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DEPARTMENT OF ANIMAL HUSBANDRY & DAIRYING

Advisory to States for taking preparatory action for Lightning Thunderstorm and associated weather phenomena

Aim and Objective:

The main aim of this advisory is to reduce mortality of animals due to lightning by adopting a approach with suitable strategies and measures. The overall objective is to develop capacity of states with “animal first approach” and provide a mechanism to enhance Lightning resilience through a national programme being implemented by SDMAs and DDMAs in conjunction with Panchayati Raj Institutions (PRIs) and Animal Husbandry Department (AHD) at the levels of state, district and panchayats so that the issue is addressed in its entirety.
The emphasis is on local-level interventions to address Lightning risk and vulnerability effectively. To achieve this goal, the primary objectives of the programme are as under:

a. To reduce mortality of animals due to lightning
b. Enhancing technical capacity of Animal Husbandry Department through SDMAs and DDMA's for lightning risk management, strengthening and improving existing early warning system.
c. Aggressive Public awareness programme empowering local communities to reduce and mitigate Lightning risk through aggressive education, information and awareness campaigns based on the seasonality of lightning.
d. Policy level interventions in building bye-laws, regulatory guidelines, standardization for adequate technical know-how for a different typology of assets.
e. Creating Lightning dynamic database, analytics and knowledge management.
f. Promoting mitigation by government and public by the installation of lightning protection devices and creation of “Lightning safe shelter” for animals exposed in the open field.
g. Undertaking long-term climate action programmes to reduce the occurrence of extreme weather.
h. Reducing economic loss due to the Lightning impact

Introduction to various weather phenomena

Thunderstorm: Thunderstorm is said to have occurred if thunder is heard or lightning is seen. Usually, the thunder can be heard up to a distance of 40 km from the source of origin. Thunderstorms fall in the category of Meso-gamma weather systems with a

spatial extent of around 2~20 km and temporal scale of a few hours. Thunder storms occur round the year in different parts of the country. However, their frequency and intensity are maximum during summer months(March to June) as the most important factor for the occurrence of thunderstorms is the intense heating up of the atmosphere at the surface level. Thunderstorms have some important characteristics such as the formation of a squall, strong updraft and downdraft, towering cumulonimbus clouds which are associated with turbulence and icing, in-cloud electrification and associated lightning, localized strong rain and hailstorm.

Squall: A squall is defined as a sudden increase of wind speed of at least 29 kmph and rising to 40 kmph or more and lasting for at least one minute. The climatology of the spatial distribution of occurrence of a squall is almost the same as that of thunderstorms. The frequency and intensity of squall are maximum over eastern and northeastern States. Also, its frequency is maximum during the pre-monsoon season with an increasing trend from March to May in different parts of the country. However, there is a secondary maximum in the winter season over northwest India.

Hailstorm: India, with about 29 hail days of moderate to severe intensity per year, is among those countries in the world which experience a very high frequency of hail. Hailstorms are mainly observed during the winter and pre-monsoon seasons with virtually no events after the onset of the southwest monsoon. Hailstorms may be mixed with rain and a proportion of large stones.

Dust storm: Northwest India experiences convective dust storms, locally called “aandhi”, during the pre- monsoon season with maximum frequency and intensity in May. The frequency of dust storms is maximum over Rajasthan followed by Haryana, Punjab and West Uttar Pradesh. A dust storm associated with a thunderstorm generally carries very little rain in them and the strong winds lift loose dust from dry land in arid and semi-arid regions. Sometimes, heavy rain and hail occur which causes severe damage along with strong winds.

Lightning: Lightning stroke is the massive discharge of electricity between clouds or between cloud and objects on earth. These high voltage current reaches earth and spread on large area on ground due to dampness or water bodies. A lightning flash becomes a strike if it involves an object on the ground. Living beings including animals coming in contact with lightning, either directly or indirectly through electrical conductors, can be affected, which may lead to severe burns or even death. Lightning strikes the Earth 50 to 100 times each second. Animals are more vulnerable to lightning stroke as they are placed outside during thunderstorm and they have more step potential due to gaps between their four legs. Large animals like giraffe and elephants

are even more likely to get stroked by lightning due to higher chance of touch potential and higher side flash.

Lightning stroke can be confirmed by clinical as well as circumstantial evidence taken together. Since carcass decomposes rapidly, in most cases death can be confirmed mostly based on circumstantial evidences like smashed or burnt tree and by ruling out other diseases by thorough necropsy of a well preserved carcass.

