Consequences of Implementing Government Projects in Forest Areas in Northern Iran: Application of Systems Dynamics

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Abstract

The study investigates the impact of two government projects the Tehran-North Freeway and livestock removal from forests areas and rangelands in the Kelardasht region. It uses system dynamics (SD) and Vensim software to simulate changes in forest destruction over a 40-year period (1990-2030). The findings reveal that while the livestock removal project aimed to reduce forest destruction, it also led to an increase in villa construction and forest loss due to both legal and illegal permits. Additionally, the Tehran-North Freeway project increased land demand in the region. The simulation predicts a decline in forest area from 10,000 ha to approximately 1,000 ha by 2030. Policy recommendations emphasize the need for government consultation with experts and local residents before initiating projects in forested areas.

Methodology

This study employed qualitative methods to collect population and land allocation data from Kelardasht's local authorities. Interviews, observations, and surveys involving 17 experts were conducted to assess the impact of government projects. Triangulation ensured data validity, and expert review finalized the results. Additionally, it utilized system dynamics, a simulation methodology developed by Forrester (1961), to understand dynamic behavior in complex systems.

Fig. 1: Location of the study site
Source: Research Findings

This study investigates the impact of various parameters on forest destruction due to government projects, utilizing scenario building and mutual variable behavior analysis. The development of the system dynamics model involves hypothetical loops where agents interact, followed by simulation and interpretation. Key questions addressed include: 1) identifying drivers affecting human systems or regional development planning, and 2) examining systematic and dynamic interactions between these drivers and the sustainability of Kelardasht forest.

The study process took place four stages as follows to provide decision-making model to determine the drivers affecting the destruction of the Kelardasht forest:

a) Developing a conceptual model; b) Identifying effective patterns in the government's decision-making process in the implementation of plans in the region; c) Developing the SD model of the desired region; d) Checking the accuracy of decision-making criteria. In this study, the development process of the SD model begins with a series of hypothetical loops whose agents interact with each other; then, the simulation and interpretation of the model continue.
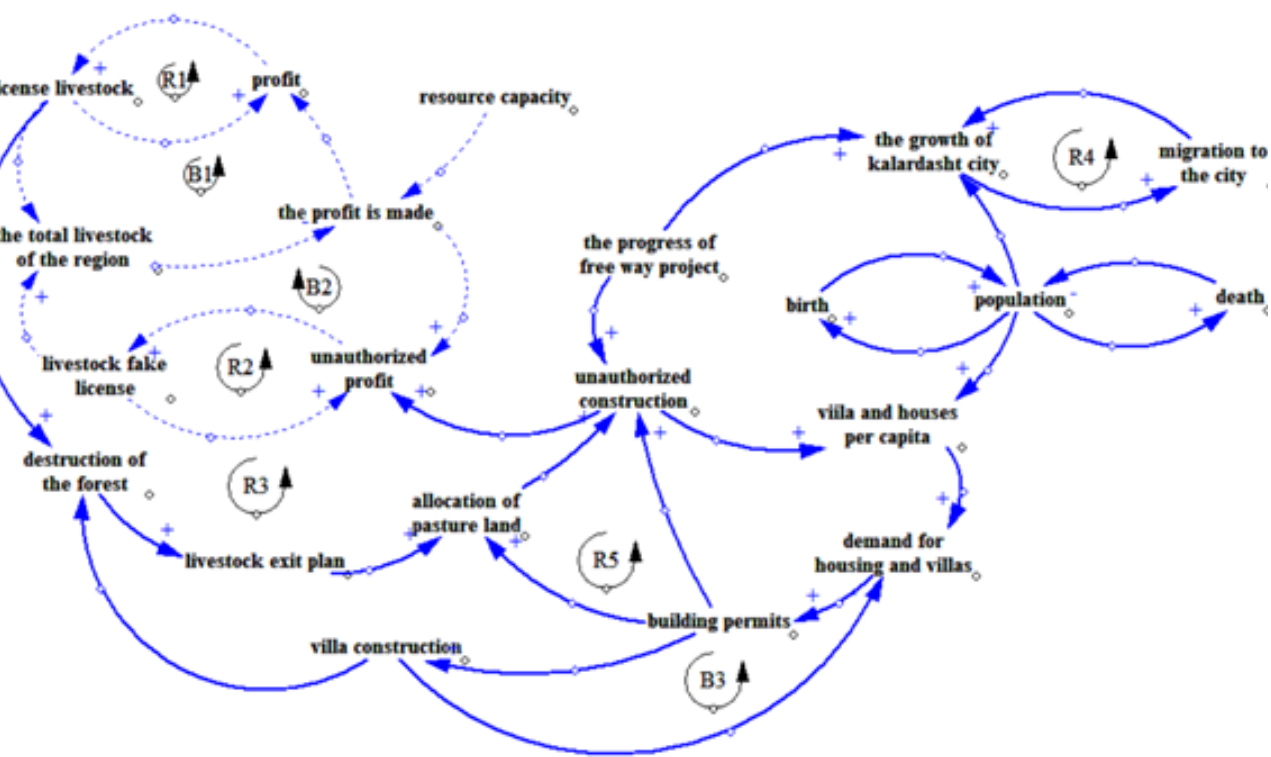

