Multi-Source Review on Domestic Stray-Animal Problems

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Abstract: This review paper examines the multi-facet societal problem—stray-animals in China. According to the data released by WHO, China is the 2nd largest habituation of stray animals. It is estimated that there are over 50 million of them in China, causing over 500 deaths each year for some of the deadliest zoonoses such as rabies and toxoplasmosis. Apart from the intuitive danger of serious zoonoses, the paper also examines more vicious influences for having such a large population of stray animals, including severe ecosystem damage, potential law conflicts, global warming, economic burden etc. For preparation, the paper tries to distill and abstract some groundwork and investigations associated with this problem within the last several decades. In this paper, 6 main elements concerning stray-animal problems are refined, each with several attributes, to further clarify and develop the study on this often overlooked yet serious issue. References are crucial for the building of this paper as well as the fruits developed in it, we extract experiment data and key dimensions for perfecting the current situation within in this very country China which can shed on light on further study or even tiniest social impact.

1. Introduction

In the past several decades, with booming economy, China has been able to make and develop policies and infrastructures that make its civilians a better life. Some serious, daunting problems have been solved over time and some are not. Stray-animal problem is definitely one of the latter. It is estimated that there are 50 million stray dogs and cats in China (including rural areas), which make up 20% of the population of stray animals worldwide. These free-ranging animals could carry devastating diseases like rabies and toxoplasmosis. According to the data given by WHO, roaming dogs, the major host of rabies, result in over 55 thousand deaths each year, among which 95% occur in Asia, and China has been the 2nd heaviest affected by the disease(only after India), reporting over 500 deaths each year. Feline cats are one of the largest threats to American ecosystem, killing 1.4–3.7 billion birds and 6.9–20.7 billion mammals annually, of which strays account for the majority of the mortality. The roaming animals in cities and rural areas have such a horrible impact on a developed country like America, let alone China and other Asian countries like India. It should be obvious that the problem of having millions of free-ranging animals has not only leaded to emotional suffer but also significant financial loss and vast mortality of human and other animals. This review aims to refine the main facets of this often-neglected problem and propose solutions that may drive further research on this tricky issue. After intensively reading pages of research and review papers, I try to clarify this problem by giving 6 main elements related to the very topic from different perspectives, including: the history and current status of strays in China, the causes and wherefores of this serious problem, a thorough discussion about TNR(Trap, Neuter, Return), existing problems with pet industry, exploration of legal issues of unowned or semi-owned animals, analysis of animal shelters, and at last, plausible solutions designed for China to handle this challenge. I hope the paper can elucidate the problem that we Chinese will sooner or later will encounter and draw some attention to this topic, hoping that more research and papers can be published effortfully since there are now very few of them, hoping that we can all one day solve this problem and work out a destination where they should be for these homeless animals.

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2. History and current status of strays in China

To start the illustration of this paper, the concept of stray animals and where it stemmed from need to be defined first. Human has started the domestication of wild cats as early as 2500 B.C. in ancient Egypt. Felis catus has in a way seen the urbanization through history. As people expanded and altered the structure of the rural areas to cities and their living habits, some domesticated cats were inevitably surrendered and then became free-ranging animals in urban, and non-urban areas. The concept of stray animals is not uniform. As an example, scholars have developed many understandings towards the term “stray dogs.” Butler believes that stray dogs are derived from domestic dogs, with the expansion of human activities in these areas of the new exotic predators in these areas. The International Companion Animal Management Coalition (ICAM) defines stray dogs as dogs that are not currently directly managed and have no restrictions on their activities. Vanak is more prone to further categorize stray dogs into urban stray dogs and rural stray dogs, depending on their living environment, in order to emphasize its impact on the ecological environment to varying degrees and the different behavior patterns presented. This paper defines stray dogs and cats as unowned or semi-owned(fed by people from time to time) animals, including their offspring, that are surrendered by owners intentionally or are lost accidently and eventually ended roaming in various environments with interactions with humans. Back to China, like many other countries in the world, has suffered from stray animal overpopulation a long time but has taken insufficient measures so the serious question remains today. The density of stray animals is ever increasing now that more people in China have become owners of a pet or two. In a study conducted in Beijing, Authors Jiang and Guo randomly investigated 52 places in Beijing to find out the density distribution of stray cats in Beijing in 2006 (Jiang and Guo 2007). Results suggest feral cats in many regions have reached more than 60 cats/〖km〗^2. In 2009, Wei Lu, president of the China Small Animal Protection Association, told reporters that the number of stray dogs in the country is difficult to census. According to her conservative estimates, the total number of stray dogs in Beijing (urban and rural areas combined) is more than 300,000. Given that stray cats and dogs are prone to live as groups and have robust fertility, the vicious influence of overpopulation involves many parts of our society and will keep worsening as time goes by if no effective policies or attention are made for this issue.

