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BFSC

14th International HCH and Pesticides Forum

TAUW Foundation

ASGM Mercury pilot remediation in Lombok and West Sumbawa
Inception, site survey and the tier 3 risk assessment

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Content of presentation

ASGM Mercury pilot remediation in Lombok and West Sumbawa

- The project objectives
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- ASGM at Lombok and Sumbawa
- Phase 1 - The generic ICSM of an ASGM site
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- Phase 2 - The tier 3 risk assessment
- Phase 3 - The pilot remediation
- Phase 4 - The toolkit to remediate ASGM sites

The project objectives

- Raise awareness on the impact of ASGM using mercury
- Develop remedial approach for Hg contaminated ASGM sites
- Pilot remediation of Hg contaminated ASGM
- Develop a toolkit to remediate Hg contaminated sites

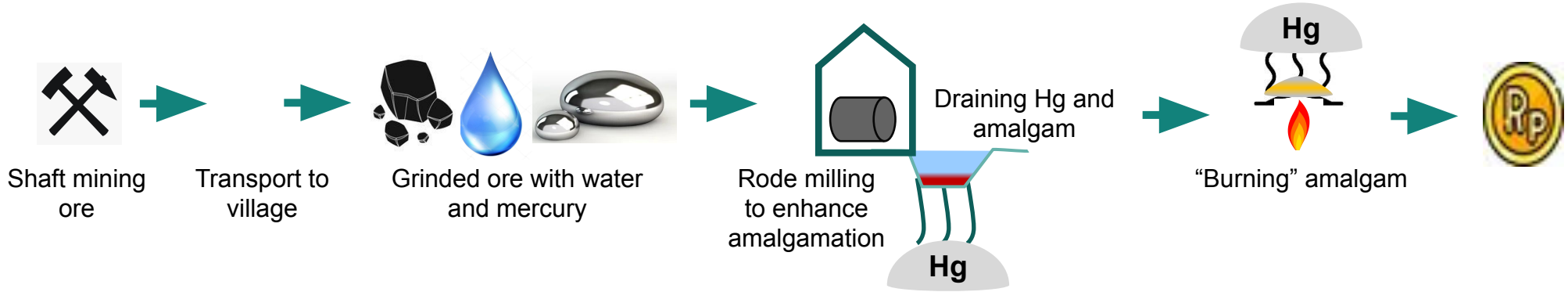
The project phases

1. Inception, investigations and selection of pilot remediation site
2. Tier 3 risk assessment
3. Remediation and monitoring
4. Outreach and development of a toolkit to remediate ASGM sites

Phase	2022	2023	2024
Inception			
Tier 3 risk assessment			
Remediation			
Awareness raising			

ASGM at Lombok and Sumbawa

- 11 villages visited at Lombok and Sumbawa
- The majority of the families in these villages practicing ASGM and use mercury
- The villagers are aware of the negative health impact when using mercury
  - ✔ Majority is drinking bottled water and do not drink water from domestic shallow wells
  - ✔ Some families are only using mercury for high prospect ore
  - ✔ Very few families have completely stopped with ASGM



