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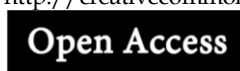
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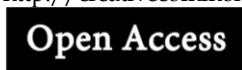
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FLYROCK THROW CALCULATIONS UNSCIENTIFIC AND UNRELIABLE – THE “HITS” JUST KEEP ON COMING

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ABSTRACT

Flyrock is the dirty little secret of the aggregate industry and its explosives engineers, and they have been remarkably successful in concealing the potentially deadly consequences of flyrock from the public, while continuing to engage in reckless blasting practices based on theoretical guesswork rather than proven practical land use planning safeguards such as permanent (fixed) onsite setbacks (excavation limits) coupled with permanent offsite separation distances from existing and potential future sensitive land uses. Flyrock is an unavoidable by-product of blasting rock, and has the potential to damage personal or real property, injure, permanently disable or kill humans and non-humans, both onsite and offsite. Flyrock, along with other adverse effects such as vibrations, that leaves the boundaries of an aggregate operation, constitutes *nuisance* and *trespass*, and damage or injury caused by detonation of explosives, should be held to *strict liability*. Implementing proactive and forward-looking land use policies that safeguard existing and envisioned sensitive land uses from the potentially deadly consequences of detonation of explosives in aggregate extraction is the most effective way to protect the long-term health, safety and welfare of existing and future generations, and to avoid interfering with the use and enjoyment of third-party real property.

Keywords: Flyrock; Liability; Mining; Explosions; Environmental impacts; Legislation

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Flyrock Throw Calculations Unscientific and Unreliable – The “Hits” Just Keep on Coming

1. INTRODUCTION

The aggregate extraction industry and explosives engineers are notorious for either ignoring or downplaying *flyrock* by constantly characterizing flyrock as a “rare” event. In Ontario, *flyrock* is an undefined term under the *Aggregate Resources Act* (ARA), and the Ministry of Natural Resources (MNRF) has never undertaken a quantitative study of flyrock incidents, even though flyrock is the most dangerous aspect of blasting rock. The different formulas used to calculate the “throw” distance of flyrock are unscientific, unreliable and self-serving. Compelling evidence is presented, which shows that flyrock is an unavoidable by-product of blasting (i.e., detonation of explosives), and can never be reduced to “zero.” Flyrock has been known to damage personal and real property, and to injure, permanently disable or kill people both onsite and offsite. Flyrock launched offsite onto publicly- or privately-owned third-party property constitutes *nuisance* and *trespass*. Blasting (detonation of explosives) to break rock is an ultra-hazardous or inherently dangerous activity, which by its nature, cannot avoid the likelihood of damaging property or harming human and non-human life.

In *Darney v. Dragon Products Company, LLC, Dist. Court*¹, District Maine (2011), the court had to say in its analysis of the dangers posed by blasting explosives:

“The Court has little difficulty agreeing with the Darneys that blasting poses a high degree of risk of some harm to both persons and property. Even defense expert Mr. McKown specifically stated on direct that “Yes, I believe that the handling of explosives is inherently dangerous”. (Tr. Vol. IV at 856.) Indeed, the Bureau of Mines conducted extensive studies on blasting done near residential structures, which demonstrated quite conclusively that blasting has the potential to cause damage to buildings from fly rock, ground vibration, and airblast. Similarly, given the extensive best practices recommended by the BOM by those engaging in quarrying activities, and the rigor with which the State of Maine oversees such activities, the Court has little difficulty that any such resulting harm has the potential to be great. In short, in applying these first two factors, the Court agrees with the Dyer Court that “blasting is inherently dangerous.” Dyer, 984 A.2d at 216 (citing Maravell, 914 A.2d at 714)”. [emphasis added]

Referring above, this article presents a “running list” of documented flyrock incidents as a continuation of previous research addressing flyrock, and should be read in conjunction with another article, “*Preventing the Potentially Deadly Consequences of Flyrock: Mandatory Minimum Setbacks and Separation Distances Required*” (Sevelka, 2022).²

¹ <https://casetext.com/case/darney-v-dragon-products-company-2>

² Sevelka, T., ‘Preventing the Potentially Deadly Consequences of Flyrock: Mandatory Minimum Setbacks and Separation Distances Required’, (2022) 5(4) Grassroots Journal of Natural Resources 66-98. <<https://doi.org/10.33002/nr2581.6853.050405>>.

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2. CONSEQUENCES OF BLASTING ROCK WITHIN REGULATORY LIMITS UNCONTROLLABLE

The term “controlled blast” is often used by the aggregate industry and explosive engineers to misleadingly imply that blasting (detonation of explosives) within regulatory limits cannot possibly cause damage to structures or buildings, or worse yet kill someone.

In *Hutchins v. Mutual of Enumclaw Insurance Co.*, (1973),³ blasting was found by the Supreme Court of Oregon to be the cause of damage to two properties located 4,000 feet (1,219 metres) from the blast site. Between October 25 and October 31, 1968, four thousand four hundred and thirty (4,430 detonations), 7,000 pounds (3,175 kg) and 8,200 pounds (3,629 kg) of explosives were detonated, each with a series of seven delays of one hundredths of a second (10 milliseconds) delay. One of the blasts damaged two properties, terrified the homeowners, and spooked two horses:

“On or about October 30, 1968, plaintiffs' home was shaken by an explosion. Mr. Hutchins was thrown to the floor and Mrs. Hutchins ran outside the house. They thought something had exploded in the basement. After the explosion, plaintiffs discovered plaster dust and pieces of plaster on the floor of their home and cracks in the wall of their dining room and living room. The east basement wall of the house was "bowed" out of line; masonry at the front of the house had been cracked and loosened, and moisture problems occurred in their basement.”

“[A neighbour, Mr. Bird, testified that]...all of a sudden the house just cracked, and there was just kind of a big concussion...It scared me, and I run outside and – to see what happened. And my horses were both trying to get out of the barn at the same time. It spooked them. They run up in the pasture like crazy....Immediately after the explosion he discovered plaster dust over his davenport and a crack in the ceiling of his home...”

The Supreme Court of Oregon rejected the defendant’s argument as presented by Mr. Cooper, an explosives engineer, “that the plaintiffs’ [homeowners’] testimony should be disregarded because it transcends the laws of nature and it was inherently physically impossible for the blasting to have caused plaintiffs’ damage.” But, the explosives engineer conceded “it’s possible... [that the October 30, 1968, blast] to [have] cause[d] some damage.” The explosives engineer also conceded that:

“[T]here is no certainty in determining the areas which may be affected by blasting since the consequences of an explosion are dependent upon many variables. Mr. Cooper described the three different types of reaction caused by such blasting, ground shock, air blast and reactive air wave, and in his opinion you cannot predict with utter certainty the consequences of a blast, that temperature, wind velocity, humidity, and components of the earth material make a difference in the transfer of the shock and the distance it travels.”

³ *Hutchins v. Mutual of Enumclaw Insurance Co.*, 516 P.2d 1273 (1973) Or: Supreme Court. <<https://casetext.com/case/hutchkins-v-mutual-of-enumclaw-ins>>, accessed 10 August 2023.

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2.1 Calculated Flyrock “Throw” Distances Unscientific and Unreliable

According to Shi et al. (2013),⁴ because of the complexity of the issues surrounding flyrock, there are no reliable formulas to accurately predict the distance that flyrock will launch from a blast site.

“With so many complex factors of blasting flyrock, there is no critical formula for prediction [of] the flying distance of blasting flyrock...[as] adapted by most...scholars. Widely existing influential prediction formulas are mainly aimed at ordinary blasting technology, using the statistical law or mechanics analysis to get the prediction. The calculated data for flyrock distance are different distinctly. Predicted values are different largely between various formulas.”

Similar findings as to the unreliability of predicting flyrock throw distance have been reached by van der Walt (2020)⁵ and Szendrei (2022)⁶:

“The testing methodologies used to measure the actual flyrock distance are not scientific and are highly dependent on the scrutiny of the researcher (van der Walt, 2020).”

“It is evident that there is no proven and reliable method for predicting flyrock velocity and throw range (Szendrei, 2022).”

3. CHARACTERISTICS OF FLYROCK – AN UNAVOIDABLE BY-PRODUCT OF ROCK BLASTING

Flyrock is the ultimate *adverse effect*, and is also the most dangerous aspect of blasting (detonation of explosives) to break rock. Blasting is an *ultra-hazardous* activity, and as blasting within regulatory limits cannot prevent flyrock, the activity is held to *strict liability* or *The Rule of Rylands*⁷ by the Courts. Flyrock can launch a considerable distance and in more than one direction from a blast site and at great speed. The characteristics of flyrock, and the potential consequences (*adverse effects*) of flyrock on the *environment*, including the people who live, work, shop and play near a blast site, are detailed in the following sections of this article.

“Flyrock” means rock that is thrown through the air as a result of blasting [i.e., detonation of explosives].⁸

- *“Flyrock can be gravel, rocks, tree trunks, construction materials, mud – even water.”⁹*

⁴ Shi, J., An, H. and Wu, C., ‘Regression and Fitting Analysis of Flyrock Prediction Formulae for Loosening Blasting’ (2013) 405-408 Applied Mechanics and Materials 2346-2350.

⁵ van der Walt, J., ‘A Critical Analysis of Recent Research into the Prediction of Flyrock and Related Issues Resulting from Surface Blasting Activities’ (2020) 120 (12) J. S. Afr. Inst. Min. Metall. <<http://dx.doi.org/10.17159/2411-9717/1103/2020>>.

⁶ Szendrei, T. and Tose, S., ‘Flyrock in surface mining – Limitations of current predictive models and a better alternative through modelling the aerodynamics of flyrock trajectory’ (2022) 122 (12) J. S. Afr. Inst. Min. Metall., <<https://dx.doi.org/10.17159/2411-9717/1873/2022>>.

⁷ *Rylands v. Fletcher*, (1868) LR 3 HL 330.

⁸ Nova Scotia, Canada, website: <<https://novascotia.ca/lae/healthandsafety/flyrock.asp>>. In Ontario, *flyrock* is an undefined term in the Aggregate Resources Act O. Reg. 244/97, s. 0.13 (1) 28, requires that *reasonable* (undefined) steps to prevent *flyrock* only if there are *sensitive receptors* within 500 metres of the boundary of the site (s. 0.13 (1) 28).

⁹ Worker’s Hazard Alert issued by the National Institute for Occupational Safety and Health (NIOSH), 2019.

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- *“Flyrock comes in different sizes and shapes, ranging in mass from [a] few ounces to several tons. Persson et al. [1994] referenced flyrock weighing approximately three tons thrown to a distance of 980 ft. [299 metres].”¹⁰*
- *“Flyrock from surface blasting operations has caused serious injury and death to employees and other persons.”¹¹*
- *[T]he discharge of fly-rock caused an “adverse effect” under paras. (b) and (g) of the definition, [s. 1(1) of the Ontario EPA] namely, it caused injury or damage to property and loss of enjoyment of the normal use of the property. Because the reporting requirement is also engaged when the discharge is “likely to cause an adverse effect,” para. (e) is also applicable since the potential existed for “impairment of the safety of any person.” The adverse effects were not trivial. The force of the blast, and the rocks [flyrock debris] it produced, were so powerful they caused extensive and significant damage, penetrating the roof of a residence and landing in the kitchen. A vehicle was also seriously damaged. The fly-rock could easily have injured or killed someone (Castonguay, 2013, Supreme Court of Canada).¹²*
- *“...[F]lyrock may be the greatest threat related to working with explosives, and it's something that those involved in the blasting situation may not realize. They may be primarily concerned about staying out of the blast radius and thereby avoiding being damaged by concussive force or ground vibrations, not realizing that flyrock may create a much greater danger....Despite the fact that flyrock uses only about one percent of the explosive energy caused by the blast, it is responsible for up to 40 percent of injuries, as opposed to, for example, ground vibration. One can easily understand this when we think of flyrock as small projectiles fired with great force by exploding gasses. Essentially, the effect of flyrock is similar to spraying an area with bullets from a machine gun....Complicating matters is the fact that separating pieces of rock from a rock face is the goal of blasting, whether it is actually to get at the minerals within the rock face or to get at what is behind it. Thus, blasters have every intention of creating this debris.”¹³*
- *“Any blasting event in surface mines produces a sudden ejection of rock pieces, called flyrock, which may result in human injuries, fatalities and property damage.”¹⁴*

¹⁰ Bajpayee, T.S., Verakis, H.C. and Lobb, T.E., “An Analysis and Prevention of Flyrock Accidents in Surface Blasting Operations,” *Centers for Disease Control and Prevention*, March 2007. <https://www.researchgate.net/publication/265184111_An_Analysis_and_Prevention_of_Flyrock_Accidents_in_Surface_Blasting_Operations>, accessed 10 August 2023.

¹¹ *Ibid*

¹² *Castonguay Blasting Ltd. v. Ontario (Environment)*, 2013 SCC 52 (CanLII), [2013] 3 SCR 323, <<https://canlii.ca/t/g1038>>, accessed 02 June 2023.

¹³ T.M. International LLC, “Preventing and Controlling Flyrock,” *T.M. International, LLC*, 2001, <<https://www.tmi2001.com/blog/preventing-controlling-flyrock>>, accessed 10 August 2023.

¹⁴ Jamei, M., Hasanipناه, M., Karbasi, M., Ahmadianfar, I. and Taherifar, S., “Prediction of flyrock induced by mine blasting using a novel kernel-based extreme learning machine” (2021) 13 (1) *Journal of Rock Mechanics and Geotechnical Engineering* 1438-1451. <<https://doi.org/10.1016/j.jrmge.2021.07.007>>.

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- *“The multiple studies reviewed and analyzed concluded that ‘there are major research gaps into the phenomena of flyrock and that this concept is not well understood (Raina, Murthy and Soni, 2015).’¹⁵*
- *van der Walt and Spiteri concluded that “the effect of blast parameters of flyrock is still not fully known or understood,” and that the findings, in part, are “contradictory [p. 712 & 714].”¹⁶*
- *“...[T]here is no magic technique that eliminates the risk of flyrock, and no matter how controlled our blast is, the best alternative is to prevent, through the identification of risk situations and the implementation of adequate control measures for these situations [i.e., permanent minimum onsite setbacks (excavation limits) and permanent offsite minimum separation distances from sensitive land uses]”¹⁷*
- *There are several empirical methods for calculating flyrock¹⁸ but none are capable of accurate prediction due to the complexity and difficulty of rock analysis.¹⁹*
- *Flyrock is unpredictable, “both in terms of distance and direction.”²⁰*
- *The potentially deadly consequences of “flyrock do not decrease with distance, as a 200-gram projectile can be as fatal at 20 metres as it is at 1,000 metres.”²¹*
- *According to Keith Taylor, General Manager, Austin Powder Company Ltd., “90% of flyrock incidents are ‘unexplainable.’”²²*
- *Tim Rath, Green Mountain Explosives, the blasting expert acting on behalf of Rivers’ Quarry application testified that he could not guarantee that flyrock will not leave the Rivers Quarry regardless of what precautions are taken to minimize the risk.²³*

¹⁵ van der Walt, J. and Spiteri, W., “A conceptual technique to mathematically quantify the trajectory of flyrock” (2023) 123 (4) Journal of Southern African Institute of Mining and Metallurgy 165-174. <<https://issuu.com/saimm/docs/saimm-202304-apr/s/25372330>>, accessed 10 August 2023.

¹⁶ van der Walt, J. and Spiteri, W., “A critical analysis of recent research into the prediction of flyrock and related issues resulting from surface blasting activities” (2020) 120 (12) Journal of the Southern African Institute of Mining and Metallurgy 701-714. <<https://www.saimm.co.za/Journal/v120n12p701.pdf>> accessed 10 August 2023.

¹⁷ Rock Blasting, “Flyrock (part 02 of 03),” *Blasting Trainings LinkedIn*, Aug 26, 2022. <<https://www.linkedin.com/pulse/flyrock-part-02-03-blasting-trainings?trk=pulse-article>>.

¹⁸ Lwin, M.M. & Aung, Z.M., “Prediction and Controlling of Flyrock due to Blasting for Kyaukpahto Gold Mine,” (2019) 5 (10) International Journal of Advances in Scientific Research and Engineering 338-346. <<https://doi.org/10.31695/IJASRE.2019.33574>>.

¹⁹ Balakrishnan, V. and Rai, P., “An Overview of Flyrock and its Prediction in Surface Mine Blasting using Soft Computing Techniques,” (2021) 2 (2) Recept Tayyip Erdogan University Journal of Science and Engineering 105-119. <<https://dergipark.org.tr/tr/download/article-file/1941187>>, accessed 10 August 2023.

²⁰ Rathore, S.S. and Jain, E.S.C., “Studies on flyrock at soapstone quarry for safe working,” (2007) Vienna Conference Proceedings, European Federation of Explosives Engineers, <<https://www.efee.eu/wp-content/uploads/2016/04/7-Health-Safety-and-Environment.pdf>>, accessed 10 August 2023.

²¹ Sauvage, A.C., “Flyrock: French Experience,” (2017) 61 SAFEX Newsletter, <<https://ap3e.pt/wp-content/uploads/2021/03/2017-2-Newsletter-61.pdf>>, accessed 10 August 2023.

²² MOE 2009 investigation Case File Number: 2283-83MN69 of two flyrock incidents at Pakenham Quarry, and investigating explosives engineer recommended 500-metre onsite setback for all future blasts. (detonation of explosives).

²³ <http://www.killthealbionquarry.org/flyrock_danger.pdf>, accessed 10 August 2023.

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- *“The phenomena of flyrock are always uncontrolled and can never be brought down to zero [p. 1].”²⁴*
- *“Anyone with experience in surface mining has experienced flyrock issues. And of course seeing a piece of broken drill still sticking out of a roof a long way from a blast can be disquieting. Or finding a small chunk of rock on a roof or in a yard miles away happens all too frequently.”²⁵*
- *“There isn’t a company that could stand up here and say they don’t have flyrock,” said Shawn McGoldrick, of McGoldrick Brothers Blasting Services.²⁶*
- *“Accidental flyrock in blasting operations has a major impact on the external environment...due to the hazards involved and is more significant than vibrations or airblast....[E]ven if it is normal practice in these zones to take into account the impact of possible vibrations and even the effects of airblast when modeling the project, flyrock risks are not dealt with in initial studies, other than by way of integrating general safety distances. These risks are only sometimes taken into account much later in the operation and most often following an accident or significant flyrock being recorded externally [off-site] [p. 549].”²⁷*

4. “RUNNING LIST” OF FLYROCK INCIDENTS

Described below are details of a “running list” of *flyrock* incidents discovered from a variety of sources on the internet, which have been documented as of August 2023:

- *Flyrock 196*: On July 13, 1997, during the demolition of a hospital in Canberra, Australia, billed as a family event, included an exclusion zone of 200 yards (183 metres) to protect the spectators. The detonation of the explosives sent *flying debris* at subsonic speed that struck and killed 12-year-old Katie Bender standing in a park about 430 yards (393 metres) across a lake from the hospital.²⁸ Witnesses said debris was launched more than 500 yards (>457 metres) from the blast site.²⁹
- *Flyrock 197*: On June 7, 2022, blasting rock to make way for a residential subdivision in Hendersonville, Tennessee, launched

²⁴ Trivedi, R., Singh, T.N. and Raina, A.K., “Prediction of blast-induced flyrock in Indian limestone mines using neural networks,” (2014) xxx Journal of Rock Mechanics and Geotechnical Engineering 1-8. <<http://dx.doi.org/10.1016/j.jrmge.2014.07.003>>.

²⁵ Albrecht, M., “Flyrock in orbit!,” LinkedIn, June 11, 2016. <<https://www.linkedin.com/pulse/flyrock-orbit-mike-albrecht-p-e-/>>, accessed 10 August 2023

²⁶ Hartwell, M., “Busque quarry stonewalled at town meeting,” *Lakes Region Weekly*, November 16, 2006, Updated March 10, 2016. <<https://www.pressherald.com/2006/11/16/busque-quarry-stonewalled-at-town-meeting/>>, accessed 10 August 2023.

