Item No. 06 & 07

BEFORE THE NATIONAL GREEN TRIBUNAL
CENTRAL ZONE BENCH, BHOPAL
(Through Video Conferencing)

Original Application No. 241/2024(CZ)

Ujjwal Sharma	Applicant(s)
Vs.	
Union of India & Ors.	Respondent(s)

WITH

Original Application No.253/2024(CZ)
(O.A.No.1282/2024 – PB)

News Item titled; 1Kodo poisoning
behind elephant deaths in MP's
Bandhavgarh All you need to know ;
appearing in CNBCTV18.com

Vs

Principal Chief Conservator of Forest	Respondent(s)

Date of Hearing: 10.01.2025

CORAM: HON'BLE MR. JUSTICE SHEO KUMAR SINGH, JUDICIAL MEMBER
HON'BLE DR. AFROZ AHMAD, EXPERT MEMBER

For Applicant(s):	Mr. Ujjwal Sharma (In Person)
For Respondent(s):	Mr. Prashant M. Harne, Adv. Mr. Gaurvanvit Jain, Adv.

ORDER

1. Issue of death of 10 elephants in Madhya Pradesh, Bandhavgarh Tiger Reserve was highlighted in the media news and the matter was taken up

by the Principal Bench of this Tribunal vide O.A No. 1282 of 2024 which has been transferred to this tribunal and registered as O.A NO. 253 /2024. The similar matter has been raised in O.A. No. 241/2024 with the facts that due to environmental consequences arising from mycotoxin contamination in agricultural produce, exacerbated by climate change, which recently resulted in the tragic death of ten wild elephants in Bandhavgarh National Park, Madhya Pradesh. These deaths, representing approximately 25% of the local elephant population, were attributed to the consumption of contaminated Kodo millet (Paspalum scrobiculatum) from adjacent agricultural fields, as confirmed by toxicology reports indicating the presence of cyclopiazonic acid, a fungal neurotoxin.These elephants had migrated from Odisha/Jharkhand through Chhattisgarh, representing a larger pattern of elephant dispersal in central India. Scientific literature has extensively documented that several fungal species, including Aspergillus, Penicillium, Fusarium, and Claviceps, produce mycotoxins during crop growth and storage, presenting an insidious threat due to their odourless and tasteless nature, to both humans and animals. The environmental implications of mycotoxin contamination are particularly severe due to their resistance to high temperatures and their ability to persist post-cooking. The documented health impacts range from cancer and kidney damage to sudden death in cases of large quantity ingestion. The risk is significantly amplified by environmental and human factors prevalent in India, including improper harvesting practices, inadequate storage conditions, and importantly, climate change-induced weather anomalies.

2. In other matter which was taken cognizance by Principal Bench of the Tribunal after registering as OA No. 1282/2024-PB (which was re-registered as OA No. 253/2024-CZ) was taken by this Tribunal on 12.11.2024 and observed in para 2, 3 and 4 as follows :-

> *2. "The matter relates to the mysterious deaths of 10 elephants in Madhya Pradesh's Bandhavgarh Tiger Reserve that have been linked to Kodo millet poisoning. As per the article, initial investigations indicated the cause of death might be related to Kodo millet contamination. Samples have been sent for further analysis to two labs- ICAR-Indian Veterinary Research Institute in Uttar Pradesh and a forensic lab in Madhya Pradesh's Sagar.*
>
> *3. The news item highlights that Kodo millet is a staple food in many parts of India, known for its high dietary fibre and mineral content. However, when contaminated with mycotoxins, it can be susceptible to fungal contamination, particularly during the monsoon season, when the crop is harvested in damp conditions. it can cause severe health issues in both humans and animals, including liver damage, kidney problems, and gastrointestinal issues.*
>
> *4. Furthermore, it is alleged that it is likely the elephants at Bandhavgarh Tiger Reserve had consumed contaminated Kodo millet or its byproducts, resulting in poisoning. The mycotoxins produced by the fungal infestation would have caused severe health issues, leading to the elephants' deaths. The discovery of such contamination is concerning, as it poses a risk to both wildlife and livestock that may come into contact with the crop."*

5. Both the matters were taken together. Learned Counsel for the State Mr. Prashant M. Harne filed the reply on behalf of the respondents-Forest

Department and submitted that there has been no violation of either the Forest Conservation Rules 1980 or the Environment Protection Act of 1986. It is submitted that vide Gazette Notification dated 14.12.2016, Bandhavgarh Tiger Reserve including Panpatha Buffer Zone was declared an Eco-Sensitive Zone by the Ministry of Forest, Environment & Climate Change. Furthermore, within the jurisdiction of Bandhavgarh Tiger Reserve, Umaria, Panpatha Buffer Zone, fall a revenue village by the name of Salkhaniya, which is less than a kilometer away from the boundary of the Bandhavgarh Tiger Reserve.

6. Within the territorial boundaries of Revenue Village Salkhaniya, which is less than a kilometer away from the boundary of Bandhavgarh Tiger Reserve, the local agriculturists had undertaken the cultivation of Kodo millet as part of their routine agricultural practices. That during the intervening night between the 28.10.2024, and the 29.10.2024, a herd of wild elephants, deviating from their natural migratory routes, entered the agricultural fields situated within the said village and in the course of grazing, the aforementioned wild elephants ingested substantial quantities of both standing and previously harvested crops of Kodo millet. It was subsequently observed that the crops in question were contaminated with a toxic fungal infestation, rendering them hazardous for consumption. As a direct and proximate consequence of consuming the contaminated crops, the elephants experienced severe health complications, which ultimately led to their untimely demise.

7. The post-mortem examinations of ten deceased wild elephants were conducted and that the said examinations were carried out under the supervision of the Principal Chief Conservator of Forests (Wildlife),

Madhya Pradesh, and other designated officers and departmental staff. That during the course of the post-mortem, biological and environmental samples were systematically collected from the deceased elephants, and were carefully sealed to maintain the chain of custody and subsequently dispatched to various accredited laboratories for detailed forensic and pathological analysis throughout the nation. Furthermore, additional environmental samples, including but not limited to, Kodo millet, paddy, grazing material, water, soil, dung, and flora in the vicinity of the incident site, were also procured and transported to specialized laboratories.

8. The copy of the report of Center for Wildlife Conservation Management and Disease Surveillance (ICAR), Indian Veterinary Research Institute, Izjatnagar, Bareilly, UP, India has been filed on and the report/toxicological examination are as follows :-

> *"Sub: Submission of toxicological examination report of elephants-reg.*
>
> *Sir,*
>
> *This has reference to the letter no. S. No/Management/WL/Exam/2885, dated 01.11.2024. Vide which visceral organs, Stomach and intestinal contents were received on 02.11.2024 in saturated salt solution for toxicological examination. The उप संचाल4) report is as follows:*

Species	*Sample(s)*	*Toxicological examination*
Elephant (D1)	*Liver, kidney, spleen, heart, lung, stomach and intestinal contents*	*A pooled sample of each organ/GI contents was prepared. These pooled samples were analysed for the presence of HCN, nitrate-nitrite, heavy metals, commonly used insecticides and Kodua*
Elephant (D2)		
Elephant (D3)		
Elephant (D4)		
Elephant (D5)		
Elephant (D6)		
Elephant (D7)		
Elephant (D8)		
Elephant (D9)		

Elephant (D10 -16)		*active principle (i.e. Cyclopiazonic acid). The samples were found negative for the presence of HCN, nitrate-nitrite, heavy metals as well as Organophosphate, Organochlorine, Pyrethroid and Carbamate group of insecticides. Presence Cyclopiazonic acid was detected in all pooled samples. Approximate concentration of cyclopiazonic acid detected in the sample was above 100 ppb. Further screening of all the samples is being made to estimate the exact concentration (Ref no. CAD-877/2024-25 dated 05-11-2024). The results indicate that the elephants might have consumed large quantity of Kodo plant/grains.*

Advisory:

1. Kindly correlate with the history and necropsy findings

2. Survey and destruction of the fungal infected kodua crop residue as well as avoiding the entry of domestic and wild animals into such fields

3. Awareness among the farmers and livestock owners in and around BTR for fungal infected crop.

4. Detailed study should be conducted on cropping and ambience in and around BTR etc.

5. Similarly, detailed study is required to know the LDso of cyclopiazonic acid in domestic and wild animals."

9. The report of the State Forensic Science Laboratory Service is as follows:-

"परीक्षण प्रतिवेदन

पार्सल/ पैकेट/ प्रदर्शों का विवरण एवं सील की स्थिति

विषयांकित से संबंधित 49 (उनन्चास) सीलयुक्त प्रदर्श इस कार्यालय में वनक्षेत्रपाल श्री दीपकराज प्रजापति के द्वारा दिनांक 02/11/2024 को प्राप्त हुये, जो कि यहाँ "C-1" से लगातार "C-48" तक तथा "C-57" से अंकित किए गये है, इन पर "WHO BTR UMR" की सील लगी है, तथा लगी हुई सीलें, नमूना सील के समान है।