3. Whys and wherefores

3.1. Root of existing strays

There is currently a considerable load of free-ranging animals in China. Their overall existence can be attribute to 5 main reasons, and they’re: Non or delayed sterilization, lack of registration, robust productivity, general faulty conscience, and finally overpopulation in rural areas. The behavior of delaying sterilization can have a serious impact on the overpopulation of cats and dogs, ended up being street animals(Marsh 2010）. As the study pointed out, approximately 45% of sterilized cats in Massachusetts, U.S. were reportedly sterilized after 12 months of age. It turned out that these 45% of later sterilized cats have similar effect on the reproduction of roaming feline animals compared to the fertile species. Another investigation in 2013 further revealed this effect by laying data proving that that 8% of owned male cats and 13%–20% of owned female cats were known by owners to have produced at least 1 litter before they underwent sterilization. Once the Secondly, the current faulty pet-registration system in China also begets a number of roaming animals. By 2020, there hasn’t been a national law to explicitly name and regulate Chinese pet owners, resulting in a high rate of abandon and relevant legal issues for a lack of monitored responsibility. Even in those more developed cities like Shenzhen, an adult only needs to have a certificate of estate to get the permission of owning a cat and renew the permission once a year. This, indeed, has shown its drawbacks and inadequacy in recent years when particular questions happen again and again. Lost animals in China has a fairly low rate of return due to various reasons, and one of them is that pets barely carry identity that can be used to look for their owners. In recent

years, relatively developed cities have been introducing more advanced technology to help keep track of the pets once they are registered. For example, Hong Kong has been using electronic chips implanted into dogs' body to keep record of these owned pets with a low cost and thus has reduced the difficulty of finding a lost pet or legal issues when an owned dog harmed another person. However, there is still a long way to go to normalize the use of technology to advance the current registration and monitoring system. Additionally, the robust productivity of stray animals themselves is a major reason for millions of existing feral animals. An unregulated cat can beget 38 thousand at most in her lifespan. The measures taken in most cities to deal with strays is to do TNR. Unfortunately, some of these roaming animals habituating in human neighborhood and blocks are rather hard to find. Any unsterilized animal can cause more and more troubles as time goes by. Next, the faulty conscience that general Chinese holds is another reason for strays. According to the White Papers in Pet Industry, China, 2019, over 13% of the pet owners consider their animal friends as just a pet friend or even only a pet. The proportion is still high after a few generations. Strays are the product of outdated, faulty opinions on pets. For example, 50.4% pet owners are still college students who will need to get jobs and move their residence in few years, which expires the owner a lot of energy and time so that the pets have a high rate of being abandoned or transferred to others and eventually causing the dog or cat to be free-roaming. The White Papers has also discovered a 50% of the owners make less than 4000RMB a month, 43% of the owners reporting medicals for pets are too expensive. Lack of financial ability to keep a pet will also eventually result in the produce of strays. Finally, the stray problems in rural areas are the most serious and tricky. There is a high proportion of Chinese farmers having a pet, in which the pets are often considered as a guard for the farmers' house when they go out to the farmlands. To that end, the pets in farming families are raised with the lowest cost and regulation. Therefore, these animals have a high fertility rate. A female cat gives birth to 5 kittens at a time on average and that number for dog is 3. Conservatively estimating, a female feline is able to have a first child at 4 to 7 months of age, with an average of 4.25 kittens per birth and an average of 5.25 births per female cat, taking into account the average rate of 42% of young cats and a relatively low survival rate of female cats (2:1). Without any human intervention, the feral mother cat and her family will bring 3,200 new lives to the world over 12 years. The extra animals are both financially difficult to raise and hard to manage, which results in the constantly reoccurring surrendering behavior. These felines and dogs are mostly abandoned outside of the village, ended up to be caught for "business" or just keeps roaming and producing.