²⁷ Blanchier, A., ‘Quantification of the levels of risk of flyrock’, (2012), The 10th International Symposium on Rock Fragmentation by Blasting (Fragblast 10), Leiden, p. 549-553.

²⁸ Inquest Findings, Katie Bender, 1999. <https://courts.act.gov.au/__data/assets/pdf_file/0017/1008080/Katie-Bender-redacted.pdf> accessed 11 August 2023.

²⁹ CNN, “Australian demolition kills young onlooker,” *CNN World News*, July 13, 1997. <<http://edition.cnn.com/WORLD/9707/13/australia.demo/>>, accessed 10 August 2023.

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flyrock debris that penetrated homes in a nearby Stonecrest subdivision.³⁰ Homeowner Seeley found a 5-pound rock in his backyard; which is located 1,500 feet (457 metres) from the blast site; another homeowner reported a 10- to 15-pound (4.5- to 6.8-kilogram) rock penetrating the ceiling of her home; and another homeowner discovered a rock had penetrated her garage and damaged her mower.³¹

- *Flyrock 198*: On November 24, 2020, blasting on a road project in the Chesapeake area of Lawrence County, Ohio, to remove rock launched *flyrock debris* across Highway 52 into the Sunnybrook subdivision. Some of the rocks hit and damaged homes. A fragment from a rock that hit the ground and shattered struck the leg of a neighbour.³²
- *Flyrock 199*: On October 4, 2022, blasting rock at a new site for the Louisville VA Medical Center launched *flyrock debris* onto Watterson Expressway (I-264) causing drivers to swerve to avoid being hit. Flyrock debris, characterized as a “meteor shower,” littered the streets in the neighborhoods adjacent to the construction site and several homes had rocks in their yards, driveways and gutters, and some houses were pierced and damaged by rocks.(As of Jan 23, 2023, repairs had still not been undertaken.)³³
- *Flyrock 200*: On February 8, 2023, a single-hole blast at the Williamson County rock quarry (302 Beasley Dr. Franklin, Tennessee) launched *flyrock debris* as far as 2,000 feet (610 metres) from the blast site that caused road damage, damaged several vehicles and that pelted the Williamson County Election Commission building, which was occupied at the time of the blast. In this so-called “routine” blast, the hole did not contain the explosive slurry as planned; instead, it seeped into the ground below and more explosives were loaded into the cavity, and when detonated the hole blew out causing airblast and flyrock.³⁴

³⁰ WUSA9, “Hendersonville homes pelted with rock damage after blasting,” WUSA9, YouTube, June 7, 2022. <<https://www.youtube.com/watch?v=NFb9FzQ8Jkk>>, accessed 10 August 2023.

³¹ Lee, T., “Construction Blast sends large rocks sailing in Stonecrest,” *Hendersonville Standard*, June 7, 2022. <https://www.hendersonvillestandard.com/news/construction-blast-sends-large-rocks-sailing-in-stonecrest/article_aa882604-e6a5-11ec-b2dc-cb5e76379dc3.html> accessed 10 August 2023.

³² Colegrove, A., “Homes damaged by boulder blasting road project,” *WSAZ News Channel 3*, November 24, 2020. <<https://www.wsaz.com/2020/11/24/homes-damaged-by-boulder-blasting-road-project-in-ohio/>> accessed 10 August 2023.

³³ Vogt, D., “Blasting at VA medical center halted after ‘unforeseen incident’ with falling rocks,” *Wave 3*, Oct. 4, 2022. <<https://www.wave3.com/2022/10/04/blasting-va-medical-center-site-halted-after-unforeseen-incident-with-falling-rocks/>>, accessed 10 August 2023; US Army Corps of Engineers, “An investigation concluded that the flyrock incident “was the result of an unintended simultaneous detonation of several explosive charges [went off at the same time] which were designed to detonate on a precisely timed sequence.” <<https://www.lrl.usace.army.mil/Media/News-Releases/Article/3271969/investigations-into-october-blasting-incident-complete/>>, accessed 10 August 2023.

³⁴ Herald Reports, “Tuesday’s explosion came from county’s rock quarry; no reported injuries,” *Williamson Herald*, February 9, 2023.

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- *Flyrock 201*: On February 15, 2023, a blast at the Mayali stone quarry in Jashpur district of Chhattisgarh, India, launched *flyrock debris* including a large boulder that struck 18-year-old student Kesari Bai, killing her instantly, at a distance of over one kilometer (>1,000 metres) from the quarry while on her way to a park with her friend. She died of severe head injury after profusely bleeding while her friend had a narrow escape.³⁵
- *Flyrock 202*: On October 13, 2006, a blast at a quarry in Far North District, New Zealand, launched *flyrock debris* that damaged a hydro transmission line leaving 10,000 properties north of the Mangamuka Ranges without electricity from 7am to mid-afternoon. Homes, hospitals, emergency services, businesses and farms were all without electricity during that period.³⁶
- *Flyrock 203*: In March 1995, while constructing roadway improvements in Macon County, Tennessee, Jones Bros. blasted several large rocks, which “blew out” the top of a large boulder that launched *flyrock debris* onto nearby property, including the Bohanons’ home located 600 feet (183 metres) from the blast site. The flyrock debris damaged the roof and ceiling washroom of the Bohanons’ home.³⁷
- *Flyrock 204*: On August 11, 2014, blasting on Big Nickel Mine Road, Sudbury, undertaken by Rock Breakers launched golf ball-sized *flyrock debris* onto nearby Sandra Boulevard, Westview Drive and Buchanan Street, and that shattered two windows and punched a hole in the shed of a homeowner’s property on Sandra Boulevard. Rock Breakers characterized “the blast...as no larger than other blast and that the damage was ‘unforeseen.’”³⁸
- *Flyrock 205*: On March 12, 1991, a blast at the Martinsville stone quarry in Collinsville, Virginia, launched *flyrock debris*, which showered and damaged several homes and a vehicle owned by Mrs. Martin. In one instance the rock blasted a hole 6 feet in diameter in the brick wall of the home (and destroyed some house contents) of James Doss, who was standing within six feet of the

<https://www.williamsonherald.com/news/local_news/afternoon-explosion-at-rock-quarry-felt-throughout-franklin-beyond/article_009e1fa4-a806-11ed-9456-ff654fa9034c.html>, accessed 10 August 2023.

³⁵ TOI, “18-year-old girl dies after getting hit by flyrock of mine blast in Jashpur district of Chhattisgarh,” *The Times of India (TOI)*, February 17, 2023. <<https://timesofindia.indiatimes.com/city/raipur/18-year-old-girl-dies-after-getting-hit-by-flyrock-of-mine-blast-in-jashpur-district-of-chhattisgarh/articleshow/97996266.cms>>, accessed 10 August 2023.

³⁶ Laird, L., “Quarry blast cuts power,” *Northern Advocate*, October 16, 2006. <<https://www.nzherald.co.nz/northern-advocate/news/quarry-blast-cuts-power/NIKAS2EQXP5N4KLS4JGYL54KD4/>>, accessed 10 August 2023.

³⁷ *Steven Teddy Bohanon, et al., v. Jones Bros., Inc.*, M1998-00954-COA-R3-CV (Tenn. App. 2-22-2002). <<https://www.tncourts.gov/sites/default/files/OPINIONS/TCA/PDF/021/BohanonST.pdf>>, accessed 10 August 2023.

³⁸ Byrne, R., “Blast pelts Sudbury neighbourhood with rocks,” *Sudbury Star*, Aug 16, 2014. <<https://www.thesudburystar.com/2014/08/16/blast-pelts-sudbury-neighbourhood-with-rocks>>, accessed 10 August 2023.

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boulder, and two other rocks knocked holes in Doss’ garage roof and wall. At least two other homes were struck by flyrock debris, at a distance of about a half-mile (805 metres) from the quarry.³⁹

- *Flyrock 206*: On May 20, 2019, a blast at a rock quarry in Cannon County, Tennessee, launched *flyrock debris* that travelled across both lanes of John Bragg Highway and struck a moving vehicle and caused other additional damage, including striking a home in a nearby subdivision.⁴⁰
- *Flyrock 207*: On December 7, 2010, a blast at the Mercer Stone Co. quarry on Burgin Road (Ky. 152) in Mercer County, Kentucky, launched *flyrock debris* that sent a rock through the windshield of a pickup truck travelling on the U.S. 127 Bypass near Harrodsburg. The driver of the truck was fortunate not to have been fatally injured.⁴¹
- *Flyrock 208*: On February 14, 2023, a blast at a construction site for an apartment complex in Staunton, Virginia, launched *flyrock debris* that landed on a nearby property on Moore Street. Randy Young, the homeowner, watched the blast and “had to run for cover” to avoid being struck by the flyrock debris.⁴²
- *Flyrock 209*: On August 10, 2017, a blast at a quarry in Demodara, Sri Lanka, launched *flyrock debris* (shrapnel) that struck 24-year-old Charlie Rozilbo on his hand as he was passing nearby on his way to visit a tea factory. He was admitted to Badulla General Hospital, where his injured hand had to be operated on.⁴³
- *Flyrock 210*: On May 25, 2023, a blast at a stone quarry in Kolar Taluk, India, launched *flyrock debris* that struck 28-year-old quarry worker Somu Jadhav at a distance of 600 metres from the blast site, who succumbed to his injuries the next day at MEG Hospital in Hosakote. A second quarry worker, Gopi, was injured and taken to a hospital in Kolar (Karnataka). The quarry operators made attempts to destroy evidence. Six people, including the

³⁹ Roanoke Times, “Rocks from blast damage houses,” *The Roanoke Times*, March 14, 1991. <<https://scholar.lib.vt.edu/VA-news/ROA-Times/issues/1991/rt9103/910314/03140191.htm>>, accessed 10 August 2023.

⁴⁰ Breslow, J., “Cannon County rock quarry shut down amid state investigation,” *WKRN.COM*, May 22, 2019. <<https://www.wkrn.com/news/cannon-county-rock-quarry-shut-down-amid-state-investigation/>>, accessed 11 August 2023.

⁴¹ Lexington Herald Leader, “Blasts at Mercer quarry sends rock into windshield,” *Lexington Herald Leader*, December 7, 2010. <<https://www.kentucky.com/latest-news/article44067387.html>>, accessed 11 August 2023.

⁴² Ganesh, A., “Staunton residents concerned over blasting for Middlebrook Trace apartment complex,” *News Leader*, March 3, 2023. <<https://www.newsleader.com/story/news/2023/03/02/staunton-residents-concerned-over-blasting-for-middlebrook-trace-apartment-complex/69964510007/>>, accessed 11 August 2023.

⁴³ Fonseka, P., “French tourist injured by shrapnel from rock quarry,” *Daily Mirror*, August 11, 2017, <<https://www.dailymirror.lk/article/French-tourist-injured-by-shrapnel-from-rock-quarry-134545.html>>, accessed 11 August 2023.

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quarry owner, quarry operator and the suppliers of the explosives, were arrested.⁴⁴

- *Flyrock 211*: On December 24, 2005, a blast at Masslite Quarry, Plainville, Massachusetts, launched *flyrock debris* that penetrated the roof of Sharon Friedman’s garage studio on High Street amidst a spray of debris and damaged furniture about 1,100 feet (335 metres) from the blast site. The rock in Friedman’s studio, weighing about 150 pounds (68 kilograms), was one of three found on her property.⁴⁵
- *Flyrock 212*: On July 13, 2005, a blast at Hunts Branch Freeburn Mine, a surface coal mine located in Pike County, Kentucky, launched *flyrock debris* that struck and injured quarry employee Travis Tackett, and that damaged a blue supply truck, a yellow loader and a white pickup truck. Travis Tackett suffered a compound fracture after being struck in the leg by flyrock. Bellamy, a mining engineer who works for Mine Safety and Health Administration (MSHA) cautioned, “[E]very shot...is not going to go off exactly as...intended.”⁴⁶
- *Flyrock 213*: In April 2023, a blast at a quarry site in Virginia launched *flyrock debris* approximately 2,300 feet (701 metres) from the blast site and damaged a shed, and a rock landed next to a highway.⁴⁷
- *Flyrock 214*: On March 23, 2000, a blast at a planned residential development site in Orange County, California, launched *flyrock debris* about 1,000 feet (305 metres) injuring six construction workers and damaging several vehicles, including a truck that had a window knocked out. Four workers were taken to local hospitals, one of whom suffered a broken leg. The others received cuts and scrapes from the flying debris. Two workers were treated and released at the scene.⁴⁸
- *Flyrock 215*: On August 22, 2012, a blast at a construction site on Bonnyton Drive, Eaglesham, Scotland, launched *flyrock debris* that showered two nearby streets, causing extensive damage to cars and properties, including smashed windows and damaged roofs.

⁴⁴ DHNS, “Worker Killed, another injured in stone quarry blast in Kolar,” *DHNS, Kolar*, May 26, 2023. <<https://www.deccanherald.com/state/karnataka-districts/worker-killed-another-injured-in-stone-quarry-blast-in-kolar-1221980.html>>, accessed 11 August 2023.

⁴⁵ McCarron, H., “Milford company probing incident that sent rock into home,” *Milford Daily News*, December 29, 2005. <<https://www.milforddailynews.com/story/news/2005/12/29/milford-company-probing-incident-that/41387771007/>>, accessed 11 August 2023.

⁴⁶ Federal Mine Safety and Health Review Commission, Civil Penalty Proceeding, June 1, 2007. <<https://www.govinfo.gov/content/pkg/CFR-2004-title29-vol9/xml/CFR-2004-title29-vol9-subtitleB-chapXXVII.xml>> accessed 11 August 2023.

⁴⁷ ‘Safety Alert: *Flyrock*’, *Virginia Energy*, May 9, 2023. <https://www.energy.virginia.gov/mineral-mining/documents/SAFETY/ALERTS/BlastingFlyrock/Safety%20Alert-Flyrock_20230509.pdf>, accessed 11 August 2023.

⁴⁸ Risling, G., “Six hurt in construction blast,” *Daily Pilot*, March 24, 2000. <<https://www.latimes.com/socal/daily-pilot/news/tn-dpt-xpm-2000-03-24-export61426-story.html>>, accessed 11 August 2023.

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Colin Robertson said rocks had damaged his car and came through the roof of his home. Vibrations from the blast cracked the foundation of Susan Fraser’s home. Workmen from the construction site, who started clearing away the rocks in an effort to destroy evidence before police arrived, were told to stop five times by Susan Fraser.⁴⁹

- *Flyrock 216*: On June 17, 2011, a blast at a construction site launched *flyrock debris* that damaged cars and windows in the parking lot of East Point Shopping Centre in Saint John, New Brunswick. One rock slammed into the side of the TD Canada Trust building and lodged into the outer wall. The blast was done by a certified blaster with 35 years of experience. “He had done the holes and everything according to the standards that are set.” Ron Buchanan, a health and safety officer for Worksafe New Brunswick speculated that “[t]here was possibly a fault in the rock, which allowed the pressure of the blast to push the rocks out in this direction.”⁵⁰
- *Flyrock 217*: On September 1, 2020, a blast at a construction site launched *flyrock debris* about 1,000 feet (305 metres) that broke windows and damaged cars, one of which was occupied, at Lincoln Memorial University (LMU) in Harrogate, Tennessee. A 30-pound rock blew a hole through one of the buildings on campus. According to LMU Board of Trustees, Pete Debusk, the excavation blast hit a fault in the rock wall, and “when it has a fault in it, it just turns into a cannon.”⁵¹
- *Flyrock 218*: On March 16, 2010, a blast at a construction site for a new 750,000-gallon water tank in Ketchikan, Alaska, launched onto an adjacent residential neighbourhood that struck a number of homes and vehicles, broke windows, damaged siding, and in at least one case penetrated a residence. An employee filming the blast was peppered with sand from the explosion. Southeast Earthmovers, Inc., the blasting company, argued that the flyrock occurred because of an undiscovered seam in the rock. However, the rock was generally known to be unpredictable.⁵²
- *Flyrock 219*: On June 17, 2022, a blast at a quarry in Brazil launched *flyrock debris* that struck a 35-year old mining assistant while a

⁴⁹ Stewart, C., “Building site blast showers houses with rocks,” *Glasgow Times*, August 23, 2012. <<https://www.glasgowtimes.co.uk/news/13237133.building-site-blast-showers-houses-with-rocks/>>, accessed 11 August 2023.

⁵⁰ CBC News, “Construction blast sends rock hurtling into cars,” *CBC News*, June 20, 2011. <<https://www.cbc.ca/news/canada/new-brunswick/construction-blast-sends-rock-hurling-into-cars-1.1021105>>, accessed 11 August 2023.

⁵¹ Cole, S., “It sounded like a bomb | After explosion on campus, students say LMU should have given warning,” *10News*, September 2, 2020. <<https://www.wbir.com/article/news/education/after-explosion-on-campus-students-say-lmu-shouldve-given-warning/51-9081359c-1d8e-4e60-a66d-cf643376e838>>, accessed 11 August 2023.

⁵² *State of Alaska, et al. v. Southeast Earthmovers, Inc.*, Alaska Occupational Safety and Health Review Board, OAH No. 10-0326-OSH, 2013. <https://labor.alaska.gov/oshboard/do/10-2252-Southeast_Earthmovers.pdf>, accessed 11 August 2023.

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passenger in a work vehicle. The rock penetrated the roof of the vehicle and struck the mining assistant in the head. “The man suffered cranial trauma and died on scene.”⁵³

Previously, a total of approximately 195 flyrock incidents had been discovered and analyzed.⁵⁴ Of the 195 flyrock incidents discovered, 33 resulted in death, indicating an overall kill rate of 16.9%, and 40 people were injured in the same 33 flyrock incidents. An additional 24 flyrock incidents have been added to the “running list” of flyrock incidents bringing the total to 219. Of these additional 24 flyrock incidents, 10 people were injured, and 4 people were killed, indicating a kill rate of 16.7% ($4 \div 24$). Of the 219 flyrock incidents documented, 37 resulted in death from being struck by flyrock debris, reflecting a “kill” rate of 16.9% ($37 \div 219$), and 41 more people were injured in the same 37 flyrock incidents.

Globally, most flyrock incidents go unreported or unnoticed concealing the true extent of the potentially deadly consequences of flyrock caused by detonation of explosives to break rock in aggregate extraction operations.⁵⁵

- *Flyrock debris* that does not leave the boundaries of a quarry site is not reported;
- *Flyrock debris* that does not injure anyone onsite or offsite (unless observed and reported by the public or media) is not reported;
- *Flyrock debris* that does not damage onsite quarry equipment or offsite personal or real property (unless observed and reported by the public or media) is not reported;
- *Flyrock debris* that is launched offsite but that goes unnoticed is not reported;
- *Flyrock debris* that is launched offsite into an uninhabited area or heavily treed area goes unnoticed and unreported;
- *Flyrock debris* that is launched offsite and goes unnoticed has the latent potential to damage lawn mowing and farming equipment, and injure the operator of the equipment.

5. QUANTITATIVE ANALYSIS OF FLYROCK DISTANCES

A non-theoretical *quantitative* study of actual distances that flyrock has been launched from a blast site was undertaken by Sevelka (2021)⁵⁶ in May 2021, and included in that analysis are 92 incidents of flyrock. Since

⁵³ “Flyrock (part 01 of 03), *LinkedIn*, August 12, 2022. <<https://www.linkedin.com/pulse/flyrock-part-01-03-blasting-trainings>>, accessed 11 August 2023.

⁵⁴ Sevelka, T., “Preventing the Potentially Deadly Consequences of Flyrock: Mandatory Minimum Setbacks and Separation Distances Required,” (2022) 5(4) *Grassroots Journal of Natural Resources* 66-98. <<https://doi.org/10.33002/nr2581.6853.050405>>.

