Cementing Justice

A Guide for Communities on Cement Production and its Impacts

KESAN

The Karen Environmental and Social Action Network

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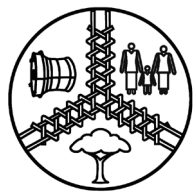
**The trees can be replanted if we cut them down,
but if we destroy that mountain
we can never get it back.**

”



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Introduction

About KESAN

The Karen Environmental and Social Action Network (KESAN) is a community-based, non-profit organization that works to improve livelihood security and to gain respect for indigenous people's knowledge and rights in Karen State of Burma, where the violence and inequities of more than 60 years of civil war have created one of the most impoverished regions in the world.

KESAN's approach to the development of sustainable rural livelihood is based on principles of democratization from below and "Free, Prior, and Informed Consent." We survey, carry out capacity building and facilitate dialogue to mobilize and empower local communities, leaders, organizations and policy makers who can then make better-informed development decisions.

About this Booklet

"Cementing Justice: A Guide for Communities on Cement Production and its Impacts" is an environmental booklet aiming to arm grassroots communities and civil society organizations in Burma/Myanmar and along the Thailand-Burma border with essential knowledge about the cement production processes, harmful impacts on social and environmental resources, and effective and practical strategies for communities and CSOs to protect their fundamental rights, land and environmental resources that they have inherited from their ancestors.

It is the hope of KESAN that this environmental booklet will empower grassroots communities, in particular those that have been affected and will potentially be affected by cement production projects and other destructive projects in their areas, so that they can voice their concerns and take effective measures to minimize the negative impacts of cement production in order to have a sustainable community.

How this manual is organized

In this booklet, there are three main sections. The first section, from chapter 1 through 3, explains the cement production process, and the second section, from chapters 4 through 7, discusses its potential impacts on the environment, health, and society. The last section, from chapters 8 through 11, provides information about minimization of negative impacts including international standards and principles, effective strategies to help local communities engage with cement companies and influence decision-making processes, and a case study from Karen State. A glossary is included at the end of the booklet for easy reference of technical terms.

Foreword

Burma is a country rich in natural resources, and its recent limited democratic reforms and economic liberalization have attracted vast and ongoing investments by local and foreign companies.These companies are investing in a variety of sectors, including oil and gas, hydropower, mining, manufacturing, hotel and tourism, agriculture and so on. However, Burma lacks both proper environmental regulations and adequate public awareness about the impacts of industrial activities.Unless these problems are addressed, natural resource investment is likely to cause disastrous and long-lasting environmental and social harm.

In Karen State, cement factories are among the development projects currently being approved by the Burmese government. Cement is used to make concrete, which is the most widely used human-made material on earth[1]. Concrete is used all over the world to build infrastructure. Even with the use of modern technology, cement production causes significant environmental and social problems by damaging the landscape, contaminating land and water, causing air and noise pollution, and depleting natural resources.

Air pollution from cement production is especially concerning, as exposure to cement dust released throughout the process can lead to major health problems. Additionally, cement production is a major driver of climate change. Because of its extensive energy consumption, cement production accounts for more than 5% of global Carbon Dioxide (CO_2) emissions[2].

By developing this booklet, KESAN aims to equip local communities in Burma and along the border with essential knowledge about the environmental and social impacts of cement production. We hope to empower affected communities to insist on their fundamental rights and protect their land and natural resources from contamination and exploitation. By doing so, we believe that communities will be able to more effectively take measures to minimize the harmful effects of development projects. Though this guide is tailored specifically for communities in Burma's Karen State, we hope its contents will be relevant and useful for local people affected by cement production in other parts of Burma and throughout the world.

[1] Crow, J. "The concrete conundrum." Chemistry World, 2008
[2] ibid

1. What is Cement?

Cement should not be confused with concrete, even though many people use the terms interchangeably. Cement is actually an ingredient used to make concrete.

Cement is a fine, soft powder made from a mixture of elements found in raw materials such as limestone, clay, sand and shale. Cement is usually grey, but white cement is also available, though it is usually expensive.

To make concrete, cement is mixed with water, sand, and gravel and then left to harden into a stone-like material. Concrete is used to build infrastructure like houses, schools, hospitals, bridges, office buildings, shopping malls, roads, dams, and so forth.

The global demand for cement and concrete is rising quickly because of rapid infrastructural development around the world:

- Concrete is the second most used substance in the world after water[3].
- Global cement production is expected to reach at least 3.7 billion tons per year by 2050[4].

2. Burma's Cement Boom

In 2012, Burmese factories produced an estimated 2.2 million tons of cement. With a demand of 7 million tons, the country made up the shortfall by importing cement from Thailand and other countries[5]. As one analyst writes for Global Cement magazine, "This kind of supply-demand gap excites foreign investors.[6]" And given that economic reforms have made the construction industry the most developed sector in Burma[7], demand for cement is likely to increase rapidly. Locally produced cement is cheaper than

[3] Adam, D. "The unheralded polluter: cement industry comes clean on its impact." The Guardian, 2014
[4] ibid
[5] "Myanmar: Offering Opportunities" World Cement, 2013
[6] Perilli, D. "Movers in Myanmar" Global Cement, November 2014
[7] Htun, T. "Developers push for production materials to be made locally" Myanmar Times, December 2014

imported cement, so investors are prioritizing expanding local production. This means that many of the country's 15 existing cement factories are being expanded or upgraded, and also that brand new factories and limestone mines are being proposed[8]. Companies from China, India, and Thailand plan to build factories throughout the country.

3. How is Cement Made?

Simple Overview

Cement is made from limestone along with small amounts of sand, clay, and shale. These raw materials are mined from the earth, and then transferred to a factory where they are crushed and heated to extreme temperatures. Once cooled, the materials are ground to a fine powder. This powder is the final product, cement, which will then be sold to concrete manufacturers.

Detailed Production Process

Quarrying

A quarry is an open pit mine that is created as heavy machinery digs into the land to extract natural materials such as limestone, rocks, and shale. Limestone, the main ingredient for cement production, is quarried by using explosives to blast the rocks from the ground. After blasting, huge power shovels are used to load dump trucks for transportation to the cement plant.

Making cement also requires small amounts of sand and clay, which contain four essential elements: calcium, silicon, aluminum, and iron. These materials are also obtained through mining.

Crushing

After the raw materials have been transported to the cement plant, the limestone and shale obtained from the quarry must be crushed into smaller pieces. The pieces are first dumped into primary crushers that reduce them

[8] "Myanmar: Offering Opportunities" World Cement, 2013

to softball-sized pieces. The pieces are then dumped into secondary crushers to crush the pieces into fragments no larger than three inches across.

Blending / Grinding

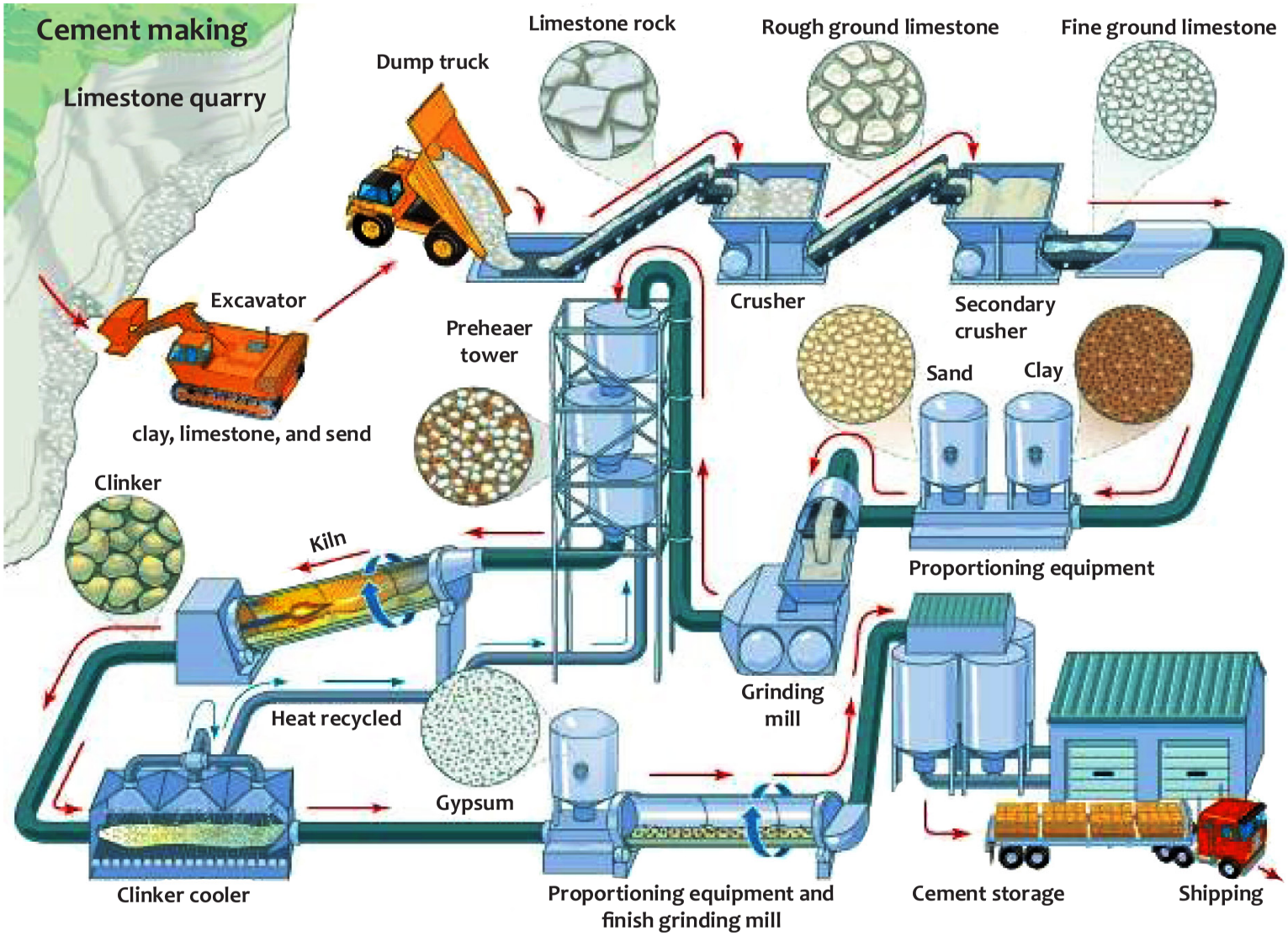
Blending or grinding, also known as homogenization, prepares the raw material for the kiln. The crushed stones are moved into ball or tube mills, which are cylindrical rotating drums that contain steel balls. These steel balls grind the materials into a fine powder. During this blending process, other materials such as fly ash or iron ore are often added to the limestone. Materials can be ground in the mill with or without water, depending on whether the plant is using the "wet" or "dry" process. The dry process is the most common around the world, as it is the most energy efficient.

