समझौता ज्ञापन

MEMORANDUM OF UNDERSTANDING

between

केंद्रीय भूमि जल बोर्ड / Central Groundwater Board

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय /

Department of Water Resources, River Development & Ganga Rejuvenation

जल शक्ति मंत्रालय / Ministry of Jal Shakti

भारत सरकार / Government of India

and

भारतीय भूवैज्ञानिक सर्वेक्षण / Geological Survey of India

खान मंत्रालय / Ministry of Mines

भारत सरकार / Government of India

on

मध्य प्रदेश के अलीराजपुर, झाबुआ तथा सिंगरौली जिलों के भूजल में यूरेनियम, फ्लोराइड एवं भारी धातुओं के त्रिआयामी स्पेस में वितरण पर महत्त्व देते हुए उनके स्रोत एवं संघटन पर अन्वेषण

An investigation on the source and mobilization of Uranium, Fluoride and heavy metals in groundwater of Alirajpur, Jhabua, and Singrauli districts of Madhya Pradesh with emphasis on their distribution in 3-Dimensional space

June'2023

Bhopal

MEMORANDUM OF UNDERSTANDING

Between

Central Groundwater board

and

Geological Survey of India

The Memorandum of Understanding hereinafter referred to as MoU signed on ..28th.... day of ..JUNE.. Year ..2023.. between Central Groundwater Board, Block 1, 4th Floor Parayawas Bhawan, Arera Hills, Jail Road, Bhopal - 462011, a Sub-ordinate office of the Department of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Government of India (hereinafter referred to as **CGWB**), which expression unless otherwise proved shall include its successors, representatives and assignees on the first part AND Geological Survey of India, Central Region, State Unit: Madhya Pradesh, E-5, Arera Colony, Bhopal - 462016, an attached Office of Ministry of Mines, Govt. of India (hereinafter referred to as **GSI**), which expression shall include, unless repugnant to the context or contrary to the meaning thereof, its successors or permitted assignees on the other part.

Preamble

Central Groundwater Board, being the apex organization, vested with responsibilities to carry out scientific studies, exploration aided by drilling, monitoring groundwater regime and groundwater quality, assessment, augmentation, management and regulation of country's groundwater resources. It is also implementing the National project on Aquifer Management (NAQUIM) in the country.

Geological Survey of India is a premier organization carrying out geological mapping, mineral exploration and multidisciplinary programme in Earth Sciences including sponsored and societal related studies in the field of engineering geology, environmental geological studies and natural hazard mitigation etc.

Geological Survey of India with over 173 years of geological expertise has evolved into an organization endowed with cultivated human resource of exceptional caliber, laboratories equipped with world- class equipment and activities spreading over air, land and ocean in the specialized fields of geology, geophysics and geochemistry.

1. Background

Presence of uranium and fluoride in Alirajpur and Jhabua districts has been reported by CGWB and non-governmental organizations with availability of better analytical facilities. INREM foundation, in 2011, reported very high levels of blood serum fluoride, urinary fluoride, severe bone deformities and osteoporosis--conditions typical of fluorosis patients, in Jasoda Khunji and Miyati villages in Jhabua district. People were drinking high fluoride water up to 8 mg/l (permissible limit <1.5 ppm, WHO, 2017), though the amount of fluoride in food was not significant enough to cause fluorosis. These important observations coupled with the fact that water from deeper handpumps had high fluoride offered some hints to supporting scientists that fluorosis was caused due to consumption of contaminated groundwater (Indiawaterportal.org). Furthermore, Aziz and Khan (2012) reported fluorosis-endemic villages in Jobat area of Alirajpur district. CGWB (2020) reported uranium in groundwater of Jhabua district and the maximum value recorded is 233.9 ppb (permissible limit 30 ppb, WHO, 2017).

Exposure to uranium through drinking water causes nephrotoxic effects. Concentration of naturally occurring uranium in groundwater depends on the uranium content of rocks, their leaching and dissolution processes. The main factors that may drive high uranium concentrations in groundwater are source rocks, oxidation states, rock-water interaction and formation of soluble complexes. Industrial processes like extraction of phosphorus from phosphate ores to produce phosphate fertilizers, uranium mine tailing disposal, and uranium mining and milling also add uranium to the environment. However, assessment of radiological health risk from drinking water is beyond the scope of this work.