⁵⁵ Uthman, S., ‘Into the ‘cracks’ Land (1): RCC Blasts Rocks for Lagos-Ibadan Road Construction, But Ogunmakin Suffers the Injury’, (2021) *Dataphyte*, November 12.: <<https://www.dataphyte.com/latest-reports/climate/into-the-cracks-land-1-rcc-blasts-rocks-for-lagos-ibadan-road-construction-but-ogunmakin-suffers-the-injury/>>, accessed 01 August 2023.

⁵⁶ Sevelka, T., “Preventing the Potentially Deadly Consequences of Flyrock: Mandatory Minimum Setbacks and Separation Distances Required,” (2022) 5 (4) *Grassroots Journal of Natural Resources* 66-98. <<https://doi.org/10.33002/nr2581.6853.050405>>.

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then, more incidents of flyrock have been documented, expanding the data set from 92 to 139 incidents of flyrock (August 2023). Where flyrock debris has been launched over a large area or in more than one direction, only the furthest distance of the flyrock from the blast site is recorded, summarized and arrayed in the following bar chart.

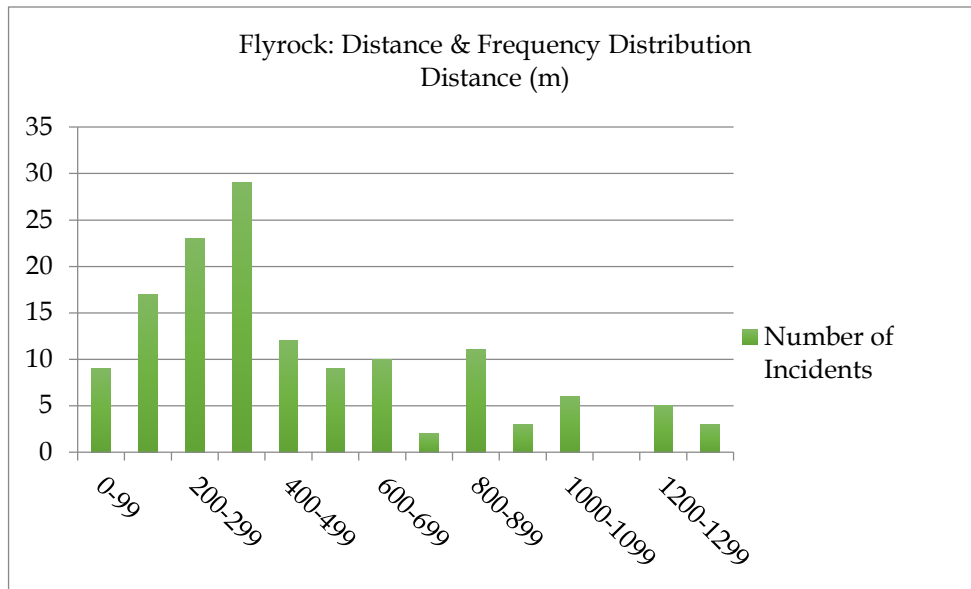


Figure 1: Analysis of Flyrock Travel Distances (May 2021; Updated August 2023)

The number of *flyrock* incidents within each interval, starting at between 0-99 metres, and the average distance travelled within each interval are summarized in table 1.

Table 1

Metres	0-99	100-199	200-299	300-399	400-499	500-599	600-699	700-799	800-899	900-999	1000-1099	1100-1199	1200-1299	1300+
Incidents	9	17	23	29	12	9	10	2	11	3	6	0	5	3
Cumulative	-	26	49	78	90	99	109	111	122	125	131	131	136	139
Average (m)	59	148	240	327	440	512	616	701	803	916	1015	-	1225	2307
% of Total	6%	12%	17%	21%	9%	6%	7%	1%	8%	2%	4%	0%	4%	2%
Cumulative %	-	19%	35%	56%	65%	71%	78%	80%	88%	90%	94%	94%	98%	100%

The following analysis is based on the data summarized in Table 1:

- An analysis of 139 *flyrock* incidents, where the distance from the blast site is known, indicate that 94% (131) of the *flyrock* incidents occurred within 1,099 metres, and 98% (136) occurred within 1,299 metres.
- At 90%, of the 139 *flyrock* incidents, 125 *flyrock* incidents in ascending order reached a distance up to the 900 – 999 metre interval, and, at 94%, which accounts for the first 131 *flyrock*

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incidents in ascending order, flyrock reached a distance up to the 1000 – 1099 metre interval.

- At 98%, of the 139 *flyrock* incidents, 136 *flyrock* incidents in ascending order reached a distance up to the 1200 – 1299 metre interval.
- On the basis of the this updated study of *flyrock* incidents (August 2023), the designated blast area (onsite safety zone) would have to be approximately 1,000 metres to effectively prevent 94% of *flyrock* incidents from leaving the boundaries of a blasting quarry site, equivalent to a 1,000-metre setback.

Only with the benefit of hindsight after two flyrock incidents at a quarry operation in the Town of Paradise, Newfoundland, did it become apparent to mining regulators that a buffer of 300 metres to protect residents in nearby residential subdivisions against flyrock debris was inadequate, and which was subsequently increased to 1,000 metres in 1996.⁵⁷ Details of the increase in the width of the buffer requirement from 300 metres to 1,000 metres to protect the public from the potentially deadly consequences of flyrock are described in *City Sand and Gravel Ltd. et al v. Newfoundland (Minister of Municipal and Provincial Affairs)*, (2005):

“Stephen Jewczek...who was previously employed as the town planner at the [St. John’s, Newfoundland] Metro Board....testified [that] any plan for Evergreen Village or Elizabeth Park [two residential subdivisions] should recognize that there is a [48-acre] quarry in the area. He also indicated planning should avoid conflicting uses [para. 24].”^[58] *City Sand and Gravel Ltd was not legally entitled to use or interfere with the use and enjoyment of adjoining or nearby third-party real property in the two residential subdivisions.*

By 1996...both Metro Board, and the Department of Mines, were of common intent in establishing a 300-metre buffer between a quarry operation and residential usages. The setting of a 300-metre buffer has not remained stagnant and changed significantly in 1996 [para. 64]....[I]n 1996 the Department of Municipal and Provincial Affairs, in its conditions for approval of quarry applications, required that...[a buffer zone of 1,000 metres be maintained] from a cottage or residence, if blasting quarry operations are carried out at the quarry... [para. 20]”^[59]
[60]

⁵⁷ On July 3, 1998, there was a third flyrock incident at the quarry, which launched flyrock debris that “caused damage to the roof of one resident of Jane Heights [an extension of Elizabeth Park] and the roof of another [para. 20].” *City Sand and Gravel Limited v. Newfoundland (Municipal and Provincial Affairs)*, 2007 NLCA 51 (CanLII), <<https://canlii.ca/t/1sfnv>>, accessed 15 July 2023.

⁵⁸ *City Sand and Gravel Ltd. et al. v. Newfoundland (Minister of Municipal and Provincial Affairs)*, 2005 NLTD 67 (CanLII), <<https://canlii.ca/t/fwvrv>>, accessed 15 July 2023.

⁵⁹ *Ibid*

⁶⁰ St. John’s, “Under the Development Regulations, a buffer not less than 1000 metres is required between a residential or apartment use and a mineral working area that involves blasting activity [p. 2].” <<https://apps.stjohns.ca/subscribe/archived/agenda/Regular%20Agenda%20-%20May%2013,%202019.pdf>>, accessed 12 August 2023.

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The Court of Appeal of Newfoundland and Labrador, (2007),⁶¹ rejected the quarry owner’s argument that *Metro Board* owed a *duty of care*⁶² both to the residents of Jane Heights, an extension of Elizabeth Park subdivision, and to *City Sand and Gravel Ltd.* On this point, the appeal court commented as follows:

“A municipal authority reviewing a proposed residential development may owe a duty of care to future residents in respect of known hazards [e.g. an existing or proposed blasting quarry operation]. Though *City Sand* emphasized that point, it did not acknowledge directly that its blasting, which entailed the inherent risk of fly-rock, exposed it also to liability in tort to those same residents. As *City Sand* had no right to eject fly-rock outside the quarry site, the respondent argued that *Metro Board* owed no duty of care to *City Sand*. The trial judge agreed – Trial Decision para. 56. I see no fundamental flaw in that position. *City Sand* carried on a legitimate but inherently dangerous operation. It constituted a danger to persons and property outside the quarry site. Prior to the development of Jane Heights, neither the owner of the land comprising that development, nor *Metro Board*, found it necessary to take legal action in respect of fly-rock landing outside the quarry site. *City Sand* could not however compel *Metro Board* to restrict development of adjacent land so that a public danger would not be created” [p. 54].

5.1 Trespass – Flyrock and Vibration

The Factum of the Interveners⁶³ in the *Castonguay* case before the Supreme Court of Canada, (2013), which involved a *flyrock* incident, describes *trespass* as follows:

“*Trespass is the intentional physical invasion of property by people or objects, however minute the invasion, without the consent of the owner of occupant. Liability in trespass does not depend on proof of damages. To deposit a foreign substance such as water on the property of another and, in so doing, disturb that person’s possession of property, however slight the disturbance, constitutes trespass, regardless of whether the substance is toxic or non-toxic.*” [citations omitted]

In *Enos Coal Mine v. Schuchart et al.*, (1963),⁶⁴ the Indiana Supreme Court ruled there is no logical reason not to extend *strict liability* for property damage from *vibrations* simply because there is no physical trespass as in falling debris (*flyrock*) from an explosion on nearby land. The court ruled that the common law principle of liability in *trespass*

⁶¹ Ibid, supra 58

⁶² *Duty of care* is defined as “a legal obligation imposed on an individual [or legal entity] to take reasonable care to avoid causing harm to another who might reasonably be affected and who ought to be in the individual’s [or legal entity’s] contemplation, p. 277, C. A. MacLean, L. M. Olivo and J. Fitzgerald, Contract and Tort Law, Second Edition, ©2018, Emond, Toronto, Canada.

⁶³ <<https://cela.ca/wp-content/uploads/2019/07/Castonguay-SCC-Factum.pdf>>, accessed 12 August 2023.

⁶⁴ *Enos Coal Mining Company v. Schuchart et al.*, 243 Ind. 692 (1963) 188 N.E.2d 406, <<https://casetext.com/case/enos-coal-mining-co-v-schuchart-et->>, accessed 11 August 2023.

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applies equally where damage is caused only by *vibration*, commenting by way of analogy, as follows:

“In these days of nuclear explosions, the breaking of sound barriers by airplanes and missiles, violent explosions from artillery and gunnery practice (to mention but a few of the advances of science), nearby buildings and property can be shattered or destroyed as effectively as by an earth quake without any physical invasion of the property.

The United States Supreme Court has recognized these modern problems in holding that property owners are entitled to compensation for deterioration in property values caused by noise and vibration of jet planes in the use of air space near an airport. Griggs v. Allegheny County (1962), 369 U.S. 84, 82 S.Ct. 531, 7 L.Ed.2d 585.”

6. NUISANCE AND THE RULE OF RYLANDS (STRICT LIABILITY)

According to Grant (2017),⁶⁵ the tort of *nuisance* is similar to the tort of *trespass*, to the extent that it is for the protection of a property owner’s “use and enjoyment” of land, and can apply to all-manner of activities conducted by a nearby quarry blasting operation that have the potential for *adverse effects*.

“Nuisance focuses on the effect of certain activities on neighbouring property holders, the nature of the interest invaded, and the extent of the invasion, rather than on the tortfeasor (as in negligence). The essence of the tort of private nuisance is that the tortfeasor has unreasonably and substantially interfered with another’s reasonable use and enjoyment of his or her land. Interference can be separated into two categories: material physical damage, and interference with enjoyment [and use] of land.

It is not necessarily a defense to nuisance to show that all possible care has been taken in carrying on the activity which caused the invasion.

In determining whether there has been an unreasonable interference with the use and enjoyment of the plaintiff’s land, the court balances the gravity of the harm caused against the utility of the defendant’s conduct in all the circumstances. The court also measures the harm in the context of factors like the character of the locale, and whether or not the plaintiff has an abnormal sensitivity.⁶⁶

The Rylands v. Fletcher rule is one of the situations at common law where there can be tort liability for unintended and non-negligent harm. The rule states that “a person who for his own purposes brings on his lands and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril, and if he does not do so, is prima

⁶⁵ Adam Grant, “Making Use of Unusual Torts in Subrogation,” July 2017, <https://mccagueborlack.com/emails/articles/unusual-torts.html?utm_source=Mondaq&utm_medium=syndication&utm_campaign=LinkedIn-integration>, accessed 12 August 2023.

⁶⁶ *Antrim Truck Centre Ltd. v. Ontario (Transportation)*, 2013 SC 13, and Allen M. Linden & Bruce Feldthusen, *Canadian Tort Law*, 10th ed (Toronto: LexisNexis Canada, 2015) at 609-621. *Antrim Truck Centre Ltd. v. Ontario (Transportation)*, 2013 SCC 13 (CanLII), [2013] 1 SCR 594, <<https://canlii.ca/t/fwdn1>>, accessed 12 August 2023.

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facie answerable for all the damage which is the natural consequence of its escape.”

The three criteria necessary to succeed in an action under the rule in *Rylands v. Fletcher* (strict liability) are:

1. *The defendant brought something capable of causing harm onto his or her land.*
2. *The defendant made use of the thing for his or her own profit or benefit.*
3. *The use of the thing, in addition to being dangerous, was unusual or non-natural [p. 339].*⁶⁷

7. CONFLICTING LAND USES, LONG-TERM LAND USE PLANNING AND PRECAUTIONARY PRINCIPLE

Aggregate extraction operations can remain operational indefinitely in jurisdictions such as Ontario, Canada, where a license or permit issued to extract aggregate has no expiry date, which means that the adverse effects suffered by the surrounding communities are effectively permanent. Accordingly, municipal land use planning (e.g. zoning, official plan, master plan, etc.) should be undertaken in a manner that supports anticipated population growth long-term, while simultaneously restricting aggregate extraction operations to locations far enough removed from sensitive land uses, existing and planned, that do not interfere with the use and enjoyment of private third-party property or the health, safety and welfare of existing and future generations. This proactive and forward-looking approach to land use planning is consistent with the Precautionary Principle, which in essence holds that it is “better to be safe than sorry.”

In *EQT Production v. Borough Jefferson Hills*, (2019),⁶⁸ three objectors provided relevant, probative and credible testimony as to the adverse effects on the environment and the impact on health and quality of life (use and enjoyment of property), and attendant loss in property value, as a consequence of residing in proximity to the “Trax Farm site,” a similar natural gas extraction operation in Union Township, Pennsylvania. EQT purchased easements and rights-of-way, characterized as “gag agreements” by one objector, over nearby properties for “noise, dust, light, smoke, odours, fumes, soot or other pollution [and] vibrations” and other adverse impacts which may emanate from EQT’s Trax site operations. EQT was not entitled to the free use of adjoining land as a “dumping ground” for the adverse impacts that EQT could not prevent from leaving the boundary limits of the Trax site. Precautionary and proactive planning measures (e.g. permanent onsite setbacks coupled with offsite separation distances) could have prevented the land use conflicts, preserved property values, and protected the environment, and the health and safety of existing and future residents of the community, deleterious impacts that

⁶⁷ MacLean, C. A., Olivo, L. M. and Fitzgerald, J., *Contract and Tort Law*, Second Edition (2018, Emond, Toronto, Canada).

⁶⁸ *EQT Production v. Borough Jefferson Hills*, 208 A.3d 1010 (2019).
<<https://casetext.com/case/eqt-prod-co-v-borough-of-jefferson-hills->>, accessed 12 August 2023.

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cannot be overcome by any amount of money paid to purchase easements and rights-of-way over properties near the Trax site operations.

“...Bob Domman related that because “the Trax site was probably the closest one to where I lived, we followed that pretty closely,” and he testified that EQT had offered what he characterized as “gag agreements” to individuals who lived next to the site, and he provided Council with copies thereof which were entered into the evidentiary record. N.T. Jefferson Hills Council Public Hearing (“Hearing”), 11/10/15, at 138, 143. Because these individuals had apparently complained that EQT’s extraction activities at the Trax Farm site constituted a nuisance which interfered with the use and enjoyment of their property, the agreements provided that, in exchange for a \$50,000 cash payment, the residents would grant EQT easements and rights-of-way over their properties for “noise, dust, light, smoke, odors, fumes, soot or other pollution, [and] vibrations ... [and other] adverse impacts or other conditions or nuisances which may emanate or be caused by [EQT’s] operations.” Id. at 139-40. These easements were for varying lengths of time, ranging from one year to perpetuity. Id. at 140.”

As reported in *The Magazine of Mining Health and Safety (MESA)*, (1978),⁶⁹ “being too close” to the blast was the most frequently cited reason for property damage, injury and death from flyrock:

“Of 34 accidents that occurred during scheduled blasting, 28 involved death, injury or property damage as a result of flyrock striking persons, equipment, buildings or other property the MESA reports showed. Where flyrock was the agent, “being too close” to the blast was the reason most frequently listed in the accident reports on death and injuries of miners. In one case...a 37-year-old miner with 12 years of mining experience was 1,600 feet [488 metres] from the blast when he was struck and killed by a flying rock fragment attributed to undetected fissures in the rock being blasted. Flyrock which travelled 1,200 feet [366 metres] through the air left another miner an invalid for life. In still other instances, flyrock broke the leg of a miner who was 2,500 feet [762 metres] from the explosion and damaged nine houses located from 1,650 [feet] [503 metres] to 2,000 feet [610 metres] from the center of the blast [p. 5].”

In applying the *precautionary principle*, the Federal Republic of Nigeria National Environmental (Quarrying and Blasting Operations) Regulations, 2013, preclude blasting quarry operations from locating within certain distances from sensitive land uses to prevent potential adverse effects and any form of human discomfort:⁷⁰

20. A person shall not locate a quarry or engage in blasting within three kilometers (3km) of an existing residential, commercial or industrial area.

⁶⁹ The Magazine of Mining Health and Safety (MESA), December-January 1978. <<https://books.google.ca/books?printsec=frontcover&id=SwNl7rxA5ugC#v=onepage&q&f=false>>, accessed 13 August 2023.

⁷⁰ National Environmental (Quarrying and Blasting Operations), 2013. <<https://faolex.fao.org/docs/pdf/NIG208283.pdf>>, accessed 12 August 2023.

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22. – (1) A person shall not blast in such a way that the impact of such blast will cause any form of discomfort or nuisance to the public and residents within 1,000 meters from the epicenter of the site or users of the users of the roads thereof.

22.(2) Subject to the provisions of these Regulations, the act of blasting shall be complete, whether or not the alleged act is preceded or accompanied with vibration, noise, air over pressure, fly rock, dust, fumes, or that the impact is felt within 1,000 meters from the site or epicenter of the blasting.

8. BLASTING OPERATIONS ARE DANGEROUS AND MUST PAY THEIR OWN WAY

While it is recognized that aggregate extraction operations are “necessary” for construction of structures, buildings and roads in support of economic activity, it is not “reasonable” for a private company such as a blasting aggregate operation to enhance profits by interfering (directly or indirectly) with the use and enjoyment of land owned by neighbouring property owners who do not share in the profits of a private for-profit enterprise. In this respect, the Supreme Court of Indiana in *Enos Coal Mining Co. v. Schuchart et al.*, (1963), made the following observations:

“It is also urged that in business and industry certain operations are “necessary” for the encouragement of industrial development and that even though such business activities cause some injury to neighbouring properties, a “reasonable use” is permissible. From our viewpoint, this is to say that “a little damage” is “reasonable” and legal, but too much damage is “unreasonable” and wrong. What is or is not “reasonable” is an uncertain yardstick. Although it is a standard of conduct in some cases because of the lack of a better one, it is to be avoided, so far as possible, because of its vagueness and lack of certainty.

“The individual citizen may be deprived of his home or other property by the proper exercise of the power of eminent domain; but it ought not to be said that it can be lawfully destroyed without compensation in the interest of a mere business enterprise, simply because such enterprise is of great magnitude and general public interest.” *Watson v. Mississippi R.P. Co.* (1916), 174 Iowa 23, 34, 156 N.W. 188⁷¹.

