


# A Review: Keystone Environmental Problems are the Labyrinth Root causes that Resonate together with Socioeconomic Factors on Igniting Global Conflicts and Warfare

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## Graphical Abstract

<p><b>Aims</b></p> <ul style="list-style-type: none"> <li>❖ Finding <b>common</b> environmental and demographic causes of environmental conflicts</li> <li>❖ Using the interconnected nature of environmental problems as cause-effect establish relationships with the wars</li> <li>❖ Ascertaining the role of keystone environmental problems on igniting the crises</li> <li>❖ Establishing conclusive remarks based on the history of progression of environmental conflicts</li> </ul>	<p><b>Methodology</b></p> <ul style="list-style-type: none"> <li>▪ Qualitative content analysis methodology</li> <li>▪ Collect data based on codes/ themes (environmental problems)</li> <li>▪ Establishing the relationship with root keystone environmental problems</li> <li>▪ Satisfying research question on the keystone environmental problems and their resulting disputes</li> <li>▪ Meaningful findings to give a conclusive result</li> </ul>	<p><b>Results</b></p> <p><b>CATEGORIES of ENVIRONMENTAL CONFLICT</b></p> <ul style="list-style-type: none"> <li>✚ Direct intranational environmental conflicts</li> <li>✚ Indirect intranational environmental conflicts</li> <li>✚ Direct international environmental conflicts</li> <li>✚ Indirect international environmental conflicts</li> </ul>
<p><b>Findings</b></p> <p>Keystone environmental problems are the labyrinth root causes along with socio-cultural and political factors.</p> <p>N.B.: Technology cannot be considered as a causative factor. But it plays a vital role in the progression of conflict (not included in this study)</p>	<p><b>Comment</b></p> <p>Findings of the study were supported by flow charts based on environmental and demographic factors</p>	<p><b>Future Research</b></p> <ul style="list-style-type: none"> <li>○ Temporal analysis to be done on environmental problems.</li> <li>○ Time is also an important factor here.</li> <li>○ The upcoming paper to be published in the same journal will consider the environmental problems and its occurrence along with timeline.</li> </ul>

## Abstract

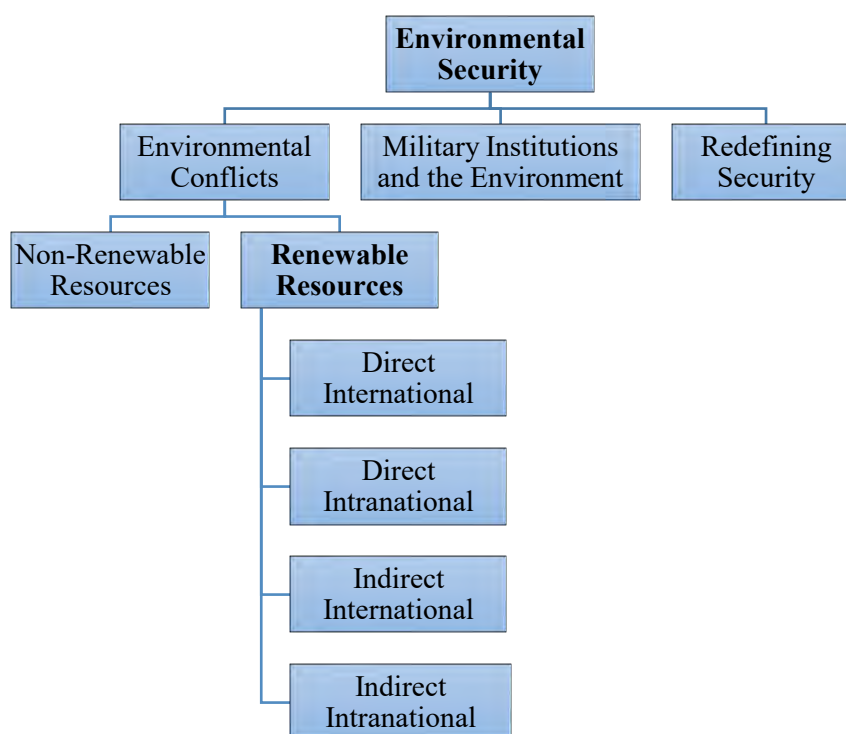
When mitigating a man-made environmental problem, if it results in the permanent disappearance of one or more other environmental problem/s, then that mitigated problem can be considered a keystone environmental problem. Based on the aforesaid definition, eight environmental problems have been identified, such as population explosion, air pollution, deforestation, water pollution, scarcity and salination, overexploitation of natural resources, urbanisation (including industrialization, urban

sprawl and settlements), intensive farming, and the global energy crisis. It has also been found that there is a significant relationship between these keystone environmental problems and global conflicts. For instance, according to the United Nations Environmental Programme (UNEP), over the last six decades, globally, more than 40% of the internal conflicts have been caused by overexploitation of natural resources, which is a known keystone environmental issue. Thus, the importance of identifying the role of keystone environmental problems in igniting global environmental conflicts and warfare has been widely realised. This study was conducted using qualitative content analysis methodology reveals that labyrinth established by root keystone environmental problems resonates together with socio-economic factors conflagrate global environmental conflicts and warfare, such as Cauvery River conflict between Tamil Nadu and Kerala States in South India, conflict from trespassing fishermen poaching in waters of neighbouring country from both India and Sri Lanka, Environmental Conflict in Northeast India and Bangladesh due to flooding (natural disaster) caused by climate change led to migration, West bank water crisis between Israel and Palestine, Russia's invasion into Ukraine in 2022, Alto Cenepa war, Grand Ethiopian Renaissance Dam (GERD) crisis between Ethiopia and Egypt, environmental conflicts in Philippines, conflict for land resources in Ethiopia, environmental conflict in Mexico, environmental conflict in Peru, Northeast India, Pakistan, Israel (Gaza), conflict of Mauritania and Senegal, Israel-Palestine (West bank), Somalia- Ethiopia, El Salvador-Honduras, Conflict between Kenyan tribes, dispute between North and South Sudan, and transboundary air pollution (causing acid rain) issue between the USA and Canada.

**Keywords:** *environment, environmental problems, environmental conflicts, keystone environmental problems, primary environmental problems, wars*

## **1. Introduction**

Environmental conflicts occur for three main reasons: overconsumption of renewable resources, pollution or unfavourable changes in the environment, and depletion of living space. According to Schwartz and Singh (1999), environmental conflict is a subset of environmental security (Figure 1) and was initially mentioned in an article titled "Redefining Security" written by Lester Brown of the World Watch Institute in 1977. It was further justified that the security threats leading to military warfare could also be caused by environmental problems that are derived from human population increase, resource depletion, and pollution.



**Figure 1:** Environmental security and its related subdivisions

In the past, most conflicts and international warfare were caused by scarcity of resources, more precisely non-renewable resources such as oil and minerals. But today even the depletion of renewable resources such as forests, fish stocks, cropland, clean air, and potable water creates disputes. This is because modern-day conflicts are also exacerbated by the steeply increasing human population, which directly influences resource consumption and anthropogenic climate change. Global warming that leads to drought, crop loss, or water scarcity resulting in mass migration could also cause environmental conflicts.

### ***1.1 Keystone environmental problems or keystone links***

Complete dependence of an environmental problem on its cause (the parent environmental problem) may lead to the disappearance of the problem when the cause (the parent environmental problem) is mitigated. Thus, the cause can be considered as a keystone environmental problem. For instance, air pollution can be considered as a keystone problem because if air pollution ( $\text{SO}_x$ ,  $\text{NO}_x$ , and CFC) gets solved, the resulting acid rain and ozone depletion can also come to a halt. Similarly, eutrophication is caused by water pollution. When water pollution through nitrate and phosphate is prevented, eutrophication and subsequent biodiversity loss can be abated. Thus, water pollution is a keystone environmental issue. However, if more than one environmental factor causes an environmental problem, then none of the causative environmental problems can be considered the keystone. For instance, biodiversity loss is caused by land degradation and competition with invasive species; land

degradation is not a keystone environmental problem because, even if land degradation is mitigated, the competition impact from invasive species continues to fuel biodiversity loss.

Based on the aforesaid definition, eight environmental problems are considered keystone environmental problems, such as population explosion (population growth), deforestation, air pollution, intensive farming, urbanisation (including urban sprawl, industrialization, and settlements), the global energy crisis, water pollution and scarcity, and overexploitation of natural resources. It has been found that a labyrinth emerged from root-keystone environmental issues in association with social and economic factors that create conflict or war. Expressly, keystone environmental problems plotted for a particular situation can only be controlled by mitigating them. Thus, unless keystone environmental problems get mitigated, the conflicts cannot be resolved.

### ***1.2 Contextual factors of environmental conflicts***

Violence is expensive, both for the participants and for the underlying resources. Violence is the last resort for resolving a dispute. It may cause death and take time and resources away from productive activities. Conflicts can occur between nations as international conflicts or within a nation as intranational conflicts. Both consume blood and treasure, or resources. Environmental disputes turn violent in the contexts given below.

#### ***1.2.1 Contextual factors in intranational environmental conflicts***

##### ***a) Demographic and environmental stress (DES)***

DES is a three-prong concept consisting of increasing population, degradation and overexploitation of renewable resources (arable land and water), and unequal access to these resources within a society (unequal across social groups). An increasing population puts a lot of stress on social and economic factors, such as competition for limited resources, education, food, employment, etc. With an ageing population, such as in Germany, the challenge is a more dependent population relative to working age. In contrast, for a country such as Niger, the massive youth bulge is the problem because 61% of all people in Niger are under the age of 20. Second is environmental stress, which is a function of both increasing population and mismanagement of resources, resulting in a significant loss in resource productivity or the ability of the resource to regenerate (carrying capacity). The third prong is unequal access to resources. E.g., competition for arable land resources between different ethnic groups in Niger

##### ***b) Weak state capacity and legitimacy***

State capacity is the ability of the state to mobilise resources and enforce its territorial monopoly on the legitimate use of force. In many parts of the developing world, institutions such as courts and police are weak or function in a biased way; in these situations, the chances of violence or conflicts

are high. When the state's capacity and legitimacy are poor, the chances for conflicts or social unrest are high.

*c) High dependence on rural livelihoods*

When renewable resources are central to livelihoods and wellbeing. For rural societies, direct access to land and water is much more tied to the ability to provide for one's family, resulting in violent conflict over threats to access to renewable resources.

*d) High groupness*

In societies with high groupness in terms of ethnic, religious, and clan identities, these identities are vehicles for economic opportunity and political participation. They also determine who receives political benefits from those in power. In many developing countries, these identities form the basis for seeking political office. In ethnically homogeneous countries such as the Republic of Korea and extremely ethnically diverse countries such as Tanzania, there is low groupness. In contrast, in countries such as Iraq (Sunni Arabs, Shia Arabs, and Kurds), Burundi and Rwanda (Tutsis and Hutus), and Myanmar (Bamar, Shan, Cayenne, Rakhine, Mon, Khachen, and Rohingya), political cleavages and patronage networks break long identity-based lines, enabling high groupness. High groupness facilitates coordination to engage in violence. Adapted from: (Hendrix, 2020)

**1.2.2 Contextual factors in international environmental conflicts**

*a) Territorial conquest*

Environmental conflicts in territorial conquests occur due to the degradation of their own territorial land by intensive farming and their desire to capture nearby land to expand their agriculture.

E.g., the 1995 Alto Cenepa War, 1969 invasion of El Salvador into Honduras, 1977–1978 war between Somalia and Ethiopia, 1967 war between Israel and Palestine (West Bank) and 1989 Mauritania and Senegal dispute

*b) Water wars*

Competition between different nations on the utilisation of water resources may end up in conflicts. This is often due to when one's consumption hinders the other's, e.g., the Nile River conflict between Egypt and Ethiopia on grand Ethiopian Renaissance dam construction and the North Crimean Canal dispute between Russia and Ukraine in 2014

*c) Maritime disputes*

Maritime international environmental conflicts occur due to the consumption of fish resources between neighbouring countries. E.g., conflict on fishing resource consumption in the Palk Strait region between Indian and Sri Lankan fishermen

d) Other

There are other environmental causes that lead to environmental conflict, such as transboundary air pollution from the USA that causes acid rain in Canada.

## 2. Materials and Methods

Major international and intranational environmental conflicts were examined for their environmental roots. Flow charts were drawn to map the environmental problems together with the socio-economic problems. The study was conducted using *qualitative content analysis* methodology (Adu, 2017). Where the data collection was done with keystone environmental problems (themes) in mind, since the direct information was gathered as finalised flowcharts mostly from Schwartz and Singh's (1999) report. Thus, protocol and results were derived from the available study. And those results were analysed for themes (keystone environmental problems). Then the meaningful findings from the gathered information (using themes) were finally transcended to satisfy the research question. (Adu, 2017) Thus, the overall study was conducted using a combination of both qualitative content analysis and synthesis methodology.