Fig.2: Conceptual model of the implementation of destructive government projects in the Kelardasht region
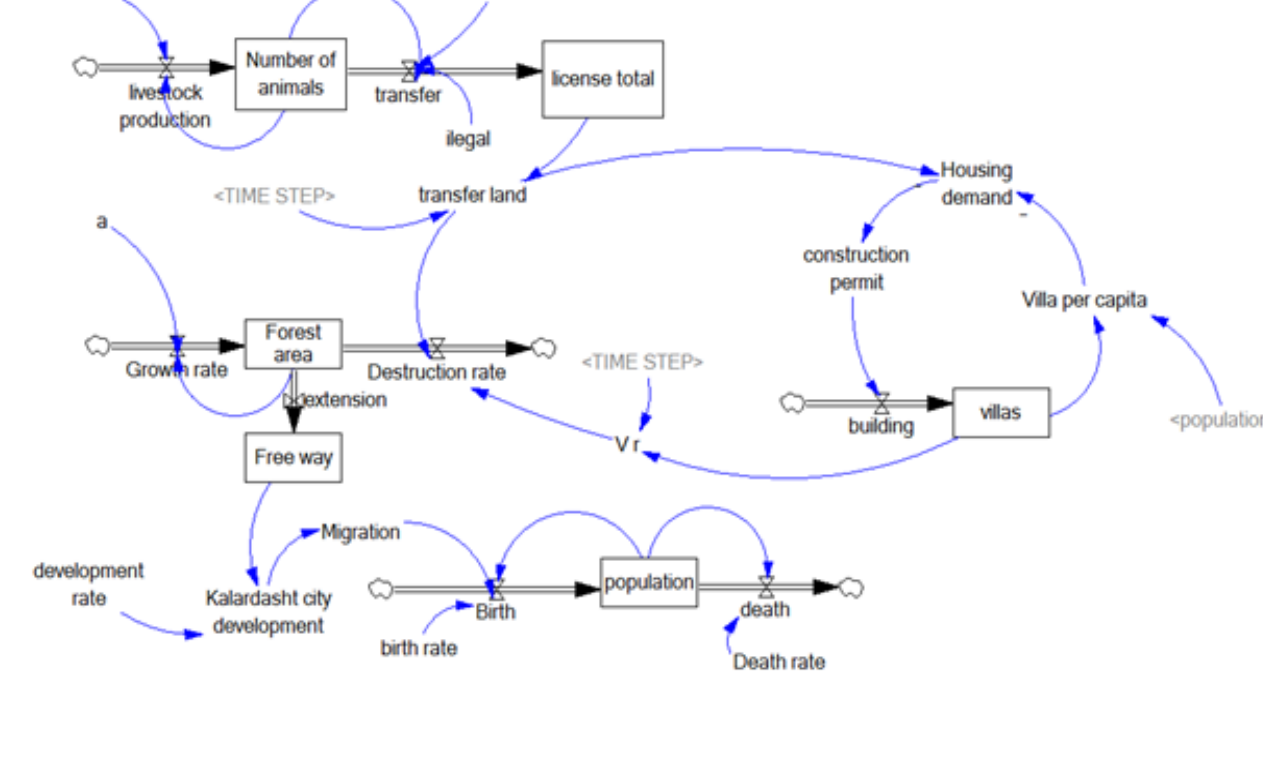Source: Research Findings