Heating

Heating the blended raw materials is the key to make cement. The blended materials are dumped into the kiln, a cylindrical rotating furnace. The kiln is 12 feet or more in diameter and 500 feet or more in length. It is made of steel and lined with fire bricks, and made extremely hot by burning coal or other fuel. As the kiln revolves, the materials put inside it roll and slide downward for about 4 hours. In the burning zone, where the heat can reach 1,500 degrees Celsius, the materials burn brightly and change in color from purple to violet to orange. As the raw materials heat up, Carbon Dioxide gas (CO_2) is released from the limestone in a process called calcination. Next, the raw materials undergo a process called sintering, where they are heated at such a high degree that they become partially liquid, but without totally melting. The materials then fuse together into round, marble-sized, glass-hard balls called clinker. The clinker is then transported into a cooler for storage.

Finish Grinding

The cooled clinker is mixed with a small amount of gypsum, which will regulate the setting time of the finished concrete product once it is mixed with water. The clinker is again processed in primary and secondary grinders. The primary grinder leaves the clinker ground to the fineness of sand, and the secondary grinder leaves the clinker ground to the fineness of flour. This final product is then stored onsite in large dry holding tanks called silos, where it awaits preparation for marketing.


Cement making
Limestone quarry
Dump truck
Limestone rock
Rough ground limestone
Fine ground limestone
Excavator
clay, limestone, and send
Crusher
Secondary crusher
Preheaer tower
Sand
Clay
Clinker
Kiln
Proportioning equipment
Heat recycled
Grinding mill
Gypsum
Clinker cooler
Proportioning equipment and finish grinding mill
Cement storage
Shipping

4. Environmental Impacts

The environmental impacts explored in this section include the effects of cement production on life forms and on the physical environment. This section focuses on the local impacts of pollution and land use. For an in-depth discussion of the added environmental impacts of burning waste as fuel, which is a common practice to heat cement kilns and dispose of dangerous poisons, please see chapter 6. For an explanation of how cement production also contributes to global climate change, please see chapter 7.

The main environmental impacts include:

- Pollution of the air, soil, and water from contaminants like dust and mercury
- Damage and health impacts from noise pollution and vibrations
- Contamination from mining or factory waste that is not managed properly
- Deforestation, habitat loss, and erosion from mining
- Destruction of ecologically and culturally important limestone formations

Air, Soil, and Water Pollution

Cement factories are known to release a wide variety of harmful pollutants into the local environment. The list of pollutants is too long to discuss all of them here, so what follows is an overview of the most well-known and hazardous pollutants. Though most of these are initially released into the air, they often end up in the soil or water nearby, thus posing further threats to the health of humans and other living things in our ecosystem.

Many of the toxins released from cement plants pose a special threat to animal and human health through a process called bioaccumulation. For example, small amounts of mercury in the coal or the wastes used as fuel can cause mercury poisoning, as mercury emitted into the air through the smoke can dissolve in water vapor and fall as rain nearby. This mercury ends up in streams, rivers or lakes, and is taken in by the things fish eat. As it moves up the food chain (to bigger fish that eat many smaller fish), mercury becomes very concentrated. This can make eating some fish that are bigger and older very dangerous for humans, especially for pregnant women.

Dust/Particulate Matter

Cement dust, a form of particulate matter (small particles suspended in the air), is the industry's "most obvious pollutant," because it can be seen billowing like clouds out from the factory[9] and settling on everything around. This dust is emitted throughout the production process: from quarrying, transportation and stockpiles of raw materials, kiln operation, clinker cooling, and milling[10]. If inhaled for a long time the dust can cause serious respiratory illness. If cement dust covers leaves it can also harm local plants and crops by blocking the amount of sunlight that the plants can take in. Limestone dust is also a kind of fertilizer for acidic soils, but where the soil is already alkaline it can make it even more so, further limiting what can be grown in the area.

Carbon Monoxide (CO)

Carbon monoxide is emitted from the kiln during the burning phase of cement production. CO is a gas with no color or smell that is poisonous to people and animals at high concentrations[11]. Even at low concentrations, CO pollution may pose a risk to people with existing heart or lung conditions. CO released into the air can also lead to the formation of ground-level ozone[12] (see below).

Sulfur Dioxide (SO_2)

The limestone used to make cement, along with the large amounts of coal burned to heat it to very high temperatures, often contains sulfur impurities. Unless expensive special devices called "scrubbers" are put on the chimneys where the smoke comes out of the plant, these impurities are released into the atmosphere as sulfur dioxide[13]. SO_2 pollution is one of the primary causes of acid rain, which forms when the SO_2 combines with water in the clouds. The acid rain that falls from these clouds can gradually weaken and damage forest and aquatic ecosystems, killing off sensitive insects, frogs, fish and even big trees. Acid rain has also been known to cause the deterioration of buildings, statues, and cars[14].

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[9] Edwards, P. "Global cement emission standards." Global Cement Magazine, 2014
[10] Abdul-Wahab, S. "Impact of fugitive dust emissions from cement plants on nearby communities." Ecological Modelling, 2006
[11] "Carbon Monoxide" U.S. Environmental Protection Agency.
[12] "Cement Manufacturing Enforcement Initiative." U.S. Environmental Protection Agency.
[13] Edwards, P. "Global cement emission standards." Global Cement Magazine, 2014
[14] "Acid Rain" U.S. Environmental Protection Agency, 2014.

Nitrogen Oxides (NO_x)

The high temperatures in cement kilns cause the formation of nitrogen oxides, often simply referred to as "NO_X". Nitrogen originally comes from the air or the fuel used to heat the kiln, but is released as NO or NO_2[15]. Like SO_2, NO_2 can cause acid rain and its related breathing and ecological problems. NO_2 also reacts with other chemicals in the air to form ozone, a pollutant described below. Both SO_2 and NO_2 are known to cause heart and lung disorders, such as asthma and bronchitis[16].

Ozone (O_3)

Unlike "good" ozone that is present high up in the atmosphere, ozone produced at ground level is known as "bad ozone" because it is harmful to human health. Ozone is formed when NO_x, one of the main pollutants of cement production, reacts in the presence of sunlight with Volatile Organic Compounds (VOCs), chemicals in the waste gases that are released from cement plants. High concentrations of ground level ozone can lead to lung disease and can damage sensitive vegetation.

Mercury (Hg)

Cement production accounts for roughly 10% of global mercury emissions[17]. Mercury is a highly toxic, silvery heavy metal that damages the nervous system of children and adults that can result in serious illness, death and birth defects. Studies have found that levels of mercury in the air and soil around cement factories are higher than natural levels[18]. Limestone itself often contains mercury, which is released upon heating in the kiln. Mercury is also found in coal, so it is released when coal is burned as fuel for a cement factory. According to the environmental NGO, Earth Justice, "just 1/70th of a tea spoon of mercury, or 0.0024 ounces, can contaminate a 20-acre lake and render the fish in that lake unsafe to eat."