## 3. Results

### 3.1 Direct Intranational environmental conflicts

#### 3.1.1 Chauvery water dispute between Tamil Nadu and Karnataka (Indian States)

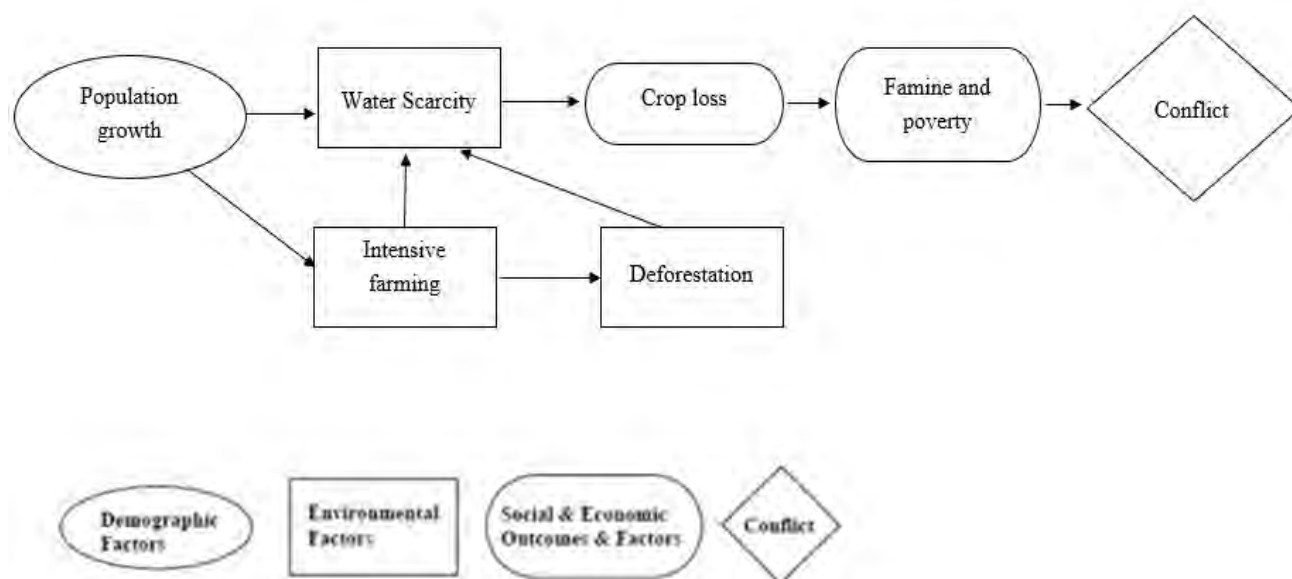
The Chauvery River flows through two South Indian states; Karnataka (upstream) and Tamil Nadu (downstream) (Figure 2). River water disputes persist over centuries. In British India, two agreements between Madras Presidency (now Tamil Nadu) and Mysore state (now Karnataka) were made on water sharing in 1872 and 1924. However, the latter lapsed in 1974. On June 2, 1990, the Indian government launched the Chauvery Water Disputes Tribunal (CWDT). In 1991, the CWDT passed an interim sharing order. However, Karnataka refused to release more water, which was stipulated by the order. In 1993, Tamil Nadu Chief Minister Jayalalithaa demanded more water as stipulated by the interim order. In 1998, the Chauvery River Authority was established to ensure the implementation of the interim order of the CWDT. In 2002, Prime Minister Atal Bihari Vajpayee instructed Karnataka to release only 9000 cusecs of water to Tamil Nadu. In 2005, Karnataka refused to implement the distress-sharing formula. In 2007, CWDT stated that the 1872 and 1924 agreements are still valid. At present, the population has doubled in both states, and even the extent of irrigated areas and dams has increased. Thus, water demand also increased. At the same time, deforestation close to catchment

areas also reduced the water flow and caused frequent droughts (Figure 3). Karnataka protested against the decision of the CWDT. In 2015, Jayalalithaa wrote to Prime Minister Narendra Modi and urged him to instruct Karnataka to release more water since that was a distress year. On September 2, 2016, the Indian Supreme Court ordered Karnataka to release 12,000 cusecs of water to Tamil Nadu, altering its previous order of 15,000 cusecs. Then the violence erupted. Natives of Tamil Nadu living in Karnataka were attacked, and vehicles registered in Tamil Nadu were set ablaze. About 30 buses were set ablaze. On the other side, in Tamil Nadu, vehicles from Karnataka were set ablaze. Adapted from Ganesan and Venkatesh (2016)



**Figure 2:** River Chauvery (Kaveri)

Source: (Coder, n.d.) License: CC-by-SA 3.0



**Figure 3:** Flowchart on Chauvery River dispute

*Keystone environmental issues:* Population growth, water scarcity, intensive farming, and deforestation

*Non-keystone environmental problems:* Famine-poverty

### 3.2 Direct International Environmental Conflicts

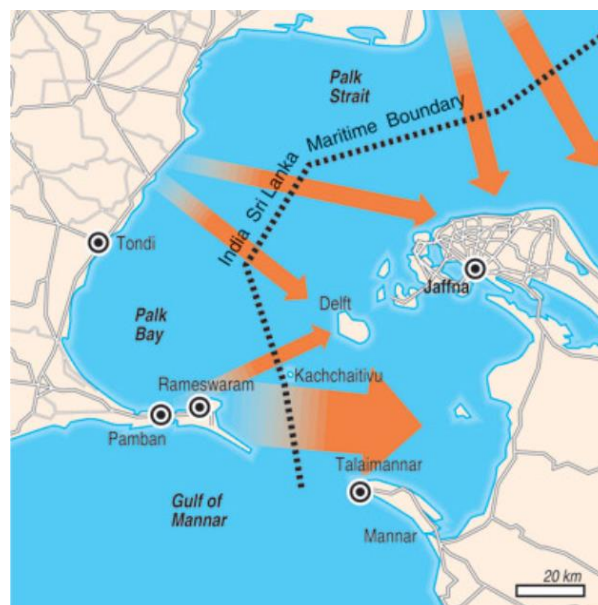
#### 3.2.1 Environmental conflict on over-exploitation of Fish stocks in Palk Strait among fishermen of India and Sri Lanka.

The poaching of fish stocks beyond the borders of India and Sri Lanka by the fishermen of both countries by violating the International Maritime Boundary Line (IMBL) becomes a major international direct environmental conflict between both nations. It has been reported that Indian fishermen are stealing \$750 million annually from Sri Lankan coastal waters. The bilateral agreements of 1974 and 1976 are being violated. Heavy use of trawlers, which are not permitted to fish on coastal seas, and the use of internationally banned bottom sea nets by Indian poachers are major threats to the coastal resources of north Sri Lanka. Trawlers catch fish flocks unselectively, the catch may include several non-targeted species and juvenile stages of fish in an unsustainable manner, thus it is a major threat to the livelihood of fishing communities in North Sri Lanka as well as a threat to the coastal biodiversity. Arresting and imprisonment of fishermen by coastal guards of both countries continues.

It has been complained that Indian fishermen are using illegal methods of fishing that are banned in Sri Lanka as well as internationally (e.g., bottom trawling). The use of deep-sea trawlers is not suitable in the Palk Strait as it is shallow and contains highly valuable coral reef structures. As per the 1993 Marine Fishing Regulation Act of India, trawlers are permitted beyond three nautical miles from the



shores, but they often violate the act due to the high catch in the region. More impressively, unlike Sri Lankan vessels, those Indian trawlers are equipped with GPS tracking systems, and they clearly know their location in the sea (beyond the border or not). Trawler fishing is an unselective way of fishing; it destroys the coral reefs, which are vital for the biodiversity of the region, and it also catches juvenile forms of fish and untargeted organisms such as endangered sea turtles. Sri Lankan fishermen do have multiday boats, and they are not as destructive as trawler fisheries. And Sri Lanka has completely banned bottom trawling since 2017 by the amendment to Section 28A of the Fisheries and Aquatic Resources Act No. 2 of 1996. It has been noticed that Indian trawlers are arriving from Nagapattinam, Thanjavur, Pudukottai, and Ramanathapuram, and they violate the IMBL and poach in Sri Lankan territorial waters (Figure 4), such as Delft, Pesalai, Iranathivu, and up to Pulmoddai at the east coast of Sri Lanka (Waduge, 2014).

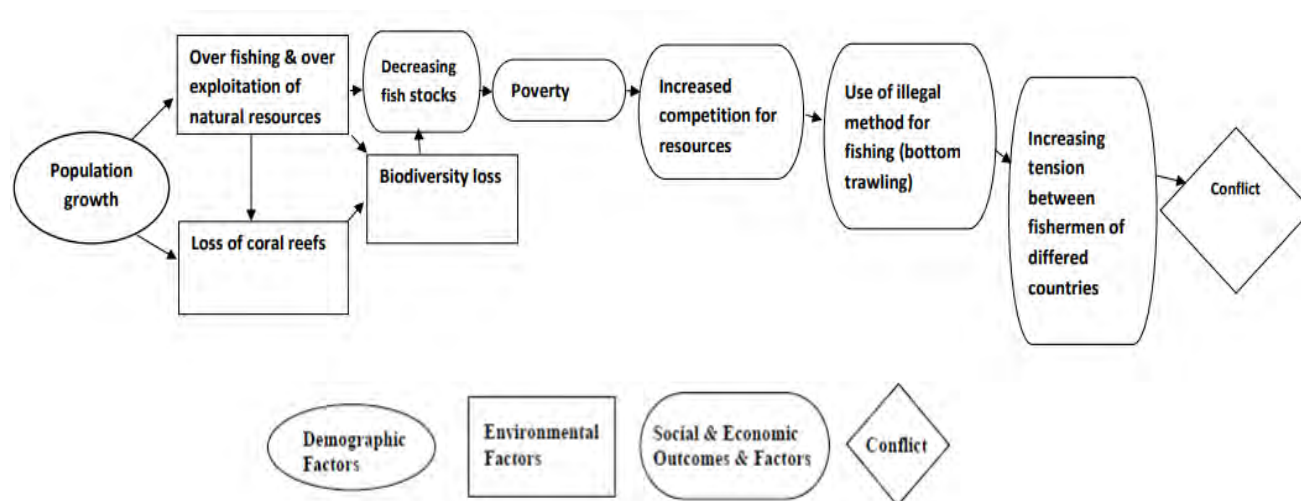


**Figure 4:** Poaching in Sri Lankan waters by Indian fishermen across IMBL (Red line: IMBL through which most trespassing occur; Purple arrows: path of Indian fishing fleet in Sri Lankan waters)

Source: [https://en.wikipedia.org/wiki/India-Sri\\_Lanka\\_maritime\\_boundary\\_agreements#/media/File:India-Sri\\_Lanka\\_maritime\\_boundary.svg](https://en.wikipedia.org/wiki/India-Sri_Lanka_maritime_boundary_agreements#/media/File:India-Sri_Lanka_maritime_boundary.svg); Image Credit: Anton, O, License: CC by SA 4.0

In 2021, the Sri Lankan Ministry of Fisheries, with the assistance of the Navy, inaugurated a splendid move to sink abandoned, deteriorating buses in the northern sea floor, which may create artificial coral-like structures to create habitats and breeding grounds for juveniles and fish, respectively. However, it has been overseen by the India-based local public media ('You Tubers') as a threat to the Indian fishing bottom trawlers trespassing maritime borders into Sri Lanka. As a consequence, Indian fishermen encroached into Sri Lankan water and destroyed the fishing nets of North Sri Lankan fishermen in the sea, causing a loss of several million rupees, and a Northern Sri Lankan fisherman

was believed to be killed (missing) by angry Indian fishermen who trespassed their waters for poaching. While Sri Lankan coast guards keep seizing their boats that trespass the maritime boundary (figure 5).



**Figure 5:** Flow chart for Environmental conflict on Poaching in Sri Lankan waters by Indian fishermen

*Keystone environmental problems:* population growth and over-exploitation of natural resources

*Non-keystone environmental problems:* coral destruction, loss of biodiversity, and poverty

### 3.2.2 Russia's invasion of Ukraine in 2022

After the separation of Ukraine from the Soviet Union, Russia had to pay Ukraine for transferring its natural gas exports to Europe via the pipelines belonging to Ukrainian soil. In addition, Ukraine poses over 1 trillion cubic metres of natural gas resources; however, this was 5.4 trillion cubic metres before Crimea was annexed by the Russian Federation. Since 80% of Ukraine's gas resources are occupied in Crimea, the importance of Crimea's geographical location was believed to be the reason for Russia's interest in Crimea. As a consequence, Ukraine cut the water supply to Crimea by blocking the North Crimean canal that brings water from the Dnieper River (Figure 6). Due to this, agriculture in Crimea dwindled. Since 85% of the water supply declined, Crimean people migrated to other regions. In addition, to overcome this crisis, Ukraine expressed its interest in joining the NATO alliance. This tragedy could also be considered one of the reasons for the full-scale Russian invasion of Ukraine on February 24, 2022, though Vladimir Putin stated that the nuclear and intercontinental ballistic missile capabilities of Ukraine, with the support of the West, were the direct cause of the war (Figure 7).



Figure 6: North Crimean canal and Crimea

Source: [https://commons.wikimedia.org/wiki/File:Possible\\_routes\\_of\\_alleged\\_Russian\\_invasion\\_of\\_Ukraine\\_\(January\\_2022\).png](https://commons.wikimedia.org/wiki/File:Possible_routes_of_alleged_Russian_invasion_of_Ukraine_(January_2022).png), Under the license CC0 1.0