Prevention, Mitigation and Preparedness Measures

A. **Preventive Measures:** Disaster prevention covers measures aimed at impeding the occurrence of a disaster incident and/or preventing such an occurrence from affecting communities. The occurrence of thunderstorm and squall can't be impeded. However, their harmful effects can be minimized through number of measures. Micro-level hazard zoning should be done and vulnerable areas must be clearly marked on a map. Sensitization of planners and decision makers can immensely help in minimizing the harmful effects of these incidents on communities. The first and foremost need is awareness generation among policymakers, administrators, engineers, architects, the general public as well as the farming community. Public awareness and education help in improving the disaster resilience of masses. The lessons learnt from previous incidents, particularly regarding gaps in rescue and relief works and the shortcomings experienced in the process, should be dealt carefully.

   Disruption of communication and transportation services and undue delays in clearing the fallen trees, electricity poles and hoardings on the roads and/or streets that further delay the immediate transportation remains a major challenge. The hierarchical structure for execution needs to be formalized so that all efforts are properly coordinated. Coordination for relief distribution is equally important to ensure qualitative and timely delivery.

B. **Hazard Resistant Construction:** United Nations Development Programme (UNDP) and NDMA, Ministry of Home Affairs, Government of India, released a "Manual on Hazard Resistant Construction in India" for the non-engineered buildings in July 2008. The popular load-bearing masonry building systems, prevalent in different parts of the country, are covered in the manual. Relevant building codes and guidelines of the Bureau of Indian Standards form the basis for this manual. Action Plan should be made in consultation with Public Works Department, SDMA and other agencies to construct hazard resistance animal houses and buildings

C. **Emergency Communication Systems:** Planning, updating and mobilization of existing radio communication resources in emergency situations and acquisition of satellite phones to make them available at the tehsil level to ensure prompt response in the event of occurrence of any disaster.

D. **Integrating Development schemes with Disaster Management Schemes:** This would enable the creation of disaster-resilient localities by way of recommendations by patwari/gram pradhan that quality raw material and technology be used in all infrastructure/construction projects.

E. **Technical, Social, Organizational and Administrative preparedness:** The most urgent need of the hour is to develop a DSS (Decision Support System). To accomplish this, the network could be expanded over all thunderstorm prone areas across the state and information thus obtained could be merged with satellite observation to generate meaningful insights for different regions with a lead time of 1-2 hours. Besides SDMAs and DDMAs, tehsil-level Disaster Management Group (TMG) at subdivision/ tehsil level should be formed with representatives of various line departmentsand Animal Husbandry Department. Village Disaster Management Committees (VDMCs) should also be formed at the village level comprising local villagers to strengthen the local response mechanisms to disasters.

F. **Emergency Plan for Veterinary Hospitals and Dispensaries:** Emergency expansion plan for veterinary hospitals, Dispensaries and Mobile Veterinary Unitsfor pre and post-disaster situation, should be in place. A list along with contact details of all thesefacilities should be available in the District Control Room. Based on the hazard assessment, emergency medicines, Operation Theatres and life-saving drugs should be kept ready.An Action Plan must be considered for training of doctors and par veterinariansstaff on handling of injured and diseased animals and treating them in case of a disaster.

G. **Building plans for Protection against Lightning:** In consultation with Public Works Department and SDMA plan should be made to install Lightning Shields and lightning arrestors and sound earthing for each building/animal house. Lightning shields are the most commonly employed structural protection measure for buildings and other structures. A lightning shield consists of the installation of a lightning conductor at a suitably high location at the top of the structure. The conductor is grounded using a metal strip of suitable conductance. The grounding of the conductor is also specially designed to ensure rapid dissipation of the electrical charge of a lightning strike into the ground. Lightning shields are not

foolproof in their effectiveness. Very tall buildings may require lightning conductors at intermediate levels of the building in addition to the ones at its roof. lightning shields are not used for the protection of large open areas due to their very high cost and reliability issues. However, they are found to be very effective for the protection of individual structures or groups of structures in an area.

H. **Prevention strategy against Lightning:** Certain types of trees, especially hardwoods such as oaks and those that are tall and have spreading root systems just beneath the ground surface, tend to be struck by lightning more often than others. Electrification of such roots charges a wide surface area, particularly when the ground is already damp. Fallen or sagging transmission wires also may electrify a pool of water, fence, or building, and an animal may also directly contact such wires. Differences exist in conductivity of soil. Loam, sand, clay, marble, and chalk are good conductors (in decreasing order), whereas rocky soil is not.

