

How to be shield against forest fire and smoke impacts: A list of recommendations for local community and population

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Megafires have been correlated with climate change, posing significant risks for the exposed receptors, such as population, critical infrastructures and the environment. Impacts are severe, especially for the rural areas nearby forests since fire expansion usually leads to human casualties and property loss; e.g. Portugal 2017, Greece 2007 [1]. However, apart from those impacts, the smoke produced poses also significant risks on the exposed receptors; it is a complex chemical mixture of a variety of substances, e.g. particles or gaseous pollutants, based on the types of materials burnt towards fire-front expansion [2]. For example, fine particles, such as $PM_{2.5}$, PM_1 and ultrafine particles ($PM_{0.1}$) can be transferred far away from the fire source, affecting areas in long distances (transboundary effects) [3-4]. According to epidemiological studies, fine and ultrafine particles are known to have adverse health effects, especially for vulnerable groups of population, such as the elderly, pregnant women, children, people with disabilities, or hidden disabilities like asthma, or cardiopulmonary diseases [5-8].

It seems that population preparedness against fire and smoke adverse effects is very important, especially for countries that are frequently affected by forest fires, like the Mediterranean ones (Greece, Italy, Portugal, Spain, France). In such case, the best way to shield population is through raising awareness and enhancing active participation of people who live in the interface with forest, brush or agricultural lands, since they are considered areas of high fire risk.

In the following, there is a list of recommendations to increase capacity of local communities/population to forest fire risks, mostly based on a number of guidelines prepared in the framework of EU-OPA [9], as well as to protect them against smoke health impacts; chemical key indicators (CKI) for monitoring air quality [10], as well as other criteria to decide upon evacuation [11-12] will be provided.

A. PREPARE FOR THE FIRE HAZARD

1. Assess the area you live as high or low risk:

High risk area:

- Your home is surrounded by heavy tall grass, forest, flammable shrubs, or dead fuels (leaves, needles, etc.)
- Low vegetation is dry (usually white-yellow color instead of green). Especially during summer/ mid-afternoon hours
- Roads leading to your home are narrow and generally hardly accessed by car
- You live near ridge tops, canyons, or areas between high points of a ridge

Low risk area:

- Less or no forest fuel
- Wide roads are available to escape in case of emergency

2. Prepare your property

- Prefer ignition resistant construction materials for roofs (metal, tile, cement), exterior walls (cement, brick, reinforced concrete), windows (metal frames), doors (metal based), fire resistant paint or varnish
- Avoid using flammable materials outside, e.g. plastic furniture, tar paper under roof
- Check if trees and branches are growing less than 3 meters away from electric power lines, or less than 5 meters from your chimney
- Clear your roof and gutters from leaves, or needles
- Remove lower dead tree branches up to 3 meters from the ground and regularly cut grass and shrubs
- Equipped in case of fire emergency with:
 - tools, such as shovel, hoe
 - water hose (long enough to cover the perimeter of your property)
 - at least one fire extinguisher (dry powder)
- Keep a water tank filled, or an agricultural sprayer filled with water

3. Check for accessibility

- Identify at least two escape routes that lead to refuge areas (e.g. squares, seaside)
- Make sure that your street name sign is clearly visible
- Check that flammable vegetation is cleared at least 3-4 meters from roads and driveways

4. Minimize accidental fire ignition potential

- Disconnect electrical tools and appliance when not in use
- Bale and stack hay when it's dry, not damp to prevent spontaneous ignition
- Do prescribed burning of agricultural crop remains, welding and angle grinding only in clear areas. Wet down the surrounding area and have extinguishing equipment nearby.

