



The Government is emphasising compulsory teaching of science in O'level. However, with it comes the use of an array of chemicals during practical science lessons, and there are no guidelines for safe disposal of chemicals. In the first part of three-part series, **Gloria Nakajubi** exposes the risk

On average, as much as 1.5kg of chemical is released into the environment during a chemistry practical lesson from one school annually. With science subjects compulsory in Uganda, the over 3,000 secondary schools could be discharging an estimated minimum of 4.5 tonnes of particular chemicals into the environment annually, without any disposal guidelines. This is equivalent to poorly disposing of 100 bags of cement chemicals in the food chain.

In a shocking discovery, both the National Environment Management Authority (NEMA) and the Ministry of Education and Sports do not have any guidelines on safe disposal of chemicals used in school practicals.

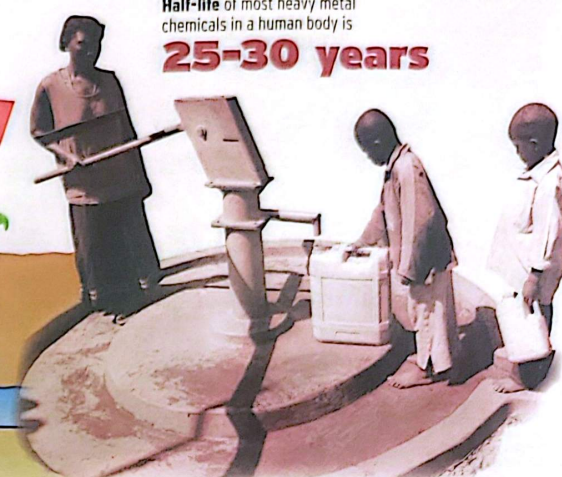
Naome Karekaho, the spokesperson for the environment watchdog says it was the primary responsibility of the education ministry to ensure proper disposal of waste chemicals from schools. Karekaho further reaffirms that, schools, like all institutions engaging in activities with potential harm to the environment, are first required to carry out an environment impact assessment (EIA). That implies every school has an EIA certificate, but none of the 20 leading schools sampled across the country had an EIA certificate. Asked how often the environmental agency reaches out to schools regarding such matters, Karekaho says: "Schools have inspectors who should be responsible for ensuring that they adhere to all standards including chemical waste management. It is, therefore, a duty of the education ministry."

Education ministry expressed ignorance that it was their responsibility to enforce environment standards. As such, the ministry has no guidelines for safe disposal of waste chemicals. "I am certain there is nothing, such as guidelines from the ministry, but we expect schools to come up with measures of proper disposal of their waste chemicals," said one of the commissioners for secondary education. The Instructional Materials Unit at the ministry, a unit ideally charged with such issues, distanced



Are school LABORATORIES killing Ugandans silently?

Half-life of most heavy metal chemicals in a human body is **25-30 years**



itself from chemicals. "Yes, ideally the unit should be in charge of such materials, but the reality is different," Deus Monday, a principal education officer attached to the unit, says. "We only supply instructional materials to primary schools. Secondary schools are almost decentralised. So, we cannot dispose of what we do not buy," Monday explains. James Droti, a chemistry expert at the National Curriculum Development Centre (NCDC), in Kyambogo, Kampala says there are currently no guidelines attached to the practical lessons for schools. "We need to develop and design a manual for handling chemical usage in schools," he says. Though, he too concurs that schools are a source of environmental pollution, Droti argues that there are other major sources of the hazardous waste.

Gravity of the problem
Schools use an array of chemicals in practical science lessons, especially chemistry. A well-equipped science laboratory may stock up to 20 harmful reagents/chemicals. The commonest used substances in science practicals include heavy metals such as lead, copper, mercury, zinc, aluminium and cadmium. With science subjects compulsory, it means at least about 300,000 candidates do practical examinations annually. Last year alone, 316,624 O'level candidates did the national examinations. However, before the exams, the four months of preparation for the national examinations can only raise more questions on how the schools dispose of the potentially

hazardous waste. Dr Mohammad Ntale, an associate professor at Makerere University's chemistry department, in one of the key experiments carried out in secondary schools is the qualitative analysis used to detect sulphur ions. This is done using lead nitrate. Similarly, Prof. Patrick Ogwok, the head of the food technology department at Kyambogo University says the fact that lead analyses often appear in national exams pushes schools to focus on that. The experts explain that sometimes, a class of about 100 students might carry out the qualitative analysis practical using lead about three times a year. A student might use as much as five grammes (equivalent to five teaspoons) of the compound in one experiment. This, therefore, means 1.5kg in one academic year. If the 1.5kg is spread out, considering the about 3,000 secondary schools in the country, the figure comes to about 4,500kg. This does not include the heavy metals used in other institutions of learning, such as universities and other tertiary institutions.