Fig. 3: Modeling the development of villas in Kelardasht region
Source: Research Findings

Result

The model simulates data from 1990 to 2030, with parameters recalibrated using observed data from 1990 to 2000. compares simulated and observed behaviors of population and livestock production variables. The correlation between observed and predicted trends indicates successful model calibration in reconstructing system parameter behaviors.
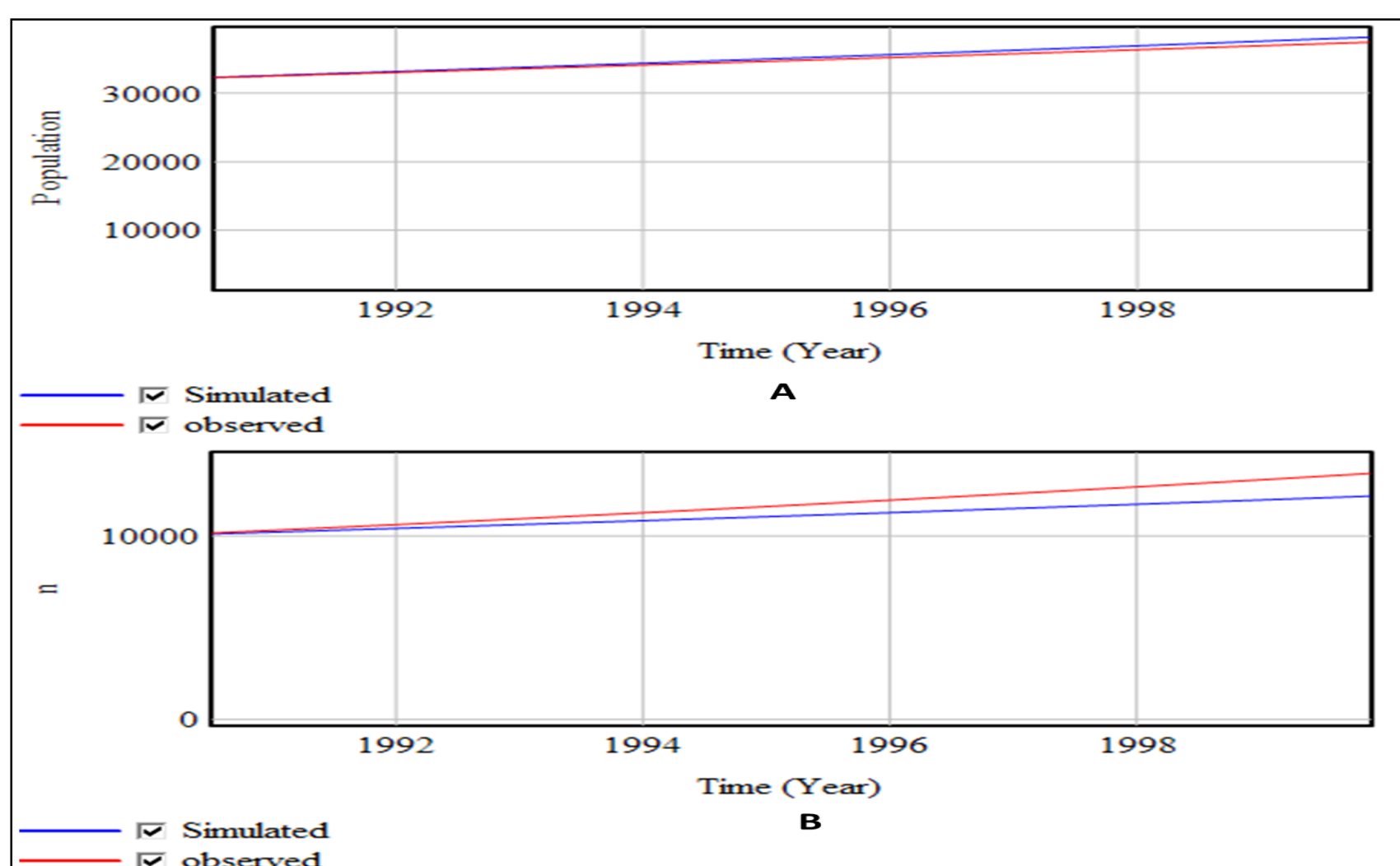