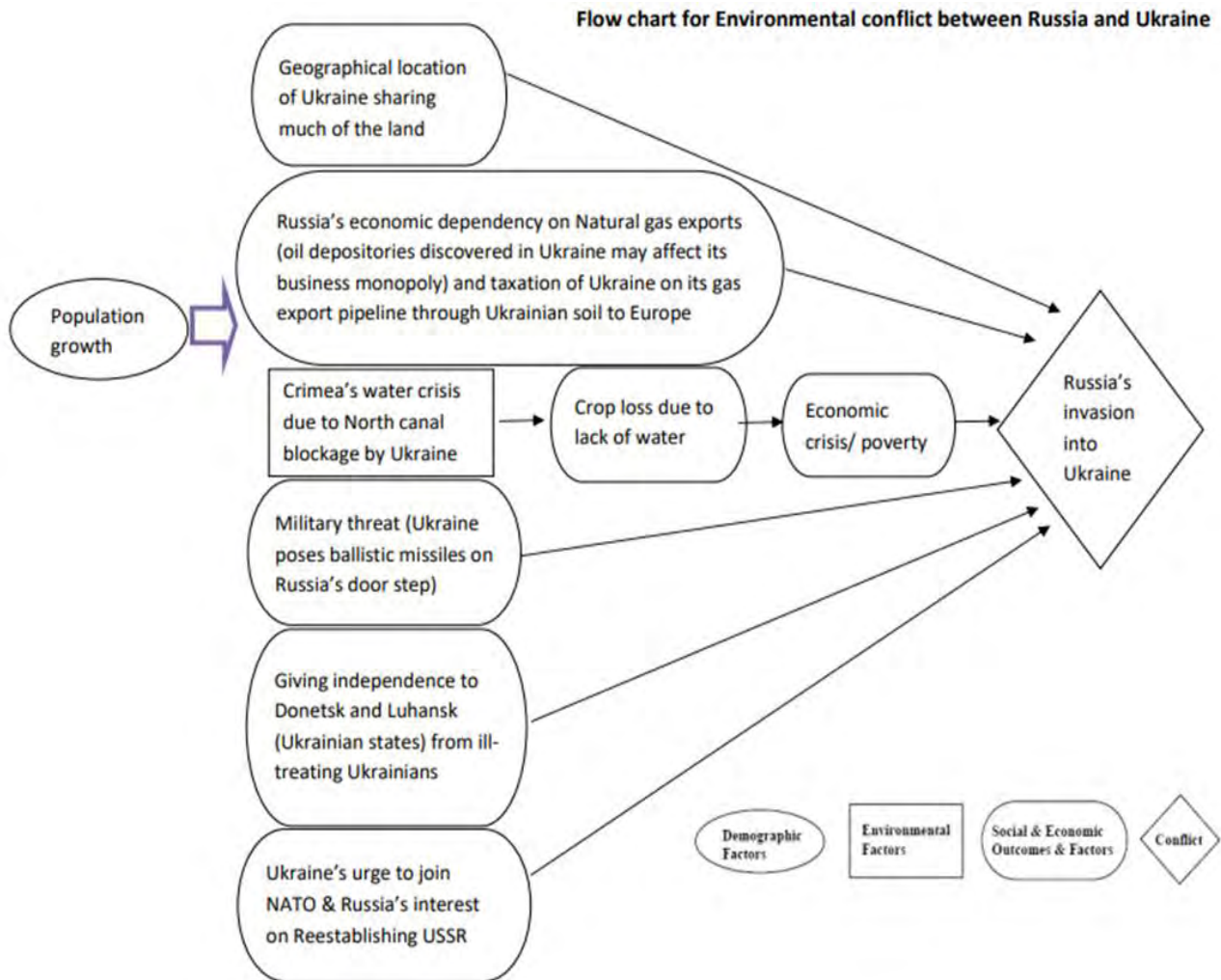


Figure 7: Flow chart for Environmental conflict between Russia and Ukraine

*Keystone environmental problems:* Population growth, Global energy crisis and water scarcity (Crimea's), *Non-keystone environmental problems:* Poverty

### 3.2.3 Alto Cenepa war

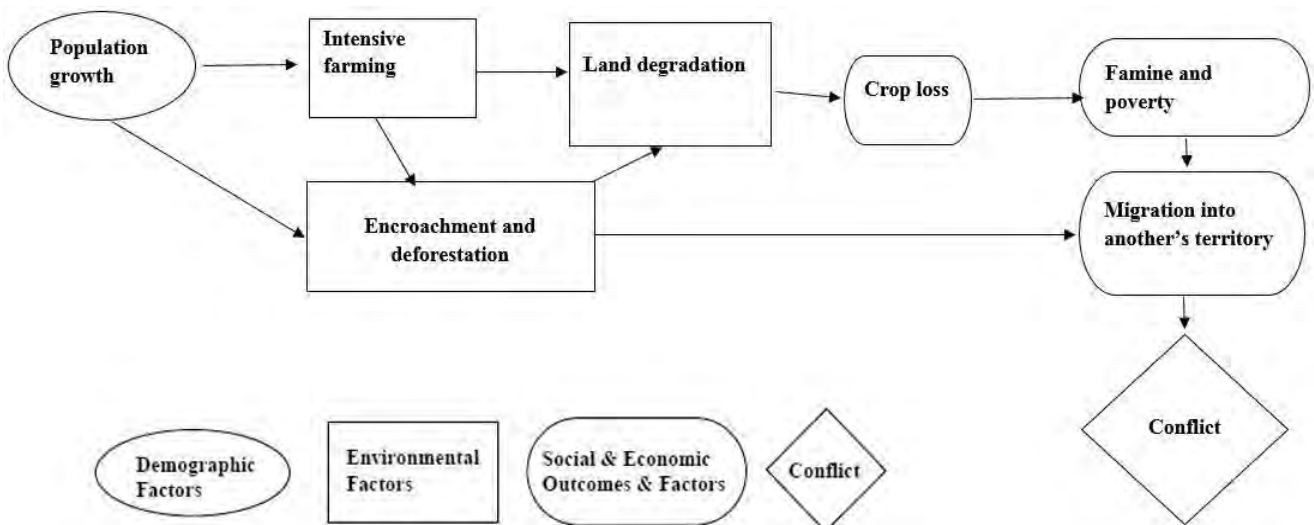
In 1995, clashes between South American nations Peru and Ecuador occurred due to the border demarcation along the headwaters of the Cenepa River in the remote outpost. In November 1994, Peruvian border patrols encountered Ecuadorian outposts in areas claimed by Peru (Figure 8). This has then become a military conflict at the Tiwinza outpost. In late February, both sides signed the Montevideo Declaration, which led to a ceasefire. However, the negotiation took more than four years and came to effect by May 1999. Ecuador agreed to cancel its claim to the areas at the headwaters of the Cenepa River, while Peru delivered one square mile of its territory at the Tiwinza outpost. Both sides claimed victory (Figure 9). Adapted from ('techwar', n.d.)



**Figure 8:** Map of Ecuador and Peru

Source: [https://commons.wikimedia.org/wiki/File:Tratado\\_Garc%C3%ADa-Herrera.png](https://commons.wikimedia.org/wiki/File:Tratado_Garc%C3%ADa-Herrera.png)

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**Figure 9:** Flow chart for Environmental conflict of Alto Cenepa war

*Keystone environmental problems:* Population growth, intensive farming, and deforestation



*Non-keystone environmental problems: land degradation and famine-poverty*

### 3.2.4 Establishing Dam to mitigate the energy crisis in Ethiopia led to water scarcity in Egypt

In 2011, Ethiopia made a decision to build the Grand Ethiopian Renaissance Dam (GERD) to meet its hydropower electricity needs, which is expected to be the largest hydropower plant in Africa, bigger than Greater London, and covering 1700 sq km (Figure 10). The Nile River flows in Africa from south to north; in the north downstream, Egypt fears the GERD would reduce the water availability to Egypt. Egypt relies on the Nile River for 90% of its water supply. According to its own estimates, if Ethiopia builds the dam in 10 years, it will reduce Egypt's water supply by 14% and destroy 18% of its farmland; if Ethiopia builds the dam in 7 years, it will cut 22% of Egypt's water supply and destroy one-third of its farmland; a five-year window would destroy half of Egypt's farmland. Thus, Egypt worked against the GERD. According to an Ethiopian source, Egypt sent rebels to neighbouring Eritrea to sabotage the dam and also promoted another Nile-sharing country, Sudan, to send its troops to its border. Thus, the issue has become a three-way dispute between Egypt, Ethiopia, and Sudan (Figure 11). However, today both of these nations are engaged in talks, but questions such as the possibility of drought in Egypt remain unanswered.

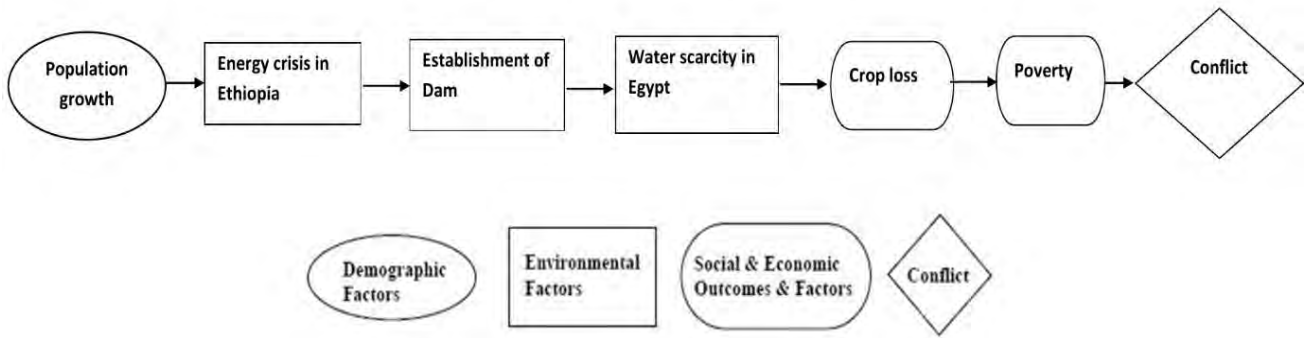
Adapted from ("What's behind the Egypt-Ethiopia Nile dispute?", 2020)



**Figure 10:** Location map of Grand Ethiopian Renaissance Dam

Source: [https://upload.wikimedia.org/wikipedia/commons/5/51/Renaissance\\_Reservoir.jpg](https://upload.wikimedia.org/wikipedia/commons/5/51/Renaissance_Reservoir.jpg)

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**Figure 11:** Flow chart for Environmental conflict on Establishing Grand Ethiopian Renaissance Dam (GERD)

*Keystone environmental problems:* Population growth, energy crisis and water scarcity

*Non-keystone environmental problems:* establishment of dams and poverty

### 3.3 Indirect Intranational Environmental Conflicts

#### 3.3.1 Population explosion causes poverty, deforestation, and land degradation (erosion) led to conflict in the Philippines

In the Philippines, in the 1970s and 80s, environmental problems such as population explosion, deforestation, and soil erosion reduced the agricultural productivity of the land. The average amount of arable land per rural inhabitant has declined to less than one acre, and it was predicted to fall to 0.6 acres per capita by the year 2000. Only 3% of the landowners controlled one-quarter of the country, while 60% of the rural families starved for land.

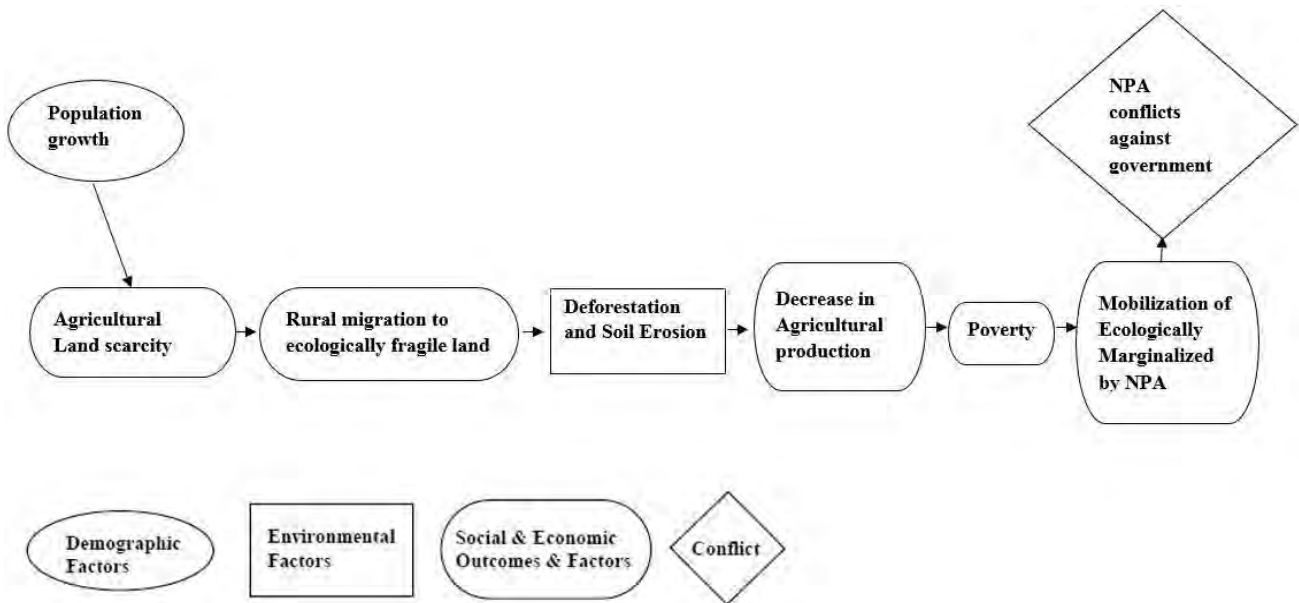
Land scarcity due to the increasing rural population also leads to deforestation and soil erosion. The rural community has been forced to migrate to ecologically fragile uplands. About 70% of Filipinos depend on agriculture and fishing for their livelihood. Chronic poverty turned Filipinos to join the NPA’s antigovernment movement (Figures 12 and 13). Adapted from (Schwartz & Singh, 1999)



**Figure 12:** Army of Philippines resisting violence

Source: [https://upload.wikimedia.org/wikipedia/commons/5/53/Philippine\\_Army\\_AIFV.jpeg](https://upload.wikimedia.org/wikipedia/commons/5/53/Philippine_Army_AIFV.jpeg)

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**Figure 13:** Flow chart of Environmental conflict for the Philippines

Source: (Schwartz & Singh, 1999)

*Keystone environmental problems:* Population growth, deforestation, and over-exploitation of natural resources (agricultural land scarcity)

*Non-keystone environmental problems:* Soil erosion (land degradation) and poverty

### 3.3.2 Impacts of climate change such as drought and pest outbreaks, and impacts of population explosion causes land degradation and famine led to conflict for land resources in Ethiopia

In the 1980s, in Ethiopia, drought conditions due to (non-anthropogenic) climate change and famine due to increasing population and resulting land degradation caused the migration of afar pastoralists into settled agricultural lands, which led to clashes between immigrant pastoralists and agriculturists. At the same time, pest outbreaks (which could be an impact of climate change and intensive farming, or monoculture) also affected the settled agriculturists and aggravated the competition for available land (Figures 14 and 15). Adapted from Semait (1989), as cited in Schwartz & Singh (1999).