   Lightning strikes vary in intensity and in the objects struck in the vicinity of the herd. These characteristics, along with the location of animals, largely influence whether the injuries are external or internal. Those factors determine whether a definitive or a circumstantial diagnosis can be made.Accidental electrocution of farm animals in a barn or adjacent confinement pen usually occurs as a result of faulty wiring. Electrification of a water or milk line stanchion or a metal creep or guard rail can result in widespread distribution of an electric current throughout the stable that may result in signs of water deprivation or feed refusal.

Indian Meteorological department (IMD) will provide weather information and forecast, on Thunderstorm and Lighting and therefore proper liaison need to be established at all times

Clinical Findings in animals caused by lightening

Injury or death from electrocution may be caused by lightning, fallen power lines, faulty electric circuits, or other causes. Death usually results from cardiac or respiratory arrest. Besides sudden death, signs can include singe marks, temporary loss of consciousness in mild cases, and fractures or muscle damage from severe contractions. Lightning stroke damage nerve, muscle, organs and/ or bones. Animals dies of asphyxiation due to respiratory failure or hypovolemic shock due to ventricular fibrillation.

In low potential stroke animal(s) become unconscious and may recover in few minutes to several hours. In many cases blindness, limb paralysis, bone fracture or eardrum

ruptures may be seen. In most animals, singing of hairs or skin burn are seen.In strong lightning stroke, as in direct strike, animal dies instantly.

Diagnosis may depend on circumstantial evidence, such as the location of groups of affected animals and lack of other signs of disease. For animals that survive the initial event, supportive care is indicated.

Post-Mortem findingsin animals caused by lightening

In most cases: Capillary congestion underneath skin, Bleeding from nostrils, eyes, ears or anus, unchewed or half chewed food in oral cavity, severe haemorrhage in organs, localized muscular rupture, haemorrhage and bone fractures, lung congested but not compressed and muscular infarction are observed.

Early rigor mortis, rapid bloating and rapid carcass decomposition (6-8 hrs) is observed

Indicative First Aid/Treatment of animals in lightening and other weather phenomena

a. Treating injuries

Generally, minor injuries can be treated in the field and the animal released. To treat minor injuries, field trapping kits should contain basic first aid equipment such as topical antiseptic, swabs/gauze, tweezers, scissors etc. Major injuries require expert care and the possibility of the animal requiring ongoing care.

b. Bleeding

It is important to stem any bleeding as soon as possible, as blood loss can lead to shock, collapse and death. Bleeding is classified according to which blood vessel is damaged. Arterial blood is bright red in colour and under pressure, so it will spurt from the wound. Venous blood is from the veins, is dark red in colour and flows rather than spurts. Capillary blood is the most common and is slow due to the blood vessels being under low pressure. Even when an animal has no obvious wounds it may still be bleeding internally. Some signs of internal bleeding include coughing up or vomiting blood, a bloated abdomen, difficulty breathing. External bleeding can be treated by applying direct pressure to the wound until it stops. For severe bleeding, a pressure bandage can be applied, and should the bleeding come through the bandage, another bandage should be applied over the top. Never take the first bandage off.

c. Wounds

Not all wounds will require veterinary treatment. Deciding whether the wound is superficial or deep will determine the appropriate treatment for the wound. Superficial wounds can be cleaned with diluted antiseptic but veterinary care should be sought for deep wounds.

Types of wounds and their management

Bruise: A closed wound with bleeding below the surface of the skin. If not extensive, or not causing disability, then it's better to release as soon as possible to avoid stress and struggling resulting in further injury and exacerbating bruising.

Abrasion: An open wound with the outer layer of skin and underlying blood vessels exposed. The wound should be cleaned with dilute antiseptic.

Cut: An open wound caused by something sharp, where the skin, soft tissue or muscle is severed. The wound needs to be cleaned thoroughly and generally the animal can be released. If the cut is large or deep it will require veterinary care.

Laceration: An open wound (e.g. caused by wire, teeth or claws) where the skin and underlying tissue are damaged. The wound should be cleaned thoroughly. If the laceration is extensive it will require veterinary care.

Puncture: An open wound caused by blunt or pointed objects in which the skin and underlying tissue is damaged, as well as possibly organ damage. Wound should be cleaned thoroughly. If the puncture severe it will require veterinary care.

