

Managerial and Economical Aspects of Harmful Invaders: The Case of TutaAbsoluta in North Cyprus

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Abstract:- Global economy introduces different challenges to production and environmental systems in the world. Invasive alien species (IAS) are species spread by human actions which present a threat to biological diversity and have a negative impact on the goods and services provided by ecosystems. IAS usually result in production and non-production costs. IAS can additionally put control costs either on a specific sector or the society depending on the type of species and the chosen policy. In North Cyprus, the producers face the damage of the tomato by TutaAbsoluta and it is important for them to face the cost incurred and to choose the right policy for the management. Management of IAS is not easy and thought to be a public interest. IAS management can be done by pre-emptive and reactive control. Pre-emptive control decreases the probability of entry and establishment of IAS. It is possible for IAS to invade the region with reactive control. After the invasion, reactive control measures reduce the magnitude and the extent of damages in the action of an invasion. The strategically applied measures lead the people to make the necessary policy, cost reduction and management.

Keywords:- Invasive Alien Species; Management; North Cyprus; TutaAbsoluta.

I. INTRODUCTION

It is known that non-indigenous species (NIS) are plants, animals and pathogens that spread to places outside their native geographic areas. Sometimes later on NIS convert themselves to invasive alien species (IAS) which threaten habitats, ecosystems and other native species in the context of economics and socio-culture, environment and health of the human-beings [1]. Some of the actions such as conversion of land form, natural ecological process and globalization help them to be spreadable through the regions [2]. [3] pointed out that 77% of native fish populations were decreased by the introduction of 31 different non-native fish in Europe, Australia, New Zealand and North America. A current study [4] has indicated that invasions of insects cost a minimum of US\$76.0 billion annually in the world.

As the movement of goods, services and people helps the introduction of IAS, this spread causes significant costs on policy makers by negatively affecting social welfare and natural biodiversity. It is understood that the movement of alien species can be done by:

1. Hanging outside of the ship. Eventually they are transported across oceans from port to port,
2. Placing themselves in the cargo inside the vessel
3. Being on the clothes and shoes of the people as seeds, spores, small animals, soil and dust etc.
4. Carrying animals like birds and small mammals that are moved from port to port
5. Taking plants as souvenirs or as food

According to some of the authors [5]; [6], the control of invasive species is an issue of economic and policy makers.

It is also known that islands are more negatively affected by IAS than other continental countries because they import more goods and services than the continental countries. [7] showed that islands have imports like 43% of their Gross Domestic Product (GDP) than the continental countries as 26.8%.

The economics of IAS consist of direct costs occurred by damages caused by them but as some of them are introduced by purpose, their damages are less than the others that are unintentionally introduced to the environment [8]; [9]. There is a study of [10] focused on the control costs and the economic damages and calculated the costs as US \$ 336 billion per year in UK, USA, Brazil, South Africa and India. The main focus for the economics of invasive species have been analyzed by ex-ante and ex-post assessment ([11]; [12]; [13])

It is significant to point out that use (recreation, food production etc.) and non-use values such as public goods are included in the total economic value of an ecosystem. It is important to detect and to exclude the invasive species in a short time period for the efficient cost-effective methods. Therefore, the main focus of the efficient management is on the correlation between net costs of prevention and control strategies ([14]; [15]).

It is realized that management is needed under uncertainty for alien species as well. In order to achieve the management of invasive species under uncertainty, [16]; [17] have suggested two ways: 1. to develop methods to get more information than before and 2. to base on other decision rules rather than on the maximization of expected utility. A number of studies such as [18]; [19], showed cost-effectiveness analysis for different policy stages and they also pointed out that it is also important to apply tariff

policies for the goods and services to have correct approaches for domestic production, imports and exports.[20]indicated that one type of policy analysis matrix, which can be easily modified to deal with invasive species,was the action-impactmatrix which is developed by the World Bank to show the relationships between environment and economy-widepolicies.

Economic policies and markets canprevent the introduction of the invasive species to the environmentifthe policy makers set in place conditions which encourage producers, consumers, traders, investors, land managers and resource users from using their own native species for many purposes. If the policy makers fail about the necessary conditions and strategies, it will be more profitable, cost-effective or cheaper for people to utilize potentially invasive species than to take the necessary safe approaches to ensure that invasions donot result from their economic activities. It is realized that market, policy, managerial and institutional failures encourage people to neglect the wider economic consequences of their actions, meaning that potentially invasive species aremore likely to be introduced and are less likely to be controlled. The underlying economic causes of invasions and consequences relate both to the conditions which lead to theintroduction and spread of potentially invasive species. With the intention of quick reach to globalization, trade liberalization and investment tools, marketsopen up to import or export products based on potentially invasive species. For example, subsidies designed to promote the export of cash crops which decrease genetic diversity of plants, and encourage the use of agro-inputs that lay agro ecosystems which were open to invasion[21].

