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Fish producers' attitude toward otters and piscivorous birds: A case study from central Bulgaria

Evgeniy Raichev[1], Stanislava Peeva[1], Georgi Zhelyazkov[2], Galin Nikolov[1], Dian Georgiev[3], Katelina Uzunowa[1]*

[1]Trakia university, Faculty of Agriculture, Department of Animal husbandry – Non-ruminant animals and special branches, 6000 Stara Zagora, BULGARIA
[2]Trakia university, Faculty of Agriculture, Department of Animal husbandry - Ruminants and animal product technologies", 6000 Stara Zagora, BULGARIA
[3]Trakia university, Faculty of Agriculture, Department of Ecology and Zoohygiene, 6000 Stara Zagora, BULGARIA
*Corresponding author: st.peeva@abv.bg

Abstract. Three types of aquaculture are applied in central Bulgaria: carp farming, trout farming, and sturgeon farming. In the period 08.2023 - 02.2024, a questionnaire survey was conducted among 88 fish farmers about their attitude toward otters (*Lutra lutra*) and three types of fish-eating birds: the White pelican *(Pelecanus onocrotalus*), the Great cormorant (*Phalacrocorax carbo*) and the Gray heron (*Ardea cinerea*). Most respondents, 70.13%, identified otters as a source of conflict with their activities, while 57% identified fish-eating birds as problematic. The attitude toward otters showed strong intolerance among 40.91% of respondents, while piscivorous birds caused even greater concern among fish farmers, with overall negativity reaching 76.13% of respondents. Lethal measures were reported only by people with a negative attitude. The issue of compensation remains a clear concern as 80.64% of respondents demand it.

Key words: *Lutra lutra, Phalacrocorax carbo, Ardea cinerea, Pelecanus onocrotalus*, conflict.

Introduction

Three types of aquaculture are applied in central Bulgaria: carp farming, trout farming and sturgeon farming (to a lesser extent). The region includes both a flat part, the Upper Thracian Plain, and a mountainous part, the central parts of the Stara Planina Mts. The only mammal that harms the fish is the Eurasian otter (*Lutra lutra*) which is listed as Near Threatened under A2c criteria on the IUCN Red List of Threatened Species. Among the birds, these are the Great cormorant (*Phalacrocorax carbo*), the Gray heron (*Ardea cinerea*), and the White pelican (*Pelecanus onocrotalus*), all with status Least-concern on the IUCN Red List of Threatened Species. The mentioned species are protected according to Bulgarian legislation (Biodiversity act, 2012). The state of the population in Bulgaria today is relatively stable (Popov et al., 2007).

The growing number of otters or the species recolonization in many places where fish production is developed leads to conflict (Kloskowski, 2005; Mysiak et al., 2013; Santos-Reis et al., 2013). In the Czech Republic (Kortan et al., 2007; Marketa et al., 2011) and Austria (Kranz, 2000), the otter was pursued as a pest. The otter is a piscivorous species with high plasticity depending on the habitat features, as in standing waters it consumes a higher percentage of fish (Krawczyk et al., 2016). In river systems, the food mainly includes carp fish (cyprinids) - 97.77% of the total food and 99.14% of all fish (Buglione et al., 2020). It is defined as generalist piscivorous predator (Lanszki

et al., 2007, 2009; Jędrzejewska et al., 2001; Kopij & Szymczyk, 2024). Studies on otter food in Bulgaria are few (Georgiev, 2006; Yanchev et al., 2017), but they prove the same.

Other well-known pests in aquaculture are the large piscivorous birds. The population of the Great cormorant and specifically its continental subspecies *Ph. c. sinensis* grew rapidly at the end of the 20th century and by 2011 numbered nearly 700,000 individuals in Europe (Steffens, 2011). The daily feed intake of the species is 400-600 g and represents 18% of the weight of the bird (Guthörl, 2006; Knösche, 2008). There are also closed fish farms like the one in the Netherlands due to the invasion of cormorants (Kohl, 2008). The problem with this species is causing conflict between nature conservationists and ornithologists, on one hand, and fishery authorities and fishing associations - on the other (Steffens, 2011). The small number of studies makes it difficult to assess the impact of heron predation. However, the damage they cause to fish is considered to be significantly less than that of other fish-eating birds, for example cormorants (Jakubas & Mioduszewska, 2005). This perception is generally accepted.