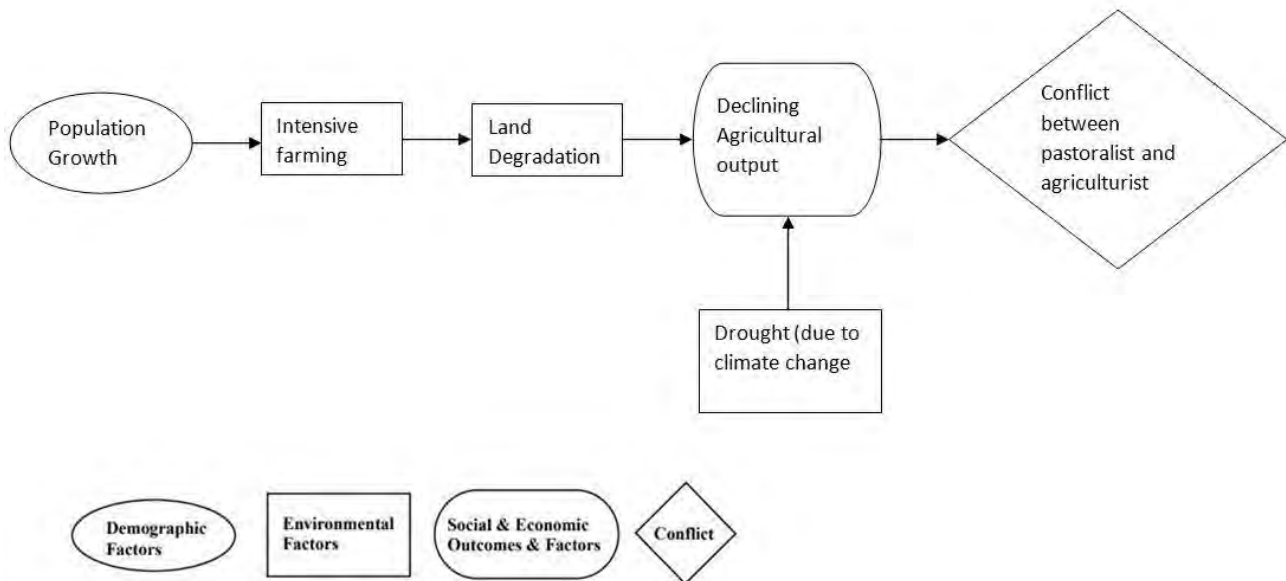


**Figure 14:** Starvation used as weapon of war in Ethiopia

Source:

[https://commons.wikimedia.org/wiki/File:Malnourished\\_children,\\_weakened\\_by\\_hunger.jpg](https://commons.wikimedia.org/wiki/File:Malnourished_children,_weakened_by_hunger.jpg)

Credit: DFID - UK Department for International Development, Used under CC by 2.0



**Figure 15:** Flow chart of Environmental conflict for Ethiopia

Source: (Schwartz & Singh, 1999)

*Keystone environmental problems:* Population growth, water crisis, and over exploitation of natural resources (land scarcity)

*Non-keystone environmental problems:* Land degradation and Climate change (drought)

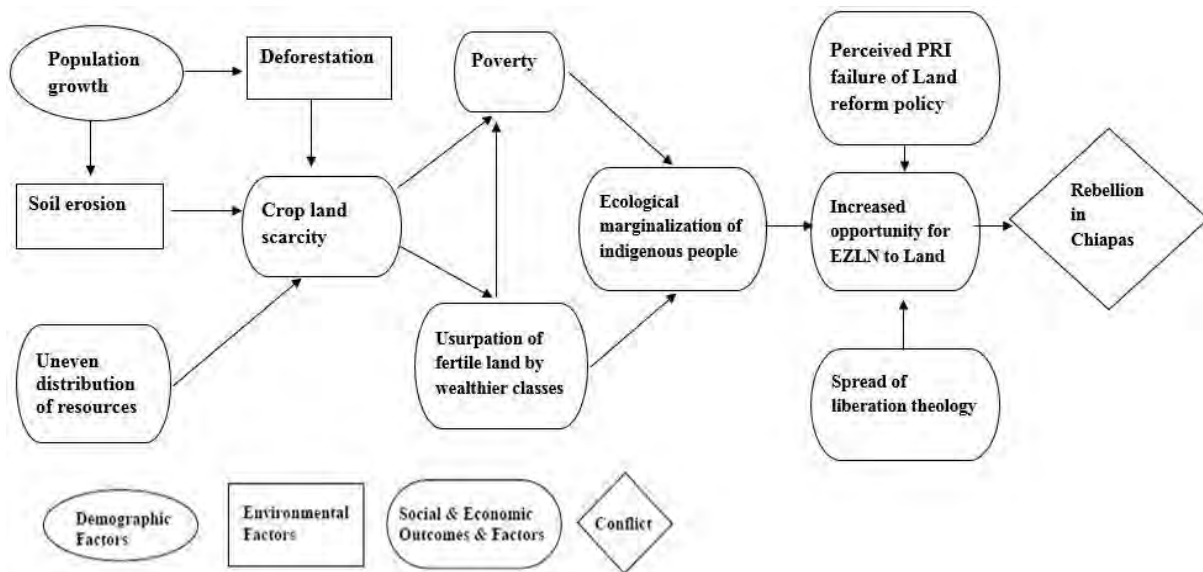
### 3.3.3 *Deforestation, land degradation, intensive farming, water scarcity and energy crisis caused by population explosion led to environmental conflict in Mexico*

In Chiapas, Mexico, the wealthier social class has access to the most fertile land, while indigenes (indigenous people) and Campesinos (Spanish-speaking subsistence farmers) have been provided with a little fertile land. However, the 1917 Mexican constitution focused on the redistribution of land to ecologically marginalised peasants, but indigenes and Campesinos felt that the Partido Revolutionary Institution (PRI) was purposely avoiding this idea as part of the PRI's 1992 economic reform policies. This resulted in a weakened Mexican government and a highly dissatisfied peasantry, who were also affected by cropland loss due to deforestation and land degradation (figure 16).

In addition, issues such as water scarcity and an energy crisis (electricity) also affected the region. In the period between 1974 and 1986, the Lacandon Rain Forest declined at a rate of 7.7% per year, and 42% was overtaken by secondary forests. It has been estimated that in the period between 1974 and 1986, about 20 to 50% of the highlands were affected by soil erosion. This is accompanied by 5% of the coffee plantation, which was degraded by heavy water logging. Soil erosion was mainly aggravated by intense rainfall, winds, deforestation, and intensive farming (unsustainable farming),



and subsequent famine and poverty among the indigenas and Campesinos resulted from ecological marginalisation, leading to a rebel movement by the Zapatista Army of National Liberation (EZLN in Spanish). Adapted from (Schwartz & Singh, 1999)



**Figure 16:** Flow chart for Environmental conflict for Chiapas, Mexico

Source: (Schwartz & Singh, 1999)

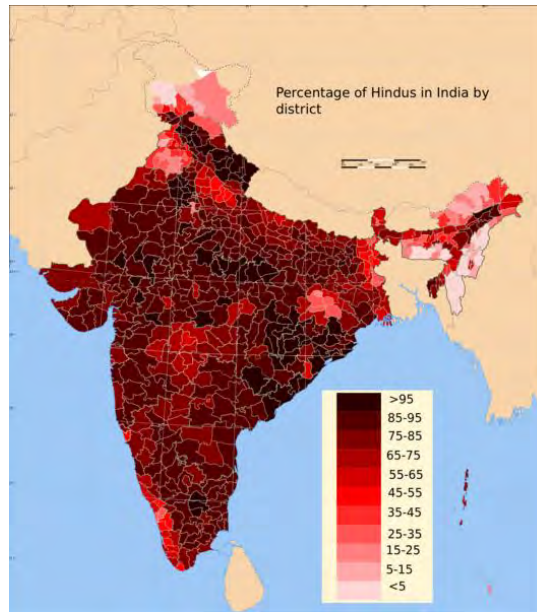
*Keystone environmental problems:* Population growth, deforestation, energy crisis, overexploitation of natural resources (uneven distribution of resources)

*Non-keystone environmental problems:* soil erosion (land degradation) and poverty

3.3.4 *Population explosion in Northeast India due to intense immigration of Bengalis affected by deforestation, resource depletion, loss of wetlands and flooding resulting from land degradation causes environmental conflict.*

In Bangladesh, deforestation and intense human encroachment adjacent to river banks resulted in flooding events and the depletion of natural resources. Lacks of natural resources and intense flooding have caused millions of Bengalis to migrate to Assam and Tripura in northeast India. However, this situation affected political stability and became a threat to indigenous culture. In addition, increased competition over resources led to ethnic clashes. As Bengali migrants are Muslims and indigenous people are Hindus, in the period between 1979 and 1985, ethnic rioting caused the deaths of more than 4000 people in Assam and Tripura of northeast India (Figures 17 and 18).

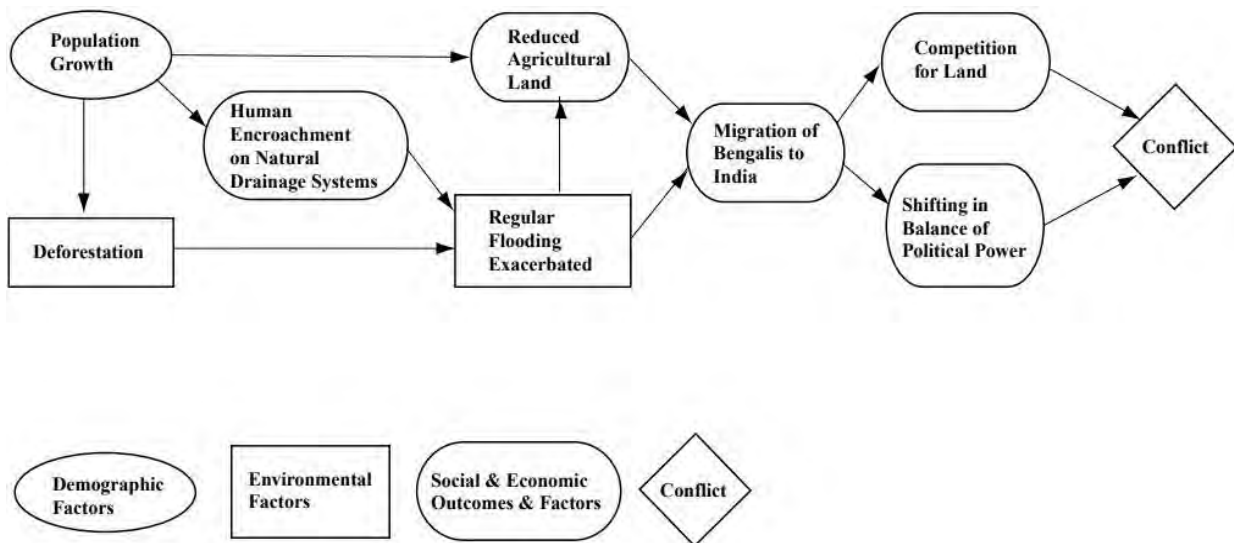
In 1988, Bangladesh experienced a massive flooding event that affected 1.6 million tons of rice production. Wetlands are converted to agricultural lands, and road development (urbanisation) makes low-lying areas more vulnerable to flooding. Deforestation in the Himalayas (upstream) also exacerbated flooding. Adapted from (Schwartz & Singh, 1999)



**Figure 17:** Map shows less Hindu population in Northeast India due to intense immigration of Muslim Bengalis

Source: [https://commons.wikimedia.org/wiki/File:India\\_Hindu\\_district\\_map\\_2011.png](https://commons.wikimedia.org/wiki/File:India_Hindu_district_map_2011.png)

Credit: ‘Superbenjamin’ Used under CC BY-SA 4.0



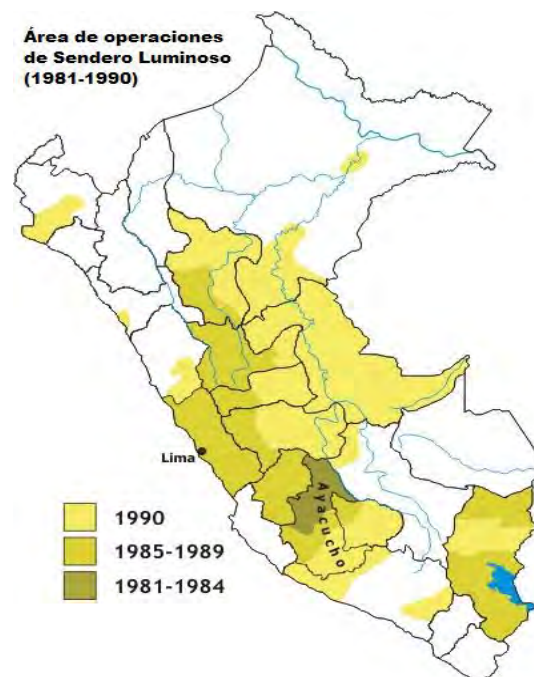
**Figure 18:** Flow chart of Environmental conflict for Northeast India

*Keystone environmental problems:* Population growth, deforestation, over exploitation of natural resources (reduced agricultural land and competition for land)

*Non-keystone environmental problems:* famine (reduced rice production), land degradation, and loss of wetlands

3.3.5 *Population explosion caused reduced land availability and land degradation from intensive farming eventually led to the loss of crop production and poverty caused environmental conflict in Peru.*

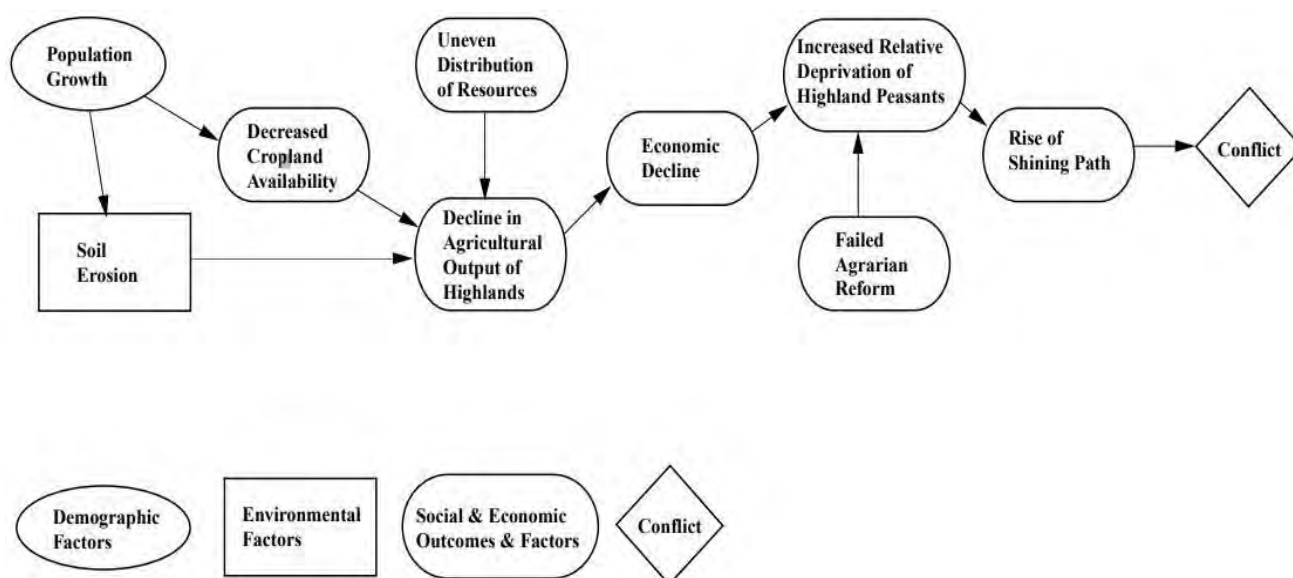
In Peru's southern highlands (Ayacucho region), during the 1980s, a population explosion reduced the land available for agriculture, which is 0.2 ha per capita. This problem was further aggravated by land degradation and the subsequent loss in agriculture production, which led to the economic crisis in the southern highland peasantry mainly in the period between the 1970s and 1980s. Failure in the implementation of agrarian reforms established under the military government from 1968 to 1980 initiated clashes between affected people (Figures 19 and 20). Unemployed graduates also joined the protest led by Sendero Luminoso ('Shining path'), which was then identified as a terrorist organisation and took tens of thousands of lives. Adapted from (McClintock & Cynthia, 1989) as cited in (Schwartz & Singh, 1999).