ASGM at Lombok and Sumbawa

Excess use of water

Excess us of mercury for amalgamation

Mercury & amalgam poured in cloth

Excess of mercury separated from amalgam

Amalgam from around 20 kg of ore

The amalgam ready for burning

Amalgam burning station

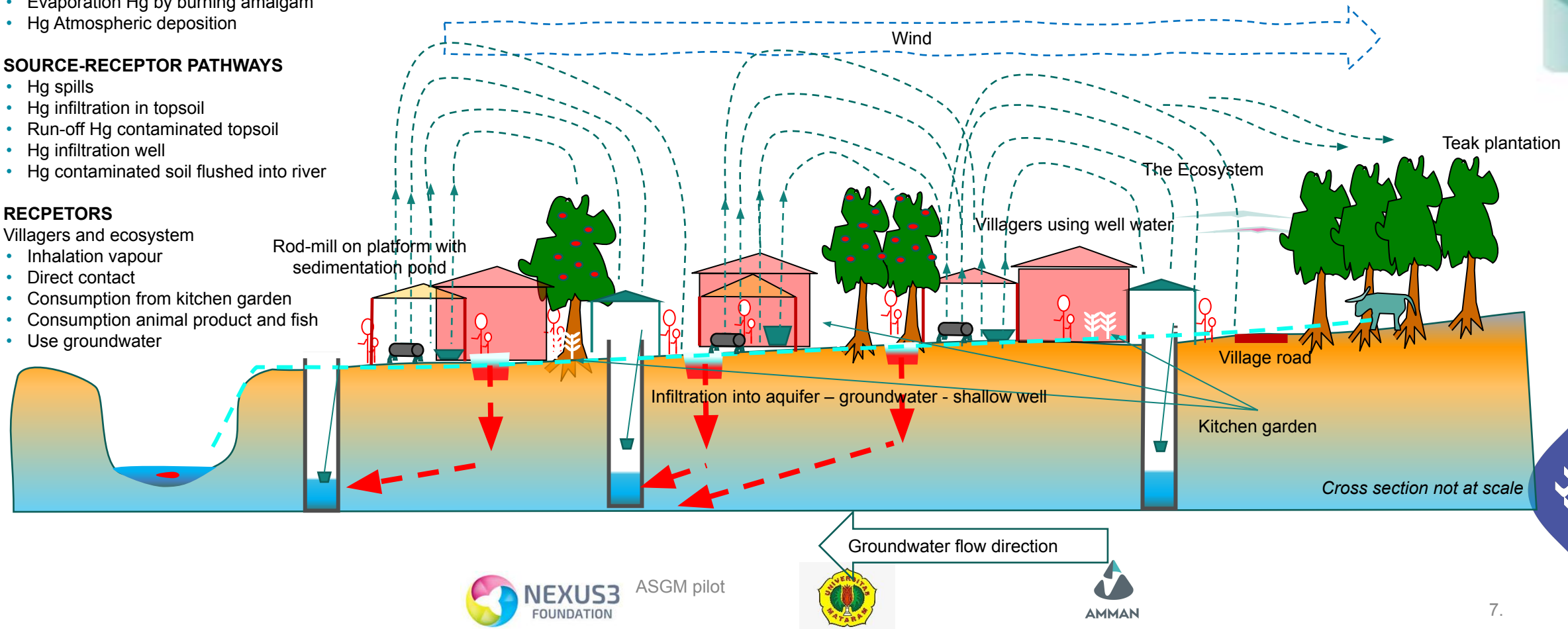
Phase 1 - The generic ICSM of an ASGM site

ASGM is practice in more or less the same manner therefore the ICSM is more or less the same for these Hg contaminated ASGM sites

SOURCES
- Hg use in ASGM
- Evaporation Hg by burning amalgam
- Hg Atmospheric deposition

SOURCE-RECEPTOR PATHWAYS
- Hg spills
- Hg infiltration in topsoil
- Run-off Hg contaminated topsoil
- Hg infiltration well
- Hg contaminated soil flushed into river

RECPETORS
Villagers and ecosystem
- Inhalation vapour
- Direct contact
- Consumption from kitchen garden
- Consumption animal product and fish
- Use groundwater



Phase 1 – The generic ICSM of and ASGM site

Source

- Use of Hg in the gold amalgamation
- Groundwater in shallow wells, below the drinking water norm of the WHO, but all above the Dutch Intervention Value
- Topsoil around rod mills slightly contaminated
- Subsoil and the sludge sedimentation ponds varies between slightly, moderately and strongly contaminated
- Highest concentrations are measured in the ponds which were actively or recently used at the time of the sampling
- The topsoil in the village is slightly contaminated with mercury
- Conclusions
  - ✔ The primary source of the mercury contamination is the ASGM using gold mercury amalgamation
  - ✔ The secondary point sources are the sedimentation ponds and the topsoil

Phase 1 - The generic ICSM of an ASGM site

Source – receptor pathways

- Hg spills during the amalgamation
- Hg evaporation during burning of the amalgam
- Hg infiltration in topsoil
- Hg infiltration in groundwater
- Use of contaminated groundwater in households and to irrigate kitchen gardens and to water livestock
- Run-off Hg contaminated topsoil
- Hg contaminated soil flushed into river