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[15] "Alternative Control Techniques Document – NOx Emissions from Cement Manufacturing" U.S. Environmental Protection Agency, 1994.

[16] "Effects of Acid Rain - Human Health", U.S. Environmental ProtectionAgency, 2012http://www.epa.gov/acidrain/effects/health.html

[17] "Mercury releases from the Cement Industry."United Nations Environment Programme, 2014.

[18] Fukuzaki, N., Tamura, R., Hirano, Y. and Mizushima, Y. "Mercury emission from a cement factory and its influence on the environment." Atmospheric Environment, 1967.

Hexavalent Chromium (Cr^{6+})

Residents near cement plants should be especially concerned about the release of hexavalent chromium. Cr^{6+} is a type of chromium that is extremely carcinogenic, meaning that it causes cancer, when inhaled or ingested through contaminated drinking water. Cement plants have been known to release Cr^{6+} into the atmosphere from dust piles[19].

Other Heavy Metals

The term "heavy metals" refers to any metalloid element with toxic environmental effects. Though mercury is the most studied of the heavy metals emitted by cement plants, they can also pollute people's environment with high levels of zinc (Zn), lead (Pb), and cadmium (Cd) such as near a cement plant in Jordan[20]. Cement factories are also known to emit arsenic (As), nickel (Ni), chromium (Cr), and manganese (Mn)[21]. Another study found higher-than-average soil concentrations of less common toxic elements downwind of a cement plant, including cesium (Cs), europium (Eu), lanthanum (La), lutetium (Lu), rubidium (Rb), scandium (Sc), samarium (Sm), terbium (Tb), thorium (Th) and ytterbium (Yb). These are the so-called "rare earth" elements, some of them radioactive and therefore dangerous simply to be near. The study also found unsafe concentrations of barium (Ba) nearby[22].

Dioxins and Furans

Dioxins and furans are the common names for a family of very toxic substances. They have many negative health effects, including causing cancer, disrupting hormones, harming unborn babies, decreasing the ability of people to have children, and suppressing people's ability to resist illness[23]. Dioxins and furans are released from cement kilns that burn waste as fuel (see chapter 6).

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[19] Wilson, J. "Plant said to emit toxic dust." The Los Angeles Times. 2008

[20] Al-Khashman, O. and Shawabkeh, R. "Metals distribution in soils around the cement factory in southern Jordan." Environmental pollution, 2006.

[21] Cementing a Toxic Legacy?"Earth Justice, 2008.

[22] Bermudez, G., Moreno, M., Invernizzi, R., Pl'a, R. and Pignata, M. "Heavy metal pollution in topsoils near a cement plant: The role of organic matter and distance to the source to predict total and HCl-extracted heavy metal concentrations." Chemosphere, 2010.

[23] "Dioxins and Furans" U.S. Environmental Protection Agency

Benzene (C_6H_6)

Benzene is released from the coal burned by cement factories. Acute exposure can lead to drowsiness, dizziness, and headaches, as well as eye, skin, and respiratory tract irritation. Long-term exposure can cause cancer, blood disorders and reproductive problems[24].

Hydrochloric Acid (HCl)

Burning of coal with chlorine impurities, or use of chlorinated solvents, results in the emission of HCl from cement plants. Acute exposure may lead to eye, nose, or respiratory infections. Long-term exposure has been linked to skin and lung diseases[25].

Summary of pollutants from cement plants

Pollutant	Source	Health Impact	Ecosystem Impact
Dust	All steps of production	Respiratory illness	Harms vegetation
Carbon Monoxide (CO)	Burning coal and limestone	Respiratory illness	
Sulfur Dioxide (SO_2)	Burning coal and limestone that contains sulfur	Respiratory illness	Damage from acid rain
Nitrous Oxides (NO_x)	Nitrogen from the air is released as NO_x from kiln	Respiratory illness	Damage from acid rain
Ozone (O_3)	Formed when NO_2 reacts with VOCs and sunlight	Respiratory Illness	Harm vegetation
Mercury (Hg)	Impurities in coal and limestone	Nerve damage, birth defects	Harm to animals
Hexavalent Chromium (Cr^{6+})	Often present in cement dust	Cancer	Surface water contamination
Dioxins and Furans	Burning of plastic wastes for fuel	Cancer, reproductive issues, immune system suppression, hormone disruption	Harm to animals
Benzene (C_6H_6) and other VOC's	Burning coal	Cancer, blood disorders, reproductive problems	Surface water pollution, harm animals
Hydrochloric Acid (HCl)	Burning coal with chlorine or using chlorinated solvents	Skin and respiratory illness	Toxic to animals in acute levels

[24] "Benzene" U.S. Environmental Protection Agency
[25] "Hydrochloric Acid" U.S. Environmental Protection Agency

Waste

In addition to the toxic gases and dusts discharged in the burning process, residents near a cement plant should be concerned about how liquid waste (effluent) is discharged. Liquid waste can contain many of the heavy metals described above as well as other dangerous chemicals. There is a danger that ammonium nitrate (NH_4NO_3) leftover from explosives used in the quarrying can run off and accumulate in surface water, harming aquatic life.

Noise Pollution

Another major problem is noise pollution from various heavy machinery such as grinding mills, fan blowers, compressors, and conveyors, in addition to the explosives used for mining in the quarry. The US Environmental Protection Agency (EPA) defines noise as "unwanted or disturbing sound," noting that noise pollution can range from being a minor annoyance like disrupting sleep or conversation, to having serious health impacts. Loud noise from cement production can damage eardrums and cause hearing impairment of local people living nearby and those working at the plant, but noise can also impact health in several other ways.

People suffer from chronic noise exposure that causes a wide range of health problems:[26] sleep disruption, mood alterations, high blood pressure, memory loss, impaired performance, increased aggression, hypertension, nausea, headaches, argumentativeness, anxiety, learning impairment, and lack of motivation.

Noise pollution also threatens wildlife by masking natural sounds[27]. This could make it harder for prey to react when a predator is nearby, or for predators to locate their prey. Noise pollution also interferes with the ability for animals to communicate about sexual activity or warning of predators. For example, songbirds near noisy oil and gas production sites in Canada's boreal forest were found to have lower success finding a mate[28].

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[26] Stansfeld, S. and Matheson, M. "Noise pollution: non-auditory effects on health." British Medical Bulletin, 2003.

[27] Barber, J., Crooks, K. and Fristrup, K. "The costs of chronic noise exposure for terrestrial organisms." Trends in ecology & evolution, 2010.

[28] ibid

Vibration and Shock

Earth movement from explosions in quarry blastings, and from the movement of large heavy trucks can cause damage to houses and other buildings near roads or quarry sites. Vibration and earth movements have many of the same impacts as described above for noise pollution. Frequently they come together and magnify the disturbing effects on people and wild animals.

Deforestation

In many cases, trees are be cut down in order to make way for the cement factory, roads, and equipment. However limestone quarries needed to mine the raw materials for the cement manufacture pose a much greater threat to forested areas. These can be of particular importance as refuges for rare species are often very steep limestone formations that protect small areas of trees and rare plants that people cannot reach. Effects of mining related deforestation include reduced biodiversity, emission of greenhouse gases, disrupted water cycles (potentially causing flooding or contaminated water), and increased soil erosion[29]. Deforestation may also have dire consequences for local people who depend on forest products for their livelihood.

Habitat and Biodiversity Loss

Even in cases where forests are not being directly cut down to make way for a cement plant and its quarries, habitat loss of other kinds is still likely to occur. Loss of habitat for many wild birds, animals, fish and plant species occurs when an ecosystem is dramatically changed by human activity, through destruction, fragmentation, or degradation[30]. Cement production is likely to lead to all three of these threats to wildlife habitat. In particular, quarrying can lead to the destruction of sensitive limestone cave habitats, often home to bats and other organisms that are not adapted to live elsewhere[31]. At a limestone quarry in Malaysia, several new species of plants,

29 "Deforestation." WWF, 2014
30 "Habitat Loss." NWF, 2014
31 Langer, W. "Potential Environmental Impacts of Quarrying Stone in Karst— A Literature Review." USGS, 2001.
32 Juniper, T. "A tiny, rare snail in Malaysia has big consequences for global cement giant." The Guardian, 2014

spiders, and snails have recently been discovered[32]. Likewise, limestone mining in Burma risks wiping out species not found anywhere else. A very remarkable diversity of bird, animal and plant species find safe places to breed, sleep, feed and grow in the many different ecosystem niches that are found in caves, cliffs, steep mountains, fertile lands, and karst formations.