Fluoride is naturally found in soil, rocks and minerals, which may be mobilized into groundwater. Industrial activity like manufacture of phosphate fertilizer may release fluoride into natural environment. Fluoride is essential for bones and teeth of human; however, high concentration of fluoride in drinking water beyond the permissible limit of 1.5 mg/l poses health problem and excess intake may lead to dental fluorosis and skeletal fluorosis. Dental fluorosis is characterized by yellowing of teeth, blackened, mottled teeth and destruction of enamel. These are clear indication of overexposure to fluoride during childhood when the teeth were developing. Skeletal fluorosis is severe and causes permanent deformations of bones and joints. Early symptoms include sporadic pain and stiffness of joints. Headache, stomach-ache and muscle weakness can also be warning signs. The next stage is osteosclerosis, i.e., hardening and calcifying of the bones. In the long run the spine, major joints, muscles and the nervous system are damaged.

Besides uranium, presence of other harmful heavy metals toxins like mercury has been reported in Singrauli Industrial Area (Sahu R., Saxena, P., Johnson, S., Mathur, H.B., Agarwal, H.C., 2014. Toxicological & Environmental Chemistry. http://dx.doi.org/10.1080/02772248.2014.939980). Among all the naturally occurring forms of mercury, alkyl mercury is the deadliest neurotoxin known for its bioaccumulation and biomagnification.

As per the decision taken during the 59th Central Geological Programming Board Meeting, a collaborative study on Uranium contamination in groundwater in India was proposed by CGWB, which has been agreed upon by GSI. In subsequent meeting between CGWB and GSI, it has been jointly agreed to include arsenic, lead, fluoride and mercury under the study. In Annual Program of 2022-23, GSI already initiated two groundwater contamination projects on fluoride and heavy metals (lead, mercury, arsenic); one in Jhabua and Alirajpur districts and the other in Singrauli district of Madhya Pradesh. These projects are continued in 2023-24. The total area coverage is 2,130 sq km in Jhabua, Ranapur and Meghnagar blocks in Jhabua district and Alirajpur, Bhabra and Udaigarh blocks in Alirajpur district. In the other project, area coverage is 959 sq km in Waidhan block of Singrauli district. In this background, a collaborative study is proposed to be taken up in Jhabua, Alirajpur and Singrauli districts of Madhya Pradesh to understand 3-dimensional spatial distribution of fluoride and uranium in aquifer systems and anthropogenic pathways of heavy metals contamination of groundwater in Singrauli industrial and mining area.

CGWB and GSI may at times be referred to individually as "**Party**" and collectively as the "**parties**" whereas CGWB and GSI have agreed upon to co-operate for the above-mentioned study. The activities to be undertaken in this cooperation, Role of GSI & CGWB, time frame and other conditions of the collaboration are given below:

2. Title of the Programme

An investigation on the source and mobilization of Uranium, Fluoride and heavy metals in groundwater of Alirajpur, Jhabua, and Singrauli districts of Madhya Pradesh with emphasis on their distribution in 3-Dimensional space

3. Objectives

i. Identification of aquifer rocks / sediments / minerals and anthropogenic waste contributing to uranium, fluoride and heavy metals (lead and mercury) contamination.

ii. Study of physico-chemical/biogeochemical processes of mobilization of uranium and fluoride in groundwater and understanding of geological controls on their mobilization.

iii. Detailed study of hydrogeological regime.

iv. Identification of anthropogenic sources of heavy metals (lead and mercury) contamination using suitable isotope tracers.

v. Three-dimensional spatial distribution of uranium, fluoride, and heavy metals (lead and mercury) in aquifers in scale 1:25,000 for demarcation of contaminated aquifer.