Phase 1 – The generic ICSM of an ASGM site

Receptors

Villagers

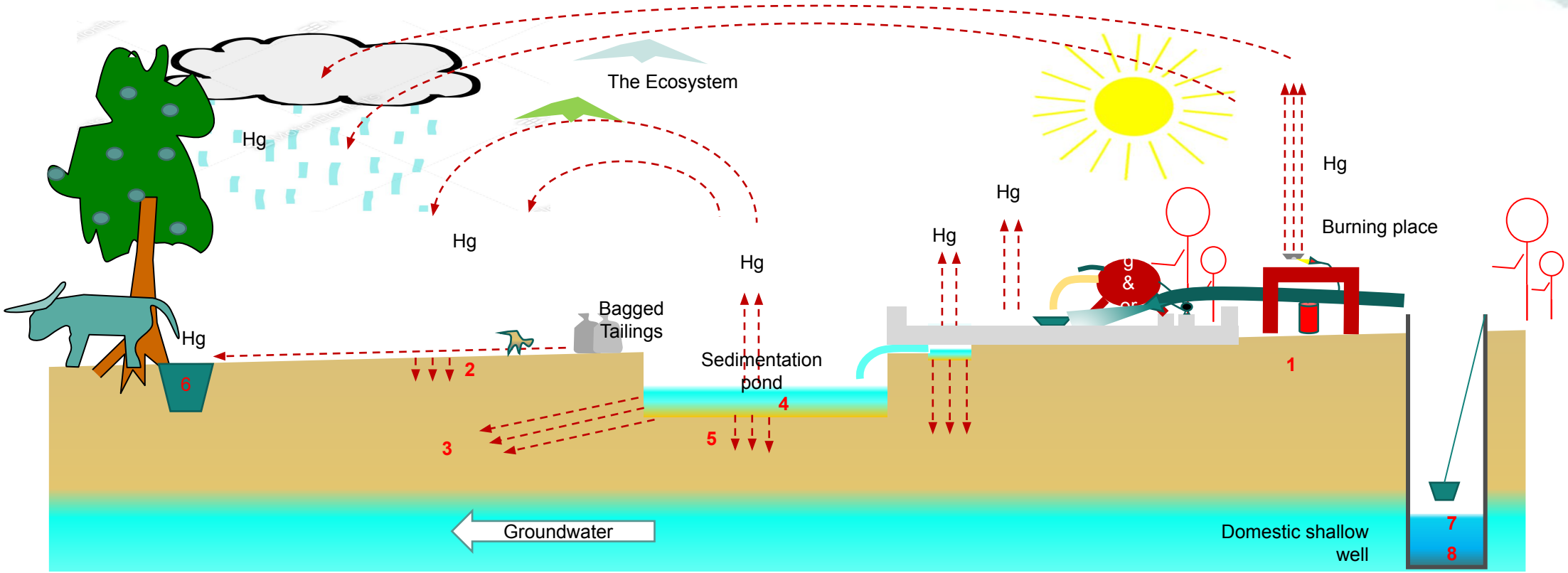
- Inhaling Hg vapour during burning of amalgam
- Inhaling Hg contaminated fine particles and Hg vapour from deposits
- Having direct contact with Hg and Hg contaminated objects and soil
- Consuming products from kitchen garden growing on contaminated topsoil and watered with contaminated groundwater
- Consuming animal product from livestock foraging on contaminated land and watered with contaminated groundwater
- Consuming contaminated fish from nearby waters

Ecosystem

- Inhaling Hg contaminated fine particles and vapour from deposits
- Having direct contact with Hg contaminated soil and sediments

Phase 1 - The ICSM of the pilot remediation site

Practiced ASGM with one rod mill on a family compound in the middle of the town



1 till 8 are the numbered gaps in the ICSM

Phase 1 - The CSM of the pilot remediation site

The soil survey results

Legend

- Site contour
- Rod-mill platform
- Backfilled sedimentation pond
- Domestic shallow well
- Borehole
- Monitoring well
- <S
- <S <T
- >T <I
- >I
- > 10 x I

