

The ghosts of old computers

In a rare example of cooperation, Israelis and Palestinians are working together to clean up electronic waste in polluted communities.

By Josie Glausiusz

Bidoo Cave in the hills west of Hebron opens with towering arches that lead through subterranean chambers carved perhaps thousands of years ago. Cut into the walls of one cavern are hundreds of small, rectangular niches where ancient residents once raised pigeons for meat, eggs and ritual sacrifice.

The cave could be an archaeological treasure, but soot coats the walls and the floor is littered with rubbish, including burnt tyres and wiring. Deep inside the cavern, beside a giant rock, is a lone upside-down computer monitor.

Bidoo is used by local children to burn 'e-waste' — mostly leftover foams and plastics from computers and televisions. Electronics are dismantled in nearby villages as part of a massive recycling industry outside Hebron in the Palestinian territories. The scale of this industry is enormous: roughly half of all the e-waste generated in Israel finds its way to a cluster of four villages in the area. About 80% of households there — including both adults and children — are involved either directly or indirectly in processing e-waste to extract copper and other valuable metals.

The informal, unregulated trade takes a heavy toll. Hundreds of e-waste burn sites are scattered about the region and have polluted the soil with lead, as well as dioxins and other toxic compounds. "The landscape is saturated with these contaminants," says Yaakov Garb, an environmental scientist at Ben-Gurion University of the Negev in Sde Boker, Israel, who has spent the past five years mapping the burn sites and assessing their effects on the health of people who live nearby. "Most houses are within a stone's throw of a current site or former site."

Locals say that the burning sickens entire villages with respiratory illnesses, and water that runs off the contaminated hillsides kills vegetation. Although medical information there is spotty, preliminary studies have found very high lead levels in children. And studies of exposure to similar e-waste sites in China have documented a range of health effects, including increases in spontaneous abortions, still births, DNA damage and breathing difficulties¹.

Now, an innovative plan is taking shape to clean up the electronics recycling industry in the Hebron Hills. Garb is working with local leaders, government agencies and nongovernmental organizations to remediate the toxic sites and replace burning with non-polluting recycling methods that still allow residents to earn a living. The Swedish International Development Cooperation Agency (SIDA) plans to

Palestinians burn refrigerator motors to extract valuable metals in the village of Idhna. Locals blame health problems on e-waste recycling.

provide US\$2.7 million to support the project, which is awaiting approval by the Palestinian Authority. And in a rare example of cooperation, the Israeli and Palestinian governments are nearing agreements to put the plan into action, says Garb.

"What he's been able to pull together is nothing short of miraculous; getting both sides to agree like that at all levels, it's remarkable," says Richard Fuller, chief executive of the non-governmental agency Pure Earth in New York City, which will be overseeing the project. The Palestinian clean-up scheme, he says, could serve as a model project for similar toxic e-waste sites in poor communities around the world, where millions of tonnes of electrical equipment gets dumped each year.

BORDER CROSSINGS

Garb has a long history of working across borders — both international and academic. Born in Johannesburg in 1960, he came to Israel as a 13 year old with his parents, who saw no future in apartheid-era South Africa. He has studied irrigation in sub-Saharan Africa, former toxic waste sites in the Czech Republic and deforestation in Guatemala.

E-waste caught his attention in 2008, when he noticed something odd while conducting a freight survey in the southern West Bank. Each morning, 70 to 80 trucks left the Hebron area and passed into Israel. They returned to the West Bank each night, laden with washing machines, refrigerators, toaster ovens, LCD screens, computers and furniture.

After publishing his traffic survey, Garb set the data aside for a few years, until he did a study analysing the water sources in hundreds of West Bank towns and villages. Residents of the town of Beit Awwa told a student working with Garb: "We used to collect the rainwater, but we



HEIDI LEVINE FOR NATURE



“What he’s been able to pull together is nothing short of miraculous; getting both sides to agree like that at all levels, it’s remarkable.”

don’t because of the ‘black rain.’ Laundry, hung out to dry, came back soot-coloured. The villagers blamed the black rain on the local recyclers, who burn electrical cables and wiring to extract copper.