**Figure 19:** Land area operated by Sendero Luminoso (shining path)

Source:

[https://commons.wikimedia.org/wiki/File:Area\\_de\\_operaciones\\_de\\_Sendero\\_Luminoso\\_\(1981-1990\).png](https://commons.wikimedia.org/wiki/File:Area_de_operaciones_de_Sendero_Luminoso_(1981-1990).png) Credit: Pejesuizo, Used under CC-BY-SA-4.0



**Figure 20:** Flow chart of Environmental conflict for Peru

*Keystone environmental problems:* Population growth, intensive farming, deforestation, over exploitation of natural resources (decreased cropland availability and uneven distribution of resources)

*Non-keystone environmental problems:* soil erosion (land degradation) and famine-poverty

### 3.3.6 Water pollution and scarcity, deforestation, and land degradation caused by population explosion led to environmental conflicts in Pakistan.

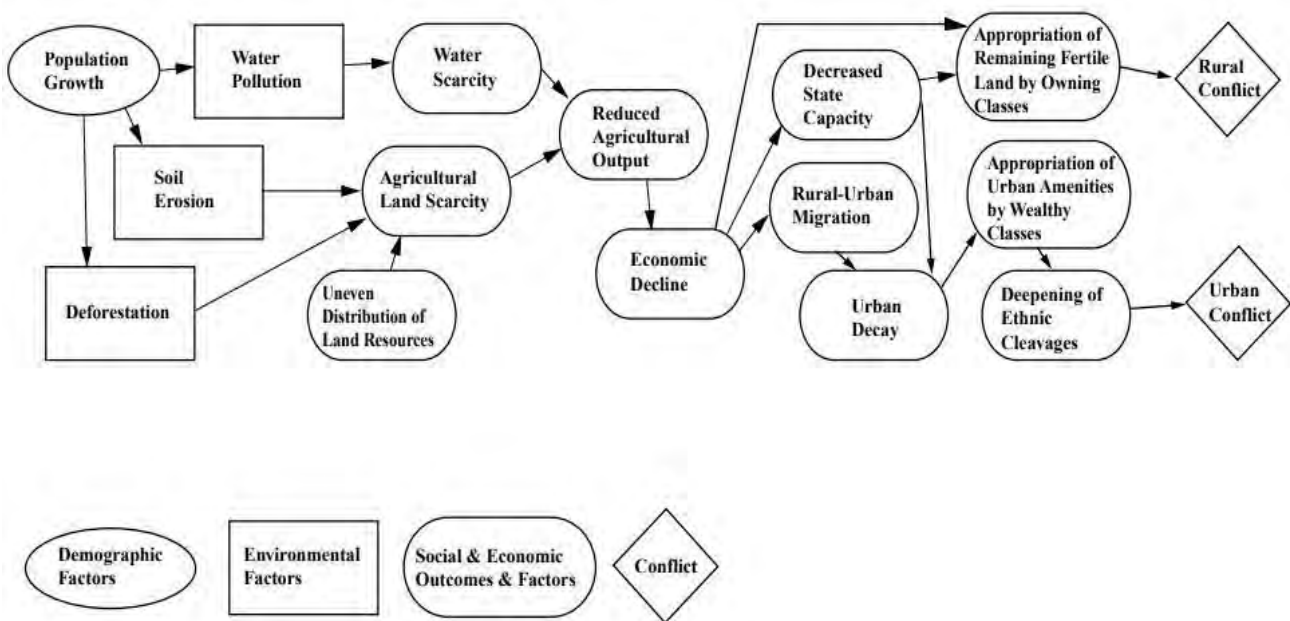
In Pakistan, population explosion accompanied by climate change and drought resulted in water scarcity, water pollution, deforestation, and soil degradation. The major causes of water pollution are industrial and domestic wastewater effluents, heavy silting, and prolonged drought conditions that led to the scarcity of potable water.

Intensive farming (increased demand for cropland) and the energy crisis (fuel wood consumption) led to reduced forest cover, from 14.2% to 5.2% of Pakistan's total land area. The impacts of deforestation associated with land degradation due to loss of organic matter, soil salinization, water logging, and flooding made Pakistani soil infertile. The subsequent loss of agricultural production and famine led to clashes between social or ethnic classes mainly in urban regions such as Karachi (Figures 21 and 22). Adapted from (Schwartz & Singh, 1999)



**Figure 21:** Karachi rioting aftermath

Source: [https://commons.wikimedia.org/wiki/File:Karachi\\_rioting\\_aftermath.jpg](https://commons.wikimedia.org/wiki/File:Karachi_rioting_aftermath.jpg), Credit: Waheed M. Zuberi, Used under CC BY 3.0



**Figure 22:** Flow chart of Environmental conflict for Pakistan

Source: (Schwartz & Singh, 1999)

*Keystone environmental problems:* Population growth, water pollution-water scarcity, deforestation, over exploitation of natural resources (uneven distribution of resources and agricultural land scarcity) and urbanization-urban sprawl-settlements (rural -urban migration and urban decay)

*Non-keystone environmental problems:* soil erosion (land degradation) and famine-poverty

3.3.7 *Desertification (land degradation) and deforestation due to intensive farming resulted from population explosion in North Sudan causes environmental conflict between North and South Sudan*

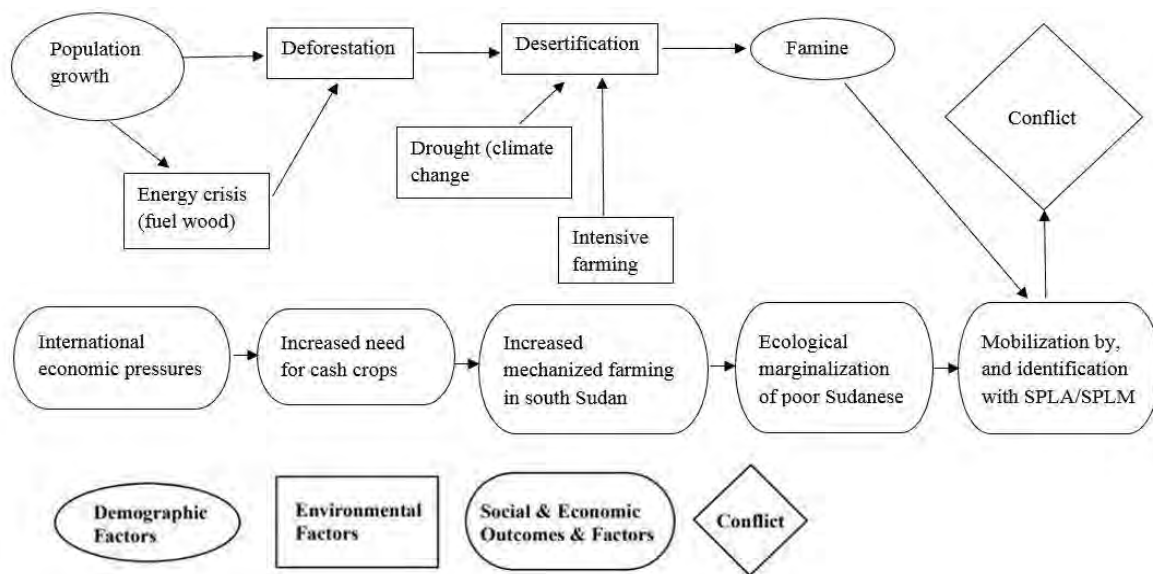
From 1966 to 1972 and 1983, a devastating civil war occurred between North Sudan and South Sudan (Figure 23). After the independence of Sudan in 1956, large-scale mechanised (intensive) farming was practiced in Northern Sudan. By the 1980s, this situation had led to land degradation and

desertification in Northern Sudan. All forest areas were expected to be denuded by 2003 due to deforestation and the energy crisis (fuel wood) caused by the increased population in North Sudan. However, land degradation was also exacerbated by the impacts of drought, climate change, and overgrazing. The Jallaba (wealthier Arab Sudanese) people of the north then migrated to South Sudan in search of arable land. Since the 1970s, Jallaba had begun several schemes related to oil, water, and land resources in Southern Sudan. Then the intense competition between ecologically marginalised Northern Sudan immigrants and South Sudanese caused clashes (figure 24). Wealthier and politically stronger (Jallaba) people formed the Sudan People’s Liberation Army (SPLA), and the war intensified. Adapted from (Schwartz & Singh, 1999)



**Figure 23:** Map of North and South Sudan

Source: [https://commons.wikimedia.org/wiki/File:South\\_Sudan\\_Sudan\\_Locator-cropped.png](https://commons.wikimedia.org/wiki/File:South_Sudan_Sudan_Locator-cropped.png)  
Used under CC0 1.0



**Figure 24:** Flow chart of Environmental conflict for Sudan



*Keystone environmental problems:* Population growth, deforestation, intensive farming (increased mechanized farming in South Sudan) and energy crisis (fuel wood)

*Non-keystone environmental problems:* desertification, climate change (drought) and famine

### 3.3.8 *Over fishing (resource depletion), eutrophication, deforestation and desertification caused environmental conflict between Kenyan tribes*

Lake Victoria is the third-largest freshwater lake in the world and is found in Kenya. The lake has been over-exploited by overfishing, and it has also been degraded by water pollution, where toxic chemicals flow from seven Kenyan rivers that feed the lake. Increased eutrophication due to the massive influx of nitrogen, phosphorous, and sulphur caused death zones due to deoxygenated regions created by algal blooms, resulting in fish deaths. In the period between 1970 and 1990, Kenya lost 11,450 ha. of forests. Deforestation results in soil degradation and desertification. Silting caused by soil erosion also pollutes nearby lakes such as Lake Jipe, Bogoria, and Turkana.

Impacts of intensive farming practices, such as pollution by agrochemicals, also exacerbated desertification and land degradation. About 483,860 km<sup>2</sup> or 83% of the total land area of Kenya was decertified. This led to reduced food production and an economic crisis. Thus, agriculturists (Kikuyu people) have been migrating in search of fertile land since the 1960s. Kikuyu agriculturists (Figure 25) occupied the Rift Valley, where the Kalenjin and other pastoralists reside. Clashes occurred in 1991 and 1992 between Kalenjin warriors and members of pastoralist tribes such as the Maasai (Figure 26) and the Kikuyu agriculturists.