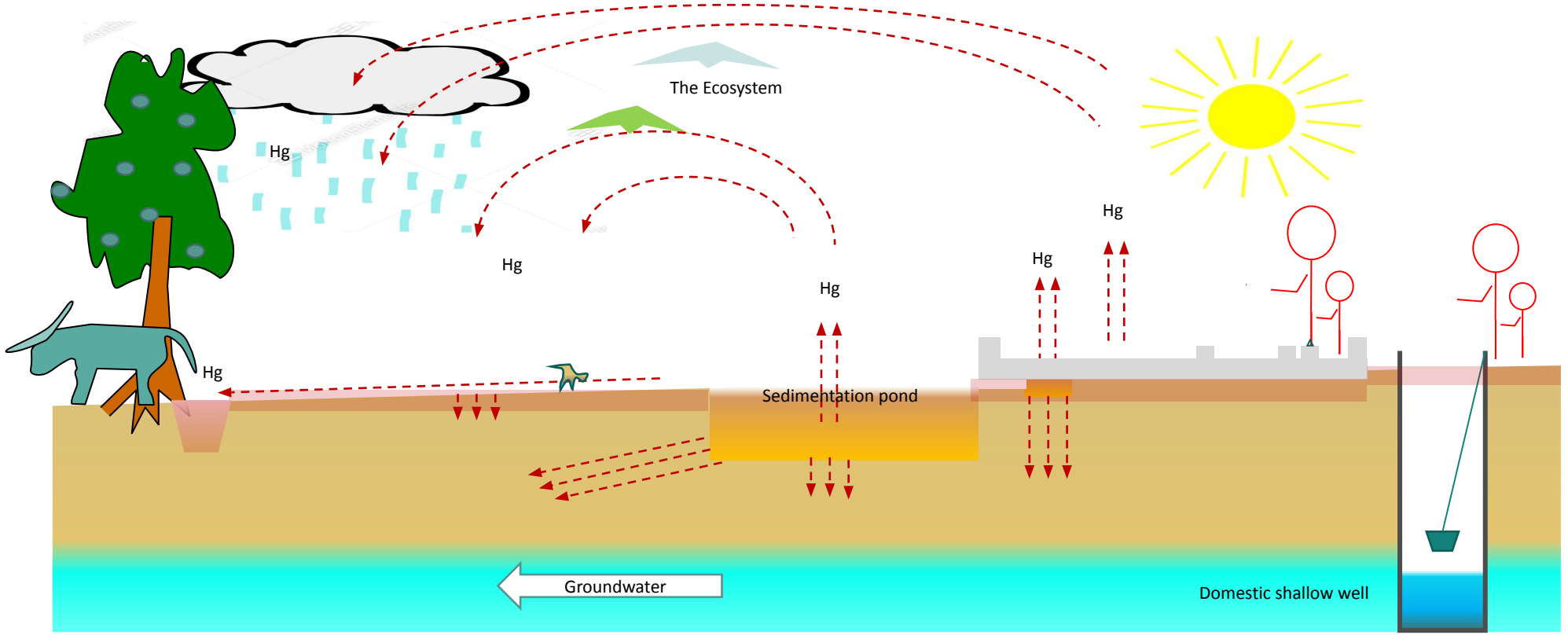
Soil
S = 1 ppm
T = 18.1 ppm
I = 36 ppm

Groundwater
S = 0.05 ppb
I = 0.3 ppb

Phase 1 - The CSM of the pilot remediation site

ASGM completely stopped two years ago

The CSM of demonstrates that contamination persists



Phase 2 - Tier 3 risk assessment

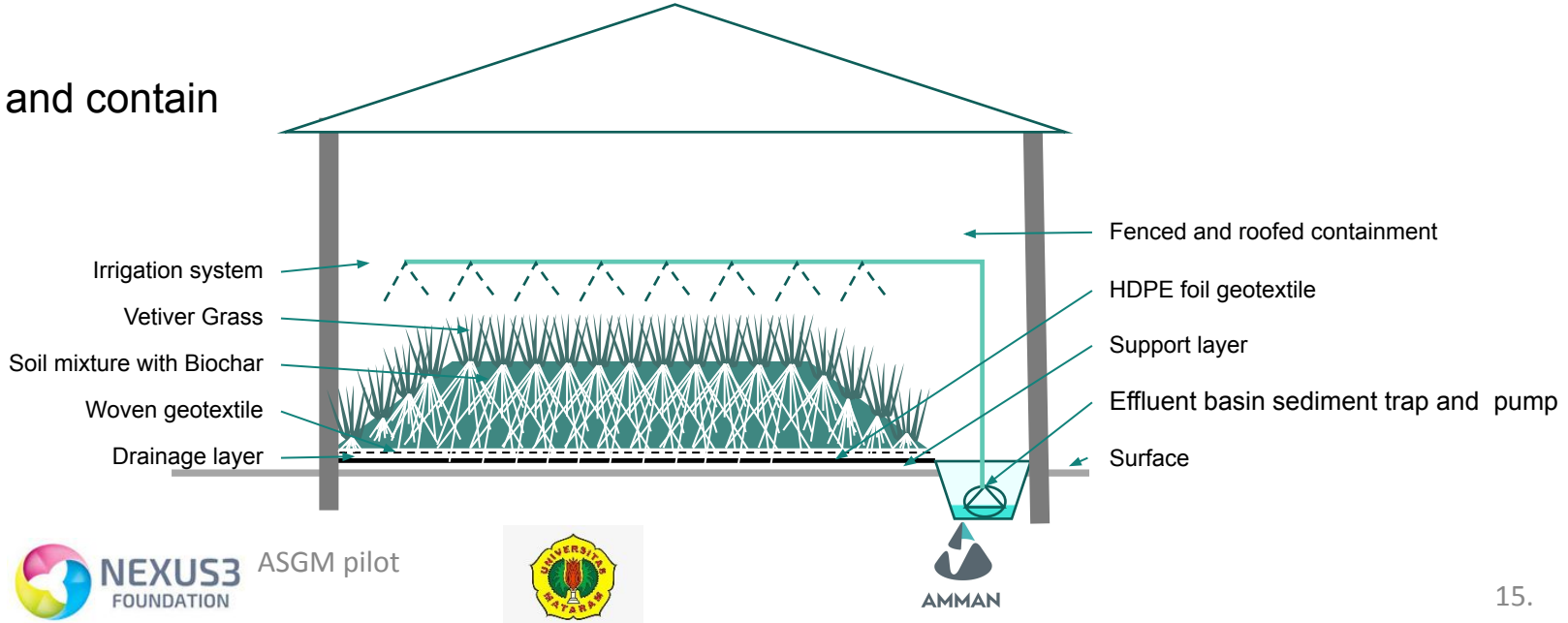
Human health risk assessment concluded that:

- Human health risks cannot be excluded at the site
- The most critical exposure routes are in order of magnitude:
  - ✔ Consumption of vegetables grown onsite
  - ✔ Consumption of meat from livestock feeding onsite
  - ✔ Groundwater exposure (in case of using groundwater as drinking water)
  - ✔ Indoor air exposure
  - ✔ Soil exposure (mainly soil and vegetable ingestion)

Phase 3 - Pilot remediation

At the selected pilot site ASM has completely stopped

- Soil remediation is justifiable as recontamination is excluded because ASGM has stopped
- The groundwater is impacted at and around the site in levels around the drinking water norm
- Groundwater remediation is not justified as elevated mercury levels are probably regional
- Based on a multicriteria analysis the proposed remediation strategy is:
  - ✔ Excavate
  - ✔ Ex-situ bioremediation and contain



Phase 4 - The toolkit to remediate ASGM

Based on pilot remediation toolkit to remediate will be developed

- Demolition of the contaminated rod-mill platform
- Excavation of contaminated soil and sediments and backfilling excavation with clean soil
- Removing contaminated sludge from the shallow wells
- Sealed and controlled transport of contaminated soil, sediments and rubble to a secured treatment cells
- Pre-treatment of contaminated soil and sediments by taking out all waste and stones
- Pre-treatment of contaminated construction waste by crushing in small gravel size aggregates
- Mix contaminated soil, sediments with crushed rubble and Biochar
- Place the soil mixture in a secured treatment cell in a layer of not more than 2 meters
- Plant Vetiver Grass on the soil in the cell
- The Biochar will immobilize and the Vetiver Grass will absorb the mercury
- Monitoring the immobilization and absorption of mercury

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THANK YOU FOR YOUR ATTENTION

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