That made Garb even more curious. He and another graduate student, John-Michael Davis of Memorial University of Newfoundland in St John’s, Canada, analysed the local e-waste economy from top to bottom by conducting hundreds of interviews and doing randomized surveys. Davis even moved to Beit Awwa for more than a year to immerse himself in the community. Their study² is the first to chart the entire e-waste recycling economy anywhere, says Garb. They found that the items in the trucks came from a variety of sources in Israel: technology

companies or government ministries upgrading computers or routers and disposing of the old equipment; repair labs that discard or sell old televisions or other hard-to-fix items; and households getting rid of old appliances. Some of it ends up in Beit Awwa, says Davis, where there is a big market for discarded furniture and appliances. Although many items are refurbished and resold, large quantities of electronic waste are dismantled and burnt in an industry spread across Beit Awwa and three adjacent villages: Idhna, Al-Kum and Deir Sammit. He and Garb calculated that some 60,000 tonnes of e-waste — about half of what is produced in Israel — were processed at these four villages in 2014.

Some residents break down or repair the equipment in informal facilities, and others burn components at more than 500 sites in and around the villages. About 70 of these sites have, at some point in the past decade, burned at least a tonne of waste per day over the course of a year, says Garb. The local industry took off in 2004 after the price of copper jumped and Israel’s construction of a security barrier made it difficult for Palestinian men in this area to cross into Israel for work.

TOXIC IMPORTS

This kind of e-waste traffic from prosperous to poorer communities happens around the world. According to a report³ compiled by the United Nations, an estimated 41.8 million tonnes of waste electrical and electronic equipment was generated in 2014 (See ‘Mountains of

e-waste'). Europe and Asia are the largest producers, and African and Asian countries — including Ghana, Nigeria, China, Pakistan, India and Vietnam — are key destinations for shipments of hazardous e-waste for dumping.

In the Palestinian territories and much of the developing world, recyclers rely on inexpensive methods — using hammers and axes to dismantle equipment and burning cables to extract the copper. These techniques are also among the most polluting. So when Garb became aware of the problem in what is practically his backyard, he felt compelled to try clean it up, he says.

In combination with Palestinian and Israeli officials, Garb and his colleagues are attempting to transform the illegal, unregulated enterprise into a formal recycling trade — with facilities that allow for safe extraction of valuable components. Instead of stamping out the industry, which he says would drive it elsewhere in the West Bank, Garb hopes to build a partnership that will benefit all parties.

A tour of Beit Awwa and surrounding villages reveals how much is at stake. An acrid smell fills the air as Garb walks past ramshackle workshops and blackened hills. One facility is stacked high with old lamps, refrigerators, sinks, cables, metal cabinets, motherboards, keyboards and a pile of binned metal scrap. Nailed to a pole outside, an old Hebrew sign warns, “Please keep [area] clean.”

A boy, about ten years old, saunters about in flip-flops over the greasy black ground. According to a small survey by Garb, the average age at which burners start in the industry is 15.

Many residents worry about the recycling industry. At a burn site close to a quarry east of Idhna, two men driving past in their truck stop to talk to Garb. They complain that rainwater run-off from the fires has rendered nearby fields so contaminated that crops cannot grow there. During burning, chickens die or lay eggs without shells or yolks, say the workers.

In an unpublished study, Garb and Davis found hints that one type of cancer might be more common near burn sites. Garb has worked with a local group, Al Yassaria Women's Association, as well as Noam Weisbrod, a contaminant hydrologist from Ben-Gurion University, to submit a proposal to the US Agency for International Development to study household exposure to e-waste burning and its health effects, including birth defects and cancer.

Preliminary results from other studies suggest that children in the area are getting high doses of heavy-metal pollution. Sulaiman Swaitti, a Palestinian nurse from Beit Awwa who is now a master's student in public health and environmental studies at Ben-Gurion University, analysed levels of lead in the blood of 22 children from Deir Sammit. Twelve children had concentrations above 5 micrograms per decilitre, the point at which the US Centers for Disease Control and Prevention recommends public-health action; the highest value was 18.7 micrograms per

decilitre. For comparison, a separate study⁴ of children in the West Bank found an average lead level of 4.2 micrograms per decilitre.

Swaitti plans to do a more formal study by measuring lead in blood samples from 40 children in each of the other villages, plus a control group. He will also test dust in their households for heavy metals, and correlate the results with school grades.

“We have been suffering from this e-waste for a very long time — from the emissions from the burning of plastics, copper and aluminium,” says Muhamad Sweity, administrator of the Al Yassaria municipality, which covers Deir Sammit, Beit Awwa and Al-Kum. “We suffer from many, many problems: contamination of water, agriculture, farm animals, nature.” Children who live close to the burn sites have breathing problems, he says, and olive-tree yields have declined year after year. “We tried several times to solve the problem with the aid of the police, the [Israeli] Civil Administration, the government — nothing helped us,” Sweity says.

