

The Views of Residents for the Actions Taken Before, During and After a Forest Fire: The Case Study of Larnaca Prefecture in Cyprus Island

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Abstract. Forest fires are considered as a major and permanent threat for the forests of Cyprus. Every year, forest fires cause enormous and irreparable damage to forest ecosystems and in some cases threaten residential regions. The present work aims at studying the perceptions and attitudes of the residents of the prefecture of Larnaca with regards to the actions of the Cyprus Fire Department and the other Services of the Prefecture, before, during and after the fires. The research was conducted with a face-to-face questionnaire.

Keywords: Forest fires, forest risk communication, residents' perceptions, actions for prevention, suppression, recovery

1 Introduction

Forest fires constitute a persisting problem, with a rather upward trend during the last twenty years, for most Mediterranean countries, even though regulatory bodies have been investing more funds in strategies to prevent and mainly suppress them (Tampakis et al., 2005).

Furthermore, the tendency of people to live within or near forests or woodlands not only increases the risk of fire but also alters priorities in the appropriation of fire extinguishing means (Jaber et al., 2001; Tabara et al., 2003) thus constituting a serious problem for the fire fighting forces (Lindeckert and Alexandrian 1990; Tampakis et al., 2005; Ioannou et al. 2011).

In earlier years, the confrontation of forest fires was more effective, as the life and prosperity of the population was directly related to the forest (Tampakis and Karanikola, 2002). Nowadays, most of the citizens become passive spectators of the desperate situation around them and help the fire extinguishing forces only when the fire threatens their villages or some settlement which is related to them and their lands (Vounassis, 1999; Tampakis et al., 2005).

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Especially for the forests of Cyprus, fires are considered as a very big threat. Every year, forest fires cause irreparable damage to forest ecosystems and in some cases threaten residential regions. There are many factors that contribute to increased fire risk in Cyprus, such as the high temperatures and the prolonged drought periods, as well as the extremely flammable vegetation. The accumulation of biomass due to the abandonment of rural areas and the increasing tourism recreation in forested areas are also important factors which contribute to increased fire risk, especially during summer months (Boustras et al., 2008).

The aim of this paper is to investigate the views of the residents in the prefecture of Larnaca with regards to the actions taken by the Forest Department, the Local Services and the residents before, during and after a forest fire. Questions that seek urgent answers are:

- (a) What preventive measures should be taken for mitigating the fire risk?
- (b) What are the potential omissions/limitations and where does the Forest Department need to put more emphasis?

2 Research Methodology

The research was carried out with the application of a face-to-face structured questionnaire delivered in the province of Larnaca, an area located on the southern coast of Cyprus, with a population of 143,192 inhabitants, of which 59% live in the city of Larnaca, the third-largest city of Cyprus after Nicosia and Limassol (CYSTAT, 2011). The state forests in Cyprus cover an area of 163,529 ha, i.e. 17.74% of the total area of the island (Boustras et al., 2008).

Random sampling was applied for the sake of simplicity in the procedure. The population ratio that is also the impartial evaluation of the real ratio of the population p and the assessment of the standard error of the population ratio of the s_p without correction of the finite population as the sampling fraction is small, has been calculated using the formulae of simple random sampling. To calculate the size of the sample, pre-sampling was performed with a sample size of 50 individuals, based on the formulae of simple random sampling (where $t=1.96$ and $e=0.048$). Even though simple random sampling without off-reset was used, the correction of the finite population was skipped as the sample size n was small in relation to the population size N (Pagano et al., 2000). More specifically, the sample size was determined to 400 individuals. The data collection was carried out during the second semester of 2014. The ensemble of questions which were reported to the possible sources of information constitutes a multi-theme variable on which reliability analysis is applied. In particular, in order to test the internal reliability of the questionnaire (Frangos, 2004), the alpha co-efficient (or reliability co-efficient α -Cronbach) was used. According to Howitt et al. (2003) values of the alpha co-efficient ≥ 0.70 are considered satisfactory, while values > 0.80 are considered very satisfactory. In practice, it is frequent that smaller reliability coefficients, that is values no bigger than 0.60, are also accepted.