4. Scope of the work

In order to fulfil the above objectives, water, soil, anthropogenic waste, surface and subsurface rock/sediment samples will be collected systematically and geochemical analysis will be carried out. In mining area and near thermal power plants, samples will be collected from mine tailings, ash ponds, leaf dust, street dust, reservoir and human settlements. Source tracing of heavy metals will be carried out using suitable isotope tracers. In addition, subsurface drilling and aquifer tests will also be carried out. Role of GSI, role of CGWB and joint responsibilities are defined as follows

5. Role of GSI

Geological Survey of India will execute the following:

i. GSI will share the water sample locations and values of uranium, fluoride and heavy metals concentration (As, Pb and Hg) in the 40 samples and 30 samples that will be collected respectively in Jhabua and Alirajpur districts, and Singrauli district from dug wells, handpumps, bore wells / tube wells and surface water and waste water. In addition, basic parameters will be analyzed in 400 samples (200 pre-monsoon+200 post-monsoon). The study area is already defined as groundwater contamination projects in a) Jhabua and Alirajpur, and b) Singrauli districts have been under implementation as separate Annual Programs of GSI since 2022-23 and continued in 2023-24. Uranium, arsenic and lead will be measured by ICP-MS, fluoride by ISE and mercury by DMA.

ii. Systematic collection of soil, rock and sediment samples (surface samples) for geochemical analysis and analysis of uranium- and fluorine-bearing minerals. In addition, industrial wastes like fly ash, leaf dust and street dust will be collected for heavy metals (As, Pb and Hg) analysis.

iii. Chemical analysis of 70 soil samples, 90 rock samples and 15 fly ash, leaf dust and street dust samples for determination of concentration of major oxides and trace elements including uranium, fluorine and heavy metals (As, Pb and Hg). Major oxides and Pb will be analyzed by XRF, U and As by ICP-MS, Fluoride by ISE and Hg by DMA.

iv. Thirty-five X-Ray diffraction (XRD) studies for mineral identification, petrography of rocks, 22 Scanning Electron Microscopy (SEM) and 35 Electron Microprobe Analysis (EPMA) of selected mineral grains for quantitative determination of abundance of uranium and fluorine.

v. Study of drill cores, preparation of lithologs and collection of subsurface samples for detailed chemical analysis, XRD, petrography and mineral chemistry (SEM & EPMA) in laboratory.

vi. Collection and chemical analysis of water samples of aquifers punctured during subsurface drilling (GSI Chemist).

6. Role of CGWB

Central Groundwater Board will execute the following:

i. Detailed hydrogeological investigations to be carried out covering the entire study area.

ii. Key wells to be established for water level monitoring, water sampling and chemical analysis.

iii. Subsurface drilling to be carried out in selected locations for groundwater exploration, identification of various hydrogeologic units and study of multiple aquifers in which 06 Nos. of EW/OW and 03 Nos Piezometer will be constructed including pumping tests, slug test and PYT with determinations of aquifer parameters in parts of Alirajpur, Jhabua and Singrauli Districts of Madhya Pradesh.

iv. Collection and chemical analysis of water samples of aquifers punctured during subsurface drilling.

v. Source tracing of heavy metals in groundwater using isotope tracers $\delta^{2}H$, $\delta^{18}O$ and tritium (outsourced from BARC or NIH).

vi. CGWB will share already existing data regarding the yield and transmissivity of different aquifers measured in the drilled wells, location and lithologs of the drilled wells, depth and thickness of different aquifers, vertical electrical sounding data, regional groundwater flow pattern and groundwater flow gradient.

vii. Carrying out 60 Nos. of VES (Geophysical Survey) in parts of Alirajpur, Jhabua and Singrauli Districts of Madhya Pradesh (CGWB's Geophysicist)

viii. Collection of 800 Nos. ground water samples {400 Nos for Pre- Monsoon (200 Nos for Basic parameters + 200 Nos for Heavy Metals) + 400 Nos for Post- Monsoon (200 Nos for Basic parameters + 200 Nos for Heavy Metals)}.

ix. Carrying out analysis of 400 samples for 11 Nos of heavy metals parameters including uranium (Cr, Mn, Fe, Ni, Cu, Zn, As, Se, Cd, Pb & U) using INP-MS (CGWB Chemist).

x. Carrying out analysis of 400 samples for 15 basic parameters (pH, EC, HCO_3, CO_3, Cl, F, NO_3, SO_4, PO_4, SiO_2, Na, K, TH, Ca, Mg) (CGWB Chemist).