Erosion

Limestone quarrying associated with cement production is known to cause serious erosion, depending on the geology of the mining site and the practices used. Water use, drilling, and blasting, all contribute to erosion[33]. Severe erosion can increase the frequency of landslides and flooding.

Landscape Destruction

Limestone quarrying for cement manufacturing drastically alters the landscape, destroying what are in many places some of the most extraordinary cliffs, mountains and caves. Limestone or "karst" formations such as those on the floodplains of the Salween River and throughout the Dawna Ranges extending down to Tanintharyi Division and Southern Thailand are often extremely steep and of unusual shape, colour and beauty.

These formations have particular cultural, spiritual and aesthetic values for both the natural environment and local cultures. Limestone peaks in the region frequently are topped with pagodas, while the caves that are common in limestone cliffs are often places of religious importance.

The beauty karst formations and limestone peaks add to the environment also adds considerable value in terms of potential tourism revenue. There are many cases where entire hills have been flattened to make way for quarries, completely destroying the many present and future values of these exceptional landscape features[34].

[33] Langer, W. "Potential Environmental Impacts of Quarrying Stone in Karst— A Literature Review." USGS, 2001.
[34] ibid

5. Social Impacts

Social impacts are the probable effects of cement production on the socio-economic environment of people living in Karen Areas. Social impacts of cement production are likely to include:

- damage to the health and safety of local people
- land confiscation,
- reduced food security
- reduced economic security due to loss of traditional resource-based livelihoods
- less access to fuelwood and clean water
- cultural loss
- potential harassment or violent conflict

Human Health

Cement factories are likely to have severe consequences for individual and community health of those living in close proximity to quarries or manufacturing plants. Many of these health impacts have been discussed above in chapter IV as they relate to pollution of the air, soil, and water. What follows is a brief overview of the types of health problems that may be associated with cement production. Health impacts are not limited to the list below, but these are the most common problems encountered.

Respiratory

Respiratory diseases are those that hinder a person's ability to breathe well, and include asthma and bronchitis, among many others. Around cement plants, respiratory diseases are likely to occur or be exacerbated by the inhalation of associated air pollutants such as cement dust and ozone. One study found that children who live near the dust plume of a cement plant experience higher rates of asthma[35]. Furthermore, cement dust usually contains silica, which when frequently inhaled can cause silicosis, a potentially fatal lung disease[36].

[35] Newcomb, P. and Cyr, A. "Conditions Associated with Childhood Asthma in North Texas." ISRN allergy, 2012.
[36] Abdul-Wahab, S. "Impact of fugitive dust emissions from cement plants on nearby communities." Ecological Modelling, 2006

Cancer

Exposure to many of the pollutants from cement factories can increase the risk of contracting cancer. For example, inhaling cement dust increases one's risk of lung, stomach, and laryngeal cancer[37]. Dust that contains hexavalent chromium (Cr^{6+}) poses an especially high cancer risk, and one study attributed high rates of stomach and rectal cancer among cement factory workers to Cr^{6+} exposure[38].

Cardiovascular

Cardiovascular diseases are those that affect the heart and blood vessels. As discussed in chapter 4, noise pollution from cement factories could lead to chronically elevated blood pressure, known as hypertension. Exposure to mercury released by cement plants could also increase the risk of heart attack[39]. Research shows that the rates of hospital admission for cardiovascular problems increase with exposure to cement plant emissions, especially among children[40].

Reproductive

Mercury and other heavy metals emitted by cement plants are known to cause birth defects and pregnancy complications. Studies have also shown that women living near cement plants are more likely to have preterm births[41].

Neurological

Mercury and other heavy metals also cause neurological problems, and can lead to severe developmental issues in infants and children. Earth Justice's report relates: "Even in low doses, mercury may affect a child's development, delaying walking and talking, shortening attention span, and causing learning disabilities"[42]. Children born to women exposed to high levels of toxic mercury can have severe brain damage and physical disabilities that

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37 Harley, J. "The Impact of Cement Kilns on the Environment." groundwork, 2007.
38 Koh, D., Kim, T., Jang, S. and Ryu, H. "Dust exposure and the risk of cancer in cement industry workers in Korea." American journal of industrial medicine, 2013.
39 "Cementing a Toxic Legacy?" EarthJustice, 2008.
40 Bertoldi, M., Borgini, A., Tittarelli, A., Fattore, E., Cau, A., Fanelli, R. and Crosignani, P. "Health effects for the population living near a cement plant: an epidemiological assessment." Environment international, 2012.
41 Yang, C., Chang, C., Tsai, S., Chuang, H., Ho, C., Wu, T. and Sung, F. "Preterm delivery among people living around Portland cement plants." Environmental research, 2003.
42 See footnote 35

require intensive lifelong care, which can be extremely difficult for a family to manage. In adults, neurotoxins like mercury can cause tremors, memory loss, and vision loss, or even more serious symptoms with greater exposure.

Workers' Safety

Workers at the cement factory are especially at risk for the health problems described above, since they are working in close proximity to the toxins. They are also at risk of physical injury from accidents.

Generally, a cement factory contains fast-moving and extremely hot material. Proper protective gear is needed to prevent any accidental injuries from stray pieces of material that fall. Quarry activity can also be risky for workers. During the quarrying process, explosives are used to mine the limestone. Establishing and implementing proper safety regulations is important in such a hazardous working environment, along with monitoring that such regulations and practices are applied.However, the cement industry – along with the entire mining industry in Burma - is notorious for poor treatment of its workers, failing to pay fair wages and neglecting safety standards. Several cement workers have died at factories as a result of industrial accidents[43]. At the mining operations at Shan State's Pinpet Mountain, seven workers were killed in 2007 after accidentally falling into a rock crushing machine[44]. Over 300 miners were killed in Mong Hsu ruby mines in 2000 when a massive series of explosions blew up warehouses where blasting equipment was stored in the densely populated mine area[45].

Safety training, use of warning sirens before blasts, good labeling, safe transportation, secure and isolated storage of dangerous materials and strong safety protocols are needed to avoid such disasters. Cement industry workers are also at risk of hearing loss from the high noise levels of machinery. The risk of harm to workers can be reduced with provision of proper safety attire, including masks, helmet, safety goggles, heat resistant gloves and overalls, and ear protectors[46].

Livelihoods and Food Security

Food security means that people have access to enough affordable and nutritious food. Cement production has the potential to threaten

[43] Steinweg, T. "Cement Sector Scan." SOMO, 2008.
[44] "Robbing the Future" Pa-Oh Youth Organization, 2009.
[45] Personal interviews with Shan and Ta-ang former mine workers, Images Asia, July 2005
[46] "Training manual for risk assessment in the cement industry" Cyprus Worker's Confederation.

villagers' food security if farmland is confiscated, livestock is harmed from pollution, pollution accumulates into the soil and then into crops, or surface water becomes contaminated with mercury or other toxics, making fish consumption unsafe. Villagers near existing cement factories in Karen State have complained that cement dust settles on their fields, damaging their crops[47]. Furthermore, restricted access to the forested areas set to be mined along with later deforestation would leave villagers unable to collect mushrooms, charcoal, and wood that they use or sell to generate income.

Cement companies may claim that building a factory will benefit a local community by providing jobs. While this may provide a small benefit, it is important to note that the great majority of jobs are likely to go to skilled outsiders and wages for employed locals may be very low. For example, Tibetans are protesting a cement factory where almost all of the workers are Chinese migrants[48]. Furthermore, it is possible that the number of jobs created will be low in comparison to the number of people who might lose their traditional livelihoods due to pollution or land confiscation. For instance, the Tigyit Coal project in Shan State employs around 500 people (mostly outsiders), but roughly 1,000 local people lost their livelihoods due to the project[49].

Cultural

There is a high risk that construction of cement plants in Karen areas could disrupt the traditional way of life, resulting in cultural loss. In particular, villagers may lose access to sacred sites or areas with plants used for traditional medicine if they are taken over for mining or construction. Mining activities could even damage important structures – such as when blasting at the Tigyit coal mine in Shan State destroyed an ancient pagoda[50].

An influx of outsiders for construction and operation of a cement plant may also shift local values, exacerbate gender inequality, and lead to an increase in gambling, drugs, alcohol, and prostitution. These impacts have been well documented around development projects in Kachin State, where sex trade and drug addiction in mining areas is especially common[51].

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47 KESAN interview with Mikayin Villager, November 2014

48 Tashi, L., Tso, C. and Tenzin, K. "Hundreds of Tibetans Protest Land Seizure Over Gold Mining Activities." Radio Free Asia, 2014.

49 "Poison Clouds."Pa-Oh Youth Organizaiton, 2011.

50 ibid

51 "Lessons from the Kachin 'Development' Experience."Kachin Development Networking Group.