पार्सल पैकेट में पाये गये प्रदर्शों का विवरण

1. प्रदर्श "C-1". "C-2", "C-3", "C-4", "C-5" तथा "C-7": प्लास्टिक की डिब्बियाँ, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Blephant ID: D1) का विसरा (क्रमशः हार्ट, लीवर, लंग्स, क्डिनी, आंत एवं स्प्लीन के टुक्डे) होना लेख है।

2. प्रदर्श "C-6°: प्लास्टिक की डिब्बी में वानस्पतिक सद्दश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D1) का Stomach Content होना लेख है।

3. प्रदर्श "C-8", "C-9" तथा "C-12": प्लास्टिक की डिब्बियों, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D2) का विसरा (क्रमशः हार्ट, क्डिनी एवं स्प्लीन के टुक्ड़े) होना लेख है।

4. प्रदर्श "C-10" तथा "C-11": प्लास्टिक की डिब्बियाँ, प्रत्येक में वानस्पतिक सद्दश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D2) का क्रमशः Intestinal Content तथा Stomach Content होना लेख है।

5. प्रदर्श "C-13", "C-14" तथा "C-17": प्लास्टिक की डिब्बियाँ, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D3) का विसरा (क्रमशः हार्ट, किडनी एवं स्प्लीन के टुकड़े) होना लेख है।

6. प्रदर्श "C-15" तथा "C-16°; प्लास्टिक की डिब्बियाँ, प्रत्येक में वानस्पतिक सद्दश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D3) का क्रमशः Intestinal Content तथा Stomach Content होना लेख है।

7. प्रदर्श "C-18", "C-19", "C-20", "C-21" तथा "C-24", प्लास्टिक की डिब्बियाँ, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D4) का विसरा (क्रमशः हार्ट, लीवर, लंग्स, किडनी एवं स्प्लीन के टुकडे) होना लेख है।

8. प्रदर्श "C-22" तथा "C-23": प्लास्टिक की डिब्बियाँ, प्रत्येक में वानस्पतिक सद्दश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D4) का क्रमशः Intestinal Content तथा Stomach Content होना लेख है।

9. प्रदर्श "C-25", "C-26", "C-27", "C-28" तथा "C-31": प्लास्टिक की डिब्बियाँ, प्रत्येक में विसरल मटेरियल पाया गया, • जिसे प्रपत्रानुसार सुत जंगली हाथी (Elephant ID: D5) का विसरा (क्रमशः हार्ट, लीवर, लंग्स, किडनी एवं स्प्लीन के टुकडे) होना लेख है।

10. प्रदर्श "C-29" तथा "C-30": प्लास्टिक की डिब्बियों, प्रत्येक में वानस्पतिक सद्दश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D5) का क्रमशः Intestinal Content तथा Stomach Content होना लेख है।

11. प्रदर्श "C-32" तथा "C-33": प्लास्टिक की डिब्बियाँ, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D6) का विसरा (क्रमशः लीवर एवं लंग्स के टुक्डे) होना लेख है।

12. प्रदर्श "C-34" तथा "C-35": प्लास्टिक की डिब्बियाँ, प्रत्येक में वानस्पतिक सद्दश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D6) का क्रमशः Intestinal Content तथा Stomach Content होना लेख है /:

13. प्रदर्श "C-36", "C-37", "C-38", "C-39" तथा "C-42"; प्लास्टिक की डिब्बियाँ, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी

(Elephant ID: D7) का विसरा (क्रमशः हार्ट, लीवर, लंग्स, किडनी एवं स्प्लीन के टुकड़े) होना लेख है।

14. प्रदर्श "C-40" तथा "C-41": प्लास्टिक की डिब्बियों, प्रत्येक में वानस्पतिक सदृश्य पदार्थ युक्त मटमैला तरल पांया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D7) का क्रमशः Intestinal Content तथा Stomach Content होना लेख है।

15. प्रदर्श "C-43", "C-44", "C-45", "C-46" तथा "C-48": प्लास्टिक की डिब्बियों, प्रत्येक में विसरल मटेरियल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: D8) का विसरा (क्रमशः हार्ट, लीवर, लंग्स, किडनी एवं स्प्लीन के टुकड़े) होना लेख है।

16. प्रदर्श "C-47": प्लास्टिक की डिब्बी में वानस्पतिक सदृश्य पदार्थ युक्त मटमैला तरल पाया गया, जिसे प्रपत्रानुसार मृत जंगली हाथी (Elephant ID: DB) का Intestinal Content होना लेख है।

17. प्रदर्श "C-57": प्लास्टिक की डिब्बी में प्रिजर्वेटिव घोल नमूना (नमक का घोल) । परीक्षण प्रतिवेदन प्राप्त होने के बाद प्रदर्श वापस बुलाये जाने की यथाशीघ्र व्यवस्था करे।

परीक्षण

प्राप्त सभी प्रदर्शों में रासायनिक विष संबंधी आवश्यक परीक्षण किये गये । इनमें पेस्टीसाइड (ऑर्गनोफॉस्फोरस, ऑर्गनोक्लोरो, पायरेथ्रम, कार्बमिट्स एवं हर्बीसाइड), धात्विक विष, अम्लीय एवं क्षारीय ड्रग्स, मेटेलिक फॉस्फाइड एवं वौलैटाइल पॉइजन के परीक्षण ऋणात्मक पाये गये ।

परीक्षण परिणाम

"प्रदर्श "C-1", "C-2", "C-3", "C-4", "C-5", "C-6", "C-7", "C-8", "C-9", "C-10", "C-11", "C-12", "C-13", "C-14", "C-15", "C-16", "C-17", "C-18", "C-19", "C-20", "C-21", "C-22", "C-23", "C-24", "C-25", "C-26", "C-27", "C-28", "C-29", "C-30", "C-31", "C-32", "C-33", "C-34", "C-35", "C-36", "C-37", "C-38", "C-39", "C-40", "C-41", "C-42", "C-43", "C-44", "C-45", "C-46", "C-47", "C-48" तथा "C-57" में रासायनिक विष के परीक्षण ऋणात्मक पाये गये ।"

10. Another report of the State Forensic Science Laboratory Service, Sagar is as follows:-

"परीक्षण प्रतिवेदन

पर्सल/ पैकेट/ प्रदर्शी का विवरण एवं सील की स्थिति

विषयांकित से संबंधित 42 (बयालीस) सीलयुक्त प्रदर्श इस कार्यालय वनरक्षक अखिलेश तिवारी परिक्षेत्र पनपथा के द्वारा दिनांक 04/11/2024 को प्राप्त हुए, जो कि यहाँ "WH-1" से "WH-12" तक लगातार, "W-2", "W-3","S-6" "C-1", "C-2", "C-3", "C-5", "C-6", "D-1" से "D-10" तक लगातार तथा "M-1" से "M-12" तक लगातार से अंकित किए गये है, इन पर "WHO BTR UMR" की चपड़ा सील लगी है, तथा लगी हुई सीले, नमूना सील के समान है।

पार्सल पैकेट में पाये गये प्रदर्शों का विवरण

प्रदर्श WH-1 से WH-12, W-2, W-3 तथा 5-6:- प्लास्टिक की ट्यूब्स पायी गयी, प्रत्येक में गंधहीन, पारदर्शी तरल पाया गया जिसे प्रपत्रानुसार पानी के नमूने होना लेख है।
प्रदर्श D-1 से D-10, C-1, C-2, C-5 तथा C-6:- पारदर्शी पॉलिथीन के पैकेट पाये गए, प्रत्येक मे चर्वित वानस्पतिक पदार्थ पाया गया जिसे प्रपत्रानुसार गोबर के नमूने होना लेख है।
प्रदर्श M-1 से M-12:- पारदर्शी पॉलिथीन के पैकेट पाये गए, प्रत्येक में भूरे रंग की मिट्टी के समान पदार्थ पाया गया जिसे प्रपत्रानुसार मिट्टी के नमूने होना लेख है।
प्रदर्श C-3:- प्लास्टिक की ट्यूब मे वानस्पतिक पदार्थ पाया गया जिसे प्रपत्रानुसार चरागन के नमूने होना लेख है।

परीक्षण

उपरोक्त प्रदर्शों में रासायनिक विष संबंधी आवश्यक परीक्षण किए गए। इनमे पेस्टीसाइड (ओर्गेनोफॉस्फोरस, ओर्गेनोक्लोरो, पायरेथ्रम, कार्बमेट एवं हरबीसाइड), धात्विक विष, अम्लीय एवं क्षारीय ड्रग्स, मेटेलिक फॉस्फाइड एवं वोलेटाइल पाइजन के परीक्षण किये गये ।

परीक्षण परिणाम

"प्रदर्श "WH-1" "WH-2" "WH-3" "WH-4" "WH-5" "WH-6" "WH-7" "WH-8" "WH-9" "WH-10" "WH-11" "WH- 12" "W-2" "W-3" "S-6" "D-1" "D-2" "D-3" "D-4" "D-5" "D-6" "D-7" "D-8" "D-9" "D-10" "C-1" "C-2" "C-5" "C- 6" "C-3" "M-1" "M-2" "M-3" "M-4" "M-5" "M-6" "M-7" "M-8" "M-9" "M-10" "M-11" तथा "M-12" मे रासायनिक विष के परीक्षण ऋणात्मक पाये गए। "

11. The samples of crops were also taken by the authorities concerned and it was sent to International Crops Research Institute for the semi-arid tropics and the report submitted by the authorities are as follows :-

"Sub: Detection of cyclopiazonic acid (CPA) from the samples received from the officials of Bandhavgarh Tiger Reserve on 6th November 2024.