7. Joint Responsibilities

i. Joint field traverse and collection of soil, rock and sediment samples for analysis of uranium, fluorine and heavy metals.

ii. Preparation of lithologs of subsurface drilling.

iii. Collection and chemical analysis of water samples of aquifers punctured during subsurface drilling.

iv. Preparation of 3D maps of contaminant (uranium, fluorine and heavy metals (lead and mercury)) distribution.

v. Data interpretation.

vi. Both the organizations will provide access to libraries, archives, research laboratories and other facilities.

vii. Preparation of final joint report of the study.

8. General Provisions

a. This MOU shall supersede all previous oral and written communications, representations and undertaking between the parties on this issue.

b. Each of the Parties recognizes that the successful implementation of this MOU to the mutual satisfaction and benefit of the both parties will require a significant degree of cooperation and good faith on behalf of both Parties. Each of the Parties resolves to act in good faith and in accordance with the spirit of this MOU to implement the provisions in accordance with the mutual desire and in the interest of the Parties.

9. Validity

The MOU shall be effective from the date on which it is executed by the parties and may continue for a period of one year and may be extended by mutual consent. The study of Alirajpur, Jhabua and Singrauli districts may be taken up immediately as a pilot project for one year from the date of signing of MoU. The proposed investigation program will be duly reflected in the annual program of both GSI and CGWB.

10. Financial Implication

While the parties agree to co-operate and otherwise act in good faith with the view to the successful implementation, **there is no financial obligation on either party.** This MoU is intended to mutual understanding of the Parties hereto as the date thereof.

11. Authorized Persons

Any notice, request or other communication required or permitted to be given under this MoU shall be in writing in the English language and shall be delivered in person or by recognized courier service or facsimile at addresses as follows or the authorized persons of two organizations to be notified separately:

IF to CGWB The Regional Director Central Groundwater Board North Central Region Block 1 4th Floor Parayawas Bhawan Arera Hills, Jail Road Bhopal – 462 011 Phone No. 0755-25576139	IF to GSI The Deputy Director General Geological Survey of India Central Region State Unit: Madhya Pradesh E-5, Arera Colony Bhopal – 462 016 Phone No. 0755-2466649, 2466642 Fax-0755-2424349

12. Final Outcome

The results of this study would help in improved understanding of distribution of uranium, fluoride and heavy metals in solids and aqueous phases, causes of their mobilization in groundwater, assessment of vulnerability of an aquifer to such contamination and identification of aquifers safe from uranium, fluoride and heavy metals contamination. In addition, anthropogenic sources of heavy metals (mercury and lead) contamination would also be determined. Possible remedial measures would be worked out. The report of the study would be placed in public domain.

Publication, if any, in respect of the said study with prior mutual consent of the Parties with prior approval of the competent authority, shall be in the names of the workers from the parties with suitable order of authorship. It will be suitably acknowledged that work has been carried out jointly by the parties.

13. Team Members

Central Groundwater Board	**Geological Survey of India**
Team of Hydrogeologists and Chemists from CGWB	**Team of Geologists and Chemists from GSI**
A nodal officer from CGWB to coordinate the requirements/inputs vis-a-vis progress of all the projects under the ambit of MoU and liaison with GSI for successful implementation (as recommended in CGPB Committee XII meeting)	A nodal officer from GSI to coordinate the requirements/inputs vis-a-vis progress of all the projects under the ambit of MoU and liaison with CGWB for successful implementation (as recommended in CGPB Committee XII meeting)

14. Transfer of Data

i. The data generated by CGWB and GSI during the said study in this MoU, shall be owned jointly by CGWB and GSI.

ii. Data provided by GSI will not be shared by CGWB with third party without the prior

approval of GSI and vice versa. Parties also agree not to utilize the shared data for any kind of commercial purpose without prior explicit permission of the other party.

iii. Data provided by GSI will be used by CGWB only for the purpose for which it has been acquired. The data provided by CGWB will also be used by GSI for their internal use.

