadoption over the length of the simulation.

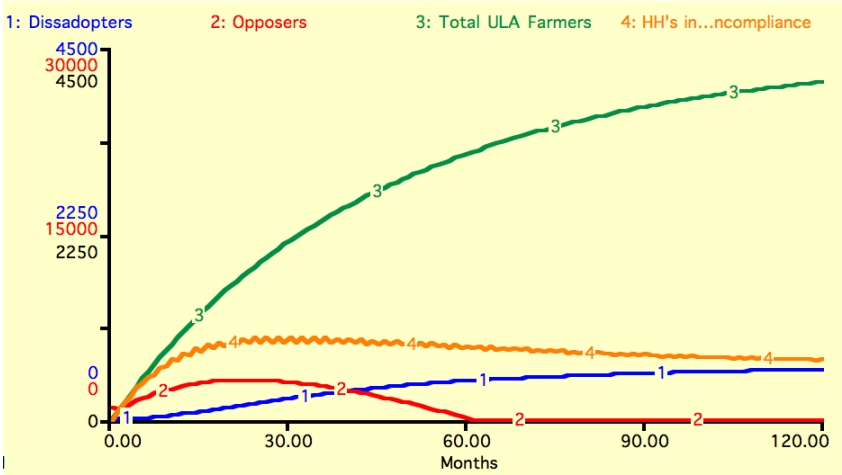
**Figure 5 Sensitivity Analysis of Time to Experienced**



## With Guild at 12 Month Time to Learn

Setting the variable 'time to experienced' at twelve months results in high ULA adoption, and lots of Guild capacity (as ULA farmers become trained and are subsequently available to train others). Compliance is high, and social opposition to ULA dissipates accordingly (Figure 6).

**Figure 6 Model Run with Guild**




## Recommendations for Immediate Action

The results of this simulation model indicate that urban chicken farming would be an attractive option for a small, but significant minority of Detroit households if legalized (most model runs estimated between 1000 and 3000 adopting households over ten years). Responses of Detroit residents and animal keepers captured in the 'Listen and Learn' sessions indicate why some households are enthusiastic about raising animals: food security; educational tool for children to learn about agriculture; and, as a source of income. In addition, many Detroiters spoke of strong ecological and health motivations for raising food they knew to be local, sustainable, and healthy.

With all of these potential benefits of ULA, however, the model, the interviews, and feedback from the 'Listen and Learn' sessions indicate the potential for negative externalities and a significant social backlash to ULA if adopted without proper training and enforcement mechanisms. If residents see animals being improperly cared for, or allowed to roam freely, or if the odor of chicken waste becomes a nuisance, they are likely to become openly hostile to ULA when they might have been neutral or even supportive previously. The more neglectful or poorly trained animal keepers there are, the more quickly opposition to ULA could build. While only a fraction of Detroit households are likely to become livestock keepers under a ULA ordinance, their ability to operate is conditional on the social acceptance of the majority of their neighbors.

The Detroit urban livestock workgroup has already proposed solutions which could prevent the problem of poorly trained and noncompliant animal keepers—specifically, through the formation of Urban Livestock Agriculture Guilds. The model results indicate that these guilds, if implemented well, would be effective training and enforcement bodies for animal agriculture in the city. Moreover, they would allow for a more agile and responsive structure than training and enforcement functions located in city government. As the model indicates, the delay typical in hiring and training new city staff as the ULA sector grows could create problems with scaling up and scaling down in response to the number of ULA operators in the city. Because guilds would be comprised of experienced animal-keepers themselves, their numbers would grow (or shrink) alongside the number of ULA operators in a more tightly coupled manner.

Another policy insight from the model is that it would be important to decrease the amount of time it takes for a farmer to become experienced in ULA as much as possible, through education and training programs. This increases the likelihood that a ULA operator will be compliant, and therefore decreases potential public opposition to ULA. Part of the Guild structure proposed by the livestock workgroup is a required 'proof of knowledge' exam or practicum before a ULA permit is issued, which could help to ensure compliance. Ongoing training and mentorship for farmers experiencing difficulty with compliance would also be part of the guild activities. Model runs with active guilds indicate that their involvement could bring noncompliance—and opposition to ULA—down to negligible levels (Figure 6).