9. CONCLUSION

As this article demonstrates, flyrock is an ever-present danger whenever blasting to break rock is conducted, and the different formulas used to calculate the “throw” distance of flyrock are unscientific and unreliable. Both onsite quarry employees and people (children, women and men) who live, work, shop and play offsite near an operational blasting quarry are vulnerable to the potentially deadly consequences of flyrock, as well as the other impacts associated with blasting quarry operations. Flyrock is an inevitable by-product of blasting rock, and as

⁷¹ <<https://case-law.vlex.com/vid/watson-v-miss-river-889538033>>, accessed 12 August 2023.

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flyrock can never be brought down to “zero” proactive and preventive land use provisions are warranted. Mandatory minimum setbacks (extraction limit) imposed on the lands slated for aggregate extraction coupled with a mandatory separation distance between the boundaries of a proposed quarry site and existing (and potential future) sensitive land uses are the only effective means of avoiding or mitigating damage to personal and real property, and the potentially deadly consequences of flyrock to human and non-human life. No quarry operation has the right to the free use of nearby land by interfering with the *use and enjoyment* of public or private third-party property. The quantitative analysis of the travel distances of 139 flyrock incidents from a blast site presented in this paper provide municipalities and its Land Use Planners with an evidence-based rationale for avoiding land use conflicts, preserving property values, and mitigating the potentially deadly consequences of flyrock (and the other impacts associated with blasting quarry operations) by the enactment of permanent minimum onsite setbacks (extraction limits) combined with offsite permanent minimum separation distances from existing and future sensitive land uses.

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Research involving human bodies or organs or tissues (Helsinki Declaration)

The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

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The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. The contexts of animals not even indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work.

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The author(s) solemnly declare(s) that this research has not directly involved any local community participants or respondents belonging to non-Indigenous peoples. Neither this study involved any child in any form directly. The contexts of different humans, people, populations, men/women/children and ethnic people are only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

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To see original copy of these declarations signed by Corresponding/First Author (on behalf of other co-authors too), please download associated zip folder [Ethical Declarations] from the published Abstract page accessible through and linked with the DOI: <https://doi.org/10.33002/jelp03.02.01>.

THE SHODDY LEGAL FRAMEWORK ON OIL SPILL IN NIGERIA: A CALL FOR A POTENT APPROACH

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ABSTRACT

Oil spills have adversely affected the oil-bearing communities in resource-rich regions of Nigeria, especially the Niger Delta Region. Over the decades, the underlying causes of this menace and its consequent effect on the environment, economy, and human rights in the Niger Delta have generated endless debates, civil unrest, and insurgencies. In order to identify the reason for these unabated oil spills, this project examined the current and relevant legislation on oil spills in Nigeria, including all legal and regulatory frameworks governing the oil and gas sector in the country. The assessment focused on how to safeguard the environment and ensure that Nigeria benefits sustainably from an oil-based economy. The fundamental finding that was found is that recurring and unabated oil spills pillage Nigeria solely because of the inadequacy of existing legislation to curb the menace. Nigeria still does not have a strong framework, with it over six decades of oil production. While there exist enforcement issues, the major problem is the inadequacy of existing laws. There is a huge gap in oil spill governance in Nigeria because several standards and legislation are missing. The existing legal framework features the absence of prevention, planning, and preparedness mechanism; lack of an immediate clean-up mechanism; lack of a contingency plan; no liability limits for removal costs and damages; pre-emption of state laws and a lax punitive measure. Although the country can boast of several laws regulating the oil sector, combining these laws has failed in minimizing or preventing oil spills. The study then projected the legal framework governing oil spills in the United States with a particular emphasis on the U.S. Oil Pollution Act of 1990 (OPA). It gave an overview of the strategies and standards contained in the U.S. legal regime. It further explained the fundamental differences and similarities between Nigeria and the U.S. The paper found that the U.S. approach to mitigating oil spill incidents could fill up the clear gaps in the oil spill regime in Nigeria. The paper recommends that Nigeria adopt the various standards inherent in the U.S. Oil Pollution Act of 1990, such as creating a contingency plan, a higher liability limit, and the non-preemption of state laws. Although there exist functional differences between the operation of the legal system in Nigeria and that of the United States, the paper highlighted how the U.S. model could easily be transferred to Nigeria. The study compiles the oil spill occurrence data from both a Nigerian Government Agency (NOSDRA) and Amnesty International. The Agency's data was mostly used in the project as it is more reliable and acceptable. The paper assessed all relevant legislation on oil spills in Nigeria. It also assessed the U.S. Oil Pollution Act, which is the major statute governing oil pollution in the U.S. The Study recommended the United States model as a potent approach because of the country's high oil production capacity being the largest oil-producing country in the world.

Keywords: Oil Spill, Oil Theft and Bunkering, Corruption in Nigeria, Oil Pipeline Vandalism, Niger Delta and Ogoniland

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The Shoddy Legal Framework on Oil Spill in Nigeria: A Call for a Potent Approach

1. INTRODUCTION

Nigeria, undoubtedly, is one of the world's largest exporters and a critical major oil supplier to Western Europe. It was regarded as the 5th largest supplier of crude oil to the United States in 2002. Nigeria's economy profoundly and solely depends on the oil sector, which accounts for 90-95% of the foreign exchange revenues and 80% of government revenues¹. The Niger Delta region of Nigeria, which comprises 9 out of 36 states, is one of the most polluted places on Earth². The four Niger Delta states of Delta, Rivers, Bayelsa, and Akwa-Ibom jointly produce 93% of Nigeria's crude oil.³ These states experience economic and environmental nightmares occasioned by decades of oil spill incidences on their land, solely attributable to unceasing oil exploration activities.⁴ There are over 1,000 oil spills per year in these oil-producing areas.⁵ These oil spill incidents have eroded the local communities' livelihoods⁶, well-being, and health⁷. Sometimes, the scale and magnitudes of these spills are so severe that it becomes imperative for local communities to emigrate to a safe environment owing to unabated human rights issues.⁸ Not only have the oil spills from wells and pipelines exposed native residents to toxic chemicals, but they have also contaminated farmlands and water bodies, thereby, truncating the people's habitual preoccupation with farming and fishing activities.⁹ Therefore, attempting to reverse the damage done to public health and the regional ecosystem would take decades. A United Environment Program (UNEP) report released in 2011 affirmed that it could take up to 30 years to reverse many of the environmental consequences of oil spillage in the Niger Delta. It further stated that the area has high rainfall and any delay in cleaning up an oil spill in the region would lead to the oil spreading wide and far, coursing its way into arable lands and community surroundings. Some of the studies at

¹ Sule-Iko, S.S.S., and Nwoye, M.I., 'Effect of International Crude Oil Prices on Nigeria's Gross Domestic Product from (1985-2020),' (2023) 11 Journal of Human Resource and Sustainability Studies 118-137. <<https://doi.org/10.4236/jhrss.2023.111008>>.

² Kalu, V.E., and Stewart, N.F., 'Nigeria's Niger Delta Crises and Resolution of Oil and Gas Related Disputes: Need for a Paradigm Shift', (2007) 25(3) Journal of Energy and Natural Resources Law 247. <<https://doi.org/10.1080/02646811.2007.11433462>>.

³ Ojewale, O., and Le Roux, A., 'Endless Oil spills blackens Ogoniland's prospect', Institute for Security Studies, March 2022, <<https://issafrica.org/iss-today/endless-oil-spills-blacken-ogonilands-prospects>>, accessed 20 July 2023.

⁴ Kadafa, A.A., Zakaria, M.P., and Othman, F., 'Oil Spillage and Pollution in Nigeria: Organizational Management and Institutional Framework', (2012) 2(4) Journal of Environmental and Health Science 22 <<https://api.semanticscholar.org/CorpusID:109426229>>.

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⁶ Azubuikwe, S.I., and Songi, O., 'A Rights-based Approach to Oil Spill Investigations: A Case Study of the Bodo Community Oil spill in Nigeria', (2020) 1.1 Global Energy, Law and Sustainability 28-54. <<https://doi.org/10.3366/gels.2020.0005>>.

⁷ Bosch, X., 'Exposure to oil spill has a detrimental effect on clean-up workers' health', (2003) 361 (9352) The Lancet 147. <[https://doi.org/10.1016/S0140-6736\(03\)12249-0](https://doi.org/10.1016/S0140-6736(03)12249-0)>.

⁸ Okonkwo, E.C., 'Environmentally displaced persons in the Niger Delta: challenges and prospects', (2016) Energy, Governance and Sustainability 269-290. Edward Elgar Publishing, Cheltenham, United Kingdom. <<https://doi.org/10.4337/9781785368462.00021>>.

⁹ Elum, Z.A., Mopipi, K., and Henri-Ukoha, A., 'Oil exploitation and its socioeconomic effects on the Niger Delta region of Nigeria', (2016) 23(13) Environ Sci Pollut Res 12880-12889. <<https://doi.org/10.1007/s11356-016-6864-1>>.

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Ejama-Ebubu in Eleme Local Government Area (LGA) found heavy oil debris present after 40 years since an oil spill incident occurred in the area, despite countless clean-up attempts.¹⁰ The figure 1 shows the confounding amount of barrels of oil spills reported in Nigerian communities in the last 15 years (2007-2022).

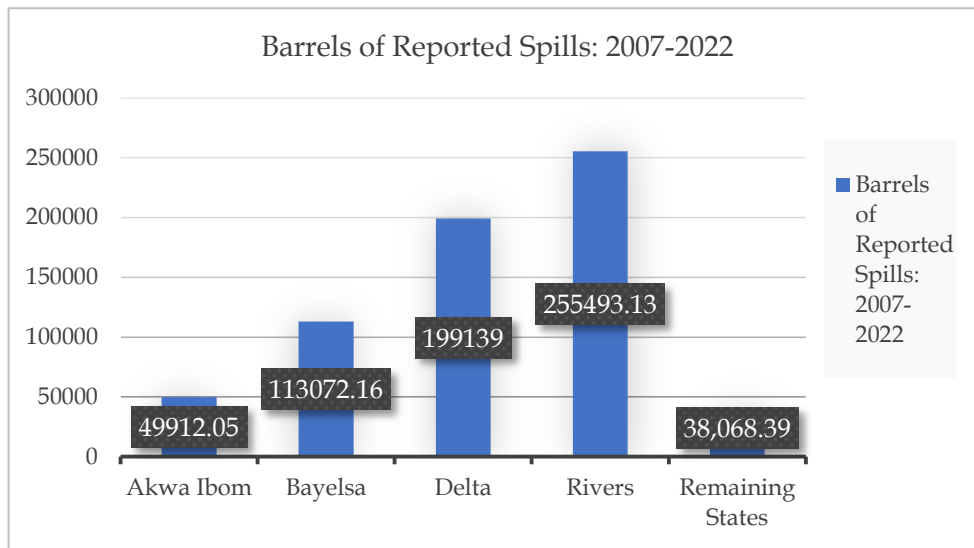


Figure 1: Amount of oil spills in Nigerian communities between 2007 and 2022 [Data Source: Nigerian Oil Spill Monitor, National Oil Spill Detection and Response Agency, Sept. 2022]

Over the decades, the underlying causes of this menace and its consequent effect on the environment, economy, and human rights in the Niger Delta have generated endless debates, civil unrest, and insurgencies.¹¹ Despite the numerous oil spill incidents that occur daily, a more robust and fail-proof framework to tackle these events has yet to be developed. The existing shoddy framework features the absence of prevention, planning, and preparedness mechanism; lack of an immediate clean-up mechanism; lack of a contingency plan; no liability limits for removal costs and damages; pre-emption of state laws and a lax punitive measure. While the nation can boast of several laws regulating the oil sector, combining these laws has failed in minimizing or preventing oil spills. Neither has any law or regulation provided effective clean-up measures or responses for the impacted sites. There are currently no penalties or fines for oil spills in Nigeria. Oil companies are only required to report oil spills and fund the clean-up of such spills if and only if the spill was the company's fault.¹² Also, the remedial measures provided are

¹⁰ Ibid

¹¹ Amnesty International, 'Nigeria: Petroleum, Pollution and Poverty in the Niger Delta', AFR 44/017/2009, 30 June 2009, <<https://www.refworld.org/docid/4a4a1dfc2.html>>, accessed 21 August 2023.

¹² *About oil spills in Nigeria*, Nigerian Oil Spill Monitor, <https://nosdra.oilspillmonitor.ng/about.html>, accessed 20 August 2023.

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insignificant as responsible parties are only liable for paying paltry sums as compensation to local communities affected. What currently exists in Nigeria is lax legislation and inadequate legislation. It was expected that an abundance of oil should cause high economic growth and a conducive environment. Still, the opposite has been the case in Nigeria, with the pollution of the oil communities as a result of these spillages. If oil spillage can be addressed in Nigeria, there will be an improved environment that will propel economic success.

The primary contention in this paper is not whether environmental laws or policies regulating oil spills exist in Nigeria but rather to see if such laws have adequate provisions sufficient for achieving the desired sustainable environment. Indeed, to consider the efficacy of existing legislation, this paper considered the model of oil pollution governance in the U.S. and took a careful look at how the U.S. is combating oil pollution. Equally, the paper also assessed the various legislation governing oil spill incidents in Nigeria to see if the existing legislation is potent enough in curtailing oil spill incidences, ensuring rapid clean-up measures, and providing adequate remedial and punitive measures to both the communities and the culprits, respectively, as is obtainable in the U.S model.

The choice of the United States as an appropriate model is predicated on the fact that relevant legislation regulating oil spills in the United States is the Oil Pollution Act of 1990, and this law has existed for over three decades. During this period, oil spill incidences in the U.S. have tremendously decreased. Although it is not the case that oil spills no longer occur in the U.S., realistically, the rate of occurrence has significantly dropped despite the increase in the volume of oil produced and transported all over the country.

This paper essentially analyzes and addresses the lax and frail legislation governing oil spills in Nigeria, hence the need to adopt a new standard. The serious daily occurrence of oil spills in Nigeria, which the existing legislation has not abated, has seriously impacted the various communities where these incidences occur.

2. ASSESSING THE LITERATION ON THE OIL SPILL REGULATORY FRAMEWORK IN NIGERIA

There is a dearth of texts about the legal framework governing oil spills in Nigeria. The current literature either examines some of the laws or looks halfway into oil spill incidents. A study¹³ found that the legislation sanctioning oil spills in Nigeria has yet to be effective, questioning the alarming rate at which oil spill incidents have increased despite the legislation sanctioning the act. The study also reviewed legislation sanctioning oil spills to identify the deficiencies in the current regulatory

¹³ Chuks-Ezike, C.I., 'Deficient Legislation Sanctioning Oil Spill in Nigeria: A Need for a Review of the Regulatory Component of Petroleum Laws in Nigeria and the Petroleum Industries Bill.' (2018) 7(1) International Journal of Environment and Sustainability, 30-44, <<https://doi.org/10.24102/ijes.v7i1.816>>

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framework.¹⁴ The study then advanced salient reasons for the inability to sanction oil spills in Nigeria effectively.¹⁵ Furthermore, another study¹⁶ explored the manner and the reason for the failure of the legal framework in Nigeria to redress the environmental destruction of oil spills caused by multinational companies. The study suggested that plaintiffs in Nigeria, i.e., oil spill victims, should approach and obtain relief from U.S. courts if they can allege transnational harm, particularly if the alleged damage is to U.S. interest since what currently exist are inadequate legislations and standards that would ensure no liability for responsible parties.¹⁷ Similarly, a study¹⁸ provided a historical background to Shell's activities in the Niger Delta region and identified the inadequacy of the current legislation, which has made monitoring and enforcement in the oil industry quite tricky. After studying the various activities of Shell and other multinational companies in Nigeria, the study concluded that inadequate legislation has resulted in a lack of monitoring of the oil production activities of these oil companies, which is the primary cause of oil spill activities.¹⁹

The literature on the oil spill legal framework in Nigeria does not provide what standards should be adopted to fill the void left by the shoddiness and inadequacy of existing legislation in Nigeria. Moreover, the literature was restricted to sanctions and monitoring of oil spills only, with a work recommending pursuing redress in U.S. courts due to the inadequacy.

This paper seeks to fill the significant gap in the existing scholarly literature by having a holistic review of the regulatory framework governing oil spills in Nigeria, from prevention and preparedness to clean-up, remediation, and punishment for responsible parties. The paper's focus is to examine and recommend new standards that could be adopted to ensure the adequacy of the legal framework in Nigeria and design an effective grievance redress mechanism for oil spills in Nigeria.

3. OIL PERTINENCE AND OIL SPILL IN NIGERIA

3.1 Why is oil important to the Nigerian State?

Nigeria is Africa's largest oil-producing region²⁰. The oil sector accounts for 80% of Nigeria's budgetary revenues and 95% of its foreign

¹⁴ Ibid.

¹⁵ Ibid.

¹⁶ Donnelly-Saalfeld, J., 'Irreparable Harms: How the Devastating Effects of Oil Extraction in Nigeria Have Not Been Remedied by Nigerian Courts, the African Commission, or U.S. Courts', (2009) 15 *Hastings West Northwest J. of Envtl. L. & Pol'y* 371.
<https://repository.uclawsf.edu/hastings_environmental_law_journal/vol15/iss2/11>, accessed 21 August 2023.

¹⁷ Ibid.

¹⁸ Konne, B.R., 'Inadequate Monitoring and Enforcement in the Nigerian Oil Industry: The Case of Shell and Ogoniland,' (2014) 47(1) *Cornell International Law Journal* 181.
<<https://scholarship.law.cornell.edu/cilj/vol47/iss1/6>>, accessed 21 August 2023.

¹⁹ Ibid.

²⁰ Nwilo, P.C., and Badejo O.T., 'Oil Spills Problems and Management in the Niger Delta', (2005) (1) *International Oil Spill Conference Proceedings* 1 May 2005, 567-570.
<<https://doi.org/10.7901/2169-3358-2005-1-567>>.

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exchange earnings.²¹ Nigeria, whose economic mainstay was agriculture in the early and mid-twentieth century, suddenly shifted and relied mainly on oil upon its discovery in the late twentieth century. The oil industry has severely affected the Nigerian State because it is the economy's mainstay.²² Oil production also funds numerous multibillion-dollar investments in Nigeria, as most sectors and infrastructure are financed through oil revenue. As a result of the inability to find cheap alternatives to oil as a form of energy, crude oil production has become more relevant in contemporary times. Thus, making oil production, a necessary evil Nigeria cannot help but embrace²³.

3.2 Causes Of Oil Spill

First, the major party responsible for oil spills in Nigeria is the oil industry. There are over 50 oil and gas companies in Nigeria, with Shell being the largest oil operator alongside Texaco, Agip, Total, Chevron, and ExxonMobil. In August 2021, Shell agreed to pay 45.9 billion Naira (US\$ 111 million) as compensation to affected communities in Ogoniland for the violations occasioned by their oil exploration activities. Unbridled oil exploration activities of oil companies are occasioned by corrosion, breaks in aging infrastructure, poor maintenance of infrastructure, and equipment failure. However, oil companies have often defended the scale of pollution by claiming that most oil spills are caused by sabotage or oil theft, thus making it impossible for communities to claim damages against the oil companies. The other parties responsible for the oil spill incidents in Nigeria are oil thieves and saboteurs. Oil spills occur due to the theft of oil and the sabotage of oil pipelines. There has been an outrageous rise in oil theft and racketeering activities in the oil sector in Nigeria.²⁴ These oils are stolen directly from oil pipelines by sabotaging oil infrastructure. Further, due to intense hostility between the multinational oil companies and the host communities, several local militants have engaged in the sabotage and vandalism of oil pipes.