Fig. 4.5: Comparing the output of the model with observation data during the behavior repetition test, variable A: population, variable B: livestock production
Source: Research Findings

In this study, the model was investigated under the extreme condition of no development of villas. With the assumption that the amount of villa construction will be zero, it is expected that villas construction will take a less upward trend, and on the other hand, the growth of villas will not be the same as in normal conditions. Based on (Fig. 6), it can be seen that the non-allocation of land to animal shelters from the Kelardasht forest area leads to a sharp decrease in the number of villas in the study area.

The forest destruction rate in case of increase in the growth of illegal licenses: In this test, with a 30 % increase in the illegal exploitation of the region, the demand behavior for villa construction, and finally, the changes in the area of Kelardasht forest have been investigated.

With the increase in the number of unauthorized licenses, the amount of forest area will decrease up to 70% within 40 years.
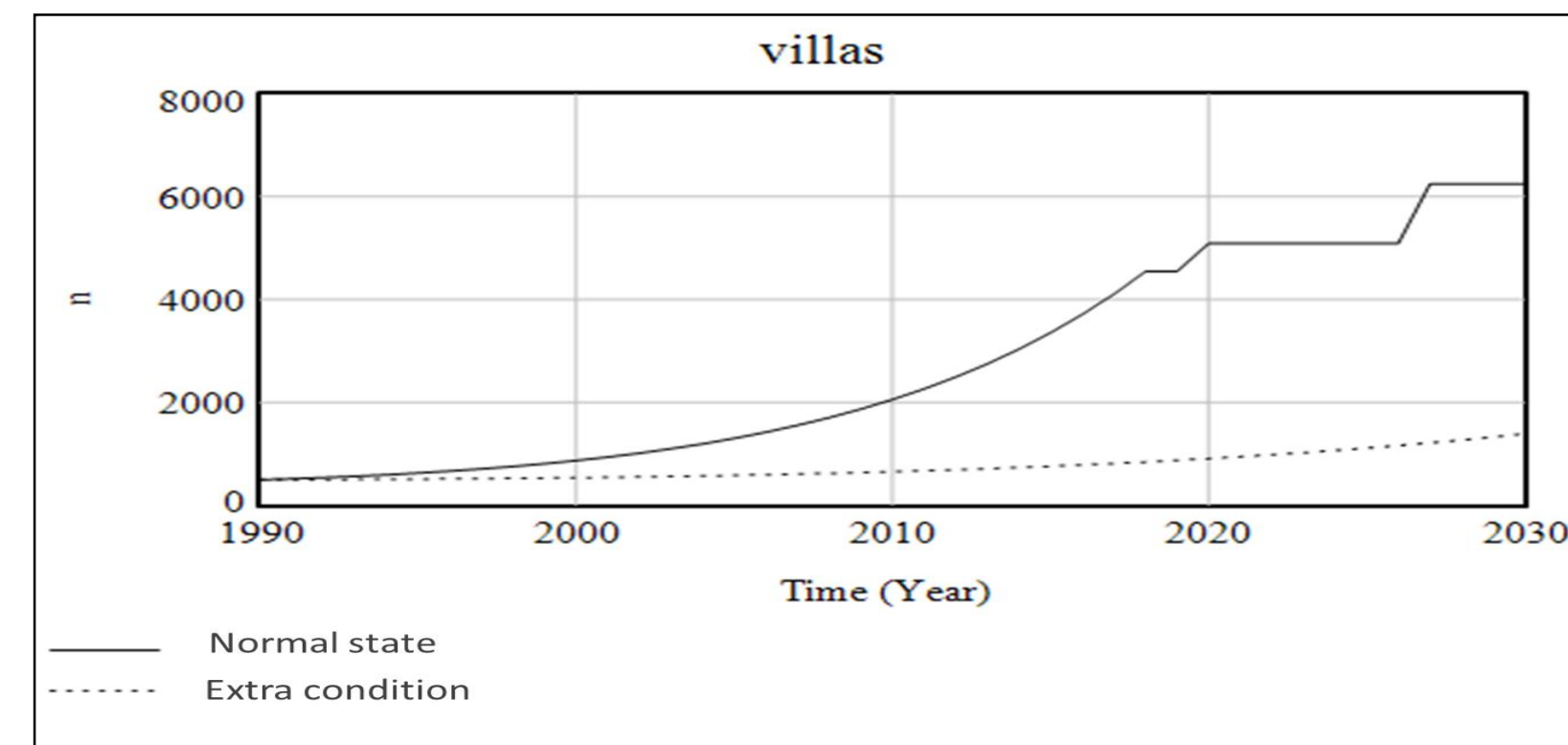