Conflict

Cement factories in Karen State also have the potential to worsen conflict in the region, especially if the Burmese military or other armed actors are involved in the investment process. Development projects often lead to increased militarization and land grabs, which serve to undermine the ongoing peace process. A cement plant planned by a Chinese investor for an area north of Hpa-an is possibly linked to plans to build the nearby Hatgyi hydropower project, in relation to which there have been numerous incidents of fighting and displacement. Cement production has been linked to violent repression of opposition in many cases around the world. For example, in Guatemala, personnel of cement company Cementos Progresos shot at indigenous protestors, killing eight people[52]. Abuses such as those in Guatemala are especially likely in Karen State, which has faced a long history of conflict and violent repression of protestors. In Shan State, militarization around a proposed cement factory at Mount Pinpet has left local people vulnerable to violence and extortion[53].

6. Waste Incineration

Some cement plants may release more toxic air pollutants than others, depending on what kind of fuel they burn to heat the kiln. Traditionally, plants have burned large amounts of coal. Burning coal is harmful to the environment because it releases local pollutants like SO_2 and mercury, and also because it emits large amounts of CO_2, thus contributing to global climate change (discussed in the next chapter). To avoid burning so much coal, and also to save money, many cement plants get energy by what they call "co-processing" of alternative fuels. Though cement companies label this as a green energy policy, what this really means is that the plant burns hazardous waste along with coal. Hazardous waste incineration, which involves very high temperature burning of some of the most dangerous or poisonous substances produced by industry, is very controversial in many places where special incinerators are made to dispose of them. This arrangement is often good for municipalities that are looking for cheap

[52] "Eight Indigenous People Killed in Guatemala Cement Factory Clash." TeleSUR, 2014.
[53] "Robbing the Future" Pa-Oh Youth Organization, 2009.

ways to dispose of the city's trash; it is also lucrative for cement factories, as they acquire a cheaper energy source and may even get money from carbon credits for using less coal. However, burning waste like solvents, spent tires, waste oil and chemicals, paint residue, wood chips, treated wood and paper, municipal solid waste, medical waste, and sewage sludge[54] can be very harmful to local communities and the environment. It is not possible to know all the potential chemical reactions that can happen with the wide variety of powerful chemicals thrown into the fire.

The problem in many parts of the world is that "through burning waste, cement kilns become simply incinerators in disguise," not subject to the same stringent emissions standards as would be required for stand-alone incinerators[55]. In places like Burma, with no air pollution standards, both waste incinerators and trash-burning cement plants are likely to harm nearby ecosystems and communities.

The causes of health and climate change problem (Illustration - Saw Kaw Soe Soe)

[54] "Cement Kilns." GAIA, 2014
[55] Harley, J. "The Impact of Cement Kilns on the Environment." groundwork, 2007.

Burning waste results in higher emissions of toxic heavy metals like mercury, lead, and cadmium[56], the effects of which were described in section 4. Cement plants that burn waste also emit high levels of dioxins and furans, which come from plastics treated with chlorine. These toxic chemicals can be carried great distances by wind and water, and are easily taken up into the environment and the food web. Dioxins and furans are some of the most powerful poisons on planet Earth. They cause reproductive health and child developmental problems, they damage immune systems, interfere with people's hormones, and cause cancer[57]. An inventory by the US EPA found that cement kilns that burn hazardous waste emit 80 times more dioxins than those that just burn coal[58].

Besides harming local health, waste-burning cement plants may also cause economic harm. In many developing countries, informal recycling gives the poor population a source of income. Informal recyclers, or "waste pickers" rely on the availability of waste materials to harvest and sell for their livelihoods. If all the waste in an area ends up being collected and burned by a cement plant, these people are left without a source of income[59].

7. Climate Change

Climate Science

One of the cement industry's biggest environmental impacts is the huge amounts of carbon dioxide (CO_2) it emits, contributing significantly to global climate change. Carbon is a "greenhouse gas", meaning that when released into the Earth's atmosphere, it traps heat from the sun, thus warming the planet. Though some greenhouse gases are natural and good, too much causes pollution and harm. The majority of CO_2 pollution is released by burning fossil fuels (coal, oil, and natural gas) for energy and transport, and from deforestation. Because of human burning activity, over the past 50 years, the amount of CO_2 in the atmosphere has risen to unsafe levels, and

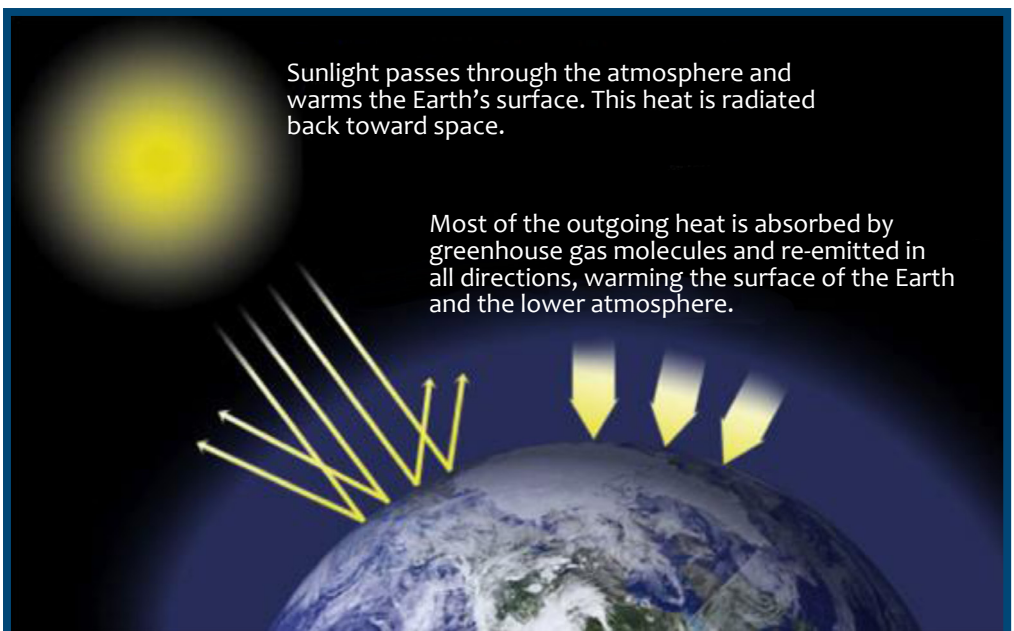
[56] Shah, D., Tangri, N., Tyler, B., Hlebarov, I. and Wilson, M. "Understanding Refuse Derived Fuel." Global Alliance for Incinerator Alternatives, 2013.
[57] ibid
[58] Harley, J. "The Impact of Cement Kilns on the Environment." groundwork, 2007.
[59] Shah, D., Tangri, N., Tyler, B., Hlebarov, I. and Wilson, M. "Understanding Refuse Derived Fuel." Global Alliance for Incinerator Alternatives, 2013.

the Earth is warming as a result. Over the past 130 years, the global average temperature has increased by a world average of 0.8 degrees Celsius and is continuing to heat up. The added heat in the climate system is already causing more deadly disasters. Most scientists agree we must keep global warming below a 2 degrees Celsius change to avoid truly catastrophic consequences.

Climate Impacts

Global warming is already causing serious harm to nature's ecosystems that all living things depend on and to human health and economies worldwide. Some of the impacts include rising sea levels and coastal flooding, longer and more damaging wildfires, more frequent and intense heat waves, an increase in extreme weather events like cyclones and typhoons, droughts in some areas and floods in others, disruption to food supplies, destruction of coral reefs, melting of ice on the snow mountains and at the poles, and loss of biodiversity.

Rich countries have historically emitted the most CO_2, but poor countries like Burma will suffer the most from climate change. Burma is one of the countries most at risk[60]. People in Burma will likely suffer from even stronger



Greenhouse Effect **(Photo - Internet)**

[60] "Climate change threatens Burma." DVB, (2012).

cyclones and flooding in low-lying coastal areas. As natural disasters become more common and agriculture is disrupted, people will be forced to migrate. Trying to reduce climate change by mitigating it instead of increasing it should be a top priority for Burma and Karen State.

Cement Production and Climate Change

Globally, cement production is documented to contribute to roughly five percent of carbon emissions. When a plant produces one metric ton of cement powder, it also releases roughly one metric ton of CO_2. Much of this carbon comes from burning vast amounts of coal needed to heat cement kilns to more than 1,500 degrees Celsius, and thus can be reduced by installing green technology to make plants more energy efficient. However, these reductions can only go so far, because CO_2 is also released in a process fundamental to manufacturing cement – the calcination of limestone. When crushed limestone (Calcium Carbonate or $CaCO_3$) is heated in the kiln to form clinker, CO_2 is released in the reaction below.

$$CaCO_3 \rightarrow CaO + CO_2(g)$$

Roughly 60% of the cement industry's carbon emissions come from this chemical reaction[61].