3.3 Impact of Oil Spill and the Extent of Environmental Damage

An Amnesty International report detailed the damaging effects of oil spills on aquatic species and man's survival.²⁵ The report showed how the Niger Delta residents heavily rely on fishing for their survival and

²¹ Sule-Iko, S.S.S., and Nwoye, M. I., 'Effect of International Crude Oil Prices on Nigeria's Gross Domestic Product from (1985-2020)', (2023) 11 *Journal of Human Resource and Sustainability Studies* 118-137. <<https://doi.org/10.4236/jhrss.2023.111008>>.

²² Uwakonye, M. N., Osho, G. S., and Anucha, H., 'The Impact Of Oil And Gas Production On The Nigerian Economy: A Rural Sector Econometric Model', (2016) 5(2) *International Business & Economics Research Journal (IBER)* 62. <<https://doi.org/10.19030/iber.v5i2.3458>>.

²³ Akinlo, A.E., 'How Important is Oil in Nigeria's Economic Growth?' (2012) 5(4) *Journal of Sustainable Development* 165. <<https://doi.org/10.5539/jsd.v5n4p165>>.

²⁴ Izoukumor, N.A., 'A Critical Assessment of the Pollution Prevention Laws and Regulations of Nigeria: Why They Failed to Protect the Environment of Nigeria', (2019) 87 *Journal of Law, Policy and Globalization*, <<https://doi.org/10.7176/jlpg/87-06>>.

²⁵ Amnesty International, 'Petroleum, Pollution and Poverty in the Niger delta Index', Amnesty International Afr/44/017/2009. <<http://www.amnesty.org/en/documents/afr44/018/2009/en/>>, accessed 10 August 2023.

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sustenance and how the continuous oil spills have adversely affected the water system. Although the Niger Delta region relies heavily on agriculture for its livelihood, it has been reported that oil pipelines run across farmlands and other oil infrastructure is very close to the farmlands.²⁶ Oil spills in the region reduce the crude protein in cassava by at least 40% and the ascorbic content of vegetables by 36%, thereby, resulting in a 24% increase in the pervasiveness of childhood malnutrition in the Niger Delta.²⁷ Another study embarked on by the United Nations Environmental Program at the request of the Federal Government of Nigeria found that virtually all water in Ogoni Land has been polluted as the drinking water contains a known carcinogen (benzene) at levels 900 times above World Health Organization (WHO) guidelines.²⁸ UNEP findings indicated that oil spills in Ogoni Land are widespread, therefore, affecting the entire Ogoni environment. In addition, the water in Ogoni Land is exposed to hydrocarbons spilled on the surface. This hydrocarbon pollution in the groundwater in Ogoni Land surpassed and exceeded the Nigerian National Standards set out by the environmental guidelines and standards for the petroleum industries in Nigeria. Another study posited that various emissions from the combustion of associated gases contain toxins that increase the risks of airborne disease, food insecurity, and weather damage.²⁹

4. A CRITICAL OVERVIEW OF EXISTING LEGISLATION RELATED TO OIL POLLUTION IN NIGERIA

There are five different major laws governing oil pollution in Nigeria, which include the 1999 Constitution of the Federal Republic of Nigeria (as amended), the Petroleum Industrial Act, the National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, the National Oil Spill Detection and Response Agency Act, and the Petroleum Production and Distribution (Anti-Sabotage) Act. This paper will clearly reveal how inadequate the current legal framework governing oil spill incidences in Nigeria is by critically examining each of these laws and their effects in curbing oil spills.

²⁶ Ibid.

²⁷ Ordinioha, B., and Brisibe, S., 'The human health implications of crude oil spills in the Niger Delta, Nigeria: An interpretation of published studies', (2013) 54 (1) Nigeria Medical Journal 10. <<https://doi.org/10.4103/0300-1652.108887>>.

²⁸ United Nations Environmental Programme, 'Environmental Assessment of Ogoni land' (2011)', <https://wedocs.unep.org/bitstream/handle/20.500.11822/7947/-Environmental%20Assessment%20of%20Ogoniland-2011UNEP_OEA.pdf?sequence=3&isAllowed=y>, accessed 10 August 2023.

²⁹ Edafienene, A., 'Media exposure, policy agenda setting and risk communication in Sub-Saharan Africa: a case study of Nigeria's Niger Delta region', (2012) Ph.D. Dissertation, University of South Wales. <[https://pure.southwales.ac.uk/en/studentthesis/media-exposure-policy-agenda-setting-and-risk-communication-in-subsaharan-africa\(4ca95e78-cb00-4677-bf3b-c65d261bde3e\).html](https://pure.southwales.ac.uk/en/studentthesis/media-exposure-policy-agenda-setting-and-risk-communication-in-subsaharan-africa(4ca95e78-cb00-4677-bf3b-c65d261bde3e).html)>, accessed 10 August 2023.

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4.1 The Constitution of the Federal Republic of Nigeria (1999)

This is the principal and towering law regulating the enactment and enforcement of all laws in Nigeria. The constitution does not explicitly make legislation on oil matters; however, it identified the level of government that would be solely responsible for making legislation regulating “mines and minerals, including oil fields, oil mining, geological surveys, and natural gas.” It vested this authority exclusively in the Federal Government.³⁰ This shows that only the Federal Government is constitutionally empowered to make laws regarding oil spill infractions, as the item was placed on the exclusive legislative list for the Federal Government. This provision itself is a fundamental defect, as state governments should be allowed to make regulations addressing oil spills in their respective states. There are provisions in the constitution with blanket statements on protecting the environment, like Section 20, which mandates the State to protect and improve the environment and safeguard Nigeria's water, air and land, forest, and wildlife³¹. Likewise, Sections 33 and 34 jointly provide for and guarantee the right to life and human dignity. However, attention should be placed on Section 17(2)(d), which forbids the exploitation of human or natural resources in whatever form but for the good of the community.³² The expression ‘for the good of the community’ might connote that environmentally detrimental activities, like oil spills, would be allowed if they benefit Nigeria economically.

Furthermore, if a state or local government attempts to make laws or regulations to address oil spills and other environmental degradation incidences in their domain, such actions could be declared null and void by the courts if they contravene the authority of the federal government. Section 4(5) of the Nigerian Constitution states that any provision of a law of a house of state assembly, that is inconsistent with federal law, shall be null and void to the extent of its inconsistency. And as stated earlier, some of the matters which the states are prevented from legislating on include oil mining, oil field geological surveys, and natural gas, thereby creating monumental incapacitation for states in the Niger Delta region, as they have been restricted from regulating oil spill incidences in their respective states. Another limitation to the efforts to substantially repress the pandemic oil spill incidences in Nigeria is the barrier to non-governmental bodies or environmental activists in bringing injunctive action against the players in the oil sector. Section 13 of the Nigerian Constitution provides that the provisions of Chapter II (Fundamental Objectives and Directive Principles of State Policy) cannot be enforced in any court. This means that the provision of Section 20, which places the responsibility of protecting and improving the environment on the federal government, is non-justiciable.³³ This provision removes the right to enforce the State's

³⁰ Schedule II, Part I, Item 39 of the 1999 Constitution of the Federal Republic of Nigeria

³¹ S. 20 of the 1999 Constitution of the Federal Republic of Nigeria.

³² S. 17(2)(D) of the 1999 Constitution of the Federal Republic of Nigeria

³³ Ugbaja, F., ‘Regulation of Environmental Pollution in the Nigerian Oil and Gas Industry: The Need for an Alternative Approach’ (2016) master’s thesis, University of Calgary, Canada. <<https://prism.ucalgary.ca>>; <<http://doi.org/10.11575/PRISM/27585>>.

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constitutionally declared obligation and the citizens' rights. So, the criticism of the Constitution that it is ineffective and offers no defense to the environment is highly justified. In critiquing Section 20 of the CFRN (1999),³⁴ a writer argued that this provision is marred with defects as the wording of the section is very broad, making its interpretation cumbersome.

Clearly, the Nigerian Constitution is the supreme law in Nigeria. All other laws derive their validity from it. While Section 20 of the Constitution provides for the protection of the environment and its values by the Nigerian government, interestingly, the Federal Government through the legislative houses has not done enough in putting up legal frameworks to combat the unceasing incidences of the oil spill in the Niger Delta region. Although the constitution reflects environmental concerns,³⁵ those concerns are grossly inadequate in addressing or providing a remedy for victims of oil spills in the Niger Delta Region of Nigeria.

4.2 Petroleum Industry Act

In 2000, the Petroleum Industry Bill (PIB) was introduced in the National Assembly for the first time; after years of discussion, the bill was re-introduced in 2012. This Petroleum Industry Bill was signed into law on the 16th of August 2021. The PIB would, among other things, put in place an environmental quality management plan that would require more outstanding commitment by companies to remedy and control environmental degradation related to oil extraction and oil spills. However, the PIB does not set out a grievance mechanism or compensation and remediation scheme for oil spill-related complaints, even though it creates yet another regulatory body that appears to duplicate existing institutions. This paper seeks to determine the new legislation's effect on addressing oil spill incidents and their environmental implications in Nigeria.

The Petroleum Act establishes the principal framework for companies to be able to hold and exercise the rights to explore for and produce oil in a given lease area. Amongst other languages on compensation, it also provides for those holding oil licenses to "be liable to pay fair and adequate compensation for the disturbance of surface or other rights to any person who owns or is in lawful occupation of the licensed or leased lands." As such, the Petroleum Act establishes the principle that those affected by the activities of the oil industry are entitled to compensation in return. However, as with other legal texts, it does not provide sufficient guidance on the assessment method of such compensation, who should carry out this assessment, or who should settle disputes arising if parties disagree on the compensation value. Therefore, reference to the Act concerning compensation matters is often meaningless.

³⁴ Fagbohun, O., 'Reappraising the Nigerian Constitution for Environmental Management', (2002) 1 (1) Ambrose Alli University Law Journal 44.

³⁵ S. 20 of the 1999 Constitution of the Federal Republic of Nigeria.

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The only aspect of oil pollution covered by the Act was regarding operators of licenses and leases (Oil Companies). The Act creates the environmental remediation fund to rehabilitate or manage negative environmental impacts from oil companies' operations. This Environmental Remediation Fund is financed through contributions charged as part of the conditions of granting a license or lease. This fund is only to be applied when an oil company's operation has caused any negative impact on the environment. However, oil companies have found a way around this by blaming oil spill incidents on saboteurs or oil thieves. This created a window for preventing strict liability for the oil spill incidence by oil companies. This is a result of the provision of the Petroleum Industry Act that states:

*'Where in any year, an act of vandalism, sabotage, or other civil unrest occurs that causes damage to petroleum and designated facilities or disrupts production activities within the host community, the community shall forfeit its entitlement to the extent of the cost of repairs of the damage that resulted from the act.'*³⁶

The Act caters to the host communities by creating a Host Community Trust Fund, which must be funded by 3% of the upstream petroleum operators' annual operating expenditure.³⁷ The fund is not for oil spill cleaning but for the economic and social benefits of the host communities in the oil-producing areas. This 3% seems very low when compared to the damages that oil spills have caused to the communities.

Furthermore, another poor provision of the Act was the creation of a funding mechanism where 30% of the Nigerian National Petroleum Commission's share of profits from oil production will be used for a new frontier exploration fund.³⁸ This seems ironical in the sense that rather than the legislation being directed towards creating an oil spill cleaning fund that will abate the devastating effects of oil spills in the host communities with existing oil wells, the act has directed the Nigerian government toward creating a new frontier of exploration fund (for further oil exploration) by using 30% of Nigerian National Petroleum Corporation's (NNPC) share of profit from oil production. The germane question to ask is why the trust fund was not set up for oil spill clean-up operations in the affected communities to assure all Nigerians of a safe, healthy, and peaceful environment. The 30% would have been better utilized in addressing oil spill incidents by funding the cleaning activities.

4.3 National Environmental Standards and Regulations Enforcement Agency (NESREA) Act, 2007

The National Environmental Standards Regulation Enforcement Agency (NESREA) is the frontline regulatory body responsible for protecting the environment in Nigeria. Surprisingly, the provisions of the NESREA Act do not apply to Nigeria's oil and gas industry. The Act

³⁶ S. 257 of the Petroleum Industry Act

³⁷ S. 240(2) of the Petroleum Industry Act

³⁸ S. 9(4) of the Petroleum Industry Act

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expressly excludes the infractions that might arise from the oil and gas sector in the country.³⁹ In other words, the most comprehensive enactment regulating environmental pollution deliberately left out the country's most fatal cause of environmental degradation and pollution⁴⁰. This decision to exclude NESREA from exercising jurisdiction over oil and gas-related pollution is the most significant shortcoming of the NESREA ACT of 2007.

4.4 The National Oil Spill Detection and Response Agency Act (NOSDRA Act 2006)

This is the only Act that appears to contain some provisions for addressing the menace of oil spills ravaging the oil-producing communities in Nigeria. The Act established an agency, the National Oil Spill Detection and Response Agency (NOSDRA), whose mandate is to prepare, detect, and respond to oil spillages in Nigeria.⁴¹ Apart from intensifying efforts towards compliance monitoring and enforcement of oil and gas regulations and standards, NOSDRA is making efforts to ensure the use of environmental-friendly drilling fluid and mud systems by the oil and gas operators. However, the agency has so far not done anything tangible in abating oil spills as it was not provided with the necessary funds to implement clean-ups. The agency relies on the oil companies' detection and clean-up activities.

Although NOSDRA's mission is to ensure zero tolerance for oil spill incidents in the Nigerian environment, this agency has turned into another colossal failure of a government body. The oil companies are the only bodies that sometimes ensure the detection of and response to oil spill incidences. What NOSDRA does effectively is to update oil spill statistics on its database. The NOSDRA Act provides that the agency shall be "responsible for surveillance and ensure compliance with all existing legislation on oil spills in the petroleum sector."⁴² This provision confers on NOSDRA the jurisdiction for implementing applicable laws to the oil and gas sector. However, the pertinent question at issue is where are the laws?

Perusing the penal provisions, Section 6(2) of the NOSDRA Act prescribes a fine of 2 million Naira (US\$ 2,500) daily for a failure to report an oil spill incident by an oil spiller. While Section 6(3) further prescribes a maximum fine of 5 million Naira (US\$ 6,250) for the failure to clean up an impacted site to all practicable extent. These are the only provision that prescribes punishment in the Act. There is currently no penalty for willful

³⁹ S.7 of NESREA Act provides that the Agency shall-
(g) enforce compliance with regulations on the importation, exportation, production, distribution, storage, sale, use, handling and disposal of hazardous chemicals, and waste other than in the oil and gas sector.

(h) enforce through compliance monitoring, the environmental regulations, and standards on noise, air, land, seas, oceans and other water bodies other than in the oil and gas sector.

(j) enforce environmental control measures through registration, licensing, and permitting systems other than in the oil and gas sector.

⁴⁰ Section 8(g) of the NESREA Act provides that the Agency shall have the power to conduct public investigations on pollution and the degradation of natural resources, except investigations on oil spillage.

⁴¹ S.1 of the NOSDRA Act 2006

⁴² S. 6(1)(a) NOSDRA Act 2006

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endangerment of life due to oil spills. Furthermore, Section 6(2) is unconvincing for two reasons. First, it does not expressly prohibit or sanction oil spills. It only prescribes penalties for failure to report the spill. Secondly, it creates an avenue for an oil spiller to rather not clean up a spill but just report it. Consequently, such a spiller would only be liable to a maximum penalty of 5 million Naira (US\$ 6,250). This makes a mockery of the “polluter must pay” principle, as this Act does not impose fines or other penalties on companies for their disastrous act of oil spillages. It only makes provision for reporting oil spill incidents.

It is quite unfortunate that despite the mandate given to NOSDRA to address oil spill incidences in Nigeria, it is not empowered to impose further penalties on oil companies for their devastating, environment-unfriendly pursuits, except for the provisions regarding the reporting of oil spills and the clean-up exercise. Thus, the legislation is inadequate, given the recurrent severe oil spill incidents in which the nation is still engulfed.

4.5 Petroleum Production and Distribution (Anti-Sabotage) Act, 2004

This law addresses the offense of sabotaging the production and distribution of petroleum products. It prohibits willful engagement with intent to obstruct or prevent the production or distribution of petroleum products in Nigeria.⁴³ This offense is capital in nature. Any person who commits a crime of sabotage is liable, on conviction, to a death sentence or imprisonment for a term not exceeding 21 years.⁴⁴ The Act also provides that anybody who aids another person, incites, counsels, or procures any other person is guilty of sabotage.⁴⁵ This stringent provision has, nonetheless, failed to deter oil thieves from diverting oil from pipelines, nor have the militants been restrained from vandalizing the oil facilities. The Nigeria Security and Civil Defense Corps (NSCDC) made over 500 arrests in 2021 but could only secure 122 convictions.⁴⁶

4.6 Summary of Findings

While it is self-evident that there are laws regulating oil spills in Nigeria, these laws need to be more adequate in preventing oil spills. This overview of relevant laws governing oil spills in Nigeria has clearly revealed that the current laws lack the standards to curb or effectively control oil spill incidences in the Niger Delta. The Constitution of Nigeria, for instance, clearly exempted the jurisdiction of state governments on oil and gas matters, thereby, making it impossible for states or local governments to make or enforce laws, regulations, and policies on oil spills. Similarly, the Petroleum Industry Act created a remediation fund. Still, it also included a caveat that the fund shall not be disbursed to the victims if an oil company disclaims liability. Similarly, PIA and other laws

⁴³ S. 1(a) of Petroleum Production and Distribution (Anti-Sabotage) Act, LFRN 2004

⁴⁴ S. 2 of Petroleum Production and Distribution (Anti-Sabotage) Act, LFRN 2004

⁴⁵ S. 1(b) of Petroleum Production and Distribution (Anti-Sabotage) Act, LFRN 2004

⁴⁶ Ajayi, O., ‘NSCDC secures 122 convictions, 503 arrests in 2021’, Vanguard, December 21, 2021, <<https://www.vanguardngr.com/2021/12/nscdc-secures-122-convictions-503-arrests-in-2021/>>, accessed 10 August 2023.

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do not provide for the creation of a trust fund for contingency plans to ensure immediate cleanup of oil spills in the event no one is taking responsibility. Another fundamental defect of the current legal framework is the lack of liability limits for responsible parties. As a matter of fact, no specific amount for liability (cleanup and damages) was provided, thereby, encouraging responsible parties to only spend paltry amounts on cleaning up and compensating victims.

Oil spill claims are not processed and awarded according to a standard guide on measuring, evaluating, and awarding compensation for environmental damage from oil industry operations. Instead, there are several pieces of legislation that in some way identify and address aspects of compensation, some of which include provisions for damages to be made. The primary and obvious problem with this is that it creates an almost limitless opportunity for dispute. Without an agreed benchmark for what compensation should be granted and how it should be assessed, it is difficult to establish even the formal procedure to decide the benchmark to solve the dispute. The result is compensation cases that are almost impossible for a local community and oil company to resolve between themselves. As such, they must be settled in court. But this can take years to do so, as a case is repeatedly assessed for its relevance to multiple and overlapping pieces of legislation on a procedural basis before it can be tested on its merits.

Another interesting shortcoming is reflected in two laws already discussed, namely NESREA Act and NOSDRA Act. NESREA Act provided for the inspection and seizure of facilities that cause pollution to the environment. However, this act excludes the operation of this provision for oil and gas activities. On the other hand, NOSDRA Act, whose provisions include the responsibility for NOSDRA to respond to oil spills, does not provide NOSDRA the authority to inspect and seize oil facilities, i.e., the body does not have the power to take preventive and clean-up actions or punitive measures against oil spill activities.

Lastly, the fines and terms of imprisonment in all these statutes are so paltry that they mock the POLLUTER-PAY-PRINCIPLE, making this viable environmental enforcement tool a mere illusion in Nigeria.