As indicated by the interviews, the Listen and Learn sessions, and the model output, communication between ULA farmers and their neighbors is critical for maintaining good community ties and reducing opposition to ULA. Many potential animal keepers at the Listen and Learn sessions indicated that they saw ULA as a community activity, and were open to using their operations to educate their neighbors about urban food production. Urban farmers should be encouraged to reach out to their neighbors before starting their operations, and should be engaged in ongoing dialog with neighbors, possibly supported by the Guilds.

While our model was parameterized with chickens in mind in terms of space requirements and number of animals per household, it could easily be adapted to represent other animal types. The overall dynamics of adoption, and the policy insights described above, can be generalized to include other animals. The major difference between animal types would be the total number of adopting households, which is likely to be much lower for rabbit or goat farming, for example, due to the greater requirements for space and care associated with these animals.

# RECOMMENDATIONS FOR FUTURE RESEARCH

This preliminary model provides some insight into the dynamics of potential ULA adoption in Detroit, but further research is needed. In particular, there is a significant spatial component to ULA adoption which is not represented here. Mapping the neighborhoods where the requirements for chicken-keeping could be met, in terms of space and setback, could yield insight into the areas which should be targeted for education and training purposes, and monitored for potential noncompliance and community opposition. In addition, more knowledge of the ULA infrastructure landscape including veterinary services, waste management and compost opportunities, and animal keeper supply stores could also be beneficial as ULA programs are initiated and scaled up.

Finally, one of the motivating factors for a ULA ordinance is its potential economic multiplier benefits. Urban livestock keepers would need access to supplies and services that could create jobs and re-circulate money within the local economy. The extent to which this proposed benefit bears fruit could be investigated with the introduction of ULA in Detroit.

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# APPENDICES

Appendix A: Interviewees' Affiliations

| |
|---|
| City Planning Commission/Detroit Food Policy Council |
| GenesisHOPE CDC |
| Detroit Future City |
| Eastern Market Corp/Detroit Food Policy Council |
| Michigan State University |
| The Greening of Detroit |
| Third Eye Group |
| G Bailey Winston Enterprise |
| Detroit Food Policy Council (3) |
| Strategic Financial Strategies |
| Neighborhood BUG |
| Kearney Development Strategies |
| Detroit Food and Fitness Collaborative/Detroit Food Policy Council |

Appendix B: Summary of Session Comments

| | |
|---|---|
| Concern | 6 |
| Enforcement | 4 |
| Limited City Resources for Enforcement | 1 |
| Look & Feel of the city | 1 |
| Neighbors Feel "blind-sided" | 1 |
| Resources are limited in the city to enforce rules | 1 |
| Public Health | 3 |
| Do we know the history of the chickens, i.e. pesticides etc. | 1 |
| health of people around animals | 1 |
| Public Health | 1 |
| Animal Welfare | 4 |
| Animals Humanely Kept | 1 |
| Industrial Animal breeding | 1 |
| Living conditions for animals | 1 |
| Safety of animals | 1 |

| | | |
|---|---|---|
| Research Need | | 5 |
| "We didn't sign up for this" | | 1 |
| Allergens | | 1 |
| Effect on Property Values | | 1 |
| What happens if neighborhoods change? | | 1 |
| What scale are we talking about? What works best? | | 1 |
| Negative Externality | 0 | 1 |
| Escapee Rabbits--threats to garden | | 1 |
| Escapes | | 1 |
| inexperienced farmers will make mistakes | | 1 |
| Look & Feel of the city | | 1 |
| Male goats smell | | 1 |
| Noise level | | 2 |
| Rodents | | 2 |
| Smells--down wind | | 1 |
| Reason to Support | 8 | 3 |
| Economic Development | | 5 |
| Develops resources, education fiber, | | 1 |
| Economic Development | | 2 |
| Milk & cheese | | 1 |
| Wool | | 1 |
| Ecosystem | | 6 |
| Creates a calming space for all | | 1 |
| Ecosystem Services - bees | | 1 |
| Endangered bee population | | 1 |
| Goats are more sustainable than lawn mowers | | 1 |
| Helps Green space/pollination | | 1 |
| Management of green spaces | | 1 |
| Education | | 8 |
| Education opportunities for Children | | 8 |
| Food Security | | 6 |
| Food Security | | 1 |
| Food Sovereignty | | 1 |
| Goes to the neighbors bellies (food security) | | 1 |