Migration caused clashes in 1993 in which 1500 people were killed. 1994 clashes were more widespread in other parts of Kenya. In addition to the Kikuyu people, Kalenjin warriors and Maasai tribes also targeted other tribes, such as the Luo, Luhya, Kisii, Kamba, Meru, and Teso (Figure 27). Adapted from (Schwartz & Singh, 1999)



**Figure 25:** Kikuyu agriculturists

Source:

[https://commons.wikimedia.org/wiki/File:Traditional\\_Kikuyu\\_men\\_and\\_women\\_dancing.jpg](https://commons.wikimedia.org/wiki/File:Traditional_Kikuyu_men_and_women_dancing.jpg)

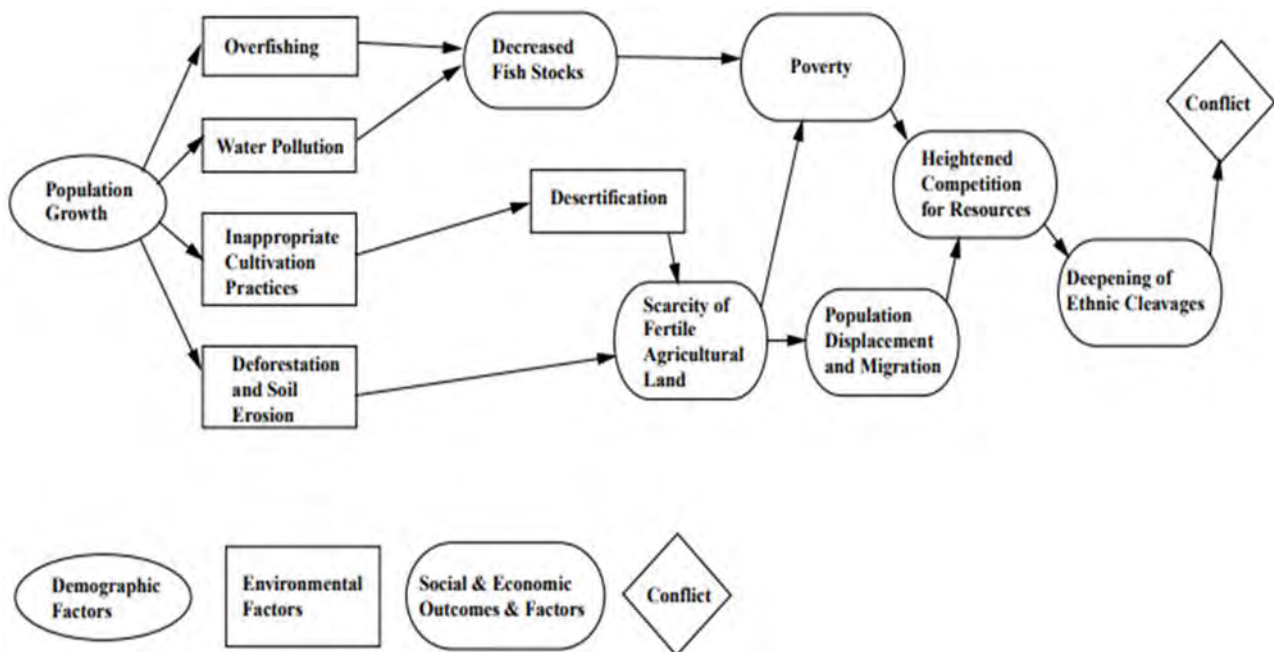
Credit: Isiyekala Used under CC-BY-SA-4.0



**Figure 26:** Maasai pastoralists

Source: [https://commons.wikimedia.org/wiki/File:Maasai\\_Tribe\\_Kenya.jpg](https://commons.wikimedia.org/wiki/File:Maasai_Tribe_Kenya.jpg)

Used under CC0 1.0



**Figure 27:** Flow chart of Environmental conflict for Kenya

*Keystone environmental problems:* Population growth, deforestation, over exploitation of natural resources (overfishing), intensive farming (inappropriate cultivation practice) and water pollution

*Non-keystone environmental problems:* soil erosion, biodiversity loss (decreased fish stocks), desertification, agrochemicals, eutrophication, and poverty

### 3.4 Indirect International Environmental Conflicts

3.4.1 *Deforestation, over-exploitation of natural resources and land degradation caused by population explosion led to environmental conflict between El Salvador and Honduras.*

The 1969 invasion of El Salvador into Honduras led to a 100-day war that killed thousands of civilians and converted over 100 thousand people into homeless and jobless refugees. It has been revealed that



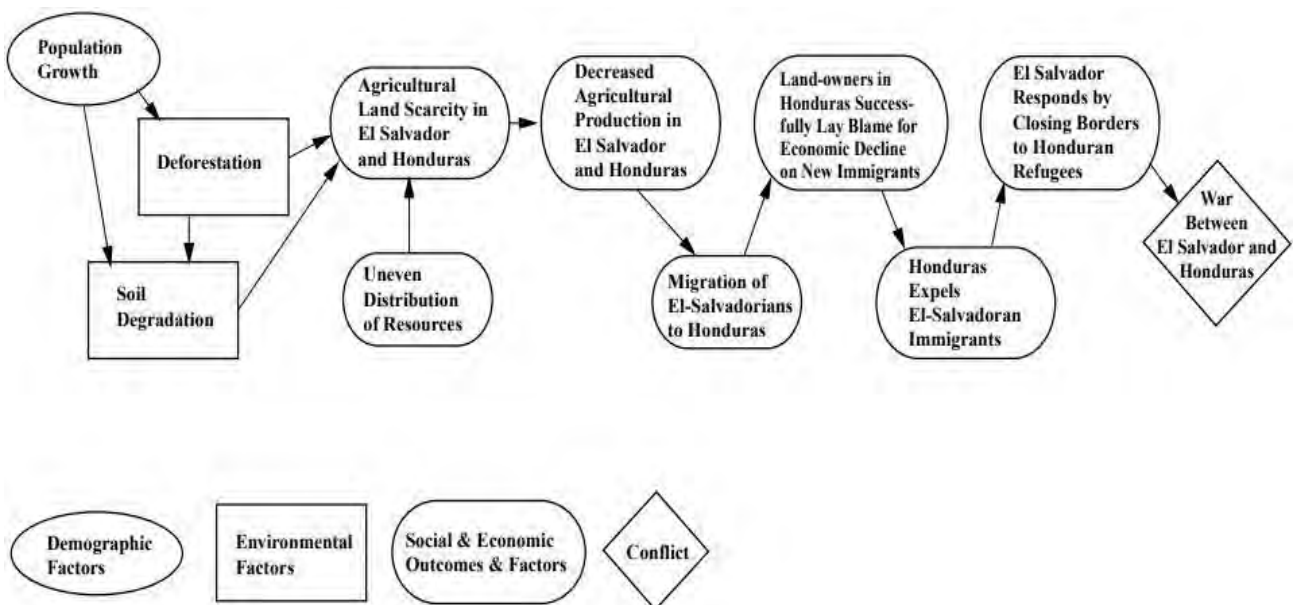
the cause of the war is the population explosion, which resulted in competition over resources and forced marginalised people in El Salvador to migrate to Honduras in search of resources (Figure 28). Deforestation in El Salvador caused the depletion of the entire virgin forest cover in the region. Intensive farming (over-irrigation) also affected the topsoil and resulted in land degradation. The arrival of Salvadoran immigrants exacerbated the competition for resources in Honduras. This resulted in an economic crisis among small-scale farmers in Honduras. Disputes between Honduran farmers and immigrants from El Salvador led to war (Figure 29). Adapted from (Schwartz & Singh, 1999)



**Figure 28:** El Salvador’s invasion into Honduras 1969

Source: <https://commons.wikimedia.org/wiki/File:HondurasHidrograf%C3%ADa2.svg>

Credit: Rowanwindwhistler, License: CC BY-SA 3.0



**Figure 29:** Flow chart of Environmental conflict for El Salvador- Honduras

*Keystone environmental problems:* Population growth, Intensive farming, deforestation, over exploitation of natural resources (uneven distribution of resources)

Non-keystone environmental problems: soil degradation

*3.4.2 Desertification due to over grazing, resource depletion, famine, and water scarcity (drought) pioneered by population explosion in Northern Somalia led to migration into eastern Ethiopia, which caused environmental conflict*

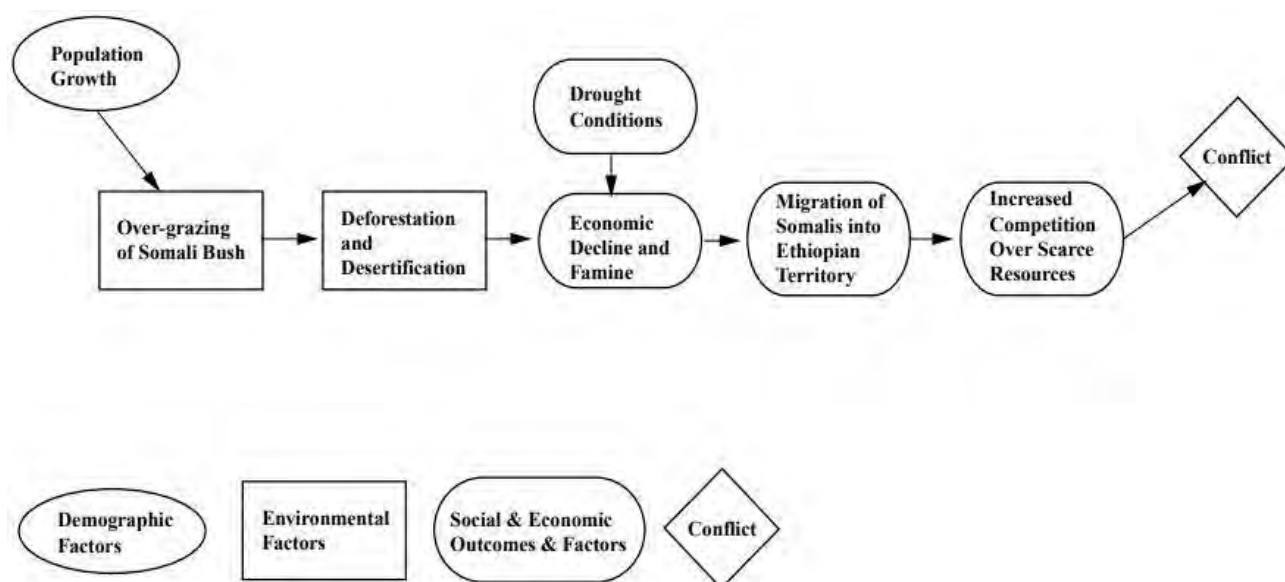
The 1977–1978 war between Somalia and Ethiopia was initiated by clashes between Ishaq and Ogaden pastoral groups. In northern Somalia, high demand for meat exports to the Middle East in the 1950s, 60s, and 70s led to overcrowding of cattle and intense grazing, which degraded the land and was accompanied by water scarcity (Markakis, 1989), and drought led to famine in the region. Thus, the Ishaq people of northern Somalia periodically migrated to the east Ethiopian Haud region in search of resources (Figure 30). The resistance against the immigrant Ishaq pastoral group by the Ogaden led to war between Somalia and Ethiopia in 1977 (Figure 31). Adapted from Markakis (Markakis, 1989) as cited in (Schwartz & Singh, 1999).



**Figure 30:** Map shows Haud and Ogaden territories

Source: [https://commons.wikimedia.org/wiki/File:Mappa\\_Ogaden.svg](https://commons.wikimedia.org/wiki/File:Mappa_Ogaden.svg)

Credit: Karte\_Ogaden\_Haud\_Somali.gif: Lencer, Used under CC BY-SA 2.5



**Figure 31:** Flow chart of Environmental conflict for Somalia-Ethiopia

*Keystone environmental problems:* Population growth, deforestation, water scarcity, intensive farming, over exploitation of natural resources (over-grazing of Somali bush)

*Non-keystone environmental problems:* desertification, climate change (drought) and famine-poverty

### 3.4.3 Water scarcity pioneered by population explosion led to environmental conflict between Israel and Palestine (West Bank)

In the 1950s, Jordan and the United Nations Relief and Work Agency (UNRWA) for Palestine Refugees were working on an irrigation scheme for the benefit of Jordan's agriculture and the resettlement of Palestinian refugees. And they have decided to divert the Yarmouk River into Lake Tiberias and to construct irrigation canals on both sides of the Jordan valley. The project was expected to irrigate 43,500 ha in Jordan and 6,000 ha in Syria. In addition, a hydroelectric power plant also generates 28,300 kWh of electricity annually for other nations. It was believed Bunger's plan would settle over 100 thousand people. However, in 1953, just before the implementation of the plan, Israel protested for its riparian rights to the Yarmouk River in the Bunger plan, even though Israel had only 10 km of land on the Yarmouk (Figure 32).

In 1967, Israel went to war with Arab nations because Arabs tried to divert the Jordan River headwaters that feed Israel (Cooley, 1984). At that time, the west bank aquifers provided 25–40% of Israel's water (Starr, 1991); (Falkenmark, 1989) as cited in (Schwartz & Singh, 1999). Disputes between Israel and Arab nations began in 1987 and lasted until 1992 (Figure 33). Due to the increased water demands, the government of Israel restricted the Palestinians from drilling wells while allowing the same to Jewish west bank settlers without any restrictions. However, Palestinians also suffer from the salinization of aquifers due to Mediterranean Sea water intrusion.

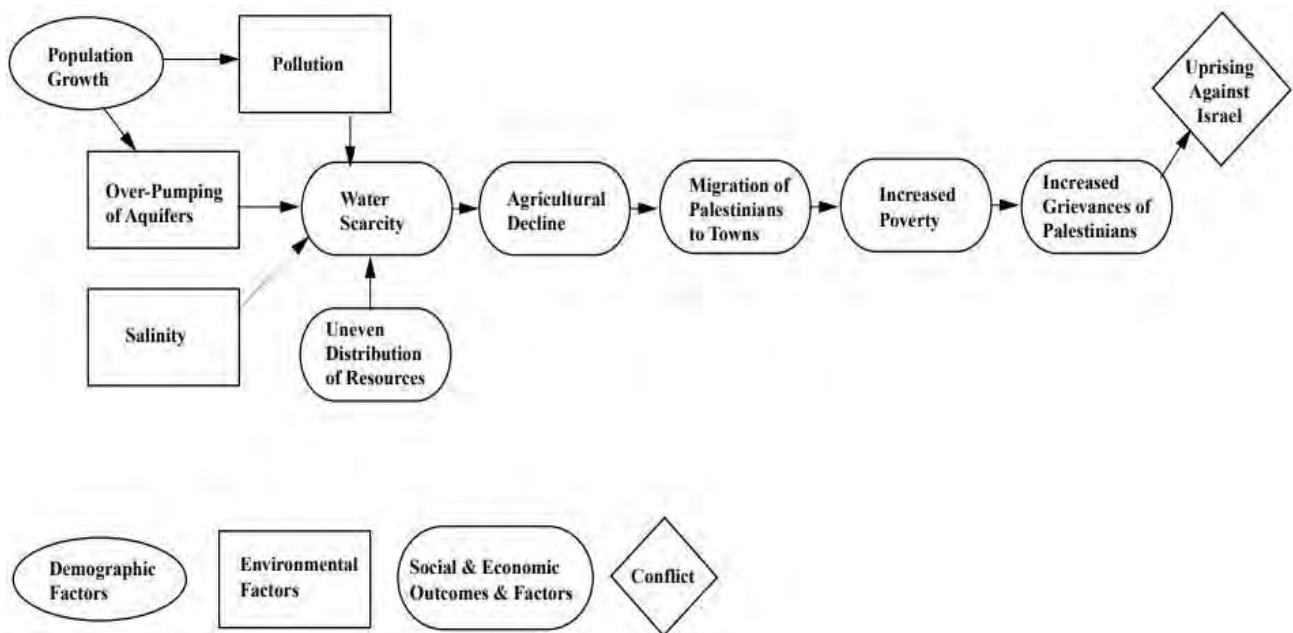
Adapted from (Schwartz & Singh, 1999)



**Figure 32:** 1967 movement of Israeli armed forces (blue arrow) and newly captured areas by Israel (light blue)

Source: [https://commons.wikimedia.org/wiki/File:Gu%C3%A8rra\\_dei\\_Si%C3%A8is\\_Jorns.png](https://commons.wikimedia.org/wiki/File:Gu%C3%A8rra_dei_Si%C3%A8is_Jorns.png)

Credit: Nicolas Eynaud, Used under CC-BY-SA-3.0



**Figure 33:** Flow chart of Environmental conflict for Israel- Palestine (West Bank)

*Keystone environmental problems:* Population growth, water pollution-water scarcity- water salinization, intensive farming, energy crisis (hydropower plant), over-exploitation of natural resources (over-pumping of aquifers), and urbanization (migration to Palestinian towns)

*Non-keystone environmental problems:* establishment of dam and famine (agricultural decline) - poverty

3.4.4 *Population explosion resulted in intensive farming led to land degradation, depletion of resources and water scarcity, and the migration of Moors of Mauritania into Senegal led to environmental conflict.*

In the regions of Mauritania and Senegal, increasing population caused intensive farming, and intensive farming led to land degradation, resource depletion, famine, and water scarcity. This is also accompanied by persistent drought (also caused by climate change). To overcome this crisis, both Black Africans residing in the Senegal River and the Moors of Northern Mauritania decided to build a series of dams along the Senegal River (Figure 34). After the establishment of dams, Northern Mauritanian Moors migrated to Southern Senegal in the mid-1980s; the land was previously administered by black Africans of Senegal. This situation resulted in clashes between Moors and black Africans. In 1989, riots in Senegal killed 35 Moors, and over 17,000 shops owned by Moors were looted or destroyed; similarly, riots in Mauritania killed over 200 black Africans (Figure 35). However, in 1992, diplomatic ties were restored between both ethnic communities.