15. Arbitration

Except as otherwise provide elsewhere in the contract in the event of any dispute or difference relating to arising from or connected with the contract, such dispute or difference shall be mutually discussed between the parties and will be finalized to the satisfaction of both the parties. Further, if need arises, dispute may be referred to Secretary, Ministry of Mines and his decision will be final and binding to both the parties. This MoU is subject to the Law of the Land. Any clause not specifically mentioned herein is subject to the rules and regulations in accordance with Law.

16. Force Majeure

Neither party shall be held responsible for non-fulfillment of their respective obligations under this agreement due to the exigency of one or more of the force majeure events such as but not limited to flood, earthquakes, acts of GOD, war, strike, lockouts, epidemics, riots, civil commotion etc. provided on the occurrence and cessation of any such events, the party affected thereby shall give a notice in writing to the other party within ten working days of such occurrence or cessation. If the force-majeure condition continues beyond six months, the parties shall then mutually decide about the future course of action.

17. Confidentiality

Both parties acknowledge confidentiality of information which may be transferred between the parties or obtained or developed during the course of this exchange from time to time as being essential to this MoU and agree not to disclose the same to any third party or any outside parties. However, each party shall be free to disclose this information as is required to be disclosed by official authorities in accordance with applicable law or regulation.

18. Intellectual Property Right (IPR)

The intellectual property right that is generated out of collaborative study shall be jointly owned by GSI and CGWB.

19. Entire Contract and Amendments

This MOU will be signed along with attached signed addends and / or subsequent agreements, which will constitute the entire agreement between the GSI and CGWB. No prior written or oral representations shall be binding and all amendments and / or subsequent agreements shall be in writing and signed by a party of equal position as those of the executing parties hereto. This MoU shall supersede all previous oral and written communications, representations and undertaking between the parties on this issue.

IN WITNESS WHERE OF the Parties hereto have duly executed this **MoU.**

The 28th Day of June Year 2023

For **CENTRAL GROUNDWATER BOARD (CGWB)** by	For **GEOLOGICAL SURVEY OF INDIA (GSI)** by
Signature:	Signature: Name: Designation:
Name: ए. के. बिसवाल / A. K. Biswal वैज्ञानिक-ई / Scientist-E & Head of Office केन्द्रीय भूमि जल बोर्ड / Central Ground Water Board उत्तर मध्य क्षेत्र, भोपाल / North Central Region, Bhopal	शुभ्रशुचि सरकार/ SUBHRASUCHI SARKAR उपमहानिदेशक/ Dy. Director General भारतीय भूवैज्ञानिक सर्वेक्षण/Geological Survey of India खान मंत्रालय,भारत सरकार/Ministry of Mines,Govt.of India रा.ई.म.प्र.,भोपाल/SU:M.P.,Bhopal
Designation: जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग / Dept. of Water Resources, RD & GR जल शक्ति मंत्रालय / Ministry of Jal Shakti भारत सरकार / Govt. of India भोपाल / Bhopal	
In the presence of	In the presence of
Witness 1.	Witness 1.
Signature: 28/6/23	Signature: 28.06.2023
Name: Dr RAKESH SINGH Dr. Rakesh Singh Scientist-D Government of India Ministry of Jal Shakti Department of Water Resources, River Development & Ganga Rejuvenation Central Ground Water Board, NCR BHOPAL (M.P.)	Name: शुभ्रांशु सान्याल/SUBHRANSU SANYAL निदेशक/Director भारतीय भूवैज्ञानिक सर्वेक्षण/Geological Survey of India खान मंत्रालय, भारत सरकार/Ministry of Mines, Govt.of India रा.ई.म.प्र., भोपाल/S.U.M.P., Bhopal
Designation:	Designation: 28.06.2023
Witness 2.	Witness 2.
Signature: 28/6/2023	Signature:
Name: Anakha Ajai	Name: दिलीप कुमार यादव/Dilip Kumar Yadav निदेशक/Director
Designation: Scientist-C ANAKHA AJAI Scientist-C Government of India Ministry of Jal Shakti D/o Water Resources, RD & GR Central Ground Water Board BHOPAL (M.P.)	Designation: भारतीय भूवैज्ञानिक सर्वेक्षण/Geological Survey of India खान मंत्रालय, भारत सरकार/Ministry of Mines, Govt. of India रा.ई.म.प्र., भोपाल/S.U.: M.P., Bhopal