Fig. 6: The trend of changes in the development of villas in Kelardasht region in normal and extreme conditions
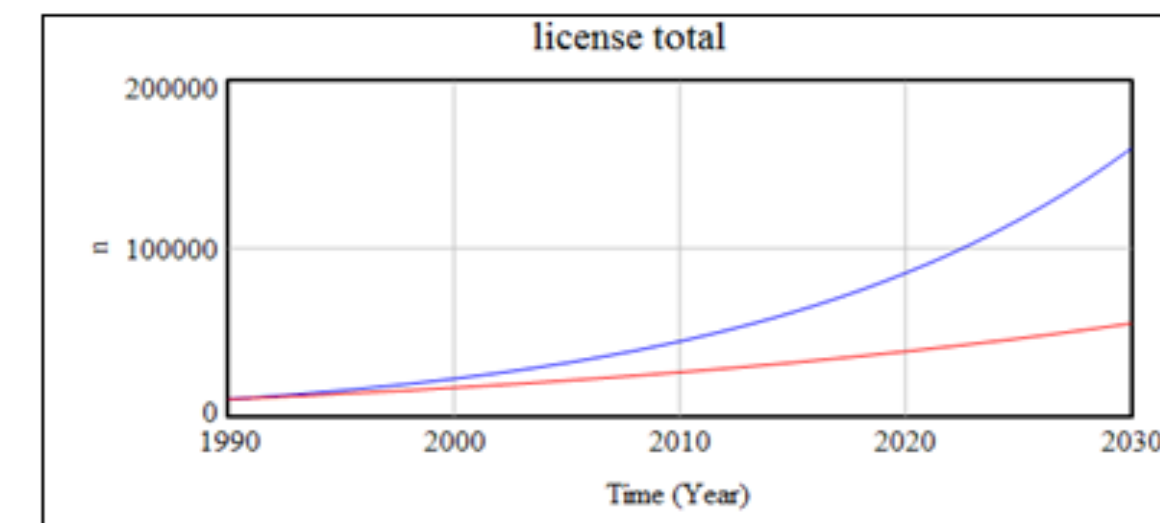Source: Research Findings