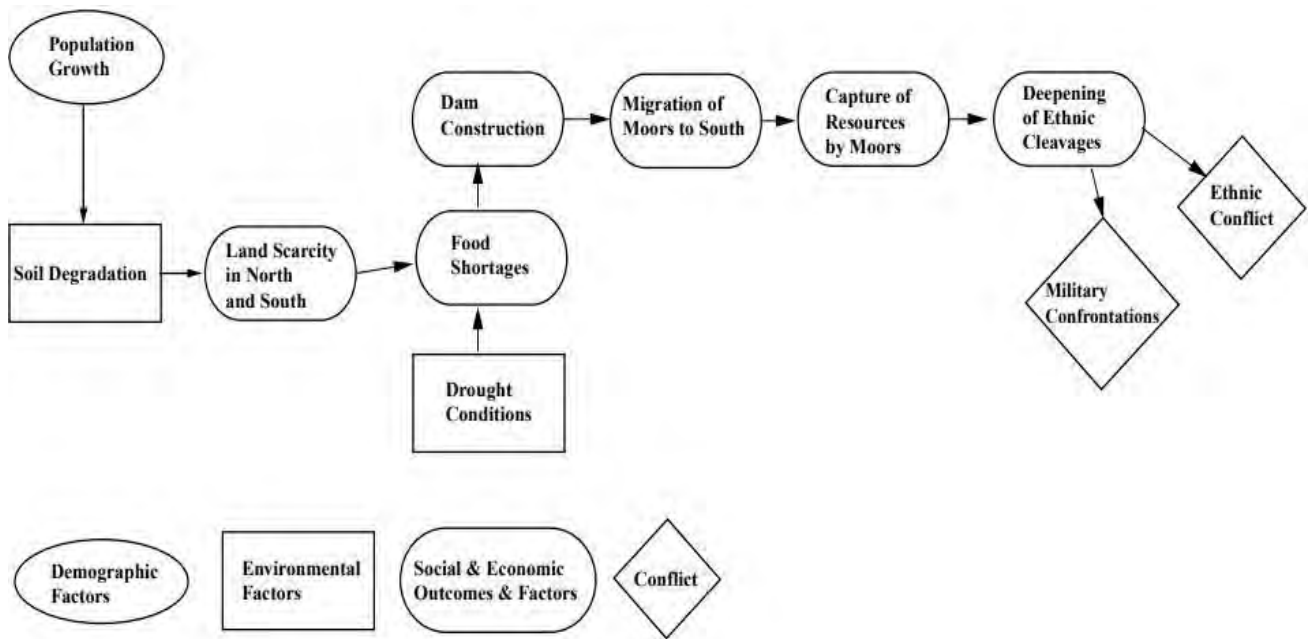
Adapted from (Schwartz & Singh, 1999)



**Figure 34:** Map of Senegal River basin

Source: <https://upload.wikimedia.org/wikipedia/commons/7/7a/Senegalrivermap.png>

Credit: Kmusser, Used under CC BY-SA 3.0



**Figure 35:** Flow chart of Environmental conflict for Mauritania and Senegal

*Keystone environmental problems:* Population growth, water scarcity, intensive farming, and over-exploitation of natural resources (resource depletion and land scarcity)

*Non-keystone environmental problems:* land degradation, establishment of the dam, famine (food shortage), climate change (drought) and famine (food shortages)

### 3.4.5 Water pollution-water scarcity due to saltwater intrusion and agrochemicals affected agriculture and caused famine and diseases including infant mortality in the Gaza

The Palestinian Authority (PA), chaired by the Palestinian Liberation Organisation (PLO) headed by Yasser Arafat, faced political opposition from Islamic militants such as Hamas. Here, both the PA and Hamas were engaged in a war against Israel.

It has been revealed that environmental factors such as water scarcity (Figure 36) and water pollution caused by saltwater intrusion, agrochemicals, and industrial effluents led to diseases and elevated child mortality. Even though the Palestinian water requirement is as high as 100 to 140 cubic metres annually, the available consumable fresh water is only 65 cubic metres per year. The saltwater intrusion of aquifers from the Mediterranean further degraded the water quality. Farmers insisted on cultivating salt-tolerant crops, which subsequently resulted in food shortages and severe economic crises (Figure 37). By using this circumstance, Yasser Arafat's political opponent Hamas increased its popularity and gained more support to legitimise its suicide raids on Israel.

Adapted from (Schwartz & Singh, 1999)

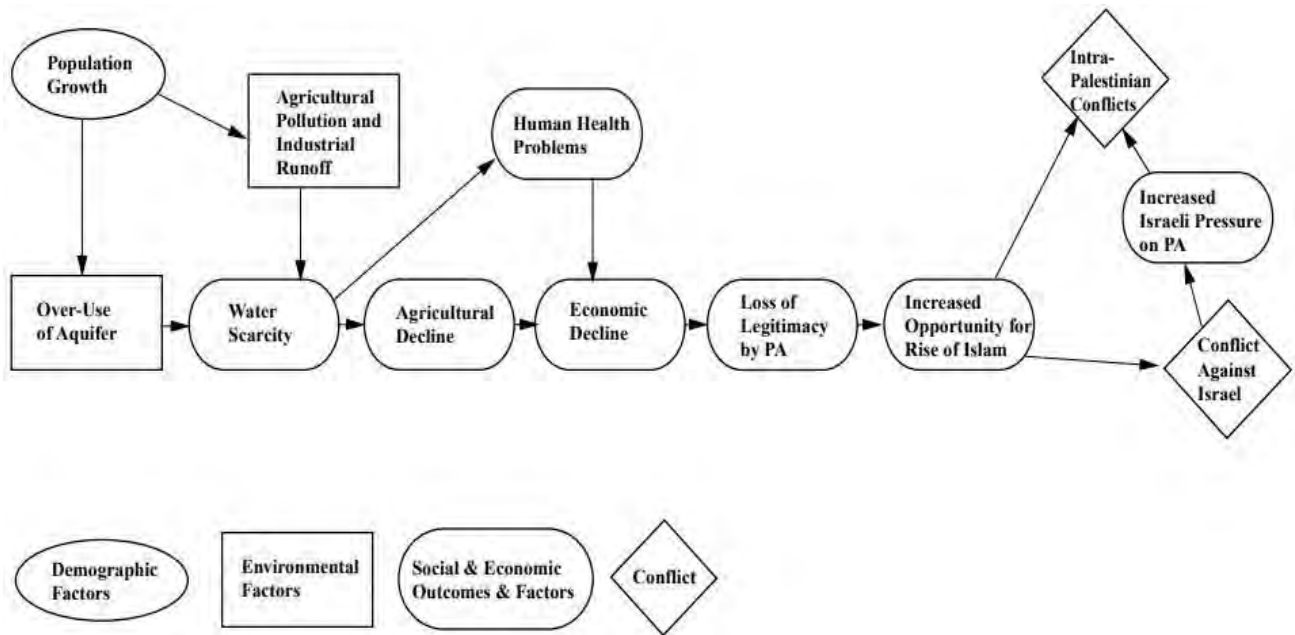




**Figure 36:** water crisis of west bank Gaza

Source:

[https://commons.wikimedia.org/wiki/File:Water\\_supply\\_in\\_West\\_Bank\\_and\\_Gaza\\_February\\_2014\\_2water\\_photoblog.jpg](https://commons.wikimedia.org/wiki/File:Water_supply_in_West_Bank_and_Gaza_February_2014_2water_photoblog.jpg), Credit: Muhammad Sabah, B'Tselem, License: CC by 4.0



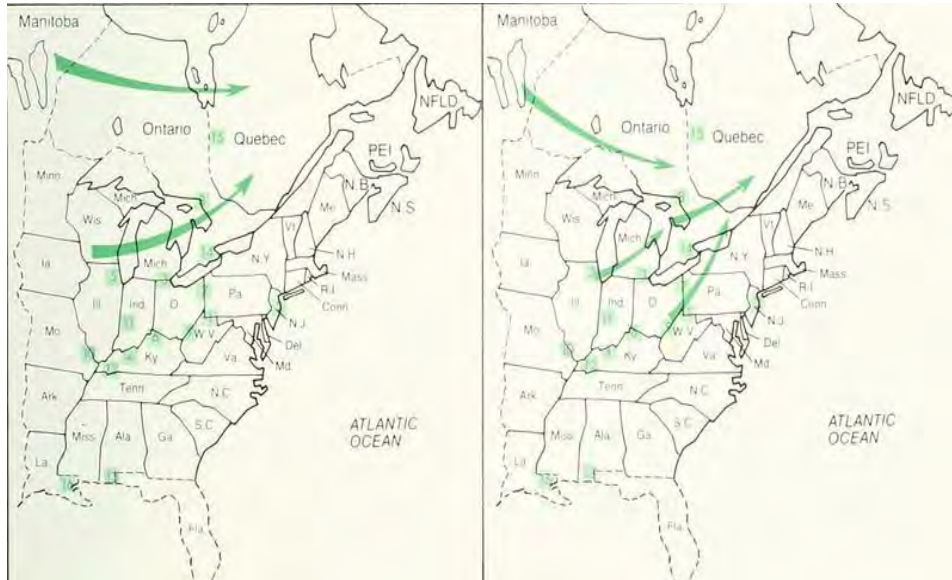
**Figure 37:** Flow chart of Environmental conflict for Israel (Gaza)

*Keystone environmental problems:* Population growth, water pollution – water scarcity, intensive farming, and over exploitation of natural resources (over-use of aquifer)

*Non-keystone environmental problems:* Agrochemicals and famine (agricultural decline)-health issues-poverty

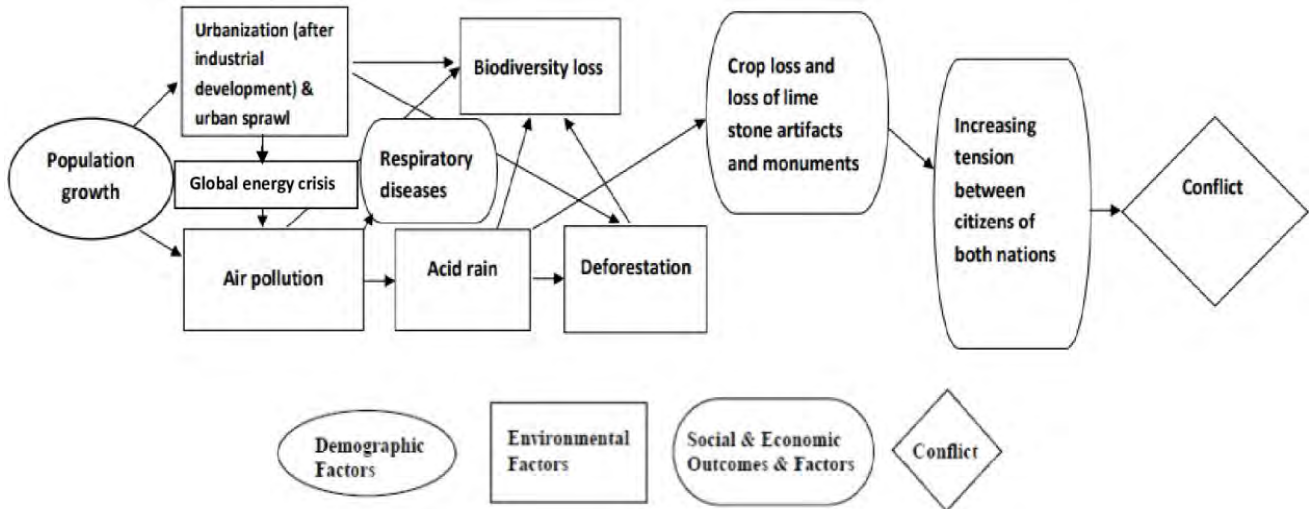
3.4.6 Emissions of the transboundary air pollutants from the USA cause acid deposition in Canada According to Munton (1997), in the 1980s, acid rain in Canadian states was caused primarily by transboundary air pollutants (SO<sub>x</sub> and NO<sub>x</sub>) from the United States (Figures 38 and 39). Each year, smelters, industrial boilers, and coal power plants in the US emit tones of air pollutants into the

atmosphere. These pollutants are carried by the air current and precipitated as acid rain in the Canadian States. Both nations adopted national acid rain controls by 1990. In 1991, the US-Canada air quality agreement was signed, which led to a significant reduction in acid deposition in Canada. In 1995, the establishment of cap-and-trade programmes in the United States reduced SO<sub>2</sub> emissions by 32% from the levels of 1990 ("United States-Canada Air Quality Agreement," 2015).