Besides the CO_2 pollution from the manufacturing processes a lot more CO_2 will also be produced per ton of cement from the energy used for mining and transporting the limestone and other materials, breaking the rock down into powder and other post manufacturing processes.

Since there is currently no alternative way to produce good quality cement on a mass-scale, and no sign that global demand for cement will stop its rapid rise anytime soon, the cement industry will likely continue to be one of the biggest drivers of climate change.

[61] Rosenthal, E. "Cement Industry Is at Center of Climate Change Debate." The New York Times, 2007.

8. Minimizing Negative Impacts

Given the wide range of potential negative social and environmental impacts associated with cement production, this section gives recommendations for how local communities can work to minimize those impacts. There are numerous ways communities can better ensure their well-being. Ideally, harmful projects should be stopped, though this is not always possible. Advocating for alternatives to traditional cement production, for mitigation measures at conventional cement plants, and for compliance with international environmental and human rights norms is another path.

Alternatives

There are currently several companies around the world developing innovative "green" cements. These projects aim to design a product that is more environmentally friendly than traditional cement, but just as reliable when used in concrete construction. Alternative cements are usually geared towards reducing carbon emissions by avoiding having to heat large quantities of limestone, but many are also likely to be less toxic to the local environment. Examples of alternative "green" cements being developed include:

- Using recovered CO_2 and seawater to mimic the process used by sea creatures to form hard shells[62]
- Using fly ash (waste from coal power plants) to form clinker instead of limestone[63]
- Lowering the calcium-silica ratio in the cement formula, thus using less limestone[64]
- Using Magnesium Silicate (dolomite rock) instead of limestone to produce a carbon neutral and recyclable cement product[65]
- Building out of Hempcrete, a plant-based cement alternative that would actually store carbon[66]

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[62] Fialka, J. "Can 'Green Cement' Make Carbon Capture and Storage Obsolete?" The New York Times, 2010.
[63] Amato, I. "Green cement: Concrete solutions." Nature, 2013.
[64] Chandler, D. "How to make stronger, 'greener' cement." MIT News, 2014.
[65] Rosenwald, M. "Building a Better World With Green Cement." Smithsonian Magazine. 2011.
[66] "What is Hempcrete?"American Lime Technology.

There are many more ideas for alternative cements, but most, including those listed above, are still in the testing phase. Questions remain as to whether production of these green cements can scale up enough to meet global demand, or whether they would be economically practical. It is also unclear what kind of pollutants these novel processes would release into the local environment. Still, local communities opposed to traditional cement production near their homes could push for exploration and adoption of new, more sustainable processes.

Mitigation

If plans for a cement plant are moving forward and alternatives to traditional cement production are unfeasible in an area, it is important to understand the possibilities for mitigating environmental and social impacts, which means reducing the amount or severity of the impact.

There are three mitigation approaches for addressing the negative impacts of cement production if the development project goes ahead: **avoidance**, **minimization**, and **compensation**. It is also good to call for proper **rehabilitation** at the end of a mining and manufacturing process; a necessary mitigation measure that should be done at the end of any environment changing process. Eventhough the end may be many years in the future, it should be planned - and most importantly - budgeted for from the beginning of the development.

1. Avoidance

Avoidance means locating cement plants and quarries at alternative sites, or using appropriate technology to eliminate social and environmental impacts. This approach is more effective when used at the early stage of project planning. Possible aspects of an avoidance approach include:

a) Not allowing the project to be implemented in certain areas that are environmentally or socially sensitive, such as a sacred site or an area with endangered species. Working to have these areas certified as protected areas or community forests may be a way to help prevent the area being mined.

b) Not burning hazardous waste to heat the cement kiln.

2. **Minimization**

Minimization means taking actions during the design, construction, and operation to minimize negative social and environmental impacts. For this approach, you must identify and predict the impacts for a long-term period. Possible minimization strategies include:

a) Scaling down the project

b) Selectively mining limestone and the coal used to heat it with less mercury and sulphur content

c) Using technology, such as filter bags or SO_2 scrubbers, to reduce pollutants released into the air.

d) If hazardous wastes are burned, strict regulation and monitoring is needed, and it is even more important that the appropriate scrubbers, filters and treatment mechanisms be installed. The resulting toxic fly ash should be safely stabilized.

3. **Compensation**

Compensation is used as a last resort to compensate for negative impacts and to remedy unavoidable residual impacts. Steps involved in this approach are:

a) Monetary compensation for damages (loss of livelihoods, loss of income, etc.)

b) New physical construction for affected local communities (e.g. houses, hospital, safe water supply, school, etc.)

c) Assistance moving, providing replacement land and/or livelihood sources of equal value, and livelihoods or vocational training.

4. **Rehabilitation**

Rehabilitation of the affected environment, for example, by covering mined areas with soil set aside at the beginning of the mining, then reforesting; restocking fish and natural habitat enhancement.

International Norms

When advocating for minimizing the impact cement production, referring to various international norms can be useful to lend legitimacy to the argument.

1. Pollution Standards

While there are no internationally agreed upon standards when it comes to pollutants released by cement production, there are standards for hazardous waste incineration that may apply. Many countries have their own national standards. In general, the limits for air pollutants from cement factories are roughly equivalent to the following:[67]

- Dust / Particulate Matter: 100mg/Nm^3
- Sulfur Dioxide (SO_2): 200 - 500mg/Nm^3
- Nitrous Oxides (NO_x): 500 - 1000mg/Nm^3
- Mercury (Hg): 0.05 - 0.10mg/Nm^3

2. Social and Environmental Protocols

In many countries, before a major development project like a cement factory or quarry can proceed, the company is required to conduct assessments of impacts and to submit for review certain safeguard documents. Examples of these are outlined below. The local community should be consulted as part of this process. It can be a valuable opportunity to express community concerns even though assessments often fail to address important issues.In Burma, unfortunately, requirements for assessments and for consultation with - and consent from - local communities is still lacking.

Environmental and Social Impact Assessment (EIA and SIA, or combined ESIA)

EIAs are supposed to be systematic studies to evaluate a project's potential environmental impacts, while SIA's are supposed to evaluate the project's potential impacts on society and communities. They can also be combined as a single ESIA. Previously, Burma's legal framework did not require any

[67] Edwards, P. "Global cement emission standards." Global Cement Magazine, 2014

EIA for a development project to be approved. This has led to extremely destructive, non-transparent projects being implemented against the will of the people. Burma is, however, currently in the process of drafting EIA rules. In general EIAs, SIAs, and ESIAs should adhere to the following best practices and be:

- Conducted and reviewed before any decisions are made to start the project
- Conducted by independent scientific experts
- Done in meaningful consultation with the local community
- Done in transparent manner and disclosed to the public with time to consider
- Used to thoroughly explore the impacts of all potential alternatives to the project
- Used to thoroughly explore the effectiveness of mitigation measures

Unfortunately, in many places EIAs have become merely "rubber stamps" that legitimize harmful projects without any real possibility of cancelling or changing the project. Oftentimes they are of poor quality, kept secret or are missing information because they avoid asking important questions. Still, it is important that local communities request a copy of the EIA and SIA for cement production or other projects that affect them. Any information you can learn from these documents will be useful as an advocacy tool. Furthermore, in the absence of a good EIA or SIA, communities can conduct their own "grassroots EIA." This means using local knowledge to document potential impacts of the project.

Biodiversity Action Plan (BAP)

The International Union for the Conservation of Nature (IUCN) recommends that cement companies implement a Biodiversity Action Plan (BAP) in order to minimize the negative impacts of limestone mining and cement production[68]. The BAP sets out a plan for systematically collecting data on living things in the area, working out concrete actions that should be done to help conserve it, and for continued monitoring of impacts on biodiversity

[68] "Biodiversity management in the cement and aggregates sector" IUCN, 2014

at the project site. The Biodiversity Action Plan should cover any area ecologically connected to the project site in a significant way, including along the watershed. It should also cover areas affected by access roads. According to the IUCN, the BAP is meant to devise strategies for biodiversity conservation at all stages of the project, including risk assessment during site-selection, minimizing impacts during project activity, and rehabilitation after project closure.

3. **Free, Prior, and Informed Consent (FPIC)**

FPIC is a human right enshrined in international law by the UN Declaration on the Rights of Indigenous Peoples(UN-DRIP), which Burma signed in 2007.

Essentially, it means that indigenous peoples have – or should have - the right to either give or withhold permission to project planners to undertake development projects in their area, such as a cement factory, that might cause adverse social and environmental impacts. By definition, it means that any decision made by the community must be free from any form of threat, pressure, or exploitation. In addition, project developers and investors are required to inform the local community of their plans and seek feedback ***before*** implementation of the project begins.

FPIC is one of the most useful tools local communities have at their disposal to prevent the construction of a cement factory or to minimize its impacts. However, there are big differences between what governments have agreed to in signing the international declaration and what is written in national laws or done in practice. The UN Declaration does however give legal right for people to call for information and for their voices to be respected.