3.2. Significance of settling the problem.

It is reported in 2008 in a study that of all the 1415 kinds of disease pathogens that can infect human, 374 can be carried by dogs and cats. Among all the 374 types of zoonoses, two most fatal ones, TOX (toxoplasmosis) and rabies, have caused quite a number of deaths and injuries. Between the year 2004 and 2006, there are 8467 reported infections of rabies in this country, among which 8403 infected died. A fatality rate of 99.24% has made it the deadliest contagious disease over the recent decades. Similarly, the TOX was reported to have a 7.8% rate of infection, causing a number of injuries and demand for medical care. Although the chance of pets nowadays carrying a disease is much lower than before due to effective vaccination and management, the unmonitored stray animals are still very dangerous possible pathogenic agents. On the other hand, the roaming animals can have a huge impact on the ecosystem. The organization of stray dogs is the biggest threat to wild animals. Studies suggest that stray dogs are highly organized in their families, so stray dogs can be deadly cluster hunters for wild rodents or hoofed animals. In fact, stray dogs can threaten not just herbivores, A study in Ethiopia has shown that stray dogs are more likely to hunt successfully when compared to local wolves that are less densely populated. The reasons for this are explained as dogs' easy access to human food, which will have a subsidy effect, that is, relying on human feeding, improve the population's own biological carrying capacity, and can then better prey on wild animals. Studies have revealed that the feral cats kill around 2.25 billion birds and 13.6 billion mammals annually (Loss et.al 2013). The same problem exists in China, too. A group of researchers in Beijing has discovered that in the parks, gardens and other animal habituations, the decline rate

of avian species and rodents is directly proportional to the number of feral cats in that area, indicating how detrimental these unregulated animals can be. Moreover, Stray dogs and cats are also a contributor to global warming. A recent study of the stray dog's carbon footprint showed that a medium-sized dog consumes 95 kg of grain and 164 kg of meat a year, and if the cumulative land cost of producing dog food is taken into account, a medium-sized dog is estimated to produce a carbon footprint of 8,400 square meters. In all, the social problem of having many strays in cities is exceedingly serious and worth to be urgently solved with abundant investigations.

4. Discussion about TNR

4.1. The definition and specific steps of TNR.

TNR, the abbreviation for Trap-Neuter-Return, by its definition it is the program through which animals are humanely trapped; sterilized and medically treated; and returned to the outdoor locations where they were found. The specific steps to carry out a full TNR in China can be concluded as following: Government issues TNR implementation plan->Local streets, neighborhood committees from the community recruit volunteers->Local CCDC(Chinese Center for Disease Control and Prevention) department prepares training for volunteers ->Volunteers in the neighborhood capture strays to nearby animal clinic->Animal clinics examine captured strays and perform ligation and then establish files and report to the local CCDC committees in a timely manner->CCDC makes full report of the plan and publish-> the strays will be recovering in areas provided by the local neighborhood before healthy enough to return to its original habituation.