Pelicans are also known to be serious fish eaters. The daily consumption is approximately 10% of the bird's weight (Guillet & Furness, 1985). The White pelican appears less often in fishponds and is not so common in Bulgaria except during migration. The species were listed in the questionnaire based on the "Local ecological knowledge".

The survey aimed to determine the extent and dimensions of conflict between fish producers, otters, and fish-eating birds. The aspiration was to shed light on some factors influencing people's attitude toward them, as well as to answer the question of whether state compensation for losses is exacted.

Materials and methods

In the period 08.2023 - 02.2024, a questionnaire survey (Table 1) was conducted among 88 fish farmers from central Bulgaria about their attitude toward otters and three fish-eating birds: the White pelican (*P. onocrotalus*), the Great cormorant (*P. carbo*) and the Gray heron (*A. cinerea*). Common carp (*Cyprinus carpio*), sturgeons (Acipenseridae spp.) and their hybrids, paddlefishes (Polyodontidae spp.) and Rainbow trout (*Oncorhynchus mykiss*) farms were covered, either single or mixed with other species such as Silver carp (*Hypophthalmichthys molitrix*), Grass carp (*Ctenopharyngodon idella*), European catfish (*Silurus glanis*), paddlefish (Polyodontidae), accompanied by weed fish such as European perch (*Perca fluviatilis*), Common rudd (*Scardinius erythrophthalmus*) or Crucian carp (*Carassius carassius*).

Diverse methods for production, using facilities like earth-fill ponds, concrete channels, dams, and mesh cages are applied. This covers the diversity of freshwater fish farming technologies in Bulgaria, excluding closed recirculation systems.

The study examined several factors influencing the extent of damage caused by otters and piscivorous birds. One key variable was the type of aquaculture system utilized. Respondents were categorized based on their particular interests—either as workers or as owners/managers. Additional factors, such as age (under 50 versus over 50) and educational level (secondary versus higher education), were also analyzed to determine their impact on the respondents' perceptions.

To assess the respondents' awareness levels, a question was included regarding the presence of otters and piscivorous birds at their respective aquaculture facilities. Furthermore, to evaluate the relative importance of damage from these species compared to other adverse factors, respondents were asked to identify the primary causes of significant fish losses over the past five years.

A group of questions (2-9; Table 1) aimed to clarify the magnitude, trend and character of losses from otters and piscivorous birds. Following questions clarify the particular protection measures already undertaken by the respondents. The last three questions pointed to reveal the degree of the conflict and the potential measure for its mitigation.

Table 1. The questionnaire used in the present study.

What is your possition?	manager-owner/worker
What is your age?	18-30/30-40/40-50/over 50
What is your education?	secondary/higher
Which fish species do you farm?	……
What kind of technology do you apply in your farm?	mesh cages/ earth-fill ponds/ concrete channels/ dams
1. Which factors have caused damage to your fish farm in the last five years?	otter/cormorants/pelecans/herons/diseases/poaching/water pollution/others
2. Is the otter present in your fish farm?	yes/no/don't know
3. Are piscivorous birds present in your fish farm?	yes/no/don't know
4. Does the presence of otters cause serious damage to fish stocks?	no, it doesn't/it causes significant damage/it causes unsignificant damage/no opinion
5. Does the presence of piscivorous birds cause serious damage to fish stocks?	no, it doesn't/it causes significant damage/it causes unsignificant damage/no opinion
6. What are the overall otter fish stock losses for your farm over the past five years?	diminishing/permanent/increasing/no opinion
7. What are the overall fish stock losses from piscivorous birds for your farm over the past five years?	diminishing/permanent/increasing/no opinion
8. Which category of fish do you think is most vulnerable to otter attacks?	fingerling/fish for consumption/broad stock/non-commercial fish/no opinion
9. Which category of fish do you think is most vulnerable to attacks by piscivorous birds?	fingerling/fish for consumption/broad stock/non-commercial fish/no opinion
10. Have you taken measures against otter attacks?	no/yes, lethal methods/yes, other
11. Have you taken measures against attacks by piscivorous birds?	no/yes, lethal methods/yes, other
12. How would you rate your attitude toward otters?	strongly negative/negative/neutral/positive/strongly positive
13. How would you rate your attitude toward piscivorous birds?	strongly negative/negative/neutral/positive/strongly positive
14. Should you receive financial compensation from the state for damage caused by otters and piscivorous birds?	yes/no/no opinion