Tear: An open wound caused by something sharp. The skin and other soft tissue will be partially or completely torn away. The skin should be returned to its original position and a pressure bandage applied. The animal may require veterinary care.

Embedded object: An open wound in which an object has embedded itself. Do not try and remove the object. The animal will require veterinary care.

d. Fractures, sprains and strains: Fractures are broken bones and they can be open, where the bone is exposed through skin, or closed, where the skin is unbroken. An initial assessment needs to be made to determine if a fracture or dislocation has occurred by feeling for abnormalities and checking for normal range of movement in limbs/pain response etc. Signs that an animal may have a fracture include not using

the limb, pain at or near the fracture site, the limb may be deformed or twisted, swelling around the fracture and shock. Open fractures carry a poor prognosis due to the increased chances of infection. Pressure or splints must never be applied to an open fracture, however they should be covered to prevent dirt entering the wound and loss of body fluid.

Symptoms of sprains and strains are similar to fractures and if in doubt should be treated as closed fractures. A temporary splint and/or bandaging may be applied in the field to stabilize the injury prior to veterinary attention being sought. It must be kept in mind that healing time for fractures is a minimum of 6 weeks with no guarantee of a full return to normality.

e. **Abdominal injuries:** Abdominal injuries usually result from heavy impacts. Signs of abdominal injury include shock, pain, vomiting and evidence of injury such as swelling, bruising and protrusion of intestines. If abdominal injuries are suspected, then the animal is likely to have a poor prognosis even with treatment.

f. **Chest injuries**: Chest injuries can range from mild to life threatening. Signs of chest injuries include pain, increased breathing effort or short rapid breaths, swelling at the site, pale gums. An animal in severe respiratory distress will have an extended head and gasp for air. If chest injuries are suspected, then the animal is likely to have a poor prognosis even with treatment.

g. **Head and spinal injuries**: Head and spinal injuries can be serious. Signs include unconsciousness, abnormal behavior, blood or clear fluid coming from the nose or ears and unequal pupil size. If an animal is unconscious it must be placed on its side and the airways kept clear. The head should be slightly lower than the neck and chest to allow any fluid to drain from the mouth. If spinal injuries are suspected (e.g. weakness in hindquarters, pain, partial or total paralysis) handling must be done very carefully.

h. **Eye injuries**: The eyes are very sensitive and can react negatively to any injury. Foreign objects, smoke and wounds are the common causes of eye injuries and may result in infections to complete blindness. A foreign object in the eye can cause discharge and redness, with the animal rubbing or pawing at the eye. The eye can be opened to examine it, and the foreign material can be washed out with clean water. Never try and remove if the object is penetrating the globe. Any attempt to remove any foreign material by means other than flushing (using sterile saline or fresh water) in a conscious animal is likely to risk additional injury to the eye. Eye injuries resulting from smoke should be treated by flushing the eyes with water or

saline. Wounds to the eyes are more serious than irritation from foreign objects or smoke and can cause bloody discharge or blood in the eye itself.

i. **Burns:** Animals with burns require veterinary attention unless the burn is very mild. When assessing burns on animals the depth (superficial, partial thickness or full thickness), extent (percentage of body burnt) and location of the burn(s) needs to be considered. An animal with burns to over 50% of their body has no positive prognosis. Cold water or a cold compress (i.e. wet cloth) needs to be applied to the burn without overcooling the animal. The animal may also need to be treated for shock, pain and dehydration.

j. **Stress:** Stress is one of the most common factors leading to death and disease in animals during the disasters.

   Signs of stress include:

   - Animal trying to attack or escape
   - Reduced activity or listlessness
   - Grinding teeth
   - Licking of forearms/shoulders/chest/hind limbs or flanks

The best way to treat stress is by placing the animal in a dark, quiet, warm (but not too warm) environment to allow them to calm down.

k. **Shock:** Shock is a result of a collapsed circulatory system and can occur due to stress, blood loss, fluid loss, low blood pressure and a damaged heart. Many animals which are badly injured show signs of shock. Signs of shock include rapid pulse or breathing, hypothermia (eg. mammals may shiver and birds fluff their feathers) and pale/white gums. The signs of shock are not always obvious and can develop over time. An animal in shock is usually still, quiet and cold. Treatment for shock should first aim at reducing stress (e.g. covering the animal's eyes), stopping any visible signs of bleeding and then making sure the animal is kept warm and quiet. Oral fluids should not be given to animals in shock. Once the animal has been warmed up, warm fluids can be given.