9. Community Strategies

The most powerful way to prevent the construction of a cement factory, or to minimize the impacts of one, is to take collective action as a community. This section contains helpful tips for how to engage with cement companies, and if a company will not accommodate the demands of the local community how it may be possible to influence decision-making.

Steps for Engagement with Project Developers[69]

1. Find out who is developing the cement factory
2. Request information from the developers
3. Seek information from all other relevant sources, including about official permits given to the developers.
4. Besides what is written in this guide, seek more information about problems other communities have faced from similar projects and how they have successfully opposed it
5. Hold discussions with your community
6. Hold community negotiations with the project developers
7. Seek independent advice
8. Maintain communication with project developers

Examples of questions to ask during a meeting with a cement company, investor, or government official

General Information

- How will the company continue to make information available to the community?
- Who will benefit from this cement factory, and in what way? Where will the cement be sold and mixed into concrete?

[69] Adapted from Oxfam's guide to Free Prior and Informed Consent

- Will the villagers receive fair compensation for land that will be taken by the company?
- Will those who suffer injuries or health problems as a result of the mining or factory operations be properly compensated?
- What technology does the company plan on using to mitigate harmful emissions from the cement factory?
- How will the cement factory heat its kiln? Will it burn coal? Will it also burn wastes, including hazardous waste?
- Can the company provide maps of all areas where the limestone and other raw materials are planned to be obtained from?

Environmental Impacts

- How will the construction of the factory affect the landscape? Will it change the water flow of the river, damage habitat, or pollute the environment?
- Does the company have a plan for preventing mercury contamination in the local environment?

Environment and cosial Impacts **(Illustration - Saw Kaw Soe Soe)**

- Does the company have a plan to mitigate carbon emissions and cut its contribution to global climate change?
- How does the company plan on managing the waste it will create? Where will the waste be deposited and how will the company ensure that it won't contaminate the area?
- Does the company have a plan to manage biodiversity? Will the company rehabilitate habitat after the mines are closed, or conserve habitat elsewhere to offset damage?

Social Impacts

- What options will the villagers have for livelihood after their farms or forests are taken away?
- Will those facing health and livelihood loss from living close to the factory be compensated? What kind of compensation will it be?
- What mechanisms will be put in place to address complaints about noise pollution, health concerns, and other impacts?
- What will be done to control dust and noise that will cause damage to crops and stress to people and wildlife?
- What will be done to minimize the danger of blasting at the mining and quarrying sites?
- How many jobs will the cement factory bring to the community and what kinds of jobs? Will local people be employed in preference to outsiders?
- Will the company offer additional services that will benefit the community and make up for its losses, such as funding local schools, clinics or alternative community livelihood support?

Advocacy Campaign

If engaging directly with the project developer is not achieving the desired results, and the project appears to be moving forward in a way not satisfactory to the community, it may be appropriate to pursue an advocacy campaign. Local NGOs or CBOs can help your community to design and implement this campaign. Below are some possible steps to take.

Conduct Research about:

a. The cement company and its investors, and the impact their operations have had in other locations.

b. Keep a careful record of everything that the authorities and political leaders say that may be relevant to decision making about the project. If possible, try to get copies of any official documents like permits and contracts that relate to it.

c. Collect more information about the local environment to show what of value would be lost if the project goes ahead, including evidence of people's livelihoods and photographs of the beauty of the areas.

d. Keep track of and record everything mentioned in the media that relates to the project (including radio, print, video).

e. Enlist the help of wildlife conservation experts to do biodiversity surveys and help quantify the potential threat of a factory or mine.

Raise Awareness

Raise awareness about the environmental and social impacts of cement production on your community. Talk to friends, family, trusted community leaders, teachers, and co-workers about your concerns. Prepare and distribute information fact sheets, write an article, or talk on the radio.The more people know what is wrong with the cement production project, the more likely they will be to join you in taking action to stop irresponsible development.

Petition

Write a letter or petition to company representatives or elected officials who have the power to make decisions about the project. Show them that your community is opposed to their current plans, and give specific recommendations for how the company could improve its operations. Be prepared to show evidence to back up your claims.

Contact the media

Contact the media and spread the word outside your community with state level, national or international news stories. Give an interview, provide

background to interested journalists or arrange a press conference. Bad press will put pressure on the company to change its behavior.

Protest or Demonstrate

Hold a demonstration to show the company they must listen to the voice of the community. The more people involved, the better. Ideas include marching to the company office, holding a silent vigil if anyone is badly hurt or killed because of the mining or cement production, using artwork to convey your message, and having community members give speeches about their concerns. Demonstrations have the potential to capture the attention of the media and gain the support of international activists. Be cautious however, because the company or government may respond to protests with violence or arrests.

International Solidarity

Ask for international solidarity to amplify your message. Contact big international NGOs that might lend their support in the campaign. Reach out to human rights groups like Human Rights Watch or Amnesty International if there has been violence to people opposing the cement project, and to environmental groups like Friends of the Earth, or Greenpeace. If they can be persuaded to help, their international influence may sway the government or company to change their behavior. However, be careful that international actors understand that the campaign must be a partnership, that they do not try to take control or take all the credit, and that local leaders maintain control of campaign goals and operations.

Disrupt business

Disrupting business is a tactic that you might consider if all else fails. This can be done by blockading the road to the cement factory, refusing to leave land that has been confiscated, or persuading workers to strike in support of affected communities. These strategies can be very effective to get your message across, but are dangerous and may be illegal. If they are tried it is important to make sure the world is watching.

10. Case Study: Karen State

Indigenous and local people all over the world have resisted irresponsible cement production in their communities. The case study described below provides a real-world example of the impacts of cement production and strategies for minimizing those impacts.

Case Study: Mikayin Village, Karen State, Burma

In April 2014, local people voiced their opposition to a proposed cement factory in Mikayin village near Hpa-an[70], which would be built by Myanmar Jidong Cement Company Ltd (MJCCL). MJCCL is the Myanmar subsidiary of the Chinese multinational company, Tangshan Jidong, whose cement operations are the sixth largest in the world. Jidong's cement plants in China have been found to repeatedly violate environmental regulatory standards, releasing particulate matter at more than five times the allowed limit[71]. The military dominated Karen State government supported the project, along with some representatives of the Karen National Union (KNU).

Mikayin residents knew of the damage cement factories can do from witnessing the impacts of two state-owned cement plants in nearby Myaing Kalay. The Mikayin villagers had heard of the bad air pollution from these factories: "They have so many patients with lung problems, from cement dust pollution in the air.[72]" Cement dust from the factories also settled on fields, making it difficult for farmers in Myaing Kalay to earn a living. Limestone mining in the area had also led to bad flooding, severe deforestation, and declining wildlife populations. Much land had been confiscated from farmers to make way for the Myaing Kalay cement factories and mines, and there had been no compensation.

Jidong's proposed factory in Mikayin is not the only recently proposed cement factory near Hpa-an. Villagers have been told that the government has approved the construction of 10 cement factories.

[70] Noreen, N. "'Majority' oppose cement factory in Hpa-an."DVB, 2014.
[71] "Responsible Investment in the Cement Industry: Still a Long Way to Go." The Institute of Public and Environmental Affairs, 2013.
[72] KESAN Interview with Mikayin villager, November 2014.

One of those is the $500 million project in Lun-Nya village to be built by Indian company, Ultra Tech[73]. Lun-Nya residents, concerned they would face similar problems as in Myaing Kalay, voiced their opposition at a meeting with the company in March 2014. It remains unclear whether the project will move ahead.

Hearing about the opposition at Lun-Nya, and empowered by civil society trainings on environmental impacts of extractive industry, Mikayin villagers organized an opposition campaign once they heard about plans to build a cement factory near their own village. More than 1,000 people attended an April 28th meeting with project proponents, where the company claimed there would be no pollution from the cement project. Not believing the company's claim, the majority of villagers refused to sign on to an agreement, citing concerns about environmental pollution and land confiscation. As a result, the Vice Minister of Industry is reported to have told parliament that the company will have to win the support of the people of the surrounding villages before the project can go ahead. The KNU is also said to have agreed to let local people have the final say on whether the project is to be approved. Still, the company has tried to claim that locals support the project, arguing that the land they will use for mining and construction is of no value to local people, and that outsiders are fueling opposition[74]. According to villagers from Mikayin, the mountain that will be mined is actually used by villagers to collect mushrooms and charcoal, an important part of their livelihoods.