Following are the results of CPA estimation in different categories of samples (a total of 23) received on 6th November 2024.

S. No.	*Kodo samples collected from the nearby fields of the incident*	*CPA (mg/kg or ppm)*	*CPA (µg/kg or ppb)*
1.	*M-2 (Koda millet grain with straw)*	*1.618441958*	*1618*
2.	*S-1 (Kodo millet grain with straw)*	*1.567489536*	*1567*
3.	*C-9 (Kodo millet straw)*	*2.593999317*	*2593*
4.	*K-1 (Kodo miilet grain with straw)*	*3221277868*	*3221*
5.	*K-2 (Kodo miilet grain with straw)*	*12 87463056*	*12874*
6.	*K-3 (Kodo miilet grain with straw)*	*9976279149*	*9976*
7.	*K-4 (Kodo miilet grain with straw)*	*5.683407363*	*5683*
8.	*K-5 (Kodo miilet grain with straw)*	*10 66759631*	*10667*
9.	*K-6 (Kodo miilet grain with straw)*	*2.082706927*	*2082*
10.	*K-7 (Kodo miilet grain with straw)*	*2 896057914*	*2896*
11.	*K-8 (Kodo miilet grain with straw)*	*4.037370804*	*4037*
12.	*L-2 (RF 489 adjoining revenue land)*	*9 167126506*	*9167*

13.	H-1 (Kodo collected from land)	4 980340822	4980

S. No.	Vomit sample	CPA (mg/kg or ppm)	CPA (µg/kg or ppb)
1	C3 (Kodo millet)	4486999231	4486

S. No.	Crop samples from nearby fields of the incident)	CPA (mg/kg or ppm)	CPA (µg/kg or ppb)
1.	A-1 (paddy sample)	4.539292731	4539
2.	R-1 (paddy sample)	183 7791663	183779
3.	R-2 (paddy sample)	27.24008286	27240
4.	R-3 (paddy sample)	5 287140173	5287
5.	R-4 (paddy sample)	3.443956607	3443
6.	R-5 (paddy sample)	2.630785	2630
7.	R-6 (paddy sample)	2.395763219	2395
8.	L-7 (paddy with straw)	6 627141881	6627
S. No.	Particulars (Stomach content sample)	CPA (mg/kg or ppm)	CPA (µg/kg or ppb)
1	D1	123. 165038	123165

Note:

- *The method used is Liquid Chromatography-Mass Spectrometry (LC-MS)*
- *The limit of detection (LOD) is 5.0 µg/kg (equivalent to ppb)*

Key Observations:

1. High levels of Cyclopiazonic acid (CPA) were found in almost all the samples. CPA is known to be produced by fungi like Aspergillus flavus, Aspergillus parasiticus, Penicillium cyclopium etc.

2. The lethal dose (LD50) for CPA was determined in the past and it was around 13 mg/kg (which is equivalent to 13,000 ppb). Here in one of the samples, it was found that the CPA was almost 10 *times more than the LD50 value. It is very lethal and can cause potential health risks upon ingestion.*

3. Aflatoxin contamination in the same samples is very minimal and is well below the acceptable limits (15 ppb is the allowable limit set by the Food Safety Standards Authority of India). So, this is not at all a cause of concern.

Immediate Next steps:

1. The fungi associated with the kodo and other crop samples at the incident place must be identified up to the species level.

2. If possible, need to collect more samples from the place where the incident happened to understand the toxin occurrence, fungi associated with the crops, the crop varieties grown etc."

Examination report:

A total of 23 samples (13 Kodo samples, 1 vomit sample from a dead elephant, 8 samples from nearby other crop fields like paddy, and 1 Kodo sample collected from a dead elephant stomach) were sent by the Forest Department, Government of Madhya Pradesh. Our objective was to test the samples for possible mycotoxin contamination. Accordingly, the samples were prepared for cyclopiazonic acid (CPA) and total aflatoxins estimation. Liquid Chromatography/Mass Spectrometry (LC/MS) method was used to quantify the cyclopiazonic acid (CPA). In all the samples, very high levels of CPA were found ranging from 1567 to 183779 µg/kg (ppb). As per the previous literature, the LDso (Lethal Dose to cause death) for CPA was around 13 mg/kg (equivalent to 13000 ppb). The sample collected from the stomach/gut of an elephant was found with 123 mg/kg. The same set of samples was subjected to quantify the presence of aflatoxins using enzyme- linked immunosorbent assay (ELISA). But very low levels of aflatoxin contamination were observed ranging from 0 to 11.9 µg/kg (ppb).

Further, we incubated a few grains from each sample, to identify the fungi associated with them. We observed that Fusarium spp., *Penicillium spp. and Curvularia spp. in almost all the samples. Penicillium spp. and Aspergillus spp. were known to produce CPA in various agricultural commodities including Kodo millet, peanut, barley ete. There were no reports so far that Fusarium spp. producing CPA. However, Fusarium spp. produce several different types of mycotoxins such as fumonisins, trichothecenes, and zearalenones.*

A detailed fungal spp. associated with each sample was mentioned in the below table. The identification was done using microscopic observations only. No molecular characterization was done-

S. No.	***Code No.***	***Details***	***Fungal species associated with grains***
1	*D-1*	*Collected from stomach/ elephant gut*	*Penicillium, Fusarium and unknown Bacteria*
2	*R-1*	*Paddy sample*	*Penicillium, Fusarium , Curvularia and Aspergillus spp.*
3	*R-2*	*Paddy sample*	*Penicillium, Fusarium , Curvularia and unknown fungi*
4	*R-3*	*Paddy sample*	*Penicillium, Fusarium , Curvularia, Aspergillus niger and unknown fungi*
5	*R-4*	*Paddy sample*	*Fusarium supp (1-2 types) and Curvularia spp. (1-2 types)*
6	*R-5*	*Paddy sample*	*Curvalaria and unknown fungi and bacteria*
7	*R-6*	*Paddy sample*	*Fusarium spp (2 or 3 types) and Curvularia spp (3 types)*
8	*M-2*	*Kodo Millet grain with straw*	*Curvularia supp (3-4 types) and A. Niger*
9	*S-1*	*Kodo Millet grain with straw*	*Fusarium spp (3-4 types) and Curvularia spp (1-2 types)*
10	*C-9*	*Kodo Millet straw*	*Fusarium supp, Curvularia spp (3-4 types) and unknown fungi*
11	*K-1*	*Kodo Millet grain with straw*	*Curvularia spp (3-4 types) and unknown fungi*
12	*K-2*	*Kodo Millet grain with*	*Penicillium, Fusarium , Curvularia,*

		straw	*(3-4 types), Aspergillus spp and unknown fungi*
13	*K-3*	*Kodo Millet grain with straw*	*Fusarium , Curvularia and unknown fungi*
14	*K-4*	*Kodo Millet grain with straw*	*Fusarium and Curvularia sp (3-4 types)*
15	*K-5*	*Kodo Millet grain with straw*	*Fusarium spp (3-4 types) and Curvularia sp (1-2 types)*
16	*K-6*	*Kodo Millet grain with straw*	*Fusarium and Curvularia sp (3-4 types)*
17	*K-7*	*Kodo Millet grain with straw*	*Fusarium spp (1-2 types) and Curvularia sp (1-2 types)*
18	*K-8*	*Kodo Millet grain with straw*	*Fusarium spp (1-2 types), A. niger, Curvularia sp (1-2 types) and unknown fungi*
19	*H-1*	*Kodo Millet grain with straw*	*Fusarium and Curvularia sp (3-4 types)*
20	*L-2*	*Kodo, RF 489*	*Fusarium spp (3-4 types) and Curvularia sp (1-2 types)*
21	*L-7*	*Paddy with straw RF 489*	*Fusarium spp (1-2 types), Curvularia sp (1-2 types) and Aspergillus spp*
22	*C-3*	*Kodo with straw*	*Fusarium spp (3-4 types) and Curvularia sp (1-2 types)*
23	*A-1*	*Paddy Sample*	*Fusarium spp (1-2 types), A. niger, Curvularia spp (1-2 types) and unknown fungi*

9. Tissue samples of elephant were taken by the forest department and send to Nanaji Deshmukh Veterinary Science University, School of Wildlife Forensic and Health, Jabalpur for report and vide report dated 06.11.2024 the Director has submitted the report as follows :-

> *"Subject: Prelim histopathological investigation report of tissue samples of elephants.*

Reference : Letter number 1160, dated 01.11.2024 from the office of the range officer, Khitauli, Bandhavgarh Tiger Reserve. Umaria, Madhya Pradesh.