4.2. The feasibility analysis of TNR

China has been using the traditional measure known as Catch and Kill before the introduction of TNR. However, this seemingly once and for all solution for managing the population of free-roaming animals in the urban areas turned out to be very ineffective due to a phenomenon called “Vacuum Effect”. Well-documented among biologists, the vacuum effect describes what happens when even a portion of an animal population is permanently removed from its home range. Sooner or later, the empty habitat attracts other members of the species from neighboring areas, who move in to take advantage of the same resources that attracted the first group (like shelter and food). Killing or removing the original population creates a “vacuum” that will inevitably draw in other animals living nearby. When the cats or dogs are killed and removed out of the habitat, the felines in roam or from other zones will come and refill this place soon, making the Catch and Kill method fruitless. As one study found, “populations greatly reduced by culling are likely to rebound quickly.” Over time, the number of cats in an area where a feral cat colony has been killed or relocated will simply recover and return to its original size. In comparison, TNR measures have provided a better solution that allows the neutered animals to stay in their territory, maintaining a saturated and non-fertile population which keeps other strays from filling in once more. Therefore, one question lies ahead: how practical is it to generalize the use of TNR? As mentioned earlier in this review, stray population in China consists of a big proportion of the felines who live in the traditional Chinese enclosed neighborhood. A stable source of food is a major determinant for felines to stay locally for a long term. This ensures the stray cats are more regional than those wandering on streets. The nature of cats also gives them a eager to form a cat community within the neighborhood they live where a fairly constant food supply and rather safe environment can both be found. Using TNR to a targeted area significantly reduces the local shelter cat intake in several years compared to the non-target area, which can reasonably indicate a decline in free-roaming cats (Levy et.al 2014), in the paper clearly reveals. The use of TNR has been widely applied in many countries and has been proven effective. For China to adopt this measure in managing population of stray animals, more customized program plans should be made according to specific target area conditions.

Implementing TNR can result in significant cost savings. Manual reception is the main method taken by the Government to control stray animals at this stage, however, the establishment of a

sound system of reception and resettlement requires a great deal of manpower and financial input.

The cost of long cat includes personnel costs, construction costs, shelter and resettlement costs, management costs and harmless treatment costs, etc., in contrast, TNR costs are limited to ligation and epidemic prevention, the rest of the work such as capture, feeding, etc. are borne by volunteers, so that not only for the government to save a lot of money, It can also control the number of stray cats and dogs, and is cost-effective. The cost of housing a stray cat includes personnel costs, construction costs, shelter and placement costs, management costs and harmless treatment costs, etc., in contrast, TNR costs are limited to ligation and epidemic prevention, the rest of the work such as capture, feeding, and so on. are borne by volunteers, so that the government can not only save a lot of money, but also control the number of the urban overpopulating animals. Another factor contributing to TNR's plausibility is its wide acceptance by the general public. Stable food source is one key factor for felines to habituate in one place; the food they receive mostly come from their compassionate neighbors who constantly feed them while keeping them on the streets, a behavior that increases the trend of overpopulation when the feeding subjects are unneutered cats. The old way of Catch and Kill can at some degree hurt the semi-owners' (people who feed the animals but not actually keep the animals as pets) and for which they would slightly reject the using of Catch and Kill. On the other hand, while the TNR can return the cats back to their community with lower aggressiveness to human, rate of disease-carrying, and no fertility that makes the situation worse, it can also make it easy for these semi-owners to accept and understand the measures themselves.

Overall, TNR is currently the best solution for Chinese government to fix the problem and slow down and even stop the rate of overpopulation of stray animals.

5. Malady in pet industry

Over the past few years, the pet industry in China has soared to develop, particularly pet dogs and cats. However, the promising growth of pet economy may somehow worsen the problem of overpopulation and stray problems in China for the reasons analyzed in this paragraph. According to the White Paper of Chinese Pet Industry, the pet industry in 2019 has seen an 8.4% increase in the total population of felines and dogs, reaching 99.15 million in numbers, with the number of urban cat and dog owners reaching 56.48 million aggregately. The ever-growing population is at the first sight beneficial to the whole society and the economy. Nevertheless, there are some parts of the problem worth studying.

The direct effect of this growth is a boom in development of markets like staple food, pet toys and such, which is irrelevant to this essay; meanwhile, other aspects may be concerned or even significant in solving the problem of existing urban strays. As we mentioned earlier, surrendering is a major root for the urban roaming animals. With regard to this, a larger group of pet raisers will directly account for a larger number of abandoning behaviors, especially when their revenue is fairly low and can't afford the potential medical needs for their pets as the data in the White Paper revealed.