In order to ensure reliability, the multivariate method of Factor Analysis was applied. Factor Analysis is a statistical method which aims to discover the existence

of factors which are common within a group of variables (Sharma, 1996). In particular, we used the method of Principal Components which is based on the Spectral Analysis of the variance table (correlation). Regarding the significance of the principal components, the criterion used was the one suggested by Guttman and Kaiser (Frangos, 2004), according to which, the limit for the collection of the appropriate number of the principal components is determined by the values of typical roots which are equal or higher to one. Furthermore, we also used the matrix rotation of the main factors applying the Kaiser's method of maximum variance rotation.

3 Results and Discussion

According to the Cypriot local authorities, all fires occurring (or expanding) within the State forest or within two kilometers from the boundaries of the State forest are classified as forest fires. The primary responsibility for them lies with the Department of Forests of the Ministry of Agriculture, Natural Resources and Environment (Boustras et al., 2007).

With regards to prevention, suppression and recovery of forest fires the inhabitants of the prefecture of Larnaka were asked to assess these actions of the Cyprus Department of Forests. In particular, the respondents evaluated the actions for the suppression of forest fires as very good (40.3%) and good (46.2%). Accordingly, the actions for prevention had good acceptance from the inhabitants (30.1% very good and 50.1% good), while the actions of recovery in the burnt areas faced lower acceptance (33.8% mediocre and 32.7% good) (Table 1).

Table 1. Actions of the Cyprus Department of Forests regarding forest fires

Variables		Very Good	Good	Mediocre	Bad	Very Bad	No answer
Prevention of forest fires	%	30.1	50.1	17.7	1.6	0.3	0.3
	s_p	0.0234	0.0255	0.0195	0.0063	0.0026	0.0026
Suppression of forest fires	%	40.3	46.2	11.4	1.3	0.5	0.3
	s_p	0.0250	0.0254	0.0162	0.0058	0.0037	0.0026
Actions for the recovery of burnt areas	%	21.8	32.7	33.8	9.4	1.3	1.0
	s_p	0.0211	0.0239	0.0241	0.0149	0.0058	0.0052

For the prevention of forest fires, fire outposts were manned during the fire season and patrolling was organized in various forest regions, not only within forests but especially along the forest delimitation line where most of the forest fires start (Boustras et al., 2008). In particular, the respondents acknowledged that the Cyprus Department of Forests often (33.2%) and sometimes (28.3%) manned the fire posts and patrolled along the forest delimitation line (often 34.3% and sometimes 28.3%). Their view was more positive with regards to patrolling within the forests (often 40.0% and sometimes 29.4%)(Table 2).

Table 2. Residents' assessment of actions taken before, during and after the forest fires