Results and Discussion

Of the 88 respondents, 38 were workers, while 50 were owners or managers. A total of 32 respondents had higher education, while 56 had secondary education. The majority of respondents were over 50 years old (37 people), followed by those of 40-50 years (27 people), 30-40 years (22 people), and under 30 years old (2 people). This age distribution, with respondents randomly selected, suggests that aquaculture in Bulgaria is predominantly practiced by middle-aged and older farmers, which implies a responsible approach to the issues addressed.

The majority of respondents, 70.13%, identified otters as a source of conflict with their activities, while 57% identified fish-eating birds as problematic. Factors such as fish diseases and water pollution were mentioned less frequently, at 40.26% and 38.96%, respectively (Fig. 1). Poaching was the least concerning factor, reported by only 10.39% of the fish farmers.

Losses attributed to otters over the past five years were described as consistent by the largest proportion of respondents (34.9%), while losses from piscivorous birds were most commonly described as increasing (30.68%) or consistent

(28.41%; Fig. 2). Notably, a significant percentage of respondents were uncertain about the trends in losses: 38.64% for otters and 29.54% for piscivorous birds. These findings indicate that the conflict with otters and fish-eating birds is generally intensifying, and concerns about their presence are growing.

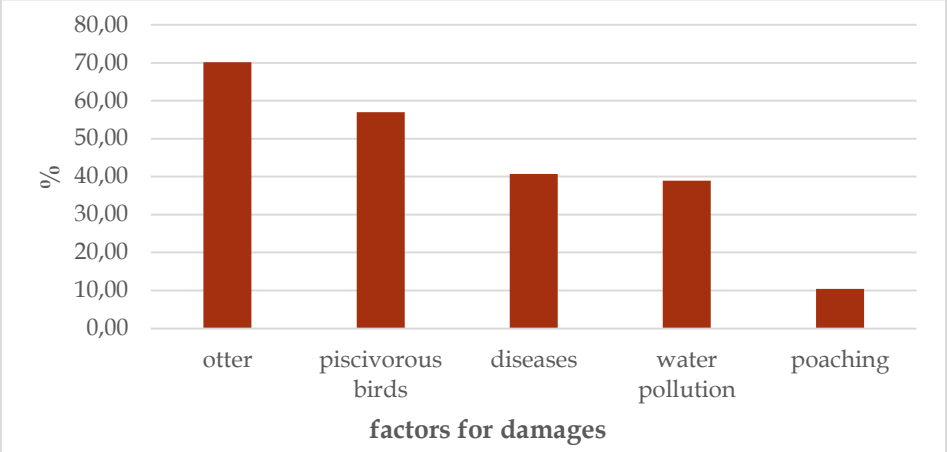

Fig. 1. Significance of factors causing damage to aquaculture according to fish producers.

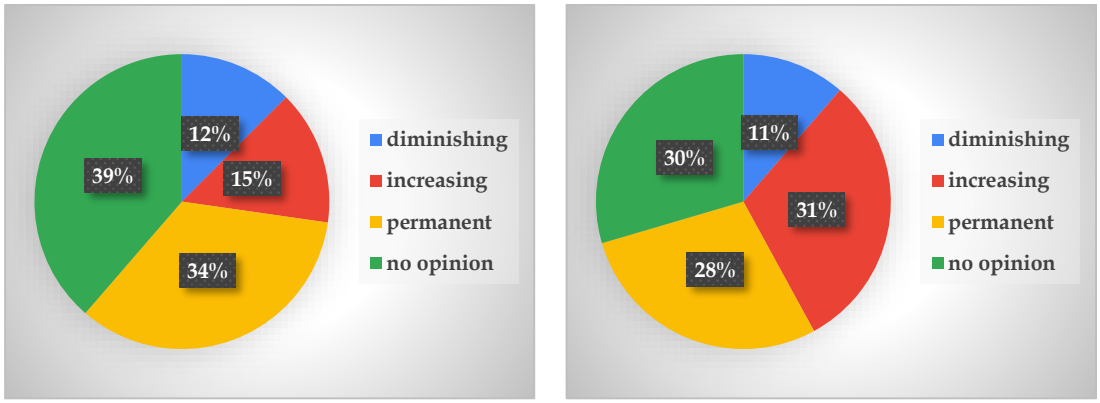

Fig. 2. Tendency of losses caused by otter (left) and piscivorous birds (right) presence for the last five years.