Formalin-preserved tissue samples collected from ten elephant carcasses were analysed for histopathology examination. Tissue samples collected from major vital organs including lungs, heart, liver, spleen, kidney, stomach and intestine were subjected to tissue processing. Tissue sections of formalin-preserved organs were stained with Haemtoxylin & Fosin (H&F) stain, which revealed following observations on microscopic examination Histopathological features were similar in all the cases: + Tissue sections of lungs showed pulmonary oedema at places, extensive haemorrhages across parenchymal tissues, large areas of emphysema, epithelial lining showed infiltration of blood cells at places. Tissue sections of heart showed degenerated myofibres and extensive haemorrhages and cellular infiltration. Tissue sections of liver showed cellular necrosis especially around central vein, fatty changes were observed, degenerative changes were observed in vascular endothelial linings and extensive haemorrhages could also be observed. Tissue sections of kidney showed acute tubular necresis along with areas of haemorrhages. Tissue sections of spleen showed congested vessels with patches of haemorrhages. Tissue sections of stomach and intestines showed haeniorrhages along with mild cellular infiltration, sloughing of epithelial linings and necrotic changes in mucosal layers. Opinion: Cieneralized haemorrhages and acute cellular injuries in major vital organs were observed. Pulmonary lesions, hepatocellular injuries and GIT lesions were markedly observed. Correlating with the gross lesions observed during the post-mortem examination, histopathology also indicates acute cellular injuries might be associated with acute toxicity. However, *detailed investigation is in process and further reports will be submitted soon.*

"Subject Disease investigation report of EEHV infection in biological samples of elephants Khitauli, Bandhavgarh Tiger Reserve. Umaria, Madhya Pradesh
Reference: Letter number 1160, dated 01.11.2024 from the office of the range officer, Khitauli, Bandhavgarh Tiger Reserve. Umaria, Madhya Pradesh

Sl. No.	*Type of Sample*	*Sample ID*	*Elephant ID*	*Laboratory number*	*Terminase gene based detection of elephant endotheliotropic herpesvirus (EEHV) infection*
1	Conjunctival swab	B-68	D1	MD-659	Negative
	Oral discharge				
2	Heart	B-70	D4	MD-660	Negative
	Lung				
	Kidney				
	Oral swab				
	Rectal swab				
	Conjunctival swab				
3	Heart	B-71	D5	MD-661	Negative
	Lung				
	Liver				
	Kidney				
	Spleen				
	Heart Blood				
	Tongue				
	Nasal discharge				
4	Heart	B-72	D7	MD-662	Negative
	Lung				
	Liver				
	Kidney				
	Spleen				
5	Heart	B-73	D9	MD-663	Negative
	Lung				
	Liver				
	Kidney				
	Spleen				
6	Heart	B-74	D2	MD-664	Negative

	Liver				
	Lymph Node				
	Spleen				
	Kidney				
	Tongue				
	Lung				
	Heart Blood				
	Nostril discharge				
	Oral swab				
7	Heart	B-75	D3	MD-665	Negative
	Liver				
	Kidney				
	Spleen				
	Tongue				
	Heart Blood				
	Conjunctival Swab				
8	Heart	B-83	D10	MD-666	Negative
	Liver				
	Lung				
	Kidney				
	Spleen				
	Conjunctival Swab				
9	Lung	B-84	D8	MD-667	Negative
	Liver				
	Kidney				
	Spleen				
	Heart				
	Tongue				

10. The report dated 08.11.2024 is as follows :-

"Subject: Detailed histopathological investigation report of tissue samples of elephants.
Reference: Letter number 1160, dated 01.11.2024 from the office of the range officer, Khitauli, Bandhavgarh Tiger Reserve, Umaria, Madhya Pradesh.

Formalin-preserved tissue samples from vital organs collected from ten elephant carcasses were analysed for histopathological examination. Tissue sections of formalin-preserved organs were stained with Haemtoxylin & Eosin (H&E) stain, which revealed *following observations on microscopic examination. Tissue sections of lungs showed pulmonary oedema at places, extensive haemorrhages across parenchymal tissues, and large areas of emphysema, epithelial lining showed infiltration of blood cells at places and thinning of alveolar septa at some places. Pulmonary oedema was evidently observed with shreds of blood cells. Tissue sections of heart showed degenerated myofibres, extensive haemorrhages and cellular infiltration along the myocardial fibres. Tissue sections of liver showed perivascular hepatocellular necrosis especially around central vein, fatty changes were observed in some cases, degenerative changes could also be observed in vascular endothelial linings and extensive haemorrhages were observed in the interstitial tissues. Tissue sections of kidney showed acute tubular necrosis along with areas of haemorrhages in the interstitial tissues. Tissue sections of spleen showed congested vessels with patches of haemorrhages. Tissue sections of stomach and intestines showed haemorrhages along with mild cellular infiltration, sloughing of epithelial linings and necrotic changes in mucosal layers. Tissue sections of tongue showed extensive haemorrhages along the epithelial lining. Sample numbers HP 2288 (D1), HP 2289 (D2), HP 2292 (D5) and HP 2294 (D7) could also show loss of cellular morphology at places which was indicative of developing autolytic changes. However, remaining all the samples numbers HP 2290 (D3), HP 2291 (D4), HP 2293 (D6), HP 2295 (D8), HP 2296 (D9) and HP 2297 (D10) had similar presentation. Opinion: Generalized haemorrhages and acute cellular injuries in major vital organs were observed. Pulmonary lesions, hepatocellular injuries and GIT lesions were markedly observed."*

11. The postmortem examination record has been filed by the respondent/State/Forest Department which shows that elephant were grazing and moving through nearby crop field with kodo and there was no external injury observed or noticed.

12. Learned counsel for the applicant has argued that several strikingly similar incidents have often occurred with other animals, and the first can be traced back to December 17, 1933, wherein fourteen elephants perished near the Vannathiparai Reserve Forest of Tamil Nadu after consuming Kodo millet, as documented by RC Morris in the Journal of the Bombay Natural History Society (1934).

13. That the scientific literature has extensively documented that several fungal species (including Aspergillus, Penicillium, Fusarium and Claviceps) produce mycotoxins when they infect crops during growth and storage. The problem grows manifolds as these mycotoxins, being odourless and tasteless, cannot be detected by wildlife, including elephants with their exceptional olfactory capabilities. These mycotoxins possess characteristics that make them particularly hazardous to human and animals alike, being odourless and tasteless, thereby rendering them undetectable even to species with advanced olfactory capabilities like elephants. Furthermore, these toxins demonstrate remarkable resistance to high temperatures, persisting even after cooking, and their chemical composition can be altered by plants during growth, making conventional detection methods ineffective. Thereby, these pose a very high risk to humans as well.

14. That it has been well established that multiple fungal species including Aspergillus, Penicillium, Fusarium and Claviceps are responsible for mycotoxin production, capable of infecting crops both during field growth and storage phases. This contamination can affect various crops including maize, wheat, rice, sorghum, peanuts, and notably in the present case, Kodo millet and that the scientific evidence overwhelmingly demonstrates

that in the absence of appropriate preventive measures, monitoring mechanisms, and regulatory frameworks, the risk of mycotoxinrelated wildlife mortality remains unacceptably high, particularly in the context of changing climate patterns and increasing wildlife-human interface zones.

15. It is further argued that Respondent authorities have not taken preventive measures or monitoring mechanism particularly in the following fields:-

    a) The historical precedents of the incidents establishing the lethal potential of mycotoxin-contaminated kodo millet;

    b) The scientific understanding of increased fungal contamination risks during adverse weather conditions given climate change;

    c) The ongoing pattern of animal dispersal caused by direct human interference, illegal deforestation and climate change making them increasingly dependent on agricultural landscapes;

    d) and importantly the foreseeable amplification of such risks due to climate change-induced weather anomalies.

16. It is further argued that unseasonal weather events, particularly untimely rains during crop maturation or post-harvest periods, create ideal conditions for fungal growth and subsequent mycotoxin production. The incident at Bandhavgarh National Park occurred following a period of heavy rainfall in the region, which created moist conditions conducive to fungal infection of the kodo millet crop, as evidenced by the toxicology reports and that climate change predictions indicate an increase in the frequency and intensity of such unseasonal weather events, thereby

elevating the risk of mycotoxin contamination in agricultural produce. This presents an escalating threat to not only humans but also wildlife populations, particularly migratory species like elephants that frequently interact with agricultural landscapes.

17. The changing patterns of elephant movement and dispersal in central India, as demonstrated by the migration of the affected elephant population from Odisha/Jharkhand through Chhattisgarh to Bandhavgarh, expose these animals to greater risks of consuming contaminated agricultural produce. The process of elephant dispersal from their original range and establishment of new populations becomes increasingly perilous in the context of climate change-induced alterations in fungal infection patterns.

18. The scientific community has documented a clear correlation between climate variables and mycotoxin production, wherein temperature fluctuations and moisture conditions significantly influence fungal growth and toxin production. The changing climate patterns thus create a complex web of risk factors that demand immediate regulatory attention and preventive action.