Variables		Very often	Often	Mediocre	Rarely	Never	No answer
<i>A. Before the forest fires</i>	There are patrols along the forest delimitation line	% 14.3 s _p 0.0179	34.3 0.0242	28.3 0.0230	15.8 0.0186	4.9 0.0111	2.3 0.0077
	There are patrols within the forests	% 14.8 s _p 0.0181	40.0 0.0250	29.4 0.0232	9.6 0.0150	4.7 0.0108	1.6 0.0063
	There are manned fire-outposts	% 18.4 s _p 0.0198	33.2 0.0240	29.1 0.0232	10.9 0.0159	4.9 0.0111	3.4 0.0092
	The Department of Forests conducts vegetation removal-clearance in forests	% 17.7 s _p 0.0195	35.1 0.0244	28.8 0.0231	11.2 0.0161	4.2 0.0102	3.1 0.0089
	Residents remove all dry greens from their farmland	% 13.2 s _p 0.0173	32.7 0.0239	31.7 0.0237	16.1 0.0188	4.4 0.0105	1.8 0.0069
	There are recreational areas within the forests that attract visitors	% 43.9 s _p 0.0253	37.1 0.0247	15.3 0.0184	1.3 0.0058	0.5 0.0037	1.8 0.0068
	Residents light fires to burn agricultural leftovers even if this is forbidden	% 34.3 s _p 0.0242	40.5 0.0251	18.4 0.0198	4.2 0.0102	1.6 0.0063	1.0 0.0052
	Residents are educated –informed on how to deal with a forest fire	% 7.8 s _p 0.0137	29.6 0.0233	33.8 0.0241	22.1 0.0212	5.2 0.0133	1.6 0.0063
	Residents built their residence within or next to the forest	% 22.1 s _p 0.0212	35.8 0.0245	26.8 0.0226	12.7 0.0170	1.6 0.0063	1.0 0.0052
	<i>B. During the forest fires</i>	The fire is dealt with along the forest delimitation line	% 18.7 s _p 0.0199	37.7 0.0247	27.5 0.0228	8.1 0.0139	3.6 0.0096
The fire is dealt with within the forest		% 20.0 s _p 0.0204	34.0 0.0242	26.2 0.0224	11.9 0.0166	4.4 0.0105	3.4 0.0092
The fire is dealt with at the village edges		% 27.5 s _p 0.0228	40.8 0.0251	22.3 0.0213	3.6 0.0096	2.1 0.0073	3.6 0.0096
Residents participate in the extinguishing of the fires		% 51.4 s _p 0.0255	32.2 0.0238	9.6 0.0150	3.9 0.0099	1.3 0.0058	1.6 0.0063
There was participation of Services other than the Fire Service in the fires		% 51.7 s _p 0.0255	32.5 0.0239	10.9 0.0159	3.1 0.0089	0.8 0.0045	1.0 0.0052
There is requisition and mobilization of private fire extinguishing machinery		% 43.4 s _p 0.0253	33.2 0.0238	15.3 0.0184	5.2 0.0113	2.1 0.0073	0.8 0.0045
Trees are logged to create anti- fire zones		% 26.8 s _p 0.0226	31.7 0.0237	24.9 0.0221	9.4 0.0149	4.4 0.0105	2.9 0.0085
With the appearance of air fire extinguishing forces, ground forces stop operating		% 9.9 s _p 0.0152	20.8 0.0207	24.9 0.0221	22.6 0.0213	19.0 0.0200	2.9 0.0085
There is immediate evacuation of villages in case of danger		% 33.2 s _p 0.0240	29.1 0.0232	22.9 0.0214	12.2 0.0167	2.3 0.0077	0.3 0.0026
<i>C. After the forest fires</i>		Reforestation took place when recovery failed	% 20.0 s _p 0.0204	34.0 0.0242	32.7 0.0239	8.8 0.0145	1.6 0.0063
	Residents participate in reforestation efforts	% 20.5 s _p 0.0206	29.4 0.0232	35.1 0.0244	10.9 0.0159	2.9 0.0085	1.3 0.0058
	There is financial support for the people affected	% 10.1 s _p 0.0154	27.3 0.0227	37.9 0.0248	19.0 0.0200	2.6 0.0081	3.1 0.0089
	Proposals for buying new fire extinguishing equipment took place	% 12.7 s _p 0.0170	28.6 0.0231	34.0 0.0242	17.4 0.0193	4.4 0.0105	2.9 0.0085
	Grazing from farm animals took place in the greening burnt areas	% 11.9 s _p 0.0159	22.6 0.0213	33.0 0.0240	20.3 0.0205	7.3 0.0133	4.9 0.0111
	The residents of burnt areas abandoned them	% 4.9 s _p 0.0111	14.8 0.0181	34.0 0.0242	33.5 0.0241	10.9 0.0159	1.8 0.0068
	After a big fire jobs were created, especially in reforestation	% 6.8 s _p 0.0128	11.4 0.0232	27.0 0.0227	37.7 0.0247	13.8 0.0176	3.4 0.0092
	There is appropriation of forest lands	% 12.2 s _p 0.0167	19.5 0.0202	34.8 0.0243	22.1 0.0212	7.5 0.0135	3.9 0.0099
	Proposal for buying or exchanging private lands located in the forests took place	% 7.3 s _p 0.0133	19.2 0.0201	34.8 0.0243	22.6 0.0213	10.9 0.0159	5.2 0.0113

The avoidance of accumulation of combustible material is a very important measure in the prevention of forest fires, as disrupting the continuity of combustible material prevents the spreading of fire (Kailidis and Karanikola, 2004). The respondents answered that the Cyprus Department of Forests often (35.1%) and sometimes (28.8%) conducted vegetation removal- clearance in public forests. Similar were the opinions on the removal of all the dry vegetation from their farmland, i.e. often for 32.7% of the cases and sometimes for 31.7%.