II. THE CASE OF NORTH CYPRUS: THE TUTAABSOLUTA

Tomato moth called 'TutaAbsoluta'has become a significant invasive animal for the producers in North Cyprus. Its arrival to the island was in 2009.In this study, its physical structure and its damagesto "tomato" are explained. The origin of tomato moth is South America and its adult is thin and 6 mm long, its wingspan is approximately 10 mm. Its front wings are narrow, silvery gray-brownish, with characteristic large and small blackish spots. It has a thread-shaped antenna. The egg is 0.4 mm long and 0.2 mm wide, cylindrical, cream and light yellow in color. The larvae hatched from the egg are whitish cream colored and its head is black. It goes through four larval stages. While the first stage larva is 0.9 mm long, it reaches 8 mm in the fourth stage. The head of the mature larva is brown and its body color is green, and the dark colored thin band is an important distinguishing feature. In the fourth stage, the top of the larva's body is pinkish. Pupa is 6 mm in length and light brown. It can give 10-12 generations per year in harmful greenhouses that grow rapidly in places with Mediterranean climate. Depending on environmental conditions, it completes one offspring in 29-38 days. The activity of the pest stops below 7 ° C. It is also reported that the pest is not found at altitudes above 1000 meters [22]). Adult butterflies are active at night and hide in the leaves

during the day. It lays its eggs, usually under the leaf, in the bud and on the petals of unripe green tomato fruits. A female can lay 120-260 eggs during her lifetime.The eggs hatch within 4-5 days. It goes through four larval stages. The larval period lasts 13-15 days. Depending on the environmental conditions, the larva pupates in a cocoon either in the soil or in the galleries they open on the plant. Pupa period lasts 9-11 days. It spends the winter as egg, pupa or adult.

Its damage is followed in this way: Whenever the caterpillar hatches, it feeds on the plant by opening holes in the growth tips, leaves, fruits and stems. The tunnels opened in the leaf are in the form of large transparent spaces. These tunnels then turn brown and dry. In addition, the pest's black dirt in these tunnels draws attention. The appearance of the tunnels opened by the caterpillar in the fruit is irregular, clusters are more visible in the fruit and around the stalk. Holes in the fruit cause decay in the product.

After all this explanation, it is understood that one way of protection and treatment of the product is not enough and this approach increases the cost of prevention of the reach and damage of tomato's moth to the product. The economic loss can be shown like this: if there is a 2 decare of tomato area infected by TutaAbsoluta, there will be a yield loss of approximately 300 pound. Tomato moth damages almost 80% of the cultivated area. If chemical pesticides are decided to be applied to the infected area, one decare of cultivated area will require almost 100 pound additional chemical pesticides per year and if the combined preventive and treatment methods are required to be used, the cost will increase almost 300 pound. The production price of the tomato is normally 0.35 pound and the selling price is 0.50 pound in the market. If there is the presence of the tomato's moth in the crop, the production cost increases to 0.9 which will make the selling price to rise to the level of 1.2 pound. This obtained price decreases the demand for the tomato in the market and it has beenalso emphasized that the moth has increased resistance to chemical drugs over passing years and it has been determined that many existing drugs do not affect it year by year. Therefore it is important for the producers to find the correct policy and strategy to apply in each year.

III. CONCLUSION

It is known that invasive species are significant drivers of biodiversity loss[23], disturbance of ecosystem functioning[24], spread of diseases[25];[26]and decreasing quality of life[27]in the world.Another important dimension of these negative effects is the huge economic losses such as consumption of crops [28], degradation of infrastructures [29], and declining business activities [30] and income loss[31].

If the strategies, on the other hand, which are introduced for the reduction of damage, prevention and control of the negative externalities produced by IAS, cannot be under control; then they can create unnecessary large social costs.

IAS usually result in production and non-production costs. IAS can additionally put control costs either on a specific sector or the society depending on the type of species and the chosen policy. Management of IAS is not easy and thought to be a public interest. IAS management can be done by pre-emptive and reactive control. Pre-emptive control decreases the probability of entry and establishment of IAS. It is possible for IAS to invade the region with reactive control. After the invasion, reactive control measures reduce the magnitude and the extent of damages in the action of an invasion as in the case of tomato's moth in North Cyprus. The strategically applied measures lead the people to make the necessary policies, cost reduction and management.

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