Fig.8: The scenario of 30% change in the growth of illegal license
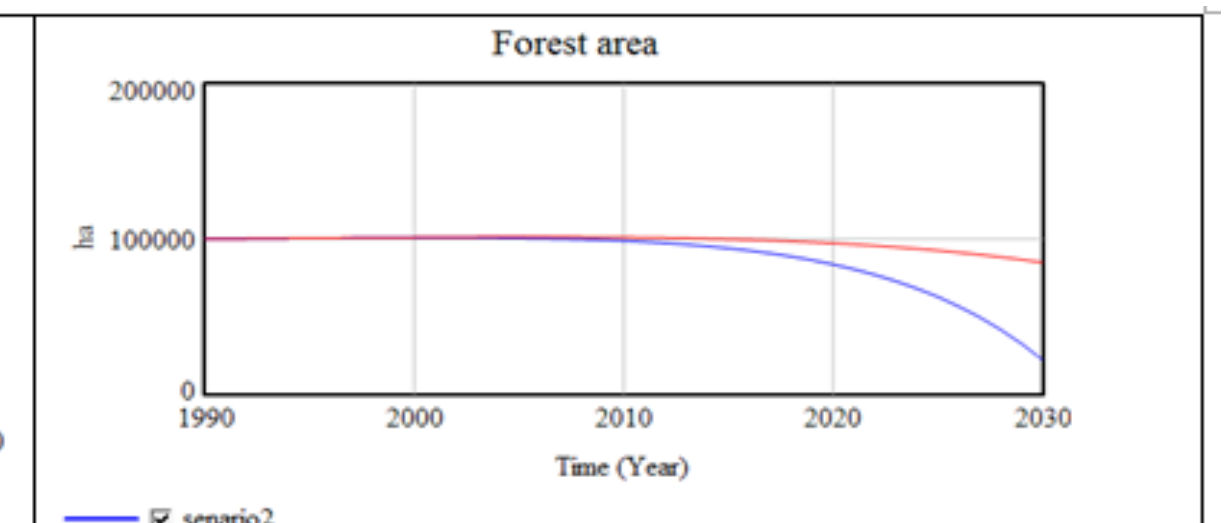Source: Research Findings

Fig.7: 70%decrease in forest area
Source: Research Findings

The forest destruction rate in case of population increase: In this test, with a 30% population increase, the demand behavior for villas, and finally, the changes in the area of Kelardasht forest have been studied. The downward trend of the forest area will decrease to a maximum of 2% in 40 years with an increased population.
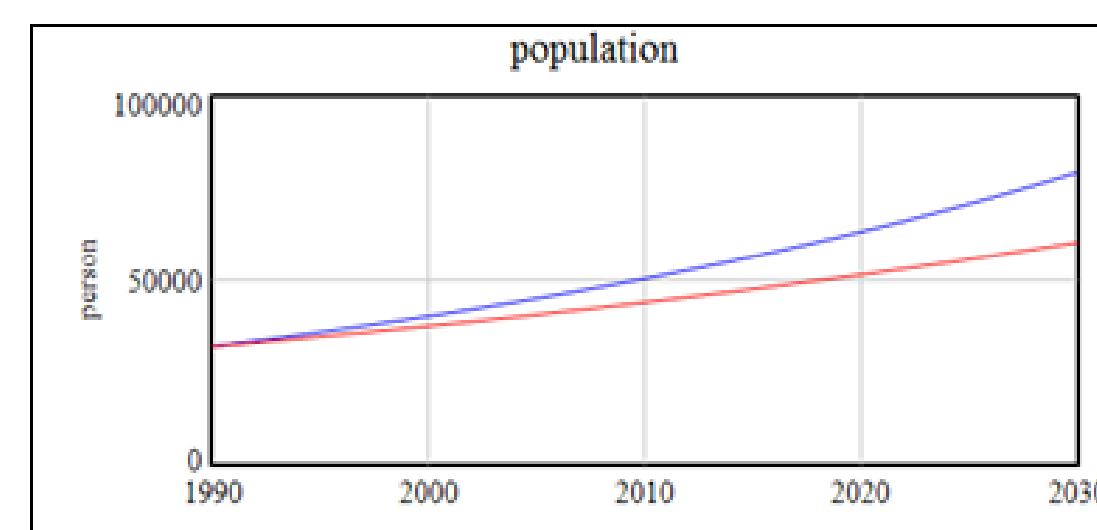