**Figure 38:** Movement of transboundary air pollutants from the US to Canada

Source: ("Fliker.com", 1982), Credit: Ontario Ministry of Environment, License: Public domain



**Figure 39:** Flowchart for Environmental conflict between Canada and USA due to transboundary air pollutants causing acid rain

*Keystone environmental problems:* Population growth, Urbanization, global energy crisis, deforestation and air pollution

*Non-keystone environmental problems:* acid rain, diseases (respiratory) and loss of biodiversity



#### **4. Discussion**

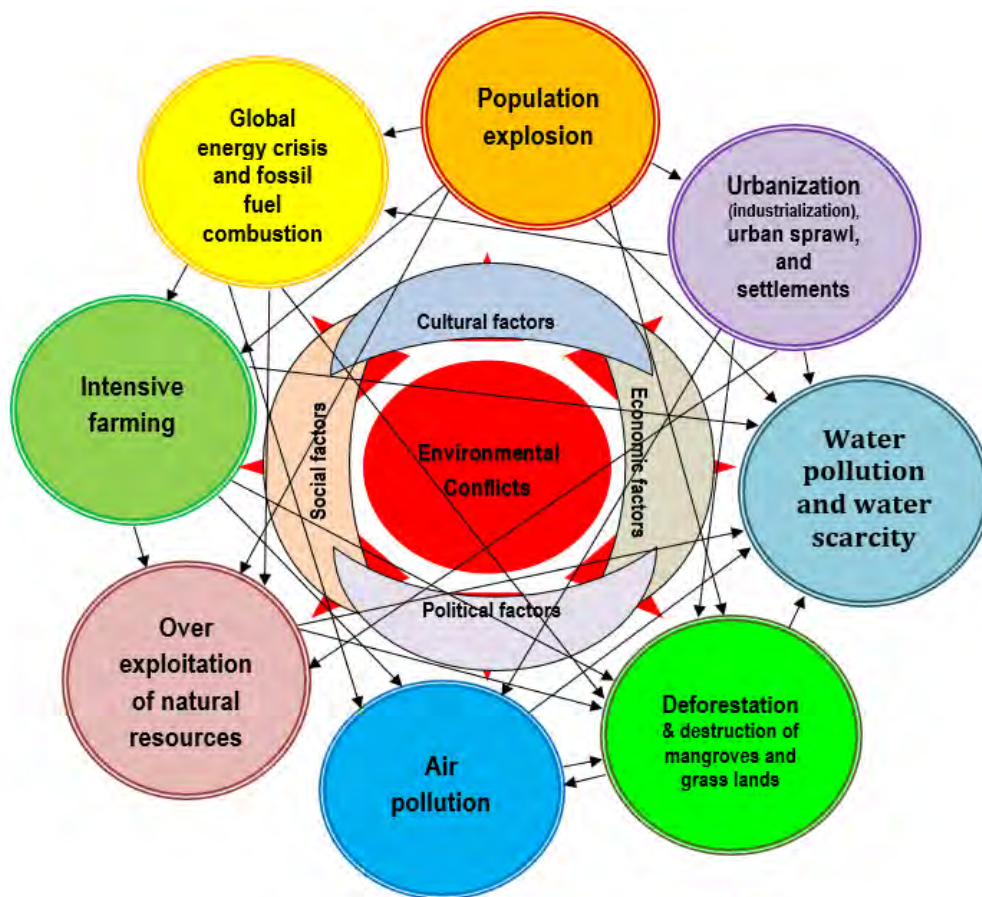
It has been found that primary environmental problems are the causative factors of every environmental conflict, regardless of whether it is a keystone environmental problem or not. For instance, air pollution (by SO<sub>x</sub> and NO<sub>x</sub>) is the primary (initial) and keystone environmental problem of the 1980s transboundary air pollution crisis between the USA and Canada. Whereas acid rain, deforestation (by loss of chlorophyll), and biodiversity loss are secondary, tertiary, and quaternary environmental issues, respectively. When mitigating a primary environmental issue, if it results in the disappearance of secondary and subsequent environmental problems, then that mitigated problem is a keystone environmental problem. However, keystone environmental problems also result from non-keystone environmental problems in the chain of cause-effect relationships, e.g., keystone air pollution causes a non-keystone acid rain problem, and acid rain causes a loss of chlorophyll in forest trees, thus causing deforestation. However, similar to air pollution (a primary problem), deforestation (a secondary problem) is also a known keystone environmental problem (where mitigating deforestation can reduce biodiversity loss and soil erosion). Similarly, in the case of the 1995 Alto Cenepa War, intensive farming was the primary and keystone environmental problem, resulting in agrochemicals (secondary), water pollution (tertiary), eutrophication (quaternary), and biodiversity loss (quinary). When the keystone environmental problem gets mitigated, all the resulting environmental problems get abated. In the above scenario, water pollution is placed as a tertiary environmental issue; however, water pollution is a known keystone issue because when water pollution is mitigated, the resulting eutrophication can be completely abated. However, in the same scenario Eutrophication is not a keystone environmental problem because even if eutrophication is mitigated, the resulting biodiversity loss cannot be mitigated for sure. This is because biodiversity loss can occur due to various other causes instead. For instance, an industrial runoff with hazardous chemical pollutants can cause the same; even the introduction of an exotic predator or competitor species can result in the loss of certain species, leading to biodiversity loss. Thus, there is a clear difference between a keystone environmental problem and a non-keystone environmental problem, regardless of whether it is a primary environmental problem (an initiative) or placed somewhere in the middle of the chain (secondary, tertiary, etc.).

The occurrence of more adverse results from environmental problems resonates with socioeconomic factors and exacerbates the chances of igniting an environmental conflict or war. The following table (Table 1) depicts the role of keystone environmental problems as primary environmental problems (the primary cause from where the crisis originates), secondary, tertiary, quaternary, etc. environmental problems in igniting an environmental conflict.

**Table 1:** Occurrences of keystone environmental problems on igniting global environmental conflicts or warfare

	International or intranational	Keystone environmental problems	Population explosion (growth)	Water pollution - scarcity - salination	Intensive farming	Deforestation	Over-exploitation of natural resources	Global energy crisis	Urbanization-urban sprawl-settlements	Air pollution
No	Type of environmental conflict	Examples of environmental problems								
1	Direct Intra	Chauvery River dispute	Yes	Yes	Yes	Yes	No	No	No	No
2	Direct Inter	Strait among fishermen of India and Sri Lanka	Yes	No	No	No	Yes	No	No	No
3	Direct Inter	Russia's invasion of Ukraine in 2022	Yes	Yes	No	No	No	Yes	No	No
4	Direct Inter	Alto Cenepa war	Yes	No	Yes	Yes	No	No	No	No
5	Direct Inter	Grand Ethiopian Renaissance Dam crisis	Yes	Yes	No	No	No	Yes	No	No
6	Indirect Intra	Philippines conflict	Yes	No	No	Yes	Yes	No	No	No
7	Indirect Intra	Ethiopian conflict	Yes	Yes	No	No	Yes	No	No	No
8	Indirect Intra	Mexican conflict	Yes	No	No	Yes	Yes	No	No	No
9	Indirect Intra	Bengalis immigrat conflict in North India	Yes	No	No	Yes	Yes	No	No	No
10	Indirect Intra	Peru's rvironmental conflict	Yes	No	Yes	Yes	Yes	No	No	No
11	Indirect Intra	Pakistan's conflict	Yes	Yes	No	Yes	Yes	No	Yes	No
12	Indirect Intra	North Sudan and South Sudan	Yes	No	Yes	Yes	No	Yes	No	No
13	Indirect Inter	El Salvador and Honduras	Yes	No	Yes	Yes	Yes	No	No	No
14	Indirect Inter	Somalia and Ethiopia	Yes	Yes	Yes	Yes	Yes	No	No	No
15	Indirect Inter	Israel and Palestine (West Bank)	Yes	Yes	Yes	No	Yes	Yes	Yes	No
16	Indirect Inter	Mauritania and Senegal 1989	Yes	Yes	Yes	No	Yes	No	No	No
17	Indirect Inter	Gaza conflict	Yes	Yes	Yes	No	Yes	No	No	No
18	Indirect Inter	USA and Canada 1980s (acid rain)	Yes	No	No	Yes	No	Yes	Yes	Yes

In general, all kinds of environmental problems can ignite a conflict situation and can be at any position (primary, secondary, tertiary, etc.) in igniting an environmental dispute. And, keystone environmental problems are unique due to their ability to conquer the occurrence of other dependent environmental problems. This is because dependent environmental issues completely depend on the keystone environmental problem alone without having any other causative environmental problem. Thus, when the keystone problem gets mitigated, all other dependent issues also get resolved. Keystone environmental problems can occur at any position (primary, secondary, tertiary, etc.) in the web of environmental issues. However, when a keystone environmental problem gets mitigated, the entire chain of environmental issues following it also gets collapsed or abated along with it. It has been found that global environmental conflicts and warfare are ignited by labyrinth (combination) of keystone environmental problems depicted in Table 1 and Figure 40. Thus, it has been revealed that environmental conflicts having several keystone environmental problem roots act together with socioeconomic factors on igniting a conflict or warfare.



**Figure 40:** Labyrinth of Keystone environmental problems that ignites environmental conflicts in varying combination

## 5. Conclusions

This study revealed that a labyrinth of keystone environmental problems together with socioeconomic factors play a vital role in the ignition of environmental conflicts. Keystone environmental problems can be found at any position (as a primary cause, a secondary cause, a tertiary cause, etc.) on the emergence of environmental problems igniting conflicts. It has been evident that resolving keystone environmental problems could also bring other linked (dependent) non-keystone environmental problems to a halt. However, the study concludes a labyrinth of keystone environmental problems that resonate together with socioeconomic factors and ignite environmental conflict or warfare. Thus, unless root keystone links are identified and mitigated, it is not possible to terminate the labyrinth of keystone environmental problems that ignite environmental conflicts and wars.

## Abbreviations

SLPA: Sudan People's Liberation Army, PLO: Palestinian Liberation Organization, GERD: Grand Ethiopian Renaissance Dam, PA: Palestinian Authority, Ejercito Zapatista de Liberacion Nacional EZIN: (Ejercito Zapatista de Liberacion Nacional) Zapatista Army of National Liberation, NPA: New People's Army, NATO: North Atlantic Treaty Organization, IMBL: International Maritime Boundary Line, CWDT: Cauvery Water Disputes Tribunal, Zapatista Army of National Liberation, PRI: Partido Revolutionary Institution, UNRWA: United Nations Relief and Work Agency, CFC: Chlorofluorocarbons

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## References

1. Adu, P., 2017. Understanding Qualitative Content Analysis. USA. <https://www.slideshare.net/kontorphilip/qualitative-content-analysis-for-systematic-reviews>. Accessed 23<sup>rd</sup> October, 2020
2. Coder, N. (n.d.). "*en.wikipedia.org*", [https://en.wikipedia.org/wiki/Kaveri#/media/File:River\\_Cauvery\\_EN.png](https://en.wikipedia.org/wiki/Kaveri#/media/File:River_Cauvery_EN.png). Accessed 22<sup>nd</sup> July 2022
3. Cooley, J., 1984. The war over water. *Foreign Policy*, 54, 13-26.
4. Falkenmark, M., 1989. Middle-East Hydropolitics: Water Scarcity and Conflicts in the Middle East. *Ambio*, 18 (6), 350.

5. Ganesan, R., & Venkatesh, S., 2016. "downtoearth.org.in".  
<https://www.downtoearth.org.in/feature/war-zone-cauvery-55848>. Accessed 22<sup>nd</sup> July 2022
6. Hendrix, C., 2020. "7. Contextual Factors in Environmental Conflicts" You Tube [video].  
<https://www.youtube.com/watch?v=F-q2FG8X8LQ>. Accessed 22<sup>nd</sup> April, 2023
7. Lowi, M., 1993. Bridging the Divide: Transboundary Resource Disputes and the Case of West Bank Water. *International Security*, 18 (01), 113-138.
8. Markakis, J., 1989. The Ishaq-Ogaden Dispute. In A. H. Ornäs, & M. M. Salih, *Ecology and Politics*, 158.
9. McClintock, & Cynthia., 1989. Peru's Sendero Luminoso Rebellion: Origins and Trajectory . In *Power and Popular Protest: Latin American Social Movements*. Berkley, California: University of California Press.
10. Munton, D., 1997. Acid Rain and Transboundary Air Quality in Canadian-American Relations. *American Review of Canadian Studies*, 27 (03), 327-358.
11. Old united nations university website". (n.d.),  
<https://archive.unu.edu/unupress/unupbooks/80858e/80858E0n.htm>. Accessed 20<sup>th</sup> March 2022
12. Richter, M., 2000. The Ecological Crisis in Chiapas: A Case Study from Central America. *Mountain Research and Development*, 20 (4), 332-339.
13. Schwartz, D., & Singh, A., 1999. *Environmental Conditions, Resources, and Conflicts: An Introductory Overview and Data Collection*. UNEP.
14. Semait, B. W., 1989. Ecology and politics: environmental stress and security in Africa. (p. 43). Scandinavian Institute of African Studies.
15. Starr, J. R., 1991. Water Wars. *Foreign Policy*, 82, 24.
16. 'Techwar'. (n.d.). <https://techwar.wordpress.com/resources/war-justifications-archive/alto-cenepa-war-1995/>. Accessed 03<sup>rd</sup> April 2022
17. US EPA., 2015. *United States—Canada Emissions Cap and Trading Feasibility Study*. US EPA and Trans boundary air issues branch Environment Canada.

18. Waduge, S., 2014. "*lankaweb.com*". Retrieved 06 14, 2021, from <http://www.lankaweb.com/news/items/2014/06/12/indo-lanka-fishing-dispute-time-for-solutions/>
19. "What's behind the Egypt-Ethiopia Nile dispute? ", 2020. <https://www.youtube.com/watch?v=JdizU0arrJ0>. Accessed 20<sup>th</sup> March 2022