Although burning e-waste is illegal, oversight in the area is complicated because local Palestinian police have to coordinate with the Israeli Civil Administration — which has military and administrative control of the area — to enter the region where much of the burning takes place. By the time police get there, the people responsible are typically gone. And many families earn their livelihood from recycling, so they are reluctant to give it up. What is really needed, Sweity says, is financial support for clean recycling companies, as well as better police enforcement and inspection schemes.

TWO WORLDS

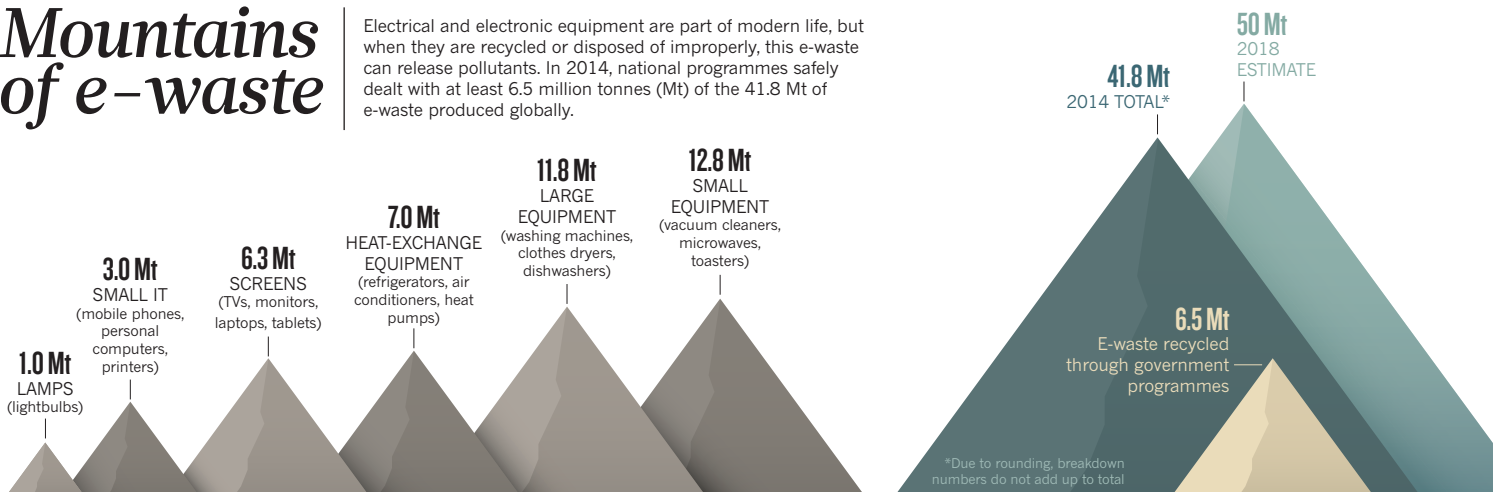
That's where Garb comes in. With his calm and easy-going manner, he gets a warm welcome in the Palestinian villages and also works effectively with Israeli authorities and other parties. “Somehow I seem to be put together in a way that allows me to move between the Arab and Jewish worlds, and between the social worlds of consulates and scrap yards, ministries and smugglers,” says Garb.

That sensibility has helped to give Garb a unique role in this area, says Johan Schaar, head of development cooperation at the Consulate General of Sweden in Jerusalem. Sweden has been active in promoting development in the Palestinian territories, and Schaar first met Garb three years ago. “What Yaakov has done, all this mapping that he has been able to do in these villages, that he has gained the confidence of all the people involved in this, is quite extraordinary,” he says.

Garb's efforts stand out, say others in the region, because there is a high degree of tension there, with little progress towards peace after nearly 50 years of Israeli occupation of the West Bank. In December 2015, SIDA gave Garb and Pure Earth a \$180,000 grant that funded a trial remediation of two sites in Beit Awwa. Workers used a tractor to scrape off the black surface goop, and then dug out the remaining toxic

Mountains of e-waste

Electrical and electronic equipment are part of modern life, but when they are recycled or disposed of improperly, this e-waste can release pollutants. In 2014, national programmes safely dealt with at least 6.5 million tonnes (Mt) of the 41.8 Mt of e-waste produced globally.





A young worker collects wiring from e-waste in Idhna.

“We suffer from many, many problems: contamination of water, agriculture, farm animals, nature.”

grime with picks and shovels. They transferred the material to a double-sealed plastic storage deposit at the same site. (Garb is now negotiating to move the contaminated soils to a certified facility for hazardous-waste disposal in Israel.)