The disposal dilemma
With no guidelines, schools are disposing of the waste chemicals the way they choose to. Richard Walugere, an author and a chemistry teacher with experiences spanning two decades, says most schools, especially those not connected to the National Water and Sewerage Corporation system, simply dispose of the used chemicals in soak pits, just like any other waste. "All the waste, therefore, leaches into the ground and who knows, maybe even up to the water table. Obviously, the chance of such ending up in drinking water is high," Walugere

Why is it a concern?
Most chemicals used in science experiments are a health risk with improper handling and disposal. They are known to increase the risk of cancers and kidney diseases as well as affect students' brain development. Though not directly confirmed to be related to school chemicals, a study released last year revealed that water in Kampala is high in heavy metals especially lead, up to 17 to the East African standards. The 2015 study by Kyambogo University's department of Food Technology assessed and November. Of these, eight were from public water taps, 12 from ground water fed spring wells and three samples each of bottled water and tap water. The study might not have explored the sources of the life threatening compounds, but a significant source. Bamuwamyie, one of the lead researchers on the Kyambogo study say schools just waste disposal measures. As revealed by most schools, the chemical waste is either poured out in the environment or is collected in soak pits like other water waste. This increases the risk of the chemicals leaching through to the water table.

observes. Moses Mugulire, a science teacher at Jinja SS explains that most schools in rural areas, have 'rooms' and not laboratories. So, in that case, waste chemicals are poured out into the compound. "There is nothing much you can do even when you know that this is quite harmful to the environment. I have not seen any guidelines, clearly stipulating how to handle chemical waste," Mugulire says. The headteacher of King's College, Budo, Patrick Baka Male, says they dispose of the

CHEMICALS USED

- A well-equipped science laboratory may stock up to 30 harmful reagents; off the 118 elements on the periodic table.
- LEAD
 - Lead nitrate
 - Lead chloride
 - Lead sulphate
 - COPPER
 - Copper oxide
 - Copper carbonate
 - Copper nitrate
 - Copper chloride
 - CHROMIUM
 - Chromium oxide
 - Chromium trioxide
 - Chromium sulphate
 - Manganese
 - Manganese
 - carbonate
 - Manganese II sulphate
 - ZINC
 - Zinc oxide
 - Zinc carbonate
 - Zinc sulphate
 - Sodium chromate
 - SODIUM
 - Dichromate
 - Mercury
 - Aluminium
 - Aluminium oxide
 - Aluminium nitrate
 - Nickel
 - Cobalt

Alarm bells
In the absence of guidelines and comprehensive studies on the impact of improper disposal of chemical waste, Ugandan schools could be one of the biggest unsuspected environment polluters, environmentalists have warned. Geoffrey Kamese, the programme manager in charge of chemical management at the National Association of Professional Environmentalists (NAPE) notes that, besides the reagents used in practical lessons, schools could be stuck with stockpiles of expired chemicals. "It is a human and environmental disaster we are courting!" laments Michael Bamuwamyie, a PhD student who has extensively studied chemical pollution in Kampala waters. Prof. Ogwok also expresses worry. This is because, most heavy metals have a low half-life and yet they are a danger to human health and environment. "The fact that there has been no comprehensive study on the significance of school laboratories to environmental pollution, it is an unknown massive risk in increasing cancer," Kamese observes. Schools with what seems to be properly functioning laboratories do not have property to separate chemicals from the other kinds of waste.

Cumulative impact
Maria Makuba Otaremwa, the managing director of Swift Waste Masters, a professional waste handling company warns against the way schools are disposing of the chemical waste. "Some schools think because they have big chunks of land, they can dispose of waste into the environment disregarding the environmental and human implication. Hazardous waste is supposed to be treated from plants in gazetted places devoid of human settlement. This should not be happening in schools," she warned. According to Bamuwamyie, the cumulative impact

of the chemicals could be grave, given the longer half-life, the time the chemicals take to break down or reduce their potency by half. For instance, half-life for lead is 25 years; meaning it takes 25 years for one gramme of the chemical to decrease by half. Bamuwamyie explains that when one eats food contaminated with lead, this settles in the kidney and bones. Lead, for instance, stays in the bones for between 25 and 30 years, hence increasing the risk of organ damage.

A heavy metal, Bamuwamyie explains, is any metallic chemical element that has a relatively high density and most of which are toxic or potentially carcinogenic (cancer-causing) even at low concentrations. They include mercury (Hg), arsenic (As), cadmium (Cd), lead (Pb) and mercury (Hg) all of which are used in Ugandan school practicals.

According to Dr Mohammad Ntale, an associate professor at Makerere University, because waste chemicals from schools with functional laboratories end up in soak pits or are released through the school waste water system, these spread out to the surrounding environment, water systems and leaching into the soils. This boosts the growth of plants around and people may not necessarily care. "Unfortunately, the crops will absorb the heavy metals and these will end up being consumed by people," he laments. Reports by the US Environmental Protection Agency indicate that heavy metals, such as arsenic, cadmium, lead, mercury, manganese, nickel (Ni) and zinc are endocrine-disrupting chemicals, which interfere with the production, release, transport, metabolism, binding, action or elimination of natural hormones in the body responsible for the maintenance of homeostasis, reproduction, development and behaviour.

Next week, our investigations expose how schools are stuck with laboratory chemicals