| | |
|---|---|
| Green space management | 1 |
| Interested in feeding themselves | 1 |
| Knowing where your food comes from | 1 |
| Social Capital | 3 |
| community building | 1 |
| Community Pride; pride for urban ag | 1 |
| Develop social Capital | 1 |
| Waste | 1 |
| Waste Composting | 1 |
| Ag Benefit | 9 |
| Catch up to what is already happening | 1 |
| Extension of Urban Ag | 1 |
| Pollination | 2 |
| Source of Good Compost/Inputs | 5 |
| Solution | 7 |
| Enforcement | 3 |
| Peer Accountability | 1 |
| Permits/Licenses | 1 |
| This is a community Effort | 1 |
| Waste | 1 |
| Compost/Manure | 1 |
| (blank) | 3 |
| Hold insurance | 1 |
| Speak to your neighbors | 1 |
| Talk to your neighbors | 1 |
| Barrier to Adopt 0 | 1 |
| Ecosystem | 1 |
| Environmental Safety Concerns | 1 |
| Enforcement | 2 |
| Care for animals welfare | 1 |
| Neighbor Nuisance | 1 |
| Animal Welfare | 1 |
| Animal Welfare accountability | 1 |
| Skill Attainment | 3 |
| "Farmers need experience and education, if done correctly neighbors shouldn't notice" | 1 |
| Investments to "do it right" are costly | 1 |
| Meat is hard to cultivate | 1 |

| | |
|---|---|
| Infrastructure | 3 |
| Access to Veterinary Services | 1 |
| Waste Composting | 1 |
| Waste Infrastructure | 1 |
| Research 1 | 2 |
| Enforcement | 5 |
| Animals eat produce | 1 |
| Enforcement Capacity | 1 |
| How to file grievances? | 1 |
| How will neighborhoods be chosen | 1 |
| What is the administrative Regulatory Agency? | 1 |
| Public Health | 1 |
| Affect on Public Health | 1 |
| Waste | 1 |
| waste - Slaughtered animals | 1 |
| Animal Welfare | 3 |
| Attract predators [ coyotes, Fox, Raccoons] | 1 |
| Proper Housing for animals in all seasons | 1 |
| What about abandoned animals | 1 |
| Research Need | 8 |
| "Free Range" Chickens, space required? | 1 |
| "We need research before" | 1 |
| Allergens | 3 |
| Liability of Damages caused by animals | 1 |
| What type of Neighborhoods? | 1 |
| Where will this be, the whole city? | 1 |
| Infrastructure | 3 |
| Animal Diseases | 1 |
| Veterinary Care | 1 |
| Waste Infrastructure | 1 |

Appendix C: Model Parameters and Data Sources

| Variable | Unit | Equation | Source |
|---|---|---|---|
| **Influence of Adopters** | | Adopters*(Potential Adopters/MAX(.00001,Adopters+Experienced_Adopters+Potential_Adopters)) | |
| **Gains from Word of Mouth** | Household | Influence_of_Adopters*WOM_Multipler | |
| **Influence of the Opposition** | | Graphical | |
| **Time for Experience** | Months | 12 | Varies |
| **Disadoption Fraction** | % | 0.01 | |
| **IOO Multiplier** | | 0.001 | |
| **Base Word of Mouth** | | 0.001 | |
| **Word of Mouth Multiplier** | | (1-INFLUENCE_OF_THE_OPPOSITION)*BASE_WOM | |
| **Externality Threshold** | Tolerance of population to noncompliance % | 0.5 | Workshop |
| **Abandoned Animal Threshold** | Tolerance of population to abandoned animal % | 0.51 | Workshop |
| **Education Opportunities Threshold** | | 0.01 | Workshop |
| **Externality Population Weight** | % | 0.001 | Workshop |
| **Abandoned Animal Population Weight** | % | 0.001 | Workshop |
| **Education Opportunities Population Weight** | % | 0.001 | Workshop |
| **Guild Management Capacity** | hh's per guild member | 5 | |
| **Households** | Households | 256000 | U.S. Census Bureau; American Community Survey, 2010 American Community Survey 1-Year Estimates, |

| | | | |
|---|---|---|---|
| **Chickens per HH** | Chickens | 3 | Ypsilanti Backyard Chicken Ordinance |
| **Potential Adopters** | Households | 5120 | estimate of single family hhs with yard space |

# Informing the Debate

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