Fig. 10: The scenario of 30% change in the growth of population
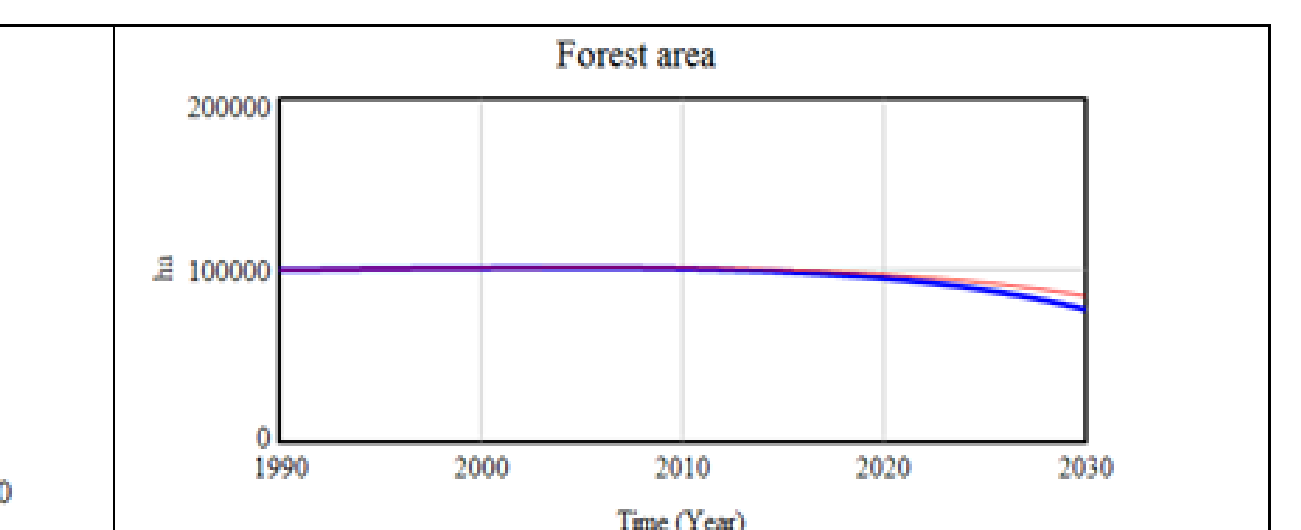Source: Research Findings

Fig. 9: 2 percent decrease in forest area
Source: Research Findings

Conclusion

1- Impact of Increased Land Permits: The 30% increase in land acquisition permits granted to local residents during the livestock removal from the forest prompted more individuals to seek using forest lands for agricultural and residential purposes. This led to a 70% increase in forest destruction, showing a direct impact of increased permits on forest cover reduction.

2- Effect of Tehran-North Freeway and Livestock Removal: The implementation of the Tehran-North Freeway and the livestock removal program from the forest created opportunities for the buying and selling of villas and properties in the region. This shift in land use, while altering the natural landscape of the region, exerts additional pressures on forest resources.

3- Impact of Government Plans: The government's top-down plans in forest areas faced strong resistance from local residents. This opposition and lack of acceptance of government plans created conditions for violations of forest protection laws, ultimately leading to further forest destruction.

4- With the government's presence and the implementation of ostensibly developmental projects, it has led to the hunting of 15,000 birds and 200 deer, as well as the construction of roads and forest fragmentation, which has aided timber smugglers in illegally harvesting 3,000 trees.