The residents also stated that recreation areas organized in the public forests very often (43.9%) and often (37.1%) attract more visitors. Although, Tampakis et al., (2005) consider that more visitations can cause more fires in the forests, this increase is mainly due to the rural abandonment and consequently due to the accumulation of fuel. The population that lives in the countryside is aged and very often, in order to clean the land, they light fires without being able to control them. In Spain, and Greece the current trend to burn the fields has been reported to increase (Velez, 1992; Karanikola et al., 2011). Similarly, the residents stated that the farmers very often (34.3%) and often (40.5%) light fires to burn agricultural leftovers, even if this is forbidden.

Younger people can more easily adopt modern methods through awareness building and training (Karanikola et al., 2011). As Baden (1981) makes clear, informing the public about causes and control of forest fires is important to their prevention. With regards to the existence of awareness building and training on how to fight forest fires, 29.6% said “often”, 33.8% “some times” and 22.1% “rarely”.

In Cyprus the suppression of a forest fire is usually done by ground personnel. Under certain conditions, aircrafts can contribute to combating fires but the final effort is made on the ground. Thus, the residents of Larnaca were asked how satisfied they were about the actions of the Forest Department within the forest and at the village edges. During the demographic development in many European and USA areas, people built their first or second residence near or within forests (Tokle, 1987). According to the residents of Larnaca this happened near or within the forests of their prefecture very often for 22.1% of the cases, often for 35.8% and sometimes for 26.8%. Respectively, the residents considered that the forest fires were successfully extinguished along the forest delimitation line (often 37.7% and sometimes 27.5%), and within the forests (often 34%, sometimes 26.2%), whereas for fires occurred at the edges of their villages the relevant percentages were 27.5% (very often) and 40.8% (often). According to Vounassis (1999), the citizens in Greece help the fire extinguishing forces only when the fire threatens their villages or some settlement which is related to them and their lands. Nevertheless, the residents of Larnaca reported that very often (51.4%) and often (32.2%) they participate to the suppression of forest fires. Also, Services other than the Fire Service, such as the Civil Defense Force, very often (51.4%) contributed to the suppression of forest fires. As the Forest Department and other public authorities don't possess adequate excavating machinery, these were borrowed by the private sector. On this matter, the respondents declared that very often (43.4%) and often (33.2%) immediate requisition of private machinery was done by the government. One important reason

for this is to create anti-fire zones. With regards to this, 31.7% of the residents declared that often trees were logged to create anti-fire zones.

Traditionally, the confrontation of fires is performed manually, with portable tools and through the creation of infrastructure for the speedy detection of fire which ensures the quick putting out of fire. The arrival of mechanical means increases the probabilities for a successful confrontation of the fire. Pumps are widely used even when it is difficult to transport them to the areas needed. However, practice shows that fire protection teams tend to move back when the sound of the pump is heard, believing that the water will do the job without manual work being needed. The same often happens when bulldozers appear in the scene. The same pattern can be detected with regards to air fire-extinguishing forces (Murphy, 1990). This behavior was also evident in our survey, where the respondents stated that ground forces stopped fighting the fire when the aircrafts arrived. Specifically, 24.9% of the people declared that this happened sometimes, 20.8% often and 22.6% rarely.

According to the current legislation, after any fire the Forest Department is obliged to take measures for the protection of the natural generation and the burnt area and for the reforestation of the areas where no significant natural rebirth is expected. On this matter, 32.7% of the residents stated that reforestation by the Forest Department, when needed, happens sometimes (and 34% often). Similar were their views for the public participation in the reforestation efforts; 35.1% said that this happened sometimes, 29.4%, often and 10.9% rarely. For a successful reforestation the burnt area is necessary to be protected from grazing. According to the residents, some years after the fire the greening land was often (22.6%), sometimes (33%) and rarely (20.3%) grazed by stock animals.