NOTE: These activities should not be carried out in high fire danger weather

- Check that all machinery is free of mechanical defects that could start a fire and has an approved spark arrester

B. IN FIRE AND SMOKE EMERGENCY

1. When a forest fire is approaching your house or the village

- Be informed by local radio or TV and if possible try to disseminate information by phone to your neighbors who live in isolated houses
- Water vegetation around house and keep roof and outside walls moist
- Remove all flammable objects outside the house
- Shut off gas, gasoil and other fuel stopcocks and turn off electricity power
- Stay all inside the house (especially if your house is made of fire proof construction materials), unless the authorities give you other instructions
- Consult a doctor if you don't feel well (especially for people with chronic lung or heart disease)

2. Evacuation due to flame-front expansion

- Seriously consider instructions of the authorities before decide to evacuate
- If you need to evacuate immediately , move in the opposite direction of the fire-front until you reach areas with little, or no vegetation fuel (e.g. a gully, underneath a stone bridge), or a shelter designed by the authorities (e.g. squares, parking place, seaside)
- Protect yourself from heat by sheltering behind solid objects (e.g. boulders, or rock outcrops)
- If you use car, avoid panic and drive carefully as much as you can
- Allow emergency vehicles to pass

- If your car is trapped by fire and smoke make sure that you can be seen and heard by the fire and rescue service (sound horn)

3. How to protect yourselves from smoke inhalation

- A critical number of chemical key indicators (CKIs) of forest fire smoke have been identified for monitoring air quality during forest fires [10]:
 - Carbon Monoxide (CO)
 - Fine particles (PM_{2,5} and PM1)
 - Benzo-pyrene
 - Benzene
 - Acroleine

In case that forest fire expands to residential areas (e.g. agricultural fields, structures) other toxic compounds (CKIs) are also produced that usually have acute health effects [2, 10]:

- Dioxins
- Polychlorinated biphenyls (PCBs)
- H₂S
- HCl
- Ammonia
- When you are at home and smoke is covering your area:
 - keep the windows and doors closed and use wet towels in their perimeter to seal possible entry points of smoke
 - Avoid cooking and vacuuming
 - Breath through a warm wet washcloth to help relieve dryness of airways
- Use the recycle or recirculation mode of the air conditioner in your home, or car
- In case you need to leave your home:
 - Try to avoid areas with dense white or grey smoke, since production of CO, fine particles and other toxic components is favored, due to incomplete combustion.

Note: High concentration of CO can even cause immediate death by inhalation.

 - The better protective equipment for particles is a filter mask of FFP3 type (EN149:2001) with valve. However, this does not offer protection against carbon monoxide toxic effects.
 - Only an escape mask that is usually used by professionals (fire-fighters) can protect you effectively from CO and particles

- If you don't have FFP3 mask try to reduce smoke exposure, by using dry handkerchief, scarf or similar (surgery mask). However, these are not effective for protection against fine and ultrafine particles or CO, but mostly for coarse total suspended particulate (e.g. soots which can range from 0,25 to 1000 μm). Their extended use is not recommended.
- Short – term averages (1-hr to 3-hr) of fine particles have been correlated to recommended actions for Public Health Officials [12] in order to assess air-quality in a forest fire and decide upon evacuation, as shown in the following table [11-12].

Categories	PM _{2.5} or PM ₁₀ Levels ($\mu\text{g}/\text{m}^3$ 1-hr to 3-hr)	Recommended Actions
Good	0-40	If smoke event forecast, implement communication plan
Moderate	41-80	- Issue public service announcements (PSAs) advising public about health effects/symptoms and ways to reduce exposure - Distribute information about exposure avoidance
Unhealthy for sensitive groups	81-175	- If smoke event projected to be prolonged, evaluate and notify possible sites for clean air shelters - If smoke event projected to be prolonged, prepare evacuation plans
Unhealthy	176-300	- Close schools (possibly based on school environment and travel considerations) - Consider canceling public events, based on public health and travel considerations
Very unhealthy	301-500	-Close schools -Cancel outdoor events (e.g. concerts and competitive sports)
Hazardous	Over 500	-Close schools -Cancel outdoor events (e.g. concerts and competitive sports) -Consider closing workplaces not essential to public health -If PM level projected to continue to remain high for prolonged time, consider EVACUATION of sensitive populations

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