That was just the first phase of a much broader project. In January this year, Garb and his team drew up an ambitious programme consisting of three components: clean up the hazardous-waste sites, create a sustainable Palestinian recycling sector and prevent further contamination of sites. The plan to build a sustainable recycling industry was key to convincing the Israeli Civil Administration to come on board, Garb says.

Schaar says that SIDA expects to provide a \$2.7-million grant, channelled through Pure Earth, to implement the broader plan. One part will be used to clean up 100 toxic waste sites. Another portion will fund an interim programme of free, legal copper recycling for residents of these villages. And a third will pay for a small rapid-response unit to shut down illegal burning.

Fuller says the project yields multiple benefits by “giving jobs to

the poorest, helping to build that economy, and that helps the whole peace process”.

The Israeli government and Palestinian Environmental Quality Authority are now in the final stages of negotiating an agreement to put the plans into place.

BACK TO THE GRIND

The cleaner future that Garb envisions is slowly taking shape in a small warehouse in Idhna. At the Safa Recycling and Material Processing company, workers shovel wiring from electronics and electrical cables into a \$220,000 grinding machine that shreds copper cables and separates them from their plastic sleeving. Safa’s owner, Ismail Suleiman, says that when he bought the machine, “everyone was happy and clapping”, but it has been difficult to turn that into a profitable business. Grinding the cables costs much more than burning them. And he had trouble obtaining the proper permits to import the cables legally from Israel, he says. “There is no enforcement of laws by the Palestinian Authority against burning,” he says. “Any way you look at it, it’s a mess.”

Money from the Swedish pilot project has helped. In February, the SIDA grant provided funds for locals to bring in cables for free grinding. Recyclers were so eager that they processed 15 tonnes in just 3 days, demonstrating that they might embrace a cleaner alternative to burning if it is economical. A portion of the new Swedish grant would provide an economic incentive to continue this legal recycling.

The Israeli government has also become involved in the clean-up efforts, because smoke from the four villages affects Israeli residents as well. Benny Elbaz, the Israeli Ministry of the Environment official who heads the West Bank environmental division of the Israeli Civil Administration in Beit El, is upbeat about the upcoming agreement. “We’re doing everything we can to ensure the success of this project,” he says.

Elbaz plans to expand the initial pilot recycling project at Safa to other materials and other companies. Garb, too, has high hopes for extending the scope of the industry. He foresees “competitive boutique recycling”, in which Palestinians develop their own micro-niches for hand-dismantling devices and extracting rare-earth metals such as neodymium from the powerful magnets found in microphones and hard drives.

Pure Earth sees the Palestinian–Israeli initiative as a model for how to clean up burn sites in urban centres of many other poor places around the world, including those in Africa. Fuller says that Garb’s project is one of the best designs he has seen, because it is politically viable. “I hope that we’re going to do it in many other places,” he says.

But making the shift from burning to clean recycling is challenging, says Kees Baldé, an associate programme officer at the United Nations University in Bonn, Germany, and co-author of the 2014 report³ on global e-waste. The higher costs of clean recycling and local corruption in many areas often conspire to doom such efforts. If the Palestinian–Israeli agreement succeeds, Baldé says, “I think that the societal impact is going to be big”. With proper facilities, e-waste recyclers will earn more money, and be protected from the toxins released by burning, he says.

Even if it works well, the project in the Hebron Hills will not completely solve the problem there, says Garb, although it will put a big dent in it. The blackened slopes around Beit Awwa and nearby villages show just how far he and his colleagues have to go in cleaning up the pollution. But here and there, a delicate purple wildflower or a green shoot pokes up amid the scattered phone cases and burned rocks — a sign of what could be. And the agreement over e-waste is a rare case of Israelis and Palestinians working together for a better future, says Garb, “to see beyond the politics of the moment to the long-term human and environmental significance”. ■

Josie Glausiusz is a science journalist in Israel.

1. Grant, K. *et al. Lancet Glob. Health* **1**, e350–e361 (2013).
2. Davis, J. M. & Garb, Y. *Techniques Cult.* **65–66**, 390–403 (2016).
3. Baldé, C. P., Wang, F., Kuehr, R. & Huisman, J. *The Global E-waste Monitor — 2014* (United Nations University, IAS — SCYCLE, 2015).
4. Safi, J. *et al. Environ. Health Perspect.* **114**, 917–922 (2006).