5. BARRIERS TO EFFECTIVE ENFORCEMENT OF LEGISLATION IN NIGERIA

There exists a lack of continuity of programs, governmental corruption, and a lack of political will in the governance of Nigeria. Each administration of government wants to pursue a new and separate agenda, hence, abandoning any measure that was previously initiated by the previous administration. In addition, while corruption is a global issue, the corrupt culture prevalent among public officials in Nigeria is worrisome.⁴⁷

⁴⁷ Ikpeze, N., 'Fusion of anti-corruption agencies in Nigeria: a critical appraisal', (2013) 1(1) Journal of Sustainable Development Law and Policy 148-167.
<<https://www.ajol.info/index.php/jsdlp/article/view/140528/130269>>, accessed 10 August 2023.

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Also, a lack of the political will to get things done by public officials in Nigeria leads to poor enforcement of policies and a lack of proper implementation of strategies.

6. THE UNITED STATES MODEL

The United States was the highest crude oil producer in the world between 2018 and 2021,⁴⁸ with crude oil being produced in 32 U.S. states. The top 5 states as of 2021 are Texas, New Mexico, North Dakota, Alaska, and Colorado. Every year, large quantities of oil are transported to several destinations in the U.S. through pipelines and vessels.⁴⁹

Sequel to 1989, the U.S. regulatory framework lacked certain standards. This led to several occurrences of large spills of oil which lingered for a long time before cleanup operations were conducted. However, in the wake of the 1989 Exxon Valdez spill, the U.S. Congress then enacted the Oil Pollution Act of 1990 to create stricter preventive standards, efficient clean-up exercises, impose severe costs, and impose penalties,⁵⁰ minimize future oil spills, and ensure that the responsible parties for oil spills pay for the damages. This response by the United States to a monumental oil spill disaster in 1989, which released approximately 11 million gallons of crude oil into Prince William Sound, Alaska, was a notable example of a country's proactiveness in remedying a shoddy regulatory framework that has proven to be inadequate in combating all forms of oil pollution.⁵¹ Consequently, over the past three decades, oil spill incidents in the U.S. have tremendously decreased. The number of oil spills in the U.S. substantially dropped from above 600 in 1990 to below 100 in 2012.⁵² Although it is not the case that oil spills no longer occur in the U.S., realistically, the rate of occurrence has significantly dropped.

7. WHY THE U.S MODEL IS MOST PREFERABLE

This paper chose the United States as a model because the U.S. is an Oil Juggernaut. The United States has been the largest oil-producing country in the world since 2018. In 2022 alone, oil production in the U.S.

⁴⁸ U.S. Energy Information Administration, 'Oil and petroleum products explained: Where our oil comes from', U.S. Energy Information Administration, 16 September 2022, <https://www.eia.gov/energyexplained/oil-and-petroleum-products/where-our-oil-comes-from.php>, accessed 20 August 2023.

⁴⁹ Jonathan, R., 'CRS Report for Congress Oil Spills in U.S. Coastal Waters: Background, Governance, and Issues for Congress', (2010) Congressional Research Service 7-5700, <https://www.epw.senate.gov/public/_cache/files/d/b/db4335ea-2eac-4e97-b37d-7bb90bb4b165/01AFD79733D77F24A71FEF9DAFCCB056.crs-oilspills043010.pdf>, accessed 10 August 2023.

⁵⁰ Oil Pollution Act of 1990, 33 U.S.C.A. S.2701

⁵¹ National Research Council (U.S) Committee on Oil in the Sea, Inputs, Fates, and Effects, 'Oil in the Sea III: Inputs, Fates, and Effects', (2003) National Academics Press (U.S), <<https://doi.org/10.17226/10388>>.

⁵² Elliot, E.D., and Esty, D.C., 'Advanced Introduction to U.S. Environmental Law,' (2021) Cheltenham, UK: Edward Elgar Publishing, <<https://doi.org/10.4337/9781800374898>>.

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topped 12.4 million barrels per day, with more than 50 million Americans living in counties with oil and gas production facilities. The U.S. Oil Pollution Act ensures an effective clean-up exercise for polluted areas. Even though OPA is thirty-three years old, the standards in the act remain strong in ensuring the prevention, remediation, clean-up, and punishment of oil spills. The act came at a time oil spills were rife in the U.S. Although there are some other countries with fair models that could be copied, however, their legal and governmental structures are different from what exists in Nigeria.

This U.S. oil pollution legal framework is an excellent approach to confronting the oil spill menace Nigeria is irretrievably embroiled in. A careful consideration of the current situation in Nigeria reveals that it is currently facing the pre-1990 situation in the United States and that she (Nigeria) lacks presently the standards enacted in the Oil Pollution Act of 1990. The significant provisions in the U.S. Oil Pollution Act are highlighted below.

7.1 The Existence of a Contingency Plan (Oil Spill Liability Trust Fund)

After every spill, one pertinent question ensues: who pays for this? Of course, the polluter must pay for it (clean-up, response and restoration)⁵³. However, polluters scarcely take responsibility for clean-up and damages. Moreover, the assessment of environmental damage to these communities could take many years to complete. In a bid to ensure a prompt response, the U.S. Federal Government set up an immediate source of funding for federal and state agencies. This source is called the "Oil Spill Liability Trust."⁵⁴ The fund can provide up to \$1 billion for an oil incident. Even though jurisdictions do not wait for the polluter to clean up before their levels of government swing into action, if the polluter is ultimately deemed liable for the spill, they must reimburse all expenses to the Federal Government.⁵⁵

The Act provides for adequate federal resources that will be available to respond to oil spills, i.e., clean-up of the site and damages. The U.S. President, acting either through the Environmental Protection Agency (EPA) or the U.S. Coast Guard, can perform the immediate clean-up⁵⁶. This is referred to as "federalizing" the spill. This prevents undue delay while waiting for the spiller to deploy its clean-up forces. The fund is also available to pay claims for damages resulting from oil discharge that exceed the responsible party's liability limits. In addition, the oil spill liability trust fund will be utilized if a polluter cannot be found, is unknown, unwilling, or unable, or if the polluter has reached his limit under the law.

⁵³ Russell V. Randle, *Oil Pollution Deskbook* (2nd ed. 2012).

⁵⁴ S. 9001 OPA, 26 U.S.C.A. S.9509

⁵⁵ S. 1001L (31) of OPA, (33 U.S.C 2701)

⁵⁶ S. 4201 of OPA

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7.2 The Concurrent Operation of State and Federal Laws (Non-Preemption of State Laws)

The Oil Pollution Act (OPA) did not pre-empt state laws. Individual states may impose additional liability (including unlimited liability), funding mechanisms, requirements for removal actions, and penalties for responsible parties in addition to those prescribed for the Federal Government by the Act⁵⁷. As a result of this, several states have enacted laws covering oil spill-related incidents.⁵⁸ For instance, the Alaska Administration Code, amongst many other state laws, provides that, except if pre-empted by Federal Law, specific requirements apply to each facility or operation for which an approved oil discharge prevention and contingency plan is required.⁵⁹ This State Code also mandates owners and operators to provide security measures and surveillance appropriate to each component of their operations to minimize the risk of vandalism, sabotage, and unauthorized entry.⁶⁰ In California, Lempert-Keene-Seastrand Oil Spill Prevention and Response Act makes provisions to prevent oil spills. And very recently, the governor signed a bill that increased criminal penalties for oil spill-related offenses. A California state court must now impose a fine of between US\$ 10,000 and US\$ 1,000,000. Again, for spills over 1,000, the court is permitted to impose an additional fine of up to \$1,000 per gallon spilled. According to the OPA, states are afforded federal funds (up to US\$ 250,000 per incident) for the immediate removal, mitigation, or prevention of a discharge. They can also be reimbursed for later-incurred costs.⁶¹

7.3 Higher Liability Limit for Responsible Parties

In the United States, there is an established liability scheme for various degrees and volumes of oil spilled by any facility or vessel owner. The Oil Pollution Act of the U.S. makes for a radical provision for the U.S. Government to establish liability against a party responsible for causing an oil spill or contributing to the action. If a party is responsible for an oil spill, such party would be liable for the removal costs and damages. The removal costs include all costs incurred by the United States, the responsible party, or any other person for any acts done by them. In addition, "Damages" include injury to natural resources, loss of real or personal property, loss of subsistence use of natural resources, loss of revenues resulting from destruction of property or natural resource injury, lost profit and earning capacity resulting from property injury or natural resource injury, and cost of providing extra public services during and after spill response.⁶²

⁵⁷ Section 1018 of OPA

⁵⁸ Morgan, J.D., 'The Oil Pollution Act of 1990', (2011) 6 (1) *Fordham Envtl. L. Rev.* 5 <<https://ir.lawnet.fordham.edu/elr/vol6/iss1/5>>, accessed 10 August 2023.

⁵⁹ Title 18 Chapter 75 Article 1 Alaska Administrative Code, 18 AAC 75. 007. *General Oil Pollution Prevention Requirement*

⁶⁰ *Ibid.*

⁶¹ Section 1019 of OPA

⁶² Section 1002 of OPA

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Furthermore, the Oil Pollution Act places strict liability on the party responsible for the spill⁶³. A claimant, i.e., a victim of an oil spill, only needs to prove that he relies on the polluted environment for his livelihood.⁶⁴ However, a responsible party will not be liable if they can prove that the cause of discharge was an act of God, an act of war, or an act/omission of a third party⁶⁵.

The liability limit for responsible parties at onshore facilities and deepwater ports is up to US\$ 350 million per spill. In comparison, holders of permits for offshore facilities are liable for up to US\$ 75 million per spill plus removal costs. Further, the liability for tank vessels larger than 3,000 gross tons is US\$ 1,200 per gross ton or \$10 million, whichever is higher.⁶⁶ This higher legal liability under the Oil Pollution Act motivated the oil industry to respond more effectively to future oil spills.⁶⁷

7.4 Punitive Measures Against Oil Discharge (Tougher Criminal Penalties and Higher Civil Penalties)

In the United States, failure to notify the appropriate federal agency of a discharge or spill of oil carries a maximum fine of US\$ 250,000 and US\$ 500,000 for an individual and organization, respectively, and 15 years in prison upon conviction⁶⁸. However, this is only applicable for 'knowing endangerment,' i.e., a violation that places another person in imminent danger of death or serious bodily injury. A negligible violation carries a fine of US\$ 25,000 and one year of imprisonment, while an intentional violation carries a fine of US\$ 50,000 and a term of imprisonment not exceeding three years.⁶⁹ In addition, if a responsible party notified the appropriate authority but failed to conduct a removal action ordered under the Oil Pollution Act or for failure to comply with such an order, the court can assess a civil penalty of up to US\$ 25,000 per day for the non-conduct of the cleanup or removal exercise.⁷⁰

7.5 Adequate Planning and Prevention (Formidable Spill Prevention and Control for All Oil Facilities)

The Oil Pollution Act, in a bid to ensure adequate planning and prevention against oil spill incidences, mandates periodic inspections of oil facilities and vessels and the development of response plans for worst-case discharges.⁷¹ There are two federal response agencies responsible for

⁶³ Morgan, J.D., 'The Oil Pollution Act of 1990', (2011) 6 (1) *Fordham Env'tl. L. Rev.* 5 <<https://ir.lawnet.fordham.edu/elr/vol6/iss1/5>>, accessed 10 August 2023.

⁶⁴ Olugbenga, T., Owolabi, S., and Okonkwo, E.C., 'Compensation for Environmental Pollution and Justice Procurement in the Niger Delta Area of Nigeria: The Mass Media Role', (2014) 16 (7) *Journal of Sustainable Development in Africa*. <<https://api.semanticscholar.org/CorpusID:110384194>>, accessed 10 August 2023.

⁶⁵ Section 1003(a)(3) of OPA

⁶⁶ Sec. 1004 of OPA

⁶⁷ Elliot, E.D., and Esty, D.C., 'Advanced Introduction to U.S. Environmental Law,' (2021) Cheltenham, UK: Edward Elgar Publishing <<https://doi.org/10.4337/9781800374898>>.

⁶⁸ Section 4301(a) & (c) of OPA

⁶⁹ Ibid

⁷⁰ Section 4301(b) of OPA

⁷¹ Section 4202 of the OPA

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preventing and responding to oil spills in the U.S.: the Environmental Protection Agency (EPA) and the U.S. Coast Guard. While the EPA is the lead federal response agency for oil spills occurring in inland waters or adjacent shorelines, the U.S. Coast Guard is the lead federal agency for spills in coastal waters and deepwater ports. Title IV of the Oil Pollution Act contains numerous provisions for preventing oil pollution in the U.S. For instance, the U.S. Coast Guard must apply stricter standards and procedures for issuing and renewing licenses.⁷² Oil companies in the United States must have oil spill control measures and an emergency response plan, which must be filed with the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) and the US Coast Guard, respectively.⁷³ That is, vessels and facilities are prohibited from handling, storing, or transporting oil if they do not have a plan approved by these agencies.⁷⁴

On its part, the EPA has an emergency response program that allows it to swing into action immediately after a spill occurs. It either conducts the removal action, i.e., clean-up, by funding the response actions directly or oversees removal actions undertaken by other parties.⁷⁵ The agency's oil spill prevention program comprises Spill Prevention, Control, and Countermeasure (SPCC). The program has reduced the number of spills to less than 1% of the total volume of oil handled each year.⁷⁶ Furthermore, to prevent future oil spills, the SPCC rules mandate that all oil facilities have an SPCC plan. Such plans include periodic inspections and equipment testing, using suitable equipment and pipeline, etc. The Oil Pollution Act also requires all new vessels built for oil transportation to be equipped with a double hull when operating in the U.S.⁷⁷

8. THE LEGAL SYSTEM AND OIL GOVERNANCE IN NIGERIA AND U.S.

Both countries practice Bicameralism, which is the operation of two legislative houses. The similarity in the form of government in both countries makes a model easily transferable from one country to another. Countries within the European Union, Canada, and Australia all practice the parliamentary system of governance. Thus, a developing country like Nigeria might not be fully suited to copy from such a legal and political system.

There exist numerous differences in the governance framework of oil and gas between the United States and Nigeria. In the U.S., it is easy for

⁷² 46 U.S.C.A.S. 7503 and 7701-7704.

⁷³ S. 4202 of OPA

⁷⁴ Congressional Research Service, 'Oil Spills: Background and Governance' (2017) Congressional Research Service <<https://www.crs.gov>>, accessed 20 August 2023.

⁷⁵ United States Environmental Protection Agency, 'EPA's Role in Emergency Response' 6 June 2023 <www.epa.gov/emergency-response/epas-role-emergency-response>, accessed 20 June 2023.

⁷⁶ United States Environmental Protection Agency, 'Basic Information about Cleanups', <www.epa.gov/cleanups/basic-information-about-cleanups#oil> accessed 20 March 2023.

⁷⁷ S. 4115 of OPA

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the government to recoup back any amount it takes out of the contingency funds to fund an oil spill because of the functioning legal system. The responsible parties can be held to refund such amounts by the U.S. Courts. However, such an effort to recover those amounts might be complicated in Nigeria because of the prevalence corruption of in the Nigerian judiciary. Corruption coupled with maladministration in the country might hamper the effectiveness of the implementation of the U.S. model in Nigeria. Similarly, in the U.S., the dominant model is private ownership of oil and gas. The exploration and production of oil and gas are typically done via an oil and gas lease between the landowner (lessor) and an oil company (lessee). This is in stark contrast to what is obtainable in Nigeria, where the Federal Government owns all the lands and resources, including oil.

Lastly, the United States has gradually begun to transition to non-renewable energy resources, while Nigeria is still heavily reliant and keeps investing in the development of oil and gas.

9. THE PROPOSED NEW STANDARD

The current predicament faced by Nigeria can be likened to the situation in the U.S. before the enactment of the Oil Pollution Act in 1990. The U.S. at that time had no adequate or formidable preventive measures in place; the criminal and civil penalties were very lenient; there was no availability of funds or trusts for clean-up activities, there was no standing liability limit, and there was no mandate on the federal government to carry out the immediate cleanup. The fragmented collection of laws with limited safeguards for oil spill incidences was the situation in the U.S. before the enactment of the Oil Pollution Act of 1990. The legislation includes the Clean Water Act of 1972, the Ports and Waterways Safety Act of 1972, the Trans-Alaska Pipeline Authorization Act of 1973, the Deep-Water Port Act of 1974 and the Outer Continental Shelf Land Act of 1978. There has been a significant reduction in oil spills in the U.S. due to the Oil Pollution Act, which results from increased governance in regulating the oil industry.⁷⁸ This improvement was immediately seen four years after the passage of the Act. In 1994, Morris J. Berman discharged 750,000 gallons of heavy oil off the coast of Puerto Rico, and within 24 hours of the spill, containment equipment and personnel were already on site.⁷⁹

To address the current weak regulatory framework on oil spills in Nigeria, such as the pre-emption of state laws, the lack of a contingency plan, the lack of a liability scheme for responsible parties, etc., the following must be urgently considered.

First, the provision in the Nigerian Constitution that gives exclusive jurisdiction on oil and gas-related matters to the federal government, thereby, excluding state governments from exercising jurisdiction either

⁷⁸ Bender, P., 'Lawmakers Question Coast Guard on Safety of Oil Tankers', Gannett News Serv., Feb. 17, 1993.

⁷⁹ Morgan, J.D., 'The Oil Pollution Act of 1990', (2011) 6 (1) Fordham Env'tl. L. Rev. 5 <<https://ir.lawnet.fordham.edu/elr/vol6/iss1/5>>, accessed 10 August 2023.

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through law-making or enforcement activities, must be amended so that oil and gas matters in Nigeria are placed on the concurrent list in the constitution. And while the Federal Government may exercise broad authority, States should also be allowed to make and enforce legislation on “oil and gas” on such matters as preventing and controlling oil pollution.

Generally, there exist some mechanisms for constitutional change. Nigeria like many other countries that operates Federalism has a rigid Constitution.⁸⁰ The authority to amend the Constitution is contained in Section 9 of the 1999 Constitution which provides that an amendment may be proposed with a two-thirds majority vote in both the Senate and the House of Representatives, respectively, and subsequently approved by a resolution of the Houses of Assembly of not less than two-thirds of all the States. However, there exist some factors that might hinder the amendment of the Constitution to allow States to exercise authority over the oil and gas sector. For instance, the competition for the control of power and resources by all levels of government is a worrisome issue. The Federal Legislature lacks the resolute to do what wouldn't be in the interest of the executive; hence, an amendment to give state governments authority to regulate oil and gas would not seem to be in the interest of the Executive. Additionally, because corruption is so rife in Nigeria, stakeholders in the oil industries, like the oil companies, would lobby against such an amendment. Another problematic issue is the slow operation of the Legislative houses. Such amendment might not be concluded in the four years tenure of the Legislative houses.

Given the importance of oil to the Nigerian economy, the Executive and the Legislature can dutifully harmonize and strategize a straightforward and timely amendment of the Constitution. These branches of government just started a new dispensation; hence a strong determination could see a successful amendment between 2023 and 2027. The Constitution should be responsive to the socio-economic demands of the country. Moreover, to ensure a comprehensive legal framework, this paper will propose enacting an Oil Spill Control Act by the Nigerian Legislature, which will harmonize all existing laws governing oil pollution in Nigeria. For this new framework to be adequate, the following standards must be enacted into a new law, or the existing legislation must be amended to accommodate them as new provisions.

9.1 Creation of an Oil Spill Liability Trust Fund as a Contingency Plan

The Federal Government in Nigeria should set up a trust fund to immediately clean up oil spill-impacted sites. This will ensure the immediate containment and clean-up of oil spills before they spread into a larger environment. The proposed fund must be adequate for ensuring effective clean-up operations. An amount above US\$ 1 billion should be sufficient. Likewise, the fund must be available for state governments to utilize for clean-up activities. If such a trust fund is created for use in

⁸⁰ Okpanachi, E., and Garba, A., ‘Federalism and Constitutional Change in Nigeria’, (2010) 7(1) Federal Governance <<https://doi.org/10.24908/fg.v7i1.4388>>.

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Nigeria, the appropriate federal and state agencies would be able to address an oil spill incident promptly.