A forest fire can cause damage to residences, fruit trees and animal stocking. 27.3% of the people answered that financial support were often provided to those who suffered losses, while 37.9% answered "sometimes". Agricultural areas face serious problems and the result is young people abandoning them (Myronidis and Arabatzis 2009). Nevertheless after disastrous fires the tendency to abandon the area is not bigger (Karanikola et al., 2011). On this issue, the respondents stated that in the prefecture of Larnaca only sometimes (34%) and rarely (33.5%) the burnt areas were abandoned. On the other hand, it was said that sometimes (27%) and rarely (37.7%) the fires created new opportunities for jobs.

It is common knowledge that in many areas globally the purpose of forest fires is the clear-cutting and then the appropriation of public forest land (Douros, 1991). Hence, the fire is a "weapon" for the removal of forest vegetation (Dimitrakopoulos, 1991). However, the forest cadaster that exists in Cyprus discourages arsonists to light fires for this reason. Nevertheless, the inhabitants of Larnaca answered that sometimes (34.8%) and rarely (22.1%) land appropriation took place after fires.

In the above variables reliability analysis was applied, after the appropriate checks were performed. The reliability co-efficient alpha was 0.861 and this result provided strong evidence that the grades of the scale are logically consistent.

Also factor analysis was applied and 8 factors were extracted. In Table 3 the loadings are given after rotation of the factors. Some of them constitute the correlation coefficients of the 8 variables with every one of the 8 variables extracted from the analysis.

Table 3. Table with factor burdens after rotation.

Variables		Factor loadings							
		1	2	3	4	5	6	7	8
<i>A. Before the forest fires</i>	There are patrols along the forest delimitation line	0.777	0.047	0.119	0.107	0.157	0.104	0.128	-0.019
	There are patrols within the forests	0.861	0.133	0.146	0.002	0.112	0.037	-0.039	0.021
	There are manned fire-outposts	0.770	0.149	-0.010	0.121	0.084	0.164	0.057	0.088
	The Department of Forests conducts vegetation removal-clearance in forests	0.409	0.102	0.066	0.137	0.121	0.649	0.160	0.035
	Residents remove all dry greens from their farmland	0.087	0.047	0.129	-0.009	-0.034	0.818	0.032	0.028
	There are recreational areas within the forests that attract visitors	0.040	0.236	-0.021	0.179	0.161	0.506	0.048	0.390
	Residents light fires to burn agricultural leftovers even if this is forbidden	0.088	0.056	0.083	0.091	0.063	0.114	0.026	0.839
	Residents are educated –informed on how to deal with a forest fire	0.355	0.129	0.105	0.425	-0.167	0.158	0.201	-0.009
	Residents built their residence within or next to the forest	-0.096	0.246	0.006	0.599	-0.014	-0.142	0.352	0.187
<i>B. During the forest fires</i>	The fire is dealt with along the forest delimitation line	0.333	0.250	-0.008	0.425	0.033	0.080	0.314	0.050
	The fire is dealt with within the forest	0.324	0.064	0.032	0.081	0.076	0.029	0.736	0.118
	The fire is dealt with at the village edges	0.374	0.477	0.184	0.117	-0.026	0.138	0.345	0.110
	Residents participate in the extinguishing of the fires	0.001	0.783	-0.069	0.023	0.237	-0.081	0.031	0.069
	There was participation of Services other than the Fire Service in the fires	0.076	0.827	-0.078	0.006	0.112	0.126	0.003	0.034
	There is requisition and mobilization of private fire extinguishing machinery	0.158	0.761	0.099	0.156	0.033	0.016	0.011	0.001
	Trees are logged to create anti- fire zones	0.170	0.581	0.081	0.193	0.133	0.327	-0.003	0.020
	With the appearance of air fire extinguishing forces, ground forces stop operating	-0.152	-0.094	0.291	-0.001	0.255	0.282	0.609	-0.231
	There is immediate evacuation of villages in case of danger	-0.059	0.346	0.245	-0.102	0.601	-0.068	0.047	0.118
<i>C. After the forest fires</i>	Reforestation took place when recovery failed	0.326	0.060	-0.025	0.065	0.696	0.091	0.223	-0.013
	Residents participate in reforestation efforts	0.089	0.223	0.115	0.175	0.713	0.056	0.034	0.070
	There is financial support for the people affected	0.256	-0.014	-0.008	0.397	0.450	0.249	-0.305	-0.152
	Proposals for buying new fire extinguishing equipment took place	0.041	0.093	0.077	0.698	0.286	0.187	-0.135	0.100
	Grazing from farm animals in the greening burnt areas took place	0.205	-0.026	0.431	0.568	0.056	0.011	-0.025	-0.044
	The residents of burnt areas abandoned them	0.162	-0.047	0.685	0.208	0.070	0.131	0.047	-0.185
	After a big fire jobs were created, especially in reforestation	0.174	0.016	0.667	0.084	0.124	0.143	0.003	-0.253
	There is appropriation of forest lands	0.002	0.087	0.785	-0.023	0.035	-0.097	0.134	0.258
	Proposal for buying or exchanging private lands located in the forests	-0.024	0.026	0.779	0.022	0.032	0.071	0.038	0.254