The emerging business is also estimated to put a lot of pressure on the supply side of veterinary medical industry. On the one hand, as one study in 2015 has reported, there are only 20 universities which offer bachelor's degree in veterinary, and less than 3000 students graduate each year. It's investigated that there are less than 10 vets in every 100,000 people in China. The scarce supply has increased the probability of pets having diseases can't be well treated either for the price or for the number. On the other hand, the medicine-development industry has been in shortage for several years since the profit margins are low and highly-restricted drug license. The lack in amount and quality of medical treatments have bothered the owners so much that they barely spend money on such items.

This kind of development should be seen as unhealthy for another factor: the breeding industry. Breeding is a rather profitable career to pursue with a grand market potential and low barriers to entry, which is why the industry has rapidly expanded. Notwithstanding the diversity and decreased price it has brought to the Chinese pet market, the ultimate outcome can be detrimental for the

urban stray problems.

The breeding industry has allowed diverse species of dogs and cats to be introduced into the domestic pet market and also a gradually decreasing price as the previous data showed.

When the once expensive pets become available over time, they will be more prone to purchase a cat rather than take in one from the shelters or streets. The breeding process also takes a lot to produce one hit in the market, and the ones who failed to have a perfect color will eventually be given to the pet stores or directly worsen the burden on the shelters. Also, the cross-species breeding attempts have resulted in recessive genetic disorders like deafness. These genetic defects are only expressed as full diseases when an individual dog carries two defective copies of the gene. If a "stud" dog carries just one copy (and thus displays no symptoms and is otherwise in good health) and mates with a healthy female, some of his puppies will carry the gene too. While this is not an immediate problem (the puppies are just carriers for the recessive gene), when these puppies are mated with subsequent litters down the line, the defective gene will become more and more common, thus producing more individuals who carry two copies of the defective gene, and potential parasitic zoonoses. Well-known examples include CHD (canine hip- dysplasia) in Alaskan Malamutes, patent ductus arteriosus in Pomeranians, and retarded development in Chihuahuas. A general picture of the health conditions of Chinese pets can better illustrate this situation. More than a half pets are unhealthy with different diseases.

Essentially, the expanding population of pets itself is going to put forward a challenge to Chinese communities' environment capacity. As we elaborated before, most communities are preoccupied by stray cat groups. Having more pets in communities will inevitably increase pets' contact with strays, elevating the possibility of infections between animals and eventually humans. The overpopulation of pets and the problems hence beget are something will be encountered sooner or later, so relevant practical measures such as increasing community monitoring and education in the veterinary will be necessary for maintaining an equilibrium which we will discuss that later on.

6. Legal issues with strays

The overflow of the free ranging animals in China, as we elaborated before, is poisonous in many respects including being disease carriers, ecosystem destructors, overpopulating, and etc. In fact, their potential destructiveness can actually exceed the psychical damage itself, in this attribute, reasons will be displayed to explain why they can pose a serious threat to the jurisdiction system in China.

To understand this problem thoroughly, we first need to understand what the legal identity of strays is. Law problems concerning strays mostly are related to animal harm to citizens and on whom the civil liability falls. There is currently no law article stressing or clarifying the legal identity of stray animals. This kind of omitting in laws can lead to ambiguity and conflicts. The rules for deciding who to take the responsibility for domesticated animals causing harm to others, which mostly resemble stray animals, are defined in some fundamental laws in China. According to General Principles of The Civil Law of China Article 127:" If a domesticated animal causes harm to any person, its keeper or manager shall bear civil liability. If the harm occurs through the fault of the victim, the keeper or manager shall not bear civil liability; if the harm occurs through the fault of a third party, the third party shall bear civil liability." As written in The Tort Law of the People's Republic of China (adopted in 2009) Chapter 10 Article 82，Where an abandoned or fleeing animal causes any harm to another person during the time period of its abandonment or fleeing, the original keeper or manager of the animal shall assume the tort liability; we can see that there is regulation towards the "abandoned or fleeing animals" about who should bear the tort liability for them. However, most of the dogs and cats in free roam are also id-free, either because they're lost pets whose owner can't be traced due to a poor registration system or just violent strays. The vagueness to some degree has elicited a number of lawsuits, and some of them have drawn great social attention. For example, the case of a stray cat causing harm in Beijing, 2013, has sparked a debate in the field of academics and the society over Joe's conviction for