19. It is further argued that there is a well-established link between weather condition and mycotoxin contamination and unforeseeable increase in such weather events due to climate change and following actions/precautions were required to be taken by the forest authorities to establish weather monitoring and early warning systems for high-risk periods, develop climate-resilient agricultural practices in areas adjacent to wildlife habitats, implement proper crop management protocols accounting for changing weather patterns and create awareness among

farmers about the increased risks of fungal contamination due to climate variability.

20. Learned Counsel for the applicant has argued that now the time is mature to consider how climate change will alter patterns of plant disease in ways that are sometimes difficult to predict, until they are reported by the research papers Rising temperature, land and water scarcity and extreme weather events such as severe droughts, wildfires and heavy precipitation, are causing unmanaged damage to our food system. These variable and extreme events can introduce or exacerbate several food safety and food security hazards around the world, with major consequences for Public Health and International Trade, Food and Agriculture Organization of the United Nation -2020.

21. The Learned Counsel has taken reliance on a research paper published in Climate Change Impact on Mycotoxins by Department of Sustainable Crop Production, University of Italy, a comprehensive review which is annexed at P-3, relevant portions are quoted below:-

> ***Modified mycotoxins***
> *There is growing interest in the so-called “masked mycotoxins” or modified mycotoxins. These compounds can result from plants and fungi actions and have been linked by themselves they often exert lower toxicity than their original form, some of them have been demonstrated to partially or totally cleaved under gastrointestinal conditions, resulting in similar toxic effects as their parent compound after ingestion. An example of modified mycotoxin concerns DON, which can be converted to DON-$-glucoside in cereal crops, yet other mycotoxins are also reportedly modified by plant defense mechanisms. Recently, “new” chemotypes have been identified in North America; Sumarah found that alterations in*

enzyme activity led to the production of a 3 – acetyl NX(3ANX) toxin. This 3ANX is structurally similar to 3ADONand its interaction with the host plant results in deacetylation to form a NX toxin apparently more toxic than DON.

Under CC conditions, the complexity of fungus–plant interactions and consequent mycotoxin modification is more complicated because of the dual effects on both actors in the system. According to Medina et al. (2017), no research has yet examined how different environmental conditions, in particular CC, will affect the production of modified mycotoxins. Nevertheless, it is often stated that CC will lead to changes in plant physiology and thereby also alter the interaction between a pathogen and its host plant. Therefore, studies addressing how these changes will lead to modifications of plant protection mechanisms are needed.

Mitigation measures

Several technologies have been recommended for reducing mycotoxin accumulation in crops and subsequent human and animal exposure. These include cultural practices, biological control, monitoring and crop destruction, grain drying, sorting, proper storage, postharvest processing, and dietary interventions. However, most of these are quite resource-consuming efforts (in terms of time, labor, and money), and some are out of reach for developing countries. Biological control strategies, breeding crops for enhanced resistance traits, and support actions from institutions and national authorities are deemed essential elements to counteract mycotoxin contamination in developing and developed countries alike.

Biological control

Regarding biological control, one successful application exploits non-aflatoxigenic strains of Aspergillus spp.,which could prevent AF contamination. Their use is based on competition for space and *substrate, the potential production of inhibitory metabolites, and on their inability to recombine with native toxigenic strains (Wambui et al., 2016). This technology was pioneered in the USA, where two atoxigenic genotypes are currently registered with the US Environmental Protection Agency for prevention of AF contamination, namely, A. flavus AF36 and Afla-Guard. The success of biocontrol products as biopesticides in the USA has encouraged researchers at the International Institute of Tropical Agriculture and USDA-ARS to develop, adapt, and improve the biocontrol approach for African agroecosystems. The result of this collaboration is the development of several biocontrol products, under the trade name "Aflasafe," that consist of four non-aflatoxigenic genetic groups (vegetative compatibility groups [VCGs]) developed to provide stable, long-term, and additive beneficial effects in diverse environments. Since the first use applications, they were able to deliver a successful control of A. flavus contamination in areas where AF contamination posed a major hurdle to farmers (in Burkina Faso, Burundi, Gambia, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Senegal, Tanzania,Uganda, and Zambia). Due to the high efficacy of this mitigation method, its application in other geographical areas has been strongly encouraged.*

In Italy, research started in 2003 and an AF biocontrol product under the commercial name AF-X' was successfully developed

In Pakistan, AflaPak, a product based on native non aflatoxigenic strains, is under development for the control of AF in maize, whereas in Serbia Mytoolbox Af01 was developed with the same aim.

Nevertheless, the efficacy of A. flavus non-aflatoxigenic strains, and more broadly the biological control approach, has been questioned under CC conditions. A recurring concern is that non-aflatoxigenic strains may be unable to sporulate on carrier grains under low humidity and severe drought conditions. But as Cotty et *al. (2007) and Doster et al. (2014) demonstrated, using the non-aflatoxigenic biopesticide A. flavus AF$* in Arizona's desert valleys, for drought-prone maize production in Texas, and for pistachio production in California has enabled those crops produce yields with low AF concentrations irrespective of AF-conducive environmental conditions. Native non-aflatoxigenic strains are being used for AF biocontrol because of their adaptation to target agroecosystems. Actually, the active ingredient of AF36 is native to them and adapted to hot, dry conditions; hence, its use has effective results under those conditions. Further, because native strains of the same fungal species are selected for each biocontrol product, a similar behavior and outcome is expected even under extreme weather conditions; in fact, AF reduction is commonly reported as being more successful in high-risk years.*

Another concern is the possibility of genetic recombination among the non-aflatoxigenic A. flavus strains used and the role that CC could play in that process. Recently, sexual reproduction in A. flavus has been reported. Yet, after about a decade of commercial use of non-aflatoxigenic A. flavus strains for biocontrol in Italy as well as Africa and for more than $# years in the USA, dangerous recombinants have not been observed, demonstrating that non-aflatoxigenic phenotypes have high genetic stability across vast geographical areas Ouadhene et al., As Moral et al. pointed out, isolates used in biocontrol formulations belong to ancient, highly stable non-aflatoxigenic VCGs selected through carefully designed and elaborate microbiological, chemical, molecular, and field studies. Members of non-aflatoxigenic VCG do not exchange genetic material with members of other VCGs (either toxigenic or atoxigenic), despite plenty of opportunities to do so in both treated and non-treated areas. Clonality is the predominant mode of A. flavus reproduction Moreover, recombination events between members of aflatoxigenic and non-aflatoxigenic VCGs are typically rare or not occurring in nature, having occurred only in laboratory settings and in certain field studies under specific conditions.

Therefore, the risk for recombination and generation of aflatoxigenic variants when applying non-aflatoxigenic isolates in the field is currently deemed minimal.

Gasperini et al. (2019) examined the preharvest and postharvest resilience of non-aflatoxigenic strains of A. flavus for the control of AFB' contamination of maize, including nongenetically modified (GM) and isogenic GM cultivars with herbicide/pesticide resistant traits. The non-aflatoxigenic biocontrol strains were tested for their resilience to temperature fluxes and their ability to tolerate a range of water availability conditions to ensure that competitiveness is maintained at both pre and postharvest phases. This study found that AFB' controlwas more effective at the milky ripe and dough stages of maize cobs at preharvest whereas at the dent stage it was less effective. The applied non-aflatoxigenic strains were less resilient in non-GM stored maize cultivars; the use of the GM cultivar led to better results in terms of relative biocontrol under abiotic stress (0.95a_w) and an increased CO2 level.

Besides the use of non-aflatoxigenic strains of A. flavus, there are other promising biocontrol agents. Dovenyi- Nagy et al. (2020) mentioned that crops treated with antagonistic strains of Pseudomonas, Bacillus, and Trichoderma spp. incurred lower A. flavus infection levels on groundnuts (Anjaiah et al., 2007). The potentiality of bacterial species is also emphasized by the work of Jallow et al. (2021), it finding that Bacillus spp., Streptomyces spp., and Pseudomonas spp. exert inhibitory effects against AF producers. Nevertheless, Gasperini et al. (2019) stated how choosing fungal species as biocontrol agents could be more effective under CC conditions, as fungi are more resilient under critical abiotic conditions than, for example, bacterial species. Bacteria require almost freely available water (>0.98-0.99a_w) aw) for their growth and have significantly less resilience to water stress than many mycotoxigenic fungi, which instead are either xerotolerant or xerophilic."

22. The research indicates that Sound Policies, sensitization actions and education activities structured in a way to raise awareness on how to face new environmental conditions have been recommended actions and it is for the policy makers and the department concerned to access to solution of these climate change impacts. In other research paper named, Word Mycotoxin Journal, 2016, 9 (5), 717-726), reveals in conclusions as follows:-

> ***"Conclusions and recommendations***
> *Climate change will have an impact on food security, by its direct effects on yield and its indirect effects on food safety, as was recognised by FAO (2008). However, to date, research addressing possible climate change effects on food security has mainly focused on yields, rather than on the safety of the available food commodities. There is a need for quantitative estimations of projected climate change impacts on food safety, particularly mycotoxins in cereals and other crops. To date, only a very limited number of such quantitative studies have been done. To our knowledge, only three quantitative modelling approaches for impacts of climate change effects on mycotoxins were published, as we reviewed in this paper, all focused on Europe.*
>
> *This review identified two research gaps. First, the available predictive models for mycotoxins are validated in only one/few countries due to (limited) data availability and accessibility. Second, current climate change impact studies for mycotoxins focus on some selected mycotoxincrop combinations only. Predictive models for other combinations of mycotoxins-crops are needed to be able to better assist mycotoxin management during crop cultivation in Europe, and to mitigate the expected climate change impacts on mycotoxins.*

Overall, the approach taken into the three recent studies showed to be promising. Such a quantitative and integrative approach for estimating impacts of climate change on food safety could also be taken for other food safety hazards and production systems, such to obtain a more comprehensive view on the consequences of climate change for food safety."