9.2 No Pre-Emption of State Laws

A somewhat inimical provision to the environment in the Nigerian Constitution is the shackling of state and local governments from exercising any authority on oil matters.⁸¹ The provision has deterred state governments from putting up measures to prepare for, prevent, and perform immediate clean-up exercises on impacted sites. This provision of the constitution⁸² has rendered States powerless in imposing liabilities, fines, and penalties against responsible parties. It has stifled their ability to enact laws covering oil-related incidents.

Taking a cursory look at the U.S. standards, the Nigerian Constitution should be amended, mainly, Schedule II, to provide for concurrent jurisdiction of the Federal Government and the State Governments on oil-related matters. This would enable the State Government, in addition to the Federal Government's efforts, to perform or order immediate clean-up of impacted sites, impose fines and penalties on responsible parties, and define a liability limit for responsible parties.

9.3 Creation of a Liability Scheme

The legal framework in Nigeria does not provide for a liability scheme nor limits for responsible parties in oil spill incidences. However, oil companies must perform clean-up operations on oil spill-impacted sites to all practicable extents.⁸³ The phrase 'all practicable extent' is discretionary and allows for flexibility. It is distinguishable from a term like "to the fullest extent possible." No Nigerian law stipulates what a party's liability should be when they cause an oil spill. On the other hand, the liability provision in the U.S. spells out the liability standards⁸⁴, the amount of liability (liability limits), and the responsible parties⁸⁵.

However, it is necessary at this juncture to clarify who a responsible party is in both Jurisdictions and distinguish between them. In the U.S., 'responsible parties' are oil companies, i.e. (facility owners and vessel owners); in Nigeria, responsible parties could be oil companies, oil thieves, or oil saboteurs. So, looking at the U.S. standard, Nigeria should enact new legislation that would contain provisions for the minimum and maximum amount to be paid by Oil Companies in the event of an oil spill. This would ensure that a proper and adequate clean-up operation is done immediately on the impacted site and that affected parties get the necessary damages. This liability limit would also provide an established liability scheme for various degrees and volumes of oil spilled by Oil Companies.

⁸¹ Schedule II, Part I, Item 39 of the 1999 Constitution of the Federal Republic of Nigeria

⁸² Ibid

⁸³ S. 6(2) NOSDRA Act.

⁸⁴ Section 1004 of the OPA.

⁸⁵ Section 1003 (a)(3) of the OPA.

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On the other hand, it is difficult to establish a liability scheme for Oil Thieves and Saboteurs. The reason for this is the differences in the financial strengths of each person or group. Therefore, in addition to the already prescribed stringent punitive measure by the Petroleum Production and Distribution (Anti-Sabotage) Act, Oil thieves and Saboteurs should be made to pay the total clean-up cost of the impacted sites.

9.4 Stringent Punitive Measures

An interesting phenomenon about oil spill governance in Nigeria is that despite the shoddiness of existing laws in preventing and combating oil spills, one piece of legislation punishes oil theft and sabotage, i.e., the Petroleum Production and Distribution (Anti-Sabotage) Act. It defines the offense of sabotage and prescribes an adequate penalty for a guilty party, i.e., the death penalty or a term of up to 21 years. However, this provision has not deterred oil thieves and saboteurs from engaging in acts that cause an oil spill. Similarly, Nigeria is in the same class as countries like Azerbaijan, Thailand, and Mexico, which are battling oil theft and sabotage issues. Mexico recently enacted a stringent law like that of Nigeria to prevent oil theft. However, it has an additional provision for public officials who fail to report oil thefts. Such officials, if found guilty, will spend 5 years behind the bars. The act of oil theft is known as “Huachicoleo” in Mexico, while in Nigeria, it is called oil bunkering.

The lack of stringent deterrent actions against responsible parties for oil spills has been the primary cause of the daily occurrences of oil spills in Nigeria. The U.S. Oil Pollution Act stipulates harsh penalties for various violations.⁸⁶ A responsible party for an oil spill incident that places another person in imminent danger of death or bodily injury or who fails to notify the appropriate federal agency is liable for a fine of US\$ 250,000 and a term of imprisonment up to 15 years. This measure is stringent for two reasons: it prevents oil spills by prescribing a penalty of bigger fines and lengthy jail time and prescribes further penalties for failing to report or disclose an oil spill incident to the appropriate authority.

Looking at the U.S. standard, Nigeria should enact legislation creating penalties for oil spills by any party. It should also embody stringent provisions sanctioning other offenses arising from oil spill incidents, such as a lack of a preventive plan, failure to report an oil spill immediately, an inadequate cleanup exercise, insufficient remediation, etc.

9.5 Oil Spill Prevention, Preparation, Detection, and Response

Although NOSDRA (the National Oil Spill Detection and Response Agency) was created to detect and respond to oil spills in Nigeria, the agency is not mandated with the responsibility of preventing and preparing for oil spills. Whilst they may attempt to operate in detecting and responding to oil spills, they lack the resources to immediately perform clean-up operations of oil spills, as Nigeria currently does not

⁸⁶ Section 4301 (a)(b)(c) of the OPA

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have a workable Federal Thrust Fund from which they could access funds for immediate clean-up.

In the U.S., the Environmental Protection Agency (EPA) and the U.S. Coast Guard are federal agencies mandated with the prevention, preparation, detection, and response to oil spills. Looking at the U.S. Standard, lawmakers in Nigeria should also expand the authority of NOSDRA to include the prevention and preparation of oil spills. Also, a federal trust fund should be created to enable them to access funds for immediate clean-ups of impacted sites.

10. CONCLUSION

This paper set out to examine the legal framework governing oil spills in Nigeria by critically assessing each of the relevant laws to see whether they contain the standards needed to ensure the right of members of the Niger Delta communities to healthy environments. This paper found that the existing legislation needs to be more robust and adequate as it needs the standards to curb and control oil spill incidences. The paper then considered the U.S. model and highlighted the importance of each contained standard.

Evidently, Nigeria needs a comprehensive, radical, and thorough effort to resolve the difficult legal and self-inflicted issues that have hobbled effective oil spill prevention, cleanup, and remedial efforts. To get this done, the Federal Government should adopt some U.S. standards. Although it is too early to predict if it will work out well, the new standard will provide a solid legal foundation to curb or reduce oil spill incidences in Nigeria to the barest minimum.

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AUTHOR'S DECLARATION AND ESSENTIAL ETHICAL COMPLIANCES

Author's Contributions (in accordance with ICMJE criteria for authorship)

This article is 100% contributed by the sole author. S/he conceived and designed the research or analysis, collected the data, contributed to data analysis & interpretation, wrote the article, performed critical revision of the article/paper, edited the article, and supervised and administered the field work.

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Research involving human bodies or organs or tissues (Helsinki Declaration)

The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not a clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

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(Optional) Research Involving Local Community Participants (Non-Indigenous)

The author(s) solemnly declare(s) that this research has not directly involved any local community participants or respondents belonging to non-Indigenous peoples. Neither this study involved any child in any form directly. The contexts of different humans, people, populations, men/women/children and ethnic people are only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

(Optional) PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

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To see original copy of these declarations signed by Corresponding/First Author (on behalf of other co-authors too), please download associated zip folder [Ethical Declarations] from the published Abstract page accessible through and linked with the DOI: <https://doi.org/10.33002/jelp03.02.02>.

RECONCILING THE DUAL WORLDVIEWS OF ANCIENT WISDOM AND MODERNITY: COLLABORATIVE-LEARNING IMPLICATIONS FOR FUTURE DISCOURSE

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ABSTRACT

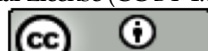
Science, climate change and traditional (or local) knowledge have been at the forefront of many academic and non-academic debates attempting to find discernible or explainable commonalities that exist between opposing worldviews (traditional knowledge/indigenous science vs. Western or Eurocentric Science). Ancient wisdom and modernity have seen their share of controversies over the past decade or more and, in particular, attended by many authors and scientists to explore these two important perspectives. This paper attempts to situate traditional knowledge and modern science by exploring the duality of ancient wisdom and modernity, and, in doing so, creates a better understanding of the importance of these opposing worldviews and how science ancient wisdom and technology/modernism can be interpreted and understood. The paper further explores meaningful interdisciplinary perspectives on how to explain coincidental relationships, components of bridging traditional knowledge/local knowledge (TK/LK) and transforming the compartmentalized view of science within a more holistic understanding of traditional ways of knowing. Lastly, merging Western or Eurocentric Sciences with Traditional Science has important policy implications that justify social-legitimacy through collaborative learning (CL) and integrating system thinking and conflict management.

Keywords: Traditional knowledge; Climate change; Modernity; Indigenous science; Worldviews

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1. INTRODUCTION

Humans have evolved on Earth for more than 8 million years. Historians have described behaviour of *Homo sapiens* in terms of their abilities to rationalize thoughts, make decisions and exercise their instincts to survive, adapt and reproduce in harsh or inhospitable conditions through the process of built-resilience and traditional or local knowledge (TK/LK). This seems to be the case wherever they have occupied lands on islands, continents, coastline, or travelled on oceans or navigating rivers. Men, women, families, and communities in many parts of the world have always culturally framed their existence on their ability to integrate or intertwine with our natural world; both spiritually and ecologically. This is because of human's cognitive and non-cognitive abilities to explore, rationalize, search for solutions, and build on practices and belief systems that are reflected in traditional or local knowledge (TK/LK). This TK/LK contains the true (mirror-image) or reflection of culture that is embedded with the land and language (pillars of identify for many Indigenous cultures). Humans have always had an intrinsic ability to adapt (and to eventually adopt) to change and have successfully and unsuccessfully done this in many of the modern advancements in science, technology, innovation. But, there is a 'price to pay' for this anthropogenic advancement or 'modernization' process. Many impacts have been seen in current generation, but these have much more profound effects on future generations. Humans themselves have intensively changed cultural landscapes and traditions, and, today, many languages and cultures are disappearing along with altering pristine ecosystems, oceans, rivers, and overfishing, over-exploration, or exploitation of resources to the point of species extinction. A legacy of maladaptation seems to supersede our abilities to support and recover cultures, societies, and ecosystems. Climate change (more recently) is 'taking the blame' for anthropogenic and ecologically-induced impacts.

According to the Indigenous Food Systems Network:¹

"The impacts of climate change on Indigenous communities are significant. The cultures that support TK around the world are often living in marginal ecosystems, such as the Arctic, mountains, deserts, and small islands. These marginal ecosystems are often the sources of key ecosystem services (e.g., role of mountain ranges in sustaining water balance) and are critical for maintaining the overall resilience and adaptive capacity of social-ecological systems are most vulnerable to climate change and will suffer the greatest change often for the worse as a result of climate change (p.1)."

Indigenous peoples' TK or local knowledge is proving critically valuable service to the global community². Sentinel like warning systems

¹ Indigenous Food Systems Network. Indigenous Peoples' Biocultural Climate Change Assessment Initiative (2014). <<https://www.indigenousfoodsystems.org/content/indigenous-peoples-biocultural-climate-change-assessment-initiative>> accessed on 12 May 2023.

² Ibid

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for climate change are based on practical observations, oral histories/narratives, beliefs, ways of knowing, songs, dances, and rituals of social, cultural and ecosystem change by Indigenous peoples. TK/LK is regarded as a traditional science because it is empirical, based on observation and

*"More importantly, the long-term place-based adaptation approaches developed by indigenous peoples provide valuable examples for the global community of low-carbon sustainable lifestyle, critical to developing local adaptations strategies in the face of climate instability. For example, the Inuvialuit of Northern Canada have observed delays in the autumn freeze, and changing sea ice distribution. Changes in sea ice distribution in turn alter the habitation patterns of seals. Such ecological observations are informing scientists and form part of the science base of studies such as the Arctic Climate Impact Assessment (ACIA) "*³ (para 3).

The TK/LK and climate change seem to be paradoxically-opposing concepts, but intimately linked via cultures, languages, traditions, belief systems and ways-of-knowing and doing. The only thing that is separating these from being understood in general context, is opposing worldviews, and how traditional knowledge differentiates from other kinds of sciences, or how traditional ways of knowing are not seen within the same context as Eurocentric or western science. The author describes this in more detail in terms of comprehending the breadth of understanding of Indigenous peoples and non-Indigenous western scientists the world over, with the intended audience being natural resource managers, scientists/academics, and traditional knowledge practitioners. One way to approach this (at least in terms of how natural resource managers confront these divergent worldviews) is the creation of a social legitimacy processes through collaborative learning and systems-thinking approaches. These processes can often be validated through transfer of oral and written "ways of knowing," even when there are divergent world views.

The aim of this research paper is to explore the intersection of science, climate change, and traditional knowledge, focusing on the contrasting worldviews of traditional knowledge/indigenous science and Western/Eurocentric Science. By examining the coexistence of ancient wisdom and modernity, the paper seeks to enhance comprehension of the significance of these divergent perspectives and their interpretation of science, technology, and modernism. Through an interdisciplinary approach, the paper aims to uncover connections between these worldviews, bridge the gap between traditional knowledge or local knowledge (TK/LK) and conventional scientific paradigms, and promote a more holistic understanding of traditional ways of knowing. Furthermore, the research will investigate the policy implications of merging western and traditional sciences, emphasizing collaborative learning (CL), systems thinking, and conflict resolution as means to achieve social legitimacy and advancement.

³ Ibid

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2. METHODS

This review was conducted through the use of a qualitative scoping review in addition to an in-depth online literature search. As part of this process, a preliminary assessment of the available literature on a specific subject was carried out with the intention of determining the breadth of the literature, its most important concepts, and the areas where additional research is needed. On the topic of traditional ecological knowledge and climate change, particular literature was gathered by searching electronic databases (e.g. Canadian Centre for Climate Services, IPCC AR6 (6th Assessment Report), NOAA, Australian Climate Change Centre, Climate Change Adaptation, LK data and documents (reports, peer reviewed journals, and theses). An additional literature review and search of studies on policy issues and health due to climate impacts and extreme events, global policy research, LK research and policy implications, loss, and damage and at risks settlements was also done. This search included pertinent literature from The University of the South Pacific (USP), Fiji National University (FNU), The University of Fiji (UniFiji), University of British Columbia (UBC Vancouver, UBC Okanagan), Thompson River University Kamloops Library, LK literature searches worldwide, and the Web of Science database that focused on intergenerational trauma, IRS, climate change adaptation and resilience studies. After that, the information gleaned from the literature review and the qualitative scoping review was subjected to thematic coding with the help of the Nvivo qualitative analysis software. The research covered a wide range of topics, including traditional knowledge, ancient wisdom, folk biology, climate change, environmental law, policy and governance, collaborative learning, climate change impacts and vulnerabilities within the context of numerous communities and socio-cultural circumstances on a global scale.

The results of the review provided a comprehensive and systematic search strategy to identify all relevant literature, using an integrative or critical review approach, to evaluate, critique, and synthesize the literature on a research topic in a way that makes it possible for new theoretical frameworks and perspectives to emerge. The purpose of this review is to create initial or preliminary conceptualizations and theoretical models of developing or novel conceptual or theoretical insights. This article explores the difference between ancient wisdom and modernity places traditional knowledge and modern science in their proper place to help the reader understand how important these two different worldviews are and how science, ancient wisdom, and technology/modernism can be understood and interpreted. The paper also brings to the forefront different conceptual or theoretical fields that can help us understand how coincidences happen, how to connect traditional knowledge with local knowledge (TK/LK), and how to use science to fully understand traditional ways of knowing.

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3. ANCIENT WISDOM AND WAYS OF KNOWING

Ancient wisdom or 'ancient ways of knowing' is not only sacred but embedded within ancestral power given to those who are ready to receive or use it. This wisdom is the spirit of knowledge that is passed down through the generations often considered sacred and is generated from knowledge handed down through the generations. The wisdom of nature and its surroundings is where Indigenous epistemologies are born. The author believes that this wisdom is a valuable tool, specific to more place-based cultures and languages but it differs in the kind of wisdom we are looking for human intentions. In balance of the nature affected the acquisition of wisdom as the land and its quintessential elements or components have been altered along with what Woodley (2002) describes as being a cognizant model of complex changes in time and space that influence TK/LK (p.11). This authors' view centres in the acquisition and transfer of knowledge and incorporates the continuum of factual and tacit or implicit knowledge (p.22). This continuum can be envisioned as an ongoing force that is intertwined with all human interactions with their environment. This has important implications, particularly with respect to climate change and how would his recognition of these types of knowledge models, helps us explain (from the Indigenous perspective), how these changes can be interpreted. The "traditional system" as Woodley (2002) calls it, that works in the past is synthesized through a cycle of knowledge acquisition supported by inter/intra relationships among context, practices, and belief systems, particular to Indigenous or cultural groups. What is more important, perhaps, is the process of knowledge construction (guided by the experimental and place-based knowledge which is intimately guided by cultural belief systems where wisdom emerges (p.22).

Hoffman (2006) equates as well. The same philosophy in that wisdom is something that is only witnessed in the presence of gifted elders (p.198). Many Indigenous cultures rely on ancient ways of knowing to explain the present, and how this relationship overlaps with other cultures in different tropical or subtropical regions. Indigenous cultures in Northern Europe, Canada, USA and other regions display many variations in ancient wisdom (depending on the culture and language spoken), but a common denominator exists. Most ancient ways of knowing or wisdom are in unique to place and space. In other words, ancient ways of knowing are specific to the Indigenous tribe, groups, community, or peoples themselves and is as diverse as individual identity.

According to Ancient Wisdom Greek mythology had an explanation for Gaia. It was the primordial Earth-Goddess from whom all life sprang, similar Earth Goddess figures are found in most cultures around the ancient world. In the 1970s, James Lovelock (2009) re-introduced the Earth-Mother concept through the medium of Ecology⁴. He proposed that all

⁴ Lovelock, J., 'The Vanishing Face of Gaia'. Basic Books (2009), p.163. ISBN 978-0-465-01549-8.

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living things are interrelated within the self-regulating systems of the earth, which provides the optimal conditions to support life itself. The 'Gaia' theory has struck a chord in the modern mind and has become a philosophy. In 2008, Lovelock made public his belief that human behaviour has already tipped the scales, and that we are now fast approaching an unprecedented global catastrophe. The same author describes ancient cultures around the world have attested to a belief in a

'female'
mother or
Earth".

earth-
"Mother



Figure 1: Earth mother earth symbol (Source: <<http://www.ancient-wisdom.co.uk/earthmother.htm>>)

Burials placed the bodies back into the ground in a foetal position, and covered the bones in red ochre, supporting the idea of a belief system that considered us as 'returning' to the earth-mother in death (Figure 1).



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Figure 2: Tree of Life⁵



Figure 3: Artistic depiction of Tree-lore⁶

3.1 Tree Lore (Sacred Trees)

According to the University of Strathclyde (Glasgow)⁷:

“trees offer us mystical connection to our spirituality and play an important role in many mythologies and religions. In ancient traditions all over the world, the tree is a symbol of life itself, representing the totality of a universe in which everything is imbued with spirit. Ancient Celts, for example, planted a tree wherever new communities were established, to provide shelter, food, and medicine, and considered trees to be sacred. The Tree of Life represents harmony and balance in nature, rebirth, and a connection of the earthly and the spiritual. Trees are symbols of strength, individuality and expression, calmness, growth, and the interconnectedness of everything. These are values and concepts which we aim to reflect in our chaplaincy. The colors in our chaplaincy trees also represent inclusion and joy” (p.1).

Ancient Wisdom⁸ also describes “tree lore” as an ancient school of knowledge with roots stretching back into our earliest symbolic imaginations. The Tree is a common universal, archetypal symbol that can

⁵ Eldridge, S., ‘tree of life’. Encyclopedia Britannica, 10 Aug. 2023, <<https://www.britannica.com/topic/tree-of-life-religion>> accessed 7 August 2023.

⁶ Snively, G., Wanost’sa & Lorna Williams, “Chapter 1 – Braiding Indigenous Science with Western Science. In: Knowing Home: Braiding Indigenous Science with Western Science” (2018), Gloria Snively, Wanost’sa & Lorna Williams. <<https://ecampusontario.pressbooks.pub/knowinghome2/>> accessed 7 August 2023.