According to the respondents, otters primarily caused damage to fish for consumption (64.77%; Fig. 3). Otters tent to target larger fish and were particularly drawn to ponds for fish fattening. Similar observations have been reported by Kloskowski (2005) in Poland and Kranz (2000) in other parts of Central Europe. Lanszki et al. (2001) further suggested that otters prefer fish weighing between 500-1000g when have an opportunity. This shows that the fears of the respondents are mostly focused on the final phase of fish production. On the other hand, fish-eating birds caused more damage to the fingerling (60.23% of the respondents), which in the case of carp is 40 to 120 g. Birds had a less significant impact on fish for consumption (15.91% of the respondents). This two-way action in an open body of water, which is difficult to guard, becomes a serious problem.

According to Carss & Marquiss (1992), birds not only prey on fish but also inflict injuries and cause stress, reducing food consumption. Thus, the damages become complex, with conflicts most pronounced in earth-fill ponds. Otters also inflicted damage on fingerlings and brood stock, with 12.5% and 11.36% of respondents reporting this, respectively. The type of pond and the fish farming technology were crucial in the development of this conflict. Concrete ponds used for trout farming, and sometimes for carp, as well as

mesh cages, were more protected, with fewer fish farmers reporting damage—46.15% due to otters and 69.23% due to piscivorous birds. These producers more frequently reported "no significant damage" compared to those managing earth-fill ponds—38.46% vs. 18.37% for otters and 10.26% vs. 8.16% for birds.

Fish farmers' attitudes toward otters and piscivorous birds also depended on the species of fish being farmed. When it comes to carp farming, 45.9% of respondents had a strongly negative attitude toward otters, and 72.13% of them, toward piscivorous birds. In trout farms, the attitudes were more moderate, with 29.63% concerned about otters and 37.04% about piscivorous birds, while neutral attitudes prevailed—44.44% toward otters and 48.15% toward birds. Summarized data on the attitudes of 88 fish farmers toward the two most common pests indicated that the combined two scales of negative attitudes generally prevailed over those of neutral and positive attitudes, both toward otters and piscivorous birds (Fig. 4).

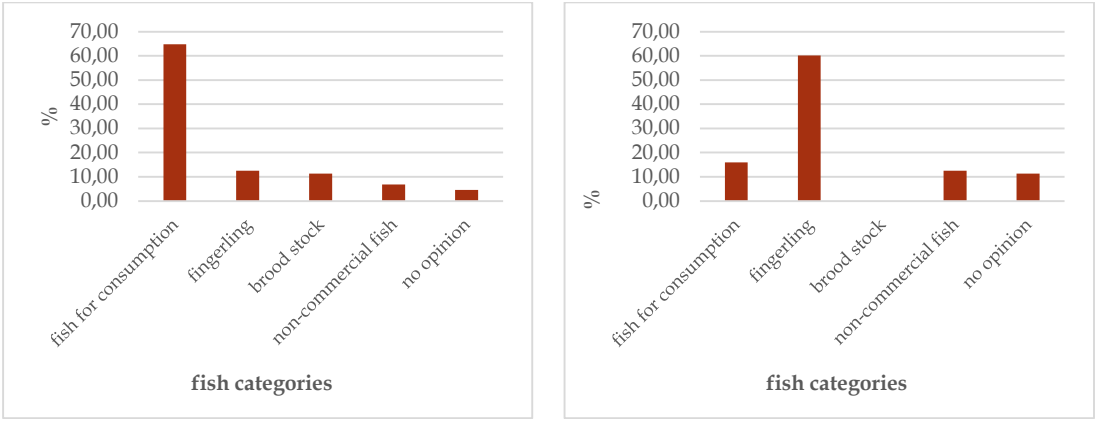

Fig. 3. Vulnerability of different fish categories to otter's (left) and piscivorous birds (right) predation.