23. During the previous hearing, the Learned counsel for the Applicant was suggested to submit the remedial measures to tackle the issue of increasing risk of mycotoxin contamination due to climate change and the Learned counsel for the Applicant has submitted the measures dividing in three stages based on crop life namely during the crop growth stage, post-harvest and storage stage, and lastly pre-crop growth stage which are as follows:-

I. Crop Growth Stage:

That during the crop growth stage, environmental factors such as temperature, humidity, and pest activity can significantly increase the risk of fungal infection and mycotoxin contamination. Therefore, implementing targeted measures during this stage is critical. These measures focus on field management practices, timely interventions, and pest control to minimize fungal proliferation and toxin production.

A. Application of Biological Control Agents in the Field

One of the most sustainable strategies is the application of biological control agents (BCAs) in the field. BCAs such as Trichoderma spp. and Bacillus subtilis have been shown to inhibit the growth of toxigenic fungi by colonizing plant surfaces and producing antifungal metabolites. These natural antagonists can reduce the need for chemical fungicides and provide a long-lasting solution to fungal infections. The *government should promote the use of BCAs by distributing them through cooperative societies and offering training on their application. Furthermore, field demonstrations of their effectiveness can help in building farmer confidence and encouraging widespread adoption.*

B. *Foliar Fungicide Application Based on Predictive Models*

Timely and judicious application of fungicides can be highly effective in preventing fungal diseases and thereby reducing the risk of mycotoxin contamination, but it requires proper guidance. Disease outbreaks can be anticipated using predictive models based on weather patterns, which allows farmers to apply fungicides only when needed. The government could provides real-time weather-based alerts, ensuring fungicides are applied during critical infection windows. This can be done either via dedicated means of communication, or mobile apps. This approach not only reduces the cost of farming but also minimises environmental impact by avoiding unnecessary chemical use. Alongside this, access to safe and effective fungicides should be ensured through farmer cooperatives and extension services.

C. *Maintenance of Optimal Field Hygiene*

Maintaining a clean field during crop growth is crucial in reducing the fungal inoculum. Weeds and crop debris can act as reservoirs for mycotoxin-producing fungi, which can spread to healthy crops. Regular field hygiene, including the removal of infected plant material, can significantly lower the risk of contamination. To support farmers, the government should provide mechanized weed removal equipment at subsidized rates and train them in integrated weed management practices. This measure can help in maintaining a clean field environment, thus reducing the chances of fungal proliferation.

D. *Use of Mulching and Drip Irrigation*

Excess moisture on the plant surface is one of the primary factors promoting fungal growth. Mulching can help regulate soil moisture, while drip irrigation ensures that water is delivered directly to the roots, minimising wetness on leaves and stems. The government can encourage farmers to adopt these methods by offering financial incentives and technical support. Partnering with local NGOs and irrigation suppliers can further facilitate the distribution and installation of drip irrigation systems.

E. Pest and Insect Management

Insects and pests create entry points for fungal pathogens, which can lead to infection and mycotoxin production. An integrated pest management (IPM) approach, combining biological, cultural, and chemical controls, can significantly reduce pest-related fungal infections. The government can promote IPM by distributing pest management kits, including pheromone traps and selective insecticides, and by conducting regular training sessions for farmers. This approach not only reduces pest populations but also lowers the likelihood of fungal infections that lead to mycotoxin production.

F. Timely Nutrient Application

Nutrient deficiencies during crop growth can weaken plant defences, making crops more susceptible to fungal infections. Balanced application of fertilizers, particularly potassium and calcium, strengthens plant cell walls and enhances resistance to pathogens. The government should establish mobile soil testing laboratories to help farmers identify nutrient deficiencies and develop crop-specific fertilisation plans. Subsidised distribution of micronutrient supplements, particularly potassium and calcium, can further strengthen plant defences against fungal pathogens, ensuring healthier crops with lower susceptibility to infection.

G. Intercropping and Use of Barrier Crops

Intercropping susceptible crops with non-host crops or using barrier crops can reduce the spread of fungal pathogens. For example, legumes and certain flowering plants can act as physical barriers and disrupt the transmission of fungal spores. The government can promote this practice by providing seeds for suitable barrier crops and offering technical guidance on effective intercropping combinations. Demonstration plots showcasing the benefits of these methods can encourage farmers to adopt them on a larger scale.

H. Regular Field Monitoring and Early Detection

Continuous monitoring of fields during crop growth is essential for the early detection of fungal infections. Early intervention can prevent the spread of infection and reduce mycotoxin production. The government can establish a network of trained field scouts equipped with diagnostic kits and mobile devices to carry out regular field inspections. By providing real-time updates and advice to farmers, these scouts can play a vital role in early detection and timely management of fungal diseases.

I. Monitoring Framework

A robust monitoring and evaluation framework should accompany these measures to track their effectiveness and ensure continuous improvement. Baseline surveys should be conducted to establish initial contamination levels, and key performance indicators such as reduced disease incidence, lower mycotoxin levels, and increased adoption of preventive practices should be monitored. Regular review meetings involving farmers, scientists, and policymakers can facilitate the sharing of best practices and help in refining the strategies over time.

By implementing these measures during the crop growth stage, the government can significantly reduce the risk of mycotoxin *contamination, thereby safeguarding human and animal health, and enhancing agricultural productivity. These actions will not only ensure safer food and feed but also improve the economic well-being of farmers by reducing crop losses.*

II. *Post – Harvest and Storage Stages:*

Post-harvest handling and storage of crops play a critical role in determining the extent of mycotoxin contamination. Improper drying, handling, and storage practices provide an ideal environment for fungal growth and toxin production. Hence, adopting effective post- harvest measures is essential to ensure food safety and prevent economic losses.

A. Rapid and Effective Crop Drying

A primary step in post-harvest management is rapid and effective crop drying. Fungi such as Aspergillus flavus and Fusarium thrive in moist conditions, and delays in drying harvested crops can lead to fungal proliferation. To address this issue, the government should promote the use of mechanical dryers, especially in regions prone to high humidity. Portable solar dryers and biomass-powered dryers can be distributed to smallholder farmers at subsidized rates. Establishing centralized drying facilities in key agricultural zones can further support farmers who lack access to on-farm drying equipment. Additionally, training programs on the importance of timely drying and the correct moisture levels for safe storage should be conducted. Proper drying reduces the water activity in crops, preventing fungal growth and ensuring that harvested produce meets safety standards.

B. Proper Storage Practices

Once crops are adequately dried, proper storage practices become crucial to prevent fungal contamination during storage. Traditional storage methods used by many farmers often lack adequate ventilation and protection from moisture, leading to *mold infestation. The government should promote the use of hermetically sealed storage bags and metallic silos that prevent moisture ingress and maintain an oxygen-depleted environment, thereby inhibiting fungal growth. Hermetic storage solutions have proven effective in significantly reducing mycotoxin levels in stored grains. Financial incentives, such as interest-free loans, can be offered to farmer cooperatives for the bulk purchase of modern storage equipment. Furthermore, the construction of community storage warehouses with climate control features can ensure that smallholder farmers have access to safe storage facilities.*

C. Monitoring and Early Detection of Mycotoxin in Stored Produce

Monitoring and early detection of mycotoxins in stored produce is another critical measure. Since mycotoxins are invisible and do not alter the appearance of the grain, routine testing is necessary to ensure food safety. The government can set up mobile mycotoxin testing labs that visit key agricultural markets and storage centres. These labs should be equipped with rapid testing kits capable of detecting aflatoxins, fumonisins, and other major mycotoxins. Farmers can be encouraged to test their stored produce regularly by providing testing services at nominal charges. Additionally, quality certification programs can be introduced, where farmers who meet specified mycotoxin limits receive a certification that can help them secure better prices in the market.

D. Promoting of Good Handling and Sorting Practices

Another important intervention is the promotion of good handling and sorting practices. Mechanical damage to grains during threshing and handling can create entry points for fungal spores. The government should promote the use of improved threshing and cleaning equipment to minimise *mechanical damage. Additionally, manual sorting of visibly moldy or damaged grains before storage can significantly reduce the fungal load. To encourage this practice, farmer awareness campaigns can be conducted, highlighting the health risks of consuming contaminated grains and the economic benefits of producing high-quality, toxin-free crops. Providing basic sorting tools and training on handling practices can further enhance the quality of stored produce.*

E. Regular Fumigation and Pest Control Measures

To maintain optimal storage conditions, regular fumigation and pest control measures should be implemented in large warehouses and community storage facilities. Pests such as insects and rodents not only damage stored crops but also introduce fungal spores that can lead to mycotoxin production. Integrated pest management (IPM) techniques, combining chemical and non-chemical methods, should be adopted. The government can partner with agricultural extension services to provide fumigation services and pest control solutions at discounted rates. Regular inspections of warehouses and large storage units can be mandated to ensure compliance with pest control protocols.