feeding a stray cat in the community. The court argued in the second instance that, from the subject of the act, Joe's feeding behavior to stray cats is not in line with the scope of an animal keeper and animal manager stipulated in China's Tort Liability Law: from the nature of the behavior, Joe's feeding behavior does not belong to the standard rescue of stray animals, and did not take effective measures to prevent the occurrence of dangerous wind invasion, Its behavior is an unreasonable interference and influence on the common interests of the public, so it should bear certain responsibilities. The scholars, lawyers and general public at then hold two different views: one believes that the feeders shall not bear such the responsibility while the other insisting such a liability on the feeders. The fact that feeding stray cats for good results in bad outcome may be something counterintuitive, considering that they'll indirectly sustain the life of strays and provide a food source. Now that the feeding behavior may result in legal disputes, the existence of strays in neighborhood should be attached more importance. The neighborhood inspection and the vagueness in law should be both fixed in time before the problem continues to develop to an irreversible situation. Unowned or semi-owned cat population in the neighborhood should be looked after more carefully by the Estate Management Personnel, which is also a legal issue. In CONTRACT LAW OF THE PEOPLE'S REPUBLIC OF CHINA，Article 60 makes the following declaration: "the parties shall abide by the principle of good faith, and perform obligations such as notification, assistance, and confidentiality, etc. in light of the nature and purpose of the contract and in accordance with the relevant usage." The obligations that Estate Management Department bears shall include providing protection for the people inside the community. Thus, the Estate Management should be argued responsible for preventing such stray attacks from the residents which could be supported by the Contract Law. Going back to the theme of this title, while the jurisdiction system is challenged, the general laws in China are better described as" failed to take in account such problems and thus failed to be supportive"(on the scale of stray animals). It is clear to see that crucial improvements and amendments toward the laws so that the stray animal won't be a hard-to-define individual and the community members can carry out effective measures to handle the hazardous stray community.

7. Analysis of animal shelters

7.1. The operating condition of existing shelters in China

According to Jiwen Chang, director of Chinese Academy of Social Sciences, there is estimated to be over 10000 shelters in China by 2009, all have played a role in managing the population of stray animals. However, these NGOs (non-government organizations) have encountered many challenges including high running costs, overloading capacity, few proper revenues, and worker burnouts etc. In this branch, the main focus is on analyzing the current situation of shelters and the dilemma they're facing, which is aimed to articulate the importance of rectifying the current condition. The shelters in China, to start with, are not backed up by government funds or any official finical aid that may support their running. The costs of operating a shelter can be high up to over $14200 a month, based on an investigation in Shaanxi, China. These costs include intake examination, neutering fee, vaccinations, food expense, human labor, medical treatments, electricity, heating, and etc. The makeup for such costs can only be seen in monthly fundraising and adoption activities with sponsorship from other NGOs, which can be seen as relatively insignificant comparing to the costs, which will be covered up using the own money of the managing crew and working staff. Unfortunately, the workers in animal shelters have a very high burnout and turnover rate. Dr. Schabram has shown us that two thirds of the shelter workers in the study burned out and eventually left the profession for other careers (Schabram and Maitlis 2017). The researchers discovered that the seeds of their disillusionment with saving animals in shelters was usually apparent from the beginning. As the researchers wrote, "They either followed a practice path that produced learning and growth, or one of two other paths that generated intense negative emotions and culminated in burnout and exit from the profession." The studies revealed that the workers in animal shelters, are more or less feel "called" to work with animals out of benevolence and caring,