Jidong Company has promised to provide education, healthcare, job opportunities, water, electricity, and road construction if the project is approved, but these promises failed to convince local people to support the project. Nan Mu Mu, one local resident at the meeting, said: "The village community hall, we built it and donated it on our own. No company came to construct it for us. We also constructed the road by ourselves. This mountain belonged to our parents – all Karen people have the responsibility to retain it. The trees can be replanted if we cut them down, but if we destroy that mountain we can never get it back. Therefore, we opposed it [the cement factory].[75]"

[73] "Residents Fight $500m Cement Factory Proposal" Karen News, 2014.
[74] Noreen, N. "Chinese firm claims Hpa-an locals support cement factory project." DVB, 2014.

It appears that Mikayin villagers have been successful, for now, in preventing construction of the cement factory in their area. But they worry that Jidong will target another village with less organized opposition. Before Mikayin, the company had tried to build the factory in a nearby village, but also failed there due to local opposition. Now they have already moved on to propose a new location.

Village meeting on proposed cement factory **(Photo - KESAN)**

Reflection

The case study illustrates how cement companies may try to push a project through – with promises to avoid pollution and to fund development projects. But through awareness from the bitter experience with similar promises, through information sharing, trainings and effectively organizing themselves, villagers around Hpa-an have been able to - at least temporarily - block these potentially destructive new projects.

[75] Thaung, N. and Pawt, C. "People Power Wins – KNU and State Officials Let Villagers Have Final Say On Proposed Cement Factory." Karen News, 2014.

Using explosives during mining (Photo - KESAN)

Small type of mining done by local people (Photo - KESAN)

Limestone mining at Myaing Kalay (Photo - KESAN)

Limestone factory at Myaing Kalay village (Photo - KESAN)

11. Conclusion

We live in a world where many natural resources, including the trees and bamboo earlier generations used for building, medicines, livelihoods and fuel, are now in short supply. Traditional building materials are much more expensive and harder to find. At the same time governments – and many people - are more focused on making money faster and faster. Cities are quickly spreading and growing tall, while the wide roads and big dams cover more and more land. Mining for the resources to make construction materials like cement and steel is increasing. However, while these developments bring benefits to many and wealth to some, they also bring serious difficulty and harm to others and to the natural environment that all life depends on. Some types of development are necessary to meet the needs of all people, however some developments are too harmful to be acceptable.

If nature's ecosystems in an area are too badly damaged the ecosystems stop working and species die away one after another. The rapid disappearance of useful trees, fertile soil, fish and wild animals is a sign that development is seriously out of balance and cannot be sustained for many more years. The cement manufacturing industry is a big part of this development imbalance.

Areas where limestone is found are often very fertile, supporting good farms and large trees. A sustainable alternative development model will replant and maintain healthy forests and fields on and around the limestone mountains, not turn them into barren holes in the Earth. Instead of an ever increasing dependence on mining and manufacturing processes that create dead lands, change the climate and turn the rain to acid, it is better to restore the balance so there are sufficient trees and bamboo for building and fuel, clean waters, productive fields and abundant fish and wildlife.

The research presented in this guide reveals cement production to be a very polluting and hazardous industry. Without proper environmental management, limestone quarries and cement factories are extremely dangerous to human and ecosystem health. Furthermore, any large-scale development in Karen State risks causing land grabs and other negative social impacts. For this reason, transparency and accountability are essential for project developers. Companies must comply with international norms for prior consultation with local communities, and must do thorough

Environmental and Social Impact Assessments.

Even with these precautions, cement production inevitably causes significant, long-term harm to the local environment and its inhabitants. It is impossible to remove limestone from the land without permanently scarring the landscape. Likewise, it is impossible to totally eliminate the emission of toxic pollutants from a cement factory. The plants, animals, soil, and water of the area may be permanently affected. It can be expected that if the ecology of the area changes, the lifestyle of the people living in that area will change too. It is crucial that local communities fully understand these potential impacts before plans for cement production in their area go forward. Hopefully, this guide will serve to raise awareness among Karen and other communities about the many harmful impacts of cement production.

It is, by all means, the cement company's responsibility to meet international standards for protecting human rights and the environment. However, cement companies and political leaders have been known to fall short time and again in these responsibilities. Thus, it is vital that local communities understand their rights and develop strategies to encourage more socially responsible and environmentally sustainable behavior by cement companies.

Finally it is important for the Burmese government and other stakeholders involved in development projects – including non-state actors such as ethnic armed groups and local leaders – to understand the importance of linkages between social justice, environmental sustainability, and economic development. Actions on one could have serious consequences on another. Respecting and recognizing the rights of indigenous peoples and others in the communities - including their rights to clean water and air, to sustainable livelihoods, and to protect natural resources and the ecosystems that serve all living things including themselves –is essential to having a country that is economically, socially and environmentally healthy and prosperous.

"We won't have a society if we destroy the environment."

- Margaret Mead -

Glossary

Acid Rain: Rain that is unusually sour and acidic, caused by pollution of the air with sulphur and nitrogen gases from burning dirty fuels. Can be harmful to plants, fish, aquatic animals, infrastructure and people.

Asthma: Chronic respiratory illness that causes inflammation of the airways. Symptoms include wheezing, coughing, chest tightness, and shortness of breath.

Benzene: Organic chemical compound in oil and released by many industrial processes. Increases the risk of cancer and other illness.

Bioaccumulation: The increasing concentration in an organism of toxic substances where more go into the body than can come out.

Biodiversity: The many different species of plants, animals and smaller organisms that live in our environment, make it work in harmony, and also provide most of us with food and resources for medicines, clothing, shelter and energy.

Bronchitis: Respiratory illness that causes coughing and sore throat that can be serious or long lasting, often caused by air pollution.

Calcination: Also referred to calcining. The process in which limestone is heated to release carbon dioxide and calcium oxide.

Carbon Monoxide (CO): Colorless, odorless gas, very toxic at high concentrations.

Carcinogen: A cancer-causing substance.

Cement mill: A large rotating cylinder containing steel balls that grinds raw materials.

Clinker: The fused product of a kiln, which is ground to make cement.

Concrete: A mixture of sand, gravel and stones held together by the bonding of cement powder and water. Very widely used for construction.

Crusher: Equipment used to crush rocks into smaller pieces.

Dioxins: Group of extremely toxic chemicals that stay in the environment for a long time.

Ecosystem: The parts of nature that work together to provide all the things needed for communities of living things to be able to live in an area. Every living thing, including people, need a combination of many things in their environment at the right times, including all their different foods and places to hide and reproduce.

Electrostatic Precipitator: Highly efficient filter that uses electric charge to remove dust and other particle pollutants from the air.

Filter Bag: Industrial air filters commonly used to reduce pollution from cement factories.

Fly Ash: Residue leftover from burning coal in a power plant or cement factory that can also be used as an ingredient to make cement.

Furans: A group of toxic chemicals released by some industrial activities.

Greenhouse Gas: Any gas in the Earth's atmosphere such as CO_2 that has the effect of trapping heat energy. Too much causes global warming and the related climate change.

Grinder: Equipment used to reduce the size of raw materials into a fine powder

Gypsum: One of the minerals added to cement to regulate how concrete sets and becomes strong. Calcium sulfate dehydrate.

Hexavalent Chromium (Cr^{6+}): Cancer causing form of the heavy metal element chromium.

Hydrochloric Acid (HCl): Clear, highly corrosive acid.

Hypertension: Chronic medical condition where a person has consistently high blood pressure, which can lead to serious heart problems.

Incineration: The burning of waste for disposal and sometimes also to produce energy.

Kiln: Oven at cement plants used to heat raw materialsto extremely high temperatures, forming clinker.

Limestone: Mineral rock made of calcium carbonate ($CaCO_3$), which is the main ingredient to make cement.

Mercury (Hg): Highly toxic, silvery heavy metal; liquid at room temperature and used in thermometers.

Mitigation: The action of reducing the severity of something.

Nitrogen Oxide (NO_x): NO_2 and NO. Air pollutant formed during combustion in the presence of nitrogen and oxygen. Causes smog and acid rain.

Ozone (O_3): A kind of air pollution gas that is harmful to people and when close to ground level, in the troposphere. Formed when NO_x reacts with Volatile Organic Compounds in the presence of sunlight.

Particulate Matter (PM): Small particles suspended in the air that can be harmful to the heart and lungs when inhaled. Cement dust is a PM.

Silicosis: Potentially fatal lung disease caused by inhaling silica dust.

Sulfur Dioxide: Harmful air pollutant with a rotten smell. Causes respiratory illness and acid rain.

Volatile Organic Compounds (VOCs): Type of very reactive, organic compound air pollutant released by many industrial activities.

"Cementing Justice: A Guide
for Communities on Cement Production and its Impacts "
is an environmental booklet aiming to arm
grassroots communities and civil society organizations
in Burma/Myanmar and along the Thailand-Burma border
with essential knowledge about the cement production processes,
harmful impacts on social and environmental resources,
and effective and practical strategies
for communities and CSOs to protect their fundamental rights,
land and environmental resources that they have
inherited from their ancestors.