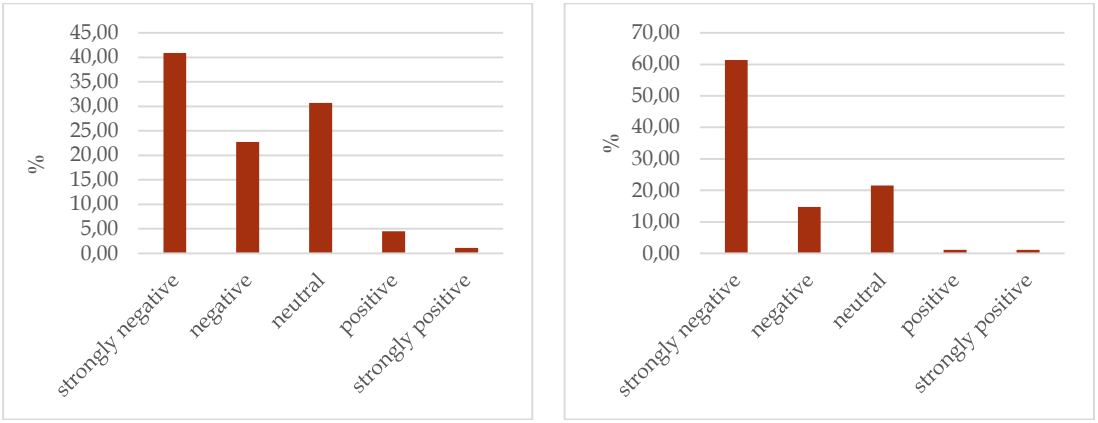

Fig. 4. Level of fish producers' attitude to the otter (left) and piscivorous birds (right).

A marked difference was observed between carp and trout farmers when asked whether they require state compensation. Almost all of the carp farmers (98.44%) demanded financial compensation for damages caused by otters and piscivorous birds, while 81.48% of trout farmers did. These findings demonstrate that the first group was more severely impacted by wildlife intrusions, leading to heightened conflict.

Educational level did not significantly influence attitudes toward otters, as both higher-educated respondents (40.62%) and those with secondary education (41.07%) expressed a strongly negative attitude. However, attitudes toward piscivorous birds differed, with a strongly negative stance among those with secondary education (71.43%), while higher-educated fish farmers expressed a similar stance to that regarding otters.

A significant part of respondents took protective measures against otters (87.05%) and piscivorous birds (89.28%).

Education influences the choice of protective measures, classified as lethal (e.g., shooting, electrocution, poisoning) and non-lethal (e.g., using dogs, gas guns, electro fences). Higher-educated farmers preferred non-lethal measures against otters (75%) and piscivorous birds (90.62%). Other respondents also favored non-lethal measures but to a lesser extent—69.64% and 64.28%, respectively. Among the latter group, there was a stronger readiness to resort to lethal methods—30.36% vs. 25% of higher-educated respondents for otters, and 35.71% vs. 9.37% for piscivorous birds. In the Czech Republic, historically, otters were viewed very negatively, with 85% of respondents using lethal measures (Václavíková et al., 2011). This suggests a positive influence of education on the choice of non-lethal measures for managing piscivorous birds, likely due to cultural constraints on killing birds. In India, a recent similar study found a predominantly neutral attitude and high tolerance to birds (Jain & Karanth, 2023). In places where the livelihood of the local population heavily depends on fish, such as Tanzania, negative attitudes toward piscivorous birds prevail (Mgomo & Reed-Smith, 2020). In Hong Kong, despite the negative attitude of fish farmers toward otters, an opposite conservation mood in youth exists (McMillan et al., 2019).

The influence of position, age, and education on the attitude toward the studied species was found weak and insignificant (Table 2).

Table 2. Influence of position, age and education on the attitude toward the studied species.

Factors	Coeficient					
	Pearson Chi- Square		Cramer's V (φ_c)		p	
	otter	birds	otter	birds	otter	birds
position	2.083[a]	0.966[a]	0.109	0.074	0.721	0.915
age	4.344[a]	3.949[a]	0.157	0.150	0.630	0.684
education	0.915[a]	8.754[a]	0.102	0.315	0.922	0.068

In this study, the attitude toward otters, measured on a five-point scale, showed strong intolerance among 40.91% of respondents, with a combined total of 63.64% expressing strong or moderate negativity. This exceeded the neutral stance (30.68%) and positive attitudes (5.68%; Fig. 4). Herons, pelicans, and cormorants caused even greater concern among fish farmers, with overall negativity reaching 76.13% of respondents. It can be concluded that birds are more disturbing due to their visible presence, which does not necessarily result in killing. Doucette et al. (2011) recommend fishery managers to consider cormorants not only as a threat but also as a part of the natural trophic web. Thus an opportunity for conflict mitigation would be possible by drawing their attention to different types of prey in surrounding water bodies.