but would eventually bail out for the intense work and stress they've experienced with fights among dogs, euthanasia and so on. The situation that workers face not only reflects the poor conditions of local shelters, but also makes it harder for shelters to hire workers for such a physically and emotionally demanding job with rate of work-related injuries and illnesses higher than the national average. An average adoption to intake ratio of approximately 10% per week has kept the shelters running at their maximum capacity or even higher, which requires more money to be spent on renovating the shelters which will draw more roaming animals from around. Many shelters in China are running in this vicious cycle. The relatively better way to lessen the stress on the shelters is adoption, which, as far as I'm concerned, is only a temporary and ineffective measure in addressing the homeless animals' overpopulation. A high chance of having problem behaviors and natural defects (for which they're abandoned in the first place) have all made it harder for shelters to give out the animals. A study has shown that many adopted dogs had at least one reported problem behavior, among which the most frequently reported were poor manners, destruction of household items, and excessively high energy (Gates et.al 2018). Almost one fifth of dogs showed aggression toward people or other dogs. It seems prudent for animal shelters to follow up with adopters to provide support for managing problem behaviors and post-adoption support programs targeted toward teaching adopters how to correctly train their dogs may be beneficial to increasing adoption satisfaction which can reduce the rate of second surrendering of adopters.

Euthanasia is another measure used by most shelters to cope with overloading capacity, but it's obvious that this measure is much debated and emotionally harmful for people, especially for workers as we mentioned before, let alone the high cost of operating the euthanasia. An effective way to address this problem is cooperation among shelters, which is generally overlooked by Chinese shelters. A study in South Korea has found it effective for shelters to reduce euthanasia by transfer of animals among shelters in a given district. In their proposed models, they used animal transfer between shelters combined with an increase of shelter capacity as a way to reduce euthanasia (Kang and Han 2019). The validity of the proposed models was demonstrated by the case study in the Seoul capital area, Korea. Their findings indicate that animal transfers and the increase of shelter capacities can contribute to a significant reduction in the use of euthanasia, which will improve the animal welfare and workers' emotional wellbeing in the shelters. Their findings also include factors that facilitate successful transfer programs that may give some important insights to Chinese shelter managers

8. Policy recommendations

8.1. Economic policy making

As we mentioned before, the booming pet industry is estimated to worsen the current status of stray problem in urban areas by increasing potential stray population. Thus, policies that affect pet market can play a role in addressing the free roaming animals in cities. Tax and subsidy can be used by the government to rectify the buying behavior of customers. As one study in Taiwan pointed out, if the market is imperfectly competitive, the regulator may tax or subsidize pet-animal buyers, while the regulator will tax pet-animal buyers if the market is perfectly competitive. These results hold true whether breeding-cost and strays' environmental-damage functions are linear or quadratic. By contrast, when the regulator aims to minimize the number of stray animals, which is equivalent to minimizing the environmental damage caused by strays. The regulator should always tax dog/cat buyers regardless of the market structure. They also find that the regulator will raise taxes or lower subsidies when the probability of abandoning purchased dogs/cats increases, the probability of abandoning adopted dogs/cats falls, the environmental damage caused by strays expands, the happiness from raising the purchased dogs/cats decreases, the happiness from raising stray dogs/cats rises, the cost of raising stray animals decreases, the breeding cost of dogs/cats rises, or the number of pet shops increases. For instance, subsidizing adopters of stray animals under the same setups of this research is worth exploring. But decreasing shelters' running costs will raise the social welfare. Therefore, the net effect is uncertain, and the equilibrium taxes or subsidies may

increase or decrease. These issues deserve further investigations. It's not clear yet about how well the tax and subsidy can play their part in real life circumstance since no relevant policies have been made and so is the research inadequate. More efforts deserve to be put in here to achieve greater social welfare for China and civilians' sense of well-being.