F. Temperature and Humidity Regulation in Storage Units

In addition to pest control, temperature and humidity regulation in storage units is essential. High humidity and fluctuating temperatures can trigger fungal growth even in well-dried grains. Therefore, storage units, especially large warehouses, should be equipped with dehumidifiers and ventilation systems to maintain stable conditions. The government can introduce schemes to provide financial support for the installation of such systems. Real- time monitoring devices that track temperature and humidity levels can also be deployed in storage facilities. These devices can send alerts to warehouse managers when *conditions exceed safe thresholds, enabling timely corrective actions.*

G. *Mycotoxin Detoxification Techniques*

Furthermore, mycotoxin detoxification techniques can be explored as a complementary strategy. While prevention remains the primary goal, certain physical and chemical detoxification methods can reduce mycotoxin levels in contaminated produce. Techniques such as ozonation, irradiation, and the use of natural adsorbents like bentonite clay and activated carbon have shown promise in reducing mycotoxin concentrations. The government can support research and development in this area and facilitate pilot projects to evaluate the feasibility of these methods at the farm and storage levels. Once proven effective, these techniques can be scaled up and made available to farmers through agricultural cooperatives.

H. *Market Linkages and Incentives for Toxin – Free Produce*

Lastly, market linkages and incentives for toxin-free produce can play a significant role in encouraging farmers to adopt safe post-harvest practices. The government can introduce premium pricing schemes for produce that meets mycotoxin safety standards. Collaborations with food processing industries and exporters can create assured markets for toxin-free grains, thereby motivating farmers to invest in better post-harvest management. Additionally, public-private partnerships can be explored to set up dedicated procurement centres for toxin-free produce, ensuring that farmers receive fair compensation for their efforts.

I. *Monitoring and Evaluation Framework*

To ensure the success of these measures, a robust monitoring and evaluation framework is essential. The government should *establish a central task force responsible for overseeing the implementation of post-harvest interventions. This task force can coordinate with local agricultural offices to conduct regular inspections of storage facilities and provide feedback on areas requiring improvement. Key performance indicators, such as the reduction in mycotoxin levels in marketed produce, adoption rates of modern storage practices, and incidence of fungal-related crop losses, should be tracked. Periodic audits and farmer surveys can provide valuable insights into the effectiveness of the measures and help in refining the strategies over time.*

III. ***Pre – Crop Growth Stage:***

That, to mitigate pre-harvest mycotoxin contamination, a comprehensive set of measures needs to be implemented. These measures, based on extensive research, focus on enhancing crop resistance, promoting sustainable agricultural practices, and strengthening farmer support systems.

A. Development and distribution of Mycotoxin-Resistant Crop Varieties

One of the most effective strategies to minimize mycotoxin contamination is the large- scale adoption of resistant crop varieties. The respondent government should collaborate with agricultural research institutes to develop and promote such varieties using advanced breeding techniques, including genetic engineering and marker-assisted selection (MAS). Resistant varieties can inhibit the growth of mycotoxin-producing fungi like Aspergillus, Fusarium, and Alternaria by either preventing fungal colonization or disrupting toxin biosynthesis. A successful example includes maize varieties engineered to reduce aflatoxin accumulation by suppressing key fungal enzymes. Distribution of these varieties through state-run seed banks and farmer cooperatives can ensure wider adoption across India.

B. Adoption of Biological Seed Treatment Methods

Biological control agents (BCAs) offer a sustainable and environmentally friendly alternative to chemical fungicides. Pre-sowing treatment of seeds with biocontrol agents such as Trichoderma species and non-toxigenic strains of Aspergillus flavus can significantly reduce fungal infection. These agents act by either outcompeting the toxigenic fungi or by producing antifungal metabolites. To facilitate adoption, the government can establish a subsidy scheme for BCAs and provide technical support for their application. Furthermore, farmer education campaigns should be launched to increase awareness about the long-term benefits of using BCAs in comparison to traditional chemical treatments.

C. Climate-Specific Sowing Guidelines and Predictive Models

Fungal contamination is closely linked to climatic conditions, particularly temperature and humidity. Therefore, the government should implement a climate-specific sowing advisory system, tailored to the microclimatic conditions of different regions in Madhya Pradesh. Advanced predictive models that integrate meteorological data with fungal epidemiology can guide farmers on optimal sowing times to avoid peak periods of fungal spore dispersal. This can be achieved by collaborating with weather forecasting agencies and agricultural universities to develop and disseminate real-time advisories through SMS alerts and mobile applications. Such measures will reduce the exposure of crops to environmental conditions that favour fungal growth.

D. Promotion of Crop Rotation and Diversification

Continuous cultivation of the same crops in the same fields promotes the build-up of soil- borne fungi. Introducing crop rotation systems involving non-host crops such as legumes can break the lifecycle of these fungi. Diversification with crops less *susceptible to mycotoxins not only reduces fungal infestation but also improves soil fertility and yields. The government can incentivize crop rotation by offering financial support to farmers transitioning to diversified cropping systems. Field demonstrations and workshops on the benefits of rotation can also play a key role in encouraging adoption.*

E. *Enhancement of Soil Health through Organic Amendments*

Maintaining healthy soil is critical for preventing fungal proliferation. The government should promote the use of organic soil amendments such as compost and biofertilizers that enhance the soil's microbial diversity and suppress fungal pathogens. Balanced fertilization, particularly the use of potassium and calcium, can strengthen plant cell walls, making crops less vulnerable to fungal penetration. By providing subsidies for organic inputs and launching awareness campaigns on the importance of soil health, the government can create a holistic approach to mycotoxin management.

F. *Implementation of Eco-Friendly Seed Coating Technologies*

Eco-friendly seed coatings enriched with antifungal peptides, essential micronutrients, and plant growth-promoting bacteria can provide an additional layer of protection against fungal attack. These coatings improve seed germination and vigour, enabling crops to withstand biotic and abiotic stress. The government should collaborate with agrochemical companies to develop cost-effective seed coatings and ensure their availability to farmers at subsidized rates. Pilot projects demonstrating the efficacy of coated seeds in reducing mycotoxin contamination can further promote their widespread use.

G. *Strengthening Agricultural Extension Services*

A key factor in ensuring the success of these measures is *continuous farmer support. The government should establish specialized mycotoxin management units within existing agricultural extension services. These units should focus on educating farmers about the risks of mycotoxins, best practices for prevention, and the use of advanced technologies. Regular training programs, field visits, and the dissemination of easy-to-understand guides can build farmer capacity. Additionally, helplines staffed by agricultural experts should be set up to provide real-time advice to farmers.*

F. Monitoring and Evaluation Mechanism

To ensure the effective implementation of these measures, a robust monitoring and evaluation framework should be put in place. Baseline surveys can help establish the current level of mycotoxin contamination, while periodic assessments can track progress. Key performance indicators should include the reduction in mycotoxin levels, the adoption rates of resistant varieties and biocontrol methods, and improvements in overall crop yield.

Quarterly review meetings with stakeholders, including farmers, scientists, and policymakers, can ensure timely course corrections and the sharing of best practices.

IV. ***Additional Measures to Ensure Safety of Animals***

A. Establish Buffer Zones with Non-Toxigenic Crops

Create buffer zones around national parks and wildlife corridors where only low-risk, non- mycotoxigenic crops (such as legumes, certain fruits, or vegetables) are cultivated. Cultivating non-mycotoxigenic crops in buffer zones reduces the chances of wildlife consuming contaminated food.

Offer subsidies or incentives to farmers cultivating low-risk crops in designated buffer zones. Provide alternative income-generating activities such as agroforestry or beekeeping to *reduce dependence on mycotoxin-prone crops like maize and sorghum.*

B. Conduct Regular Testing of Crops in High – Risk Areas

Implement a regular testing and monitoring programme for crops grown near forest boundaries to assess mycotoxin levels.

C. Regulation on Growing Mycotoxin Prone Crops in Wildlife Areas

Enforce stricter regulations on the types of crops grown near protected areas and introduce penalties for non-compliance.

4. The incident in Bandhavgarh National Park underscores the urgent need for a multi-sectoral approach to mycotoxin management, especially in areas where wildlife and agriculture intersect. By implementing the above measures in conjunction with those already discussed for managing mycotoxins in crops, the respondent government can safeguard wildlife health."