l. **Hypothermia:** Hypothermia is caused by a lowering of the body temperature. Signs of hypothermia include cold skin, lethargy, bradycardia (slow heart rate). The animal needs to be gradually warmed with a constant artificial heat source. It is preferable that the heat source comes from outside of the holding container and directed at one end so the animal can move closer to or away from the heat source. If the heat source is inside the holding container is must be padded or shielded to avoid the animal burning itself. Care must be taken not to have any electrical connections or

wiring within reach of the animal. Heat can be lethal so place a small dish of water near the heat source. Always keep a very close watch as overheating is a danger. Once the animal has been warmed to its normal body temperature, high energy fluids can be offered.

m. **Dehydration:** Dehydration is the excessive loss of fluid from the body. It can be life threatening as it can prevent every system in the body of an animal from functioning properly. To check for signs of dehydration, in animals, pinch the skin of the animal to check for elasticity. Sunken or dry eyes, a glazed look and dry tacky gums are also signs of dehydration. It is important not to offer fluid therapy to an animal until it is warm and its condition has stabilized. The best way to offer fluids (e.g. water) to an animal is by placing a shallow container of water in with them as long as they cannot tip it and get wet. If they are unable to drink by themselves, animal mouth may be touched withwet fingers, this usually results in a swallow response. Never pour water down an animal's throat. Larger animals can go a bit longer without fluids, but smaller animals and birds require fluids sooner.

n. **Hyperthermia:** Severe changes (renal failure, hypotensive shock, coma and death) can develop rapidly with hyperthermia.

Signs of hyperthermia include:

- rapid panting
- holding of wings away from the body (birds)
- hypersalivation
- licking of forearms/shoulders/chest/hind limbs or flanks (or dried saliva in those same areas)
- congested mucous membranes
- tachycardia (rapid heart rate)
- diarrhea
- dehydration.

The animal must be placed in a cool quiet environment, gradually reducing the body temperature with water and wet towels and cool circulating air.

Do's and Dont's (Thunderstorm & Lightning)

To minimize the impact of heat wave and to prevent serious ailment or death, the following measures are useful:

- Keep update on local weather forecast

- Look for darkening skies and increased wind, if thunder, is heard there are chances of struck by lightning.
- Keep monitoring local media for updates and warning instructions.
- Keep animals indoors and avoid transportation if possible.
- Ensure that animals are inside the safe buildings.
- Unplug unnecessary electrical appliances (to isolate them from the main power supply which may conduct a power surge during a lightning storm).
- Remove tree timber or any other debris that may cause a flying accident. Response
- Avoid giving a bath or a shower to animals, and keep animals away from running water. This is because lightning can travel along metal pipes.
- Keep animals away from doors, windows, fireplaces, stoves, bathtubs, or any other electrical conductors.
- Transfer animals to safe shelter immediately
- Avoid metal structures and constructions with metal sheeting in animal houses.
- Make shelter in a low-lying area and make sure that the spot chosen is not likely to flood.
- Keep animals away from all utility lines (phone, power, etc.), metal fences, trees, and hilltops.
- Do not keep animals under trees as this conduct electricity.
- Take the animals struck by lightning to a veterinary hospital or call mobile units. If possible, give basic First Aid.

Note: States may customize the contents of the Guidelines for their own use depending on their local experiences and best practices.

Awareness and Veterinary Care:

State shall ensure that the animal owners should be made aware of adverse effects of various weather phenomena and wide publicity should be given regarding the preventive measures, Do's and Dont's during this period.

Veterinary infrastructure and expertise need to be arranged/upgraded which may also include:

- Deployment of veterinarians and paravets in proper strength in disaster prone areas
- Arrangement of mineral mixtures, lifesaving drugs, fluids and other medicines and equipments in veterinary hospitals at all times
- Activation of mobile veterinary units

- Conducting awareness programmes in respect of animal management during disasters
- Identifying the disposal sites for dead animals
- Liaison with other stakeholders/agencies wherever required
- Mock exercise with Fire Department on Lightning accidents

Reference:

1. Standard Operating Procedure First aid for animals :https://www.cdu.edu.au/files/2019-11/dpaw-sop14.2-first-aid-for-animals.pdf
2. Guidelines for Thunderstorm & Lightning 2021. NDMA sop.pdf

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