When examining how the choice of whether/what type of measures against the two types of pests was influenced by the attitude toward them, it was found lethal measures to be chosen only by people with a negative attitude (Fig. 5). Accordingly, those with a neutral attitude more often did not take protective measures. A moderate to strong influence of the respondents' attitude was found on the choice of whether/what measures to take against the studied species (φ_c= 0.580; p=0.000 for the otter and φ_c= 0.707; p=0.000 for piscivorous birds).

The issue of compensation remains a clear concern—80.64% of respondents demanded it, while others were uncertain. None would refuse financial or other assistance from the state. Several possibilities for supporting fish farmers were pointed out: financial support for constructing proof fences in some provinces of Austria (Kranz & Poledník, 2020); advance payments for damages when fencing is not feasible, as in Burgenland (Kranz, 2015, 2019); compensation payments for loss, provided all protective measures have been implemented, as in Slovenia (Urban, 2016), Portugal (Sales-Luís, 2011), and the Czech Republic (Václavíková et al., 2011).

Fish farmers' perceptions of wildlife-related damage are critical when selecting mitigation measures. In many European countries, illegal lethal measures are commonly applied against

otters: Pedroso et al. (2014) for Portugal, Václavíková et al. (2011) for the Czech Republic, and Kloskowski (2011) for Poland. Bulgaria is no exception, and such practices are widespread (personal observations). According to Lanszki et al. (2001), otter conservation depends on state policy regarding aquaculture damages and procedures for assessing their extent, thus resulting in an amount of compensation.

In terms of attitudes toward otters, "self-assessed knowledge" often clashes with "factual knowledge". When the latter is substantial, it can lead to more favorable public attitudes.

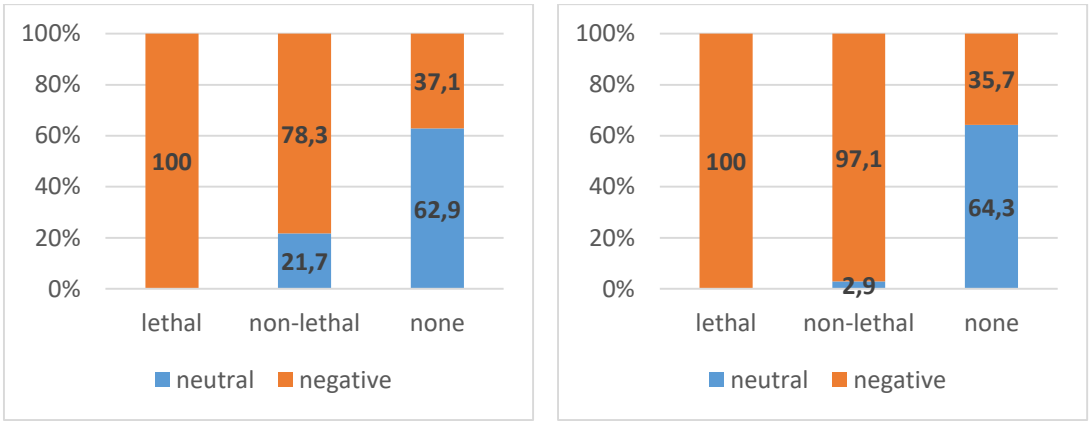

Fig. 5. Measures declared by respondents with neutral and negative attitudes for dealing with otters' (left) and piscivorous birds' (right) interference.

Conclusions

Questionnaire surveys on the attitudes of local people to otter and piscivorous birds need to be nominated as a priority. The conflict between fish farmers and otters (Raichev, 2021) and piscivorous birds (Peeva et al., 2017) still exists in central Bulgaria, leading to negative attitude toward these species. Compensation is desired by nearly all fish farmers, but an effective system for receiving it is lacking, leading many to resort to lethal control measures. Thus, the problem needs to be tracking periodically together with addressing to the authorities' attention.

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