24. Learned Counsel for the Department of Wildlife Health Management, Wildlife Institute of India, Chandra Bani, Dehradun, Uttarakhand has submitted that :--

i. The Institute offers a wide array of specialized training programs, academic courses, and expert advisory services designed to enhance capacity-building among wildlife professionals, policymakers, researchers, and other stakeholders. Additionally, WII is actively involved in conducting extensive research on biodiversity-related issues across the length and breadth of India, addressing critical ecological challenges and supporting informed management of wild. The Institute's endeavors contribute significantly to the formulation of *evidence - based policies, the advancement of scientific knowledge, and the implementation of effective strategies for the conservation of the nation's rich and diverse wildlife heritage.*

25. It is further submitted that the institute have not required facility to undertake works of diagnostic nature pertaining to poisoning and further that the findings submitted by Indian Veterinary Research Institute, bareilly reveals that this was caused by fungal contamination of the millet grains consumed by the deceased elephants and that instances of elephant mortality resulting from the ingestion of cereals contaminated with fungal toxins have been sporadically documented across various regions of the country. Historical records, including the report by Morris, R.C. (1935), titled "Death of 14 Elephants (Elephas maximus Linn.) by Food Poisoning," published in the Journal of the Bombay Natural History Society (Vol. 37, pp. 722–723), highlight the sporadic occurrences of such incidences, thereby providing an early and critical account of the vulnerability of elephants to mycotoxins.

26. That the aspect concerning potential legal violations under the provisions of the Forest (Conservation) Act, 1980, and the Environment (Protection) Act, 1986, in connection with the tragic death of elephants in the Bandhavgarh Tiger Reserve, Madhya Pradesh, allegedly due to the ingestion of contaminated cereals, does not fall within the statutory mandate or functional domain of the Wildlife Institute of India (WII). The Wildlife Institute of India is primarily an autonomous institution engaged in research, training, and advisory services related to wildlife conservation and management.

27. Learned Counsel for the State has submitted that the reports received from laboratories throughout the country clearly and explicitly concludes that no foreign substance or chemical toxin were found in any of the samples from the post-mortem examination of the deceased elephants and Kodo millet, paddy, grazing material, water, soil, dung, and flora in the vicinity. That the following was observed by various laboratories :

A. That the findings from International Crops Research Institute for the Semi-Arid Tropics, Hyderabad has conclusively identified the presence of high concentrations of Cyclopiazonic Acid, a mycotoxin known for its toxicological effects.

B. That the findings from the Indian Veterinary Research Institute, Bareilly corroborate this conclusion, confirming that Cyclopiazonic Acid was detected in samples, and its origin has been attributed to the consumption of a substantial quantity of Kodo millet crops contaminated with fungal growth.

C. Furthermore, the histopathological analysis conducted by the Nanaji Deshmukh Veterinary Science University, Jabalpur laboratory reveals evidence of acute cellular injuries, which are strongly indicative of acute toxicity resulting from the ingestion of contaminated materials.

D. The analysis undertaken by the State Forensic Lab Sagar indicates that the results for external chemical toxins, as tested in the submitted samples, were found to be negative, ruling out the possibility of external chemical poisoning."

28. Additionally, within Bandhavgarh Tiger Reserve, Umaria, the unfortunate incident of the untimely death of 10 elephants occurred between October 29, 2024, and October 31, 2024. Thereafter following a thorough

investigation of the vicinity of the incident site, no suspicious objects were discovered. Furthermore, the report from the State Forensic Laboratory, Sagar, confirmed the absence of chemical toxicity. Based on the findings of the postmortem conducted by expert wildlife veterinarians and the forensic reports from central and state government laboratories, it was determined that the cause of death was the consumption of an excessive quantity of Kodo millet crops contaminated with fungus.

29. Elephants, as non-ruminant wildlife species, exhibit significant physiological differences from ruminant animals in their digestive processes. Unlike ruminants, such as cattle, which possess a fourchambered stomach and an advanced digestive system capable of efficiently processing and detoxifying ingested substances, elephants have a single-chambered stomach and a comparatively less efficient digestive system. This anatomical and physiological limitation prevents elephants from regurgitating their food or adequately neutralizing harmful substances during digestion. Consequently, when elephants consume substantial quantities of fungus-contaminated Kodo millet crops, their digestive system is unable to mitigate the toxic effects of fungal mycotoxins, such as Cyclopiazonic Acid.

30. That the aforementioned, results in a heightened vulnerability to acute toxicity, leading to severe health complications and, ultimately, mortality. The deaths of the 10 elephants in Bandhavgarh Tiger Reserve, therefore, have been conclusively linked to the ingestion of Kodo millet crops heavily contaminated with fungal mycotoxins. This underscores the critical need for stringent monitoring of agricultural practices and wildlife interactions

within and around protected areas to prevent such incidents in the future and to safeguard wildlife from avoidable toxic exposures.

31. That, upon careful examination and analysis of the reports provided by laboratories affiliated with the Government of India and various state governments, it has been unequivocally established that the deaths of the elephants were not the result of any illegal hunting activities, poaching, or other anthropogenic (humaninduced) factors. The comprehensive findings from these authoritative sources confirm the absence of external interference, deliberate harm, or malicious intent in relation to this tragic occurrence. Instead, the incident has been classified as a natural and unforeseen calamity, arising from circumstances beyond human control. This determination underscores the importance of ongoing monitoring and preventive measures to mitigate risks to wildlife in and around protected areas, while also highlighting the need for continued vigilance to prevent such incidents in the future.

32. Our attention is also drawn towards the notification dated 13.12.2016 issued by the Ministry of Environment, Forest and Climate Change, with regard to Bandhavgarh National Park and Panpatha Wildlife Sanctuary, located in Umariya district in State of Madhya Pradesh, where the provisions have been made for zonal master plan for eco-sensitive zone and for the purpose of eco-sensitive zone, state has been directed to prepare a zonal master plan within a period of two years from the date of publication and to take remedial measures for land use, which is quoted below :-

*(1) **“Land use.-** Forests, horticulture areas, agricultural areas, parks and open spaces earmarked for recreational purposes in the Eco-sensitive Zone shall not be used or converted into areas for commercial or industrial related development activities:*

Provided that the conversion of agricultural lands within the Eco-sensitive Zone may be permitted on the recommendation of the Monitoring Committee, and with the prior approval of the State Government, to meet the residential needs of local residents, and for the activities listed against serial numbers 9,16,22,33 and 36 in column (2) of the Table in paragraph 4, namely:-

(i) Eco-friendly cottages for temporary occupation of tourists, such as tents, wooden houses, etc. for Eco-friendly tourism activities;

(ii) widening and strengthening of existing roads and construction of new roads;

(iii) small scale industries not causing pollution;

(iv) rainwater harvesting; and

(v) cottage industries including village industries, convenience stores and local amenities:

Provided further that no use of tribal land shall be permitted for commercial and industrial development activities without the prior approval of the State Government and without compliance of the provisions of article 244 of the Constitution or the law for the time being in force, including the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007):

Provided also that any error appearing in the land records within the Eco-sensitive Zone shall be corrected by the State Government after obtaining the views of Monitoring Committee, once in each case and the correction *of said error shall be intimated to the Central Government in the Ministry of Environment, Forest and Climate Change:*

Provided also that the above correction of error shall not include change of land use in any case except as provided under this sub-paragraph:

Provided also that there shall be no consequential reduction in green area, such as forest area and agricultural area and efforts shall be made to reforest the unused or unproductive agricultural areas."

33. The categories of prohibited activities, regulated activities and promoted activities have been given in Para 4, which should be monitored by the monitoring committee which is contained in section 5 of the notification.

34. In view of the above, the greater responsibility is on the monitoring committee to monitor the climate change, its effect on the harvesting and agriculture, land use and proper precautions should be taken to save the wildlife within their jurisdiction. In view of the above, we direct the Principal Chief Conservator of Forest and the Monitoring Committee as constituted under Section 5 of the notification quoted above, to take immediate action on the following fields-

i. By way of constituting an expert committee comprising mycologists, wildlife experts, agricultural scientists and forest officials to assess the current situation, develop standard operative procedures and to recommend immediate and long-term preventive measures and monitor their implementation within their territorial jurisdiction.

ii. That a comprehensive survey and testing of all susceptible cultivation areas within and adjacent to known elephant corridors and habitats is required to be taken, implementing a regular monitoring and testing program for mycotoxin contamination in these areas.

iii. To implement an integrated yearly warning system linking weather monitoring, agriculture practices and wildlife movement pattern, particularly during harvest seasons and in areas adjacent to wildlife habitats, and to develop a comprehensive guideline for climate resilient agricultural practices and self-cultivation method with proper storage protocols and regular testing mechanism in wildlife interface zones.

iv. To implement a comprehensive awareness program for farmers, forest officials and local communities regarding proper cultivation practices, mycotoxin risks, preventive measures and wildlife safety protocols.

v. The Principal Chief Conservator of Forest and the monitoring committees shall regularly monitor the future cultivation and crops and its effect on the wildlife and especially on the elephants in the sanctuary to protect their life and health.

35. A copy of the order be sent on e-mail to the Principal Chief Conservator of Forest, Secretary (Environment), Member Secretary, State Pollution Control Board and the Chairman, Monitoring Committee for information

and compliance and to take action accordingly, in addition to other actions which are required.

36. With these observations, the **Original Application No. 241/2024 and 259/2024** stand **disposed of.**

Sheo Kumar Singh, JM

Dr. Afroz Ahmad, EM

10th January, 2025
O.A. No. 241/2024(CZ)
O.A. No. 253/2024(CZ)
PN