The burdens given in bold show which variables were linked to each factor.

The bigger the loadings of the variable in each factor, the more this factor is responsible for the total variance to the grades within the variable under consideration.

The variables that 'belong' to every factor are those for which the loading (columns 1, 2, 3) is bigger (than 0.5) in this factor (Table 3).

The 1st factor (hereafter characterized as "preventive measures") comprises the 2 "patrolling" variables and "manned fire-outposts". The 6th factor (hereafter characterized as "vegetation and visitors' management" comprises the variables "vegetation removal-clearance in forests", "dry greens removal from the farmlands" and "recreational areas". The 8th factor (hereafter "burning of agricultural leftovers" includes only this variable. The 4th factor (hereafter "socialization of forest fires" consists of the variables "Information and education of citizens", "residences within the forests", "fires confronted along the forest delimitation line", "fire-fighting equipment" and "grazing of the burnt area". An interesting finding here is the fact that the residents try to stop fires at the forest delimitation line; their concern is to save their homes, rather than protecting the forests.

In the 7th factor (hereafter called "traditional ways of firefighting") the variables "fires confronted within the forest" and "with the appearance of air-fire extinguishing ground forces stop operating" are summarized. On the contrary, the 2nd factor (hereafter "integrated ways of confronting forest fires") includes the variables "fires dealt with along the village edges", "participation of other services", "requisition and mobilization of private machinery" and "anti-fire-zones". The 5th factor called "local communities and forest fires" consists of the variables "evacuation of villages", "residents' participation in reforestation", "financial support of the people affected", "reforestation at-play". The 3rd factor called "consequences of fires" comprises the variables "area abandoning", "job creation after the fire", "Encroachment of forest land" and "purchase or exchanging of private land within the state forests".

4 Conclusions

Fire constitutes the most serious danger for the forests of Cyprus, due to the lack of proper prevention measures. In particular the residents of Larnaca, with respect to the "preventing measures" group of actions, believe that the existence of manned fire outposts were not organized effectively but the patrols in the forests seem to hold a more positive view. Regarding the "vegetation management" group of actions, the residents also hold a negative view on the work made by the Forest Department to remove all the dry vegetation from the forests. They also consider that the majority of the residents don't remove the vegetation from their farmlands, a fact that raises extra concerns as the removal of combustible material is well-known as the most important way of protecting the forest from fire. Nevertheless, there seems to be reasonable awareness building among residents on how to confront forest fires.

Similarly, it becomes obvious that many farmers behave in undesirable ways when it comes to the burning of agricultural leftovers. Although it is not easy to change the behavior of aged people on the use of fire to the removal of leftovers, a possible way

to address this issue could be to promote a co-operation between the authorities and the farmers on how to control the burning of leftovers.

With regards to the actions taken after a forest fire the respondents view rather negatively the reaction of the Forest Department and of the general public in reforestation efforts. Also they are not absolutely satisfied about the financial support provided to the people affected. It is positive however that after a fire no major abandoning of the areas is reported.

On the whole, forests need to be protected not only from fire but also from other factors which contribute to their construction. The best way to guard the forests is their management with the creation of goods and services from them.

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