8.2. Means to sustain existing shelters.

Non-profit shelters take care of a majority of surrendered and roaming felines and dogs, and usually bear a running cost of over 100,000RMB a month, with workers having a high rate of burnout and turnover. Most shelters are currently in a sad plight that can't be effectively cured by only funds from the shelter owners and the society. A lack in financial ability to sustain running will end up closing and eventually free the shelter animals again to the human society, which is unrealistic and hazardous. To prevent that from happening, one way is to acknowledge such hardship for shelters and offer financial help by the government of each province, city, and district. Shelters can also be government institutions with official license and standard. However, overpopulation of stray animals can't be solved by only aiding the existing shelters, more structural and macroscopic problems are ought to be noticed by the society. The shelter can effectively reduce its intake of free-roaming dogs and cats by cooperating with other shelters and using cost-efficient programs to deal with dogs. As we mentioned before, cooperation among shelters can greatly reduce the excess in each shelter in a region, given that the animals can be transferred accordingly to each shelter's running status and capacity. However, successful coordination among shelters require a regional and national organization to be formed, and regional government can be expected to make this happen. Secondly, cost-efficient programs by carried out by local shelters and governments can also effectively reduce the number of roaming animals within in a decade. In 1981 Hillsborough County established a subsidized spay-neuter program whereby citizens who had their animals sterilized at a veterinarian's office could apply for a $20 rebate. The subsidy did not target low-income people and the majority of the people who took advantage of it were middle-income. The low-income voucher program can be applied similarly in China, targeting low-income families with pets encourage them to sterilize their pets, which can be significantly helpful in reducing the number of street dogs and cats. The study also shows that the Spay/Neuter Voucher Program (SNVP) can be very effective in managing the animal intake of shelters($r=-0.85$) (Hamilton 2019). Animal Intake in Hillsborough County Animal Services (HCAS) shelter decreased significantly as the SNVP surgeries conducted locally accumulated over time.

First stablished by the Hillsborough BOCC in 2002, providing sterilization surgery, a rabies vaccination, and a county license tag for a $10 copay, the program targeted at low-income citizens are useful but not sufficient itself, since it's hard to whether some of the cats treated through the program might actually be feral cats, strays, or unowned free-roaming cats. The Trap-Neuter-Vaccinate-Return (TNVR) settles the problem well by targeting directly toward the animals in roam with organized efforts by shelters and local governments, which was first carried out all by volunteers. China is qualified for such measures as illustrated above, with a large number of volunteers willing to put efforts in advancing animal welfare and city view. The only extra requirement is government participation in supporting shelters and organizing such events.

8.3. Legislation mend

As the capital of China, Beijing pioneered in lawmaking concerning stray animals. In the law Beijing Petkeeping Regulations enacted in 2003 writes dog owners shall not abuse or abandon their dogs, However, no substantive enforcements or punishments are clarified, so we can still see cases of law conflicts happening after 2003 concerning whom is to blame for the damage that strays bring to people. It is clear that Existing dog management regulations should be refined to clarify the legal consequences of illegal acts, such as the abuse of abandoned animals, failure to vaccinate dogs and other acts, and other punishments. In addition, the law should grant a group of organizations with litigation status, such as the Animal Protection Association, the right to sue. Jiwen Chang, an expert animal protection legislation, suggests to enact more distilled animal protection laws, regulate targeted breeding, targeted sales, and set up system of implanting chips to thoroughly regulate the

management of animals. He stressed the importance of implanting a chip with master details. This will not only detect the owner of the abandoned animal, but also punish the animal for its actions without causing ambiguity in existing laws. Moreover, the definition and identity of stray animals in laws is not yet clarified and worth further discussion by the experts.

9. Conclusion

This review is written in the sense of generalizing the findings of existing studies as well as sparking more professional, impactful studies to be conducted for the vast group of strays living in China mainland. It is worth reiterating that the appalling consequences, including deadly diseases like TOX and rabies being carried around, threat on domestic avian species, shelter workers burnout, potential legal issues etc. Previous work by domestic and international scholars have shed light on promising measures to tackle the national stray problem, as aggregated in this review, including subsidizing the pet market, taking TNR or more advanced programs like SNVP, raising awareness for pet owners to get their pets early sterilization, encouraging transfer programs among shelters and so on. Means like raising awareness for sterilization, once successfully implemented on a large scale, should have success beyond solving the stray problem, that is, help build a more civilized society that can match the economic performance of this country. The solutions mentioned in this paper are feasible enough to be executed broadly, in the hope of scholars or non-scholars can all contribute to a better living condition for the animals.

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