⁷ University of Strathclyde., ‘Why our symbol is a tree’ (2023). <<https://www.strath.ac.uk/studywithus/ourcampus/whatsoncampus/faithspiritualitysupport/whyoursymbolisatree/#:~:text=Trees%20offer%20us%20mystical%20connection,everything%20is%20imbued%20with%20spirit>> accessed 7 August 2023.

⁸ Ibid. Ancient Wisdom (2024) at supra note 3.

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be found in many different traditions around the ancient world. Trees are symbols of physical and spiritual nourishment, transformation and liberation, sustenance, spiritual growth, union, and fertility. The tree is a spiritual motif and framework, a map of conception and consciousness that brings together the temporal worlds of time, space, and consciousness. Trees are the places of birth and death; they are used as sacred shrines and places of spiritual pilgrimage, ritual, ceremony, and celebration (Graves (1961)⁹).

Sacred trees are found in the Shamanic, Hindu, Egyptian, Sumerian, Toltec, Mayan, Norse, Celtic and Christian traditions. The World-tree is described in The Upanishads as “a tree eternally existing, its roots aloft, and its branches spreading below.” How does this relate to TEK/LK and Western Science integration or overlap? The metaphorical “Braiding” of Indigenous Science and Western Science¹⁰ can be used to establish a particular relationship, or “obligation” to give, to receive, and to reciprocate and to learn or appropriate this knowledge. For example, in the First Nations communities in coastal pacific regions of Western Canada, tribes braided cedar bark to make beautiful baskets, bracelets, and blankets. Another analogy is when braiding hair, kindness and love can flow between the braids and often colours are intertwined to represent the seasons and lasting relations (all our ancestral relations).

Accordingly, braiding¹¹ is linked to certain reciprocity amongst strands, all the strands hold together. Each strand remains a separate entity, a certain tension is required, but all strands come together to form the whole. When we braid Indigenous Science (IS) with Western Science (WS) we acknowledge that both ways of knowing are legitimate forms of knowledge. For Indigenous peoples, Indigenous Knowledge (Indigenous Science) is a gift. It cannot be simply bought and sold. Certain obligations are attached. The more something is shared, the greater becomes its value¹². These commonalities exist across many Indigenous cultures and peoples.

4. INDIGENOUS SCIENCE AND A “COMMON GROUND’ PERSPECTIVE

If we take the tree-lore and braiding example and expand upon this, we can describe this as "Indigenous Science" (IS) or traditional native knowledge (Figure 3) refers to the scientific knowledge of all peoples who, as participants in culture, are influenced by the worldview and interests of their home communities and homelands. According to Ogawa's (1995) theory¹³, each culture possesses its own science, which he calls the

⁹ Graves, R., 'The White Goddess', pp 61, 123, Faber & Faber, London (1961). Ogham and Tree-lore. <<http://www.ancient-wisdom.com/treelore.htm#oghambooklore>> accessed 23 June 2023.

¹⁰ Snively, G., Wanost'sa & Lorna Williams, “Chapter 1 – Braiding Indigenous Science with Western Science. In: Knowing Home: Braiding Indigenous Science with Western Science” (2018), Gloria Snively, Wanost'sa & Lorna Williams. <<https://ecampusontario.pressbooks.pub/knowinghome2/>> accessed 7 August 2023.

¹¹ Ibid n.1.

¹² Ibid n.1.

¹³ Ogawa, M., ‘Science education in a multi-science perspective’ (1995) 79(5) Science Education 583-593. <<http://dx.doi.org/10.1002/sce.3730790507>>

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"Indigenous science" of that culture. This theory is based on Ogawa's research (p. 585). According to Yamada¹⁴ (1970), a Japanese historian of Oriental science, "every culture and every society has its own science, and its function is sustaining its mother society and culture." Ogawa (1995) cites Yamada's statement in one of his works (p. 585).

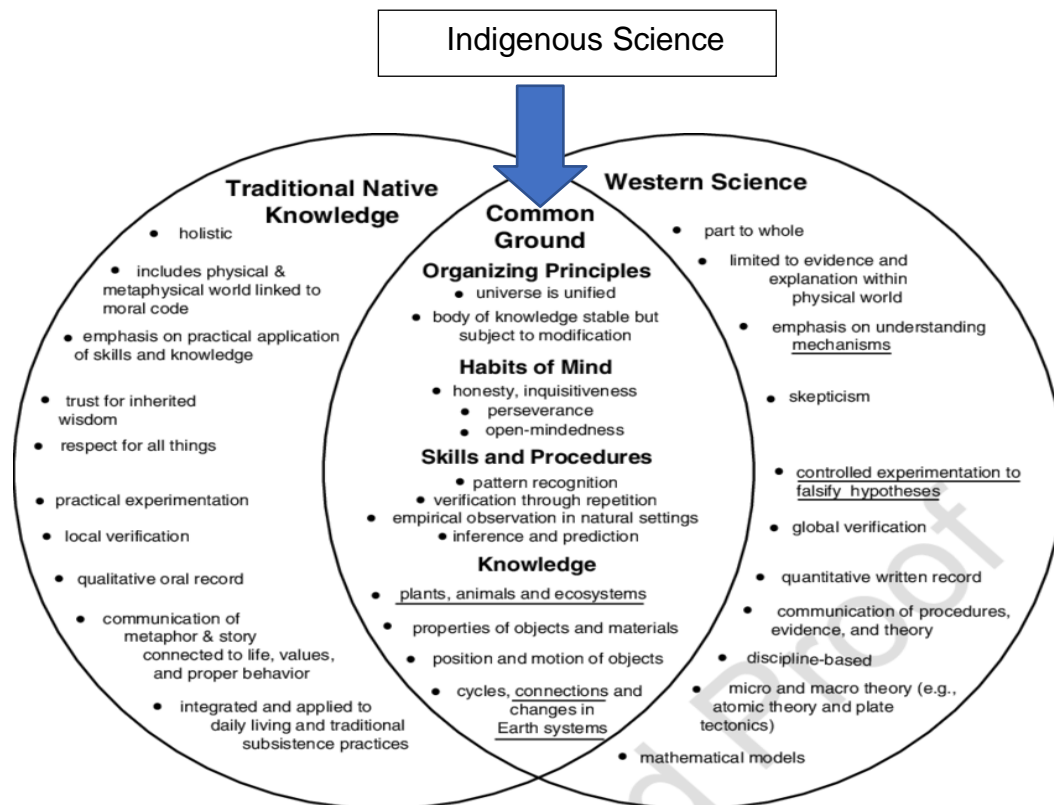


Figure 4: Intersection of Indigenous Science with Traditional Native Knowledge and Western Science. This schematic also highlights similarities and differences between traditional Native knowledge and Western Science (Modified with permission from Stephens (2000)¹⁵ in Chapin et al (2013) with the modifications underlined).¹⁶

It is interesting to note that the component of Indigenous Science (or IS) known as traditional wisdom, which encompasses the values and methods of decision-making related to scientific knowledge, contains a particularly rich variety of tried-and-true methods that promote

¹⁴ Yamada, K., 'Pattern-Ninshiki-Seisaku: Chugoku kagaku no shisotekLKi fudo (Pattern - Recognition - Production: Philosophical climate of Chinese science)', in T. Hiroshige (Ed.), *Kagakushi no susume* (Invitation to the history of science), Tokyo: Chikuma Shobo Ltd., 73 -139 (1970).

¹⁵ Stephens S, 'Handbook for culturally responsive science curriculum' (2000) Alaska rural Systemic Initiative. <<http://www.ankn.uaf.edu/handbook>>, University of Alaska Fairbanks.

¹⁶ Chapin, F. S., Cochran, Patricia, Huntington, Orville H., Knapp, Corrine N., Brinkman, Todd J., and Gadamus, Lily R., 'Traditional Knowledge, and Wisdom: A Guide for Understanding and Shaping Alaskan Social-Ecological Change., (2013) Springer Netherlands, v. 1, p. 49-62.

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environmental integrity and sustainability. Western science, also known as "officially sanctioned science," is widely regarded as the preeminent school of thought in the scientific community at the present time. Relying solely on Western Science, however, can be seen as increasingly problematic and even counterproductive due to the fact that WS has been linked to many of the ecological catastrophes that have occurred around the world, such as the contamination of pesticides, the introduction of new species, dams and water diversions that have had an effect on salmon and other native species.

Because of the existence of cultural diversity, Western Science and Indigenous Science should be seen as coexisting or as parallel fields of study. Many westerners are unable to comprehend and value the idea of Indigenous science, despite the fact that they readily acknowledge the existence of Indigenous art, music, literature, and drama, as well as political and economic systems in Indigenous cultures. As a result, an assimilative approach to science education may be construed to have taken place when Western Science is taught without acknowledging Indigenous Science¹⁷. The common-ground perspective is essentially the overlap areas or coincidental areas of commonalities in these two concentric spheres. This also resonates with the worldview knowledge pools described in figure 4.

5. THE PACIFIC ISLAND ETHNOSPHERE (LANDSCAPES OF TRADITION)

This understanding of dual Worldviews can pave a path toward important perspectives within the Pacific Islands ethnosphere.¹⁸ Broadly speaking, the Pacific Islands Ethnosphere (or PIE), is a collective of landscapes of tradition with complex cultural and ethnic identity of the various indigenous peoples. It encompasses their customs, beliefs, languages, traditional knowledge, practices, belief systems, cultural forms of expression, knowledge systems, and ways of life that have been passed down from generation to generation. The ethnosphere of the Pacific Islands is incredibly diverse, with thousands of distinct cultural groups across the region, each with its own unique traditions and heritage. This rich cultural heritage has been shaped by the islands' geography, history, and interactions with neighbouring cultures and colonial powers. Despite the many challenges faced by Pacific Islanders over the centuries, including colonization, forced assimilation, and environmental degradation, the ethnosphere of the region remains a vibrant and vital part

¹⁷ Snively, G., Wanosts'a & Lorna Williams, "Chapter 1 – Braiding Indigenous Science with Western Science. In: *Knowing Home: Braiding Indigenous Science with Western Science*" (2018), Gloria Snively, Wanosts'a & Lorna Williams. <<https://ecampusontario.pressbooks.pub/knowninghome2/>> accessed 7 August 2023.

¹⁸ The term "Pacific Islands ethnosphere" (or PIE) refers to the unique cultural and ethnic diversity found within the Pacific Islands region. It encompasses the various indigenous groups, languages, traditions, and customs that have evolved over thousands of years across the numerous islands and archipelagos in the Pacific Ocean. The Pacific Islands ethnosphere includes a wide range of cultural practices, including music, dance, art, and storytelling, as well as distinctive ways of life, such as fishing.

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of the world's cultural heritage. What remains of the ethnosphere in the Pacific Islands overlap significantly with modern science, modernity, and transitions to modern society that have eroded or acculturated some cultures and societies that are presently in the brink of losing languages, traditions, and traditional knowledge.

Many of the Pacific islands such as Fiji, Marshall Islands, Kiribati, Tuvalu, and smaller habited atolls, are facing the challenges of the impacts of climate change plus loss of landscapes of tradition or cultural mores that have been progressively eroded over the past 100 years or less. Pathways of recovery of traditional knowledge and ancient wisdom are becoming less accessible because men and women elders are passing away, traditions are changing to modernization, coupled with the impacts of climate change that can inadvertently force many communities to relocate to habitable islands that offer more stable living environment and potable water. As described in a recent World Water Day in Fiji (2023), we are falling short of achieving SDG 6 (Clean Water and Sanitation) and SDG 13 (Climate Action), which integrates with agroecological principles and practices.¹⁹

6. ORIGIN MYTHS

According to Nunn,²⁰ there are many cultures in the world that have TK/LK based on their causal explanations of the past and present. Many traditional cultures particularly in Oceania and the South Pacific, manifest cultural ways of knowing and cultural forms of expression through dance, song, oral traditions, life stories or oral narratives, and continue to practice these beliefs or manifest them through belief systems that coincide with similar cultures in the Pacific²¹. Traditional knowledge or traditional ecological knowledge underpins many of the social norms of and attitudes that continue today although many regions are being acculturated quickly due to development, modernization, influx of tourism from New Zealand, Australia, Europe, and other countries plus gradual deterioration of traditional ways of knowing and transmitting that information to future generations. Origin myths in the Pacific Islands have intrigued scientist and researchers about things they cannot explain. There are (in most cases) reasons that Pacific Islands people thrived on telling these stories or myths. One of the more interesting ones was the origin myths "fished up" or "thrown down" by (demi) Gods. According to Nunn (2003):

"Myths recalling how islands were "fished up" or "thrown down" by (demi) gods are widespread in the Pacific Islands. Fishing-up myths

¹⁹ According to Issac et al (2018), Agroecology is a science, movement and practice that draws on social, biological, and agricultural sciences and integrates these with traditional knowledge, farmers' knowledge, and indigenous peoples' knowledge. Agroecology technologies are knowledge-intensive, builds on farmers' knowledge and experiences of farmers complemented by research from the scientific community.

²⁰ Nunn, P.D., 'Fished Up or Thrown Down: The Geography of Pacific Island Origin Myths' (2003) 93(2) *Annals of the Association of American Geographers* 350–36.

²¹ Ibid

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are more numerous and are concentrated in a heartland comprising parts of Samoa, Tonga, the southern Cook Islands, and the Society Islands of French Polynesia. Geological details in many fishing-up myths suggest these recall the activities of shallow submarine (jack-in-the-box) volcanoes, notably in Tonga, and that these myths diffused to places where such volcanoes do not exist. Other fishing-up myths-particularly those recalling rapid emergence and/or successive uplift events and tectonic instability during the process of fishing-up-are suggested as recalling coseismal-uplift events (uplift coincident with large earthquakes), which are comparatively common in islands along the convergent plate boundaries of the southwest Pacific (including parts of Tonga and New Zealand). Throwing-down myths are less common in the Pacific, being effectively confined to places (near) where volcanoes erupted within the period of human occupation. Throwing-down myths are interpreted as recalling volcanic eruptions”.

Nunn²² mentions that Pacific Origin myths are linked to landscapes of traditions, and in part explain the dichotomies that exist in explaining two-opposing worldviews. Nunn describes these relationships as created or elaborated and cultural transformations based on previous cultural contacts^{23,24,25,26}.

7. THE OLD VS. THE NEW: ANCIENT WAYS OF KNOWING AND KNOWLEDGE GATHERING AND TRANSMISSION IN A TECHNOLOGICAL AGE

Human beings over the centuries have had the abilities to rationalize and acquire different forms of knowledge; as this knowledge gathering (in many traditional societies) is still considered a lifelong process and spiritual commitment. Learning and knowledge acquisition begin in our mothers' wombs, long before we take our first steps, and last throughout her life until we pass away. Knowledge gathering itself is based on experience, practices, passed-on wisdom, and beliefs, guided by cultural forms of expression²⁷ cosmology, worldviews and transmitted or shared between individuals, families, communities, and cultures, thereby validating knowledge throughout the generations. Ancient ways of knowing need constant perpetuation; just as human survival is replicated

²² Ibid.

²³ Latukefu, S, 'Church and State in Tonga', PhD thesis, Australian National University (1967).

²⁴ Mercer, P. M., 'Oral tradition in the Pacific: Problems of interpretation' (1979) 14 Journal of Pacific History 130–53.

²⁵ Gunson, N., 'Understanding Polynesian traditional history', (1993) 28 Journal of Pacific History 139.

²⁶ Teaero, T., 'Weaving a living from living cultures: challenges and opportunities. In: Koya, C.F., Nabobo-Baba, U. and Teaero, T. (editors), Education for Sustainable Development: Continuity for Sustainable Development. Volume 1. Suva, Fiji: School of Education, the University of the South Pacific and Asia/Pacific Cultural Centre for UNESCO: 149–165 (2010).

²⁷ Ibid.

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by procreation, the constant pursuit of happiness, often manifested by personal and family well-being.

Many of Indigenous cultures and ideologies today are being tried and tested by both elders and young people; as most of these people are being 'immersed' in the myriad of technological and profound social and cultural change. A changing climate has also compounded these issues and inadvertently placed many Indigenous cultures in vulnerable or disadvantaged circumstances that are generally contradictory or ill favouring their long-term resiliency. From the author's perspective, these changes are intrinsically separating many cultures from their traditional histories, stories, languages, dances, foods, oral narratives, healing practices and ways of knowing, based on place-based societal-framed traditional knowledge (LK). The challenging part for many Indigenous cultures or communities is their abilities to cope (or adapt) themselves within a technological age that is progressively acculturating (or skewing) ancient ways of knowing and learning. Locally-based LK knowledge transmission and dissemination is profoundly being changed as a result of technological innovation and many cultures are 'losing themselves' within that technology that is quickly altering cultural landscapes of identity to the point of no return.



Photo 1: BriBri Awa apprentice (shaman or medicine man);
(BriBri Talamanca, Costa Rica, December 2004). Photo:
Orcherton (2012)²⁸

Many authors consider technology and modern forms of communication *both a godsend and a curse*; an inevitable or consequential product or 'growth-factor' in this modern age and a necessary transition to

²⁸ Orcherton, D, 'Raising the bar: Recognizing the intricacies of cultural ecological knowledge in natural resource management' (2012) 12(3) BC Journal of Ecosystems and Management 55–82.

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more up-to-date or modern forms of communication that allow greater connectivity, and, therefore, greater opportunities. Modern means of connectivity links or facilitates virtual social gatherings, friendships that perpetuate an almost insatiable personal need *to be connected*. As Internet services improve across the globe, and remote locations are being 'developed', traditional oral narratives are gradually being changed to *phone-narratives*, and SMS messages (described as shortened phone narratives) are, in many cases, completely out of context from the original narratives that are place-based and culturally specific (i.e. without the drama, hand and body movements, songs, dances and other holistic nuances that often accompanied the transmission of traditional narratives).

Other than video-clips, that could (feasibly) replace the detailed life stories or the indigenous cultures, many of these stories are being lost in translation or taken out of their cultural context and placed in a narrative that has a language of their own are bombarding many indigenous cultures by social media propaganda, Facebook, Twitter, Instagram and other social media outlets, that are coursing their followers into the constant stream of "intriguing" information and knowledge"; that are now becoming more accepted in some traditional cultures or sharing circles as socially acceptable Indigenous forms of communication at the expense of traditional ways of knowing that were built on ancestral beliefs. Many of the other generations are changing modalities, lifestyle choices, food habits, which has been having a significant impact on Indigenous cultures throughout the Pacific and the Americas. What is really happening is that there is a loss of cultural contact and tacit knowledge building within different generations that aids in the factual transmission that in many traditional cultures. This was (and still is) an important holistic journey to understand the entire context, practices and belief systems embedded in Indigenous cosmologies and worldviews. Technology in many respects has severed these intricate holistic relationships and is broken knowledge acquisition links that took centuries to build.

In Lorler's (1989) book "Shamanic healing: within the medicine wheel" (29 in 30) the author describes shamanism in the cosmic conception of the world:

"Shamanic cosmic tree represented the axis of the earth; the axis of the solstice with its two poles. The summer and winter solstices, the highest and lowest points of the sun, its death and rebirth. Polaris, around which all the stars rotate, was a gateway to the heavens. Every place that gave access to supernatural beings was designated the center of the earth in ancient times. This resulted in the identification of the cosmic tree as a center of the world and

²⁹ Lorler, M-Lu, 'Shamanic Healing Within the Medicine Wheel'. Brotherhood of Life (1989). <<https://www.abebooks.com/9780914732235/Shamanic-Healing-Medicine-Wheel-Marie-Lu-0914732234/plp>> accessed on 07 August 2023.

³⁰ Crabbé, R., 'The Axis Mundi. The Shamanic Tree of Life' (2022) <<https://www.roelcrabbe.com/articles-about-shamanism/the-axis-mundi/>> accessed on 07 August 2023.

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subsequently in its consecration. In every tree the ancients saw the connection of the earthly with the divine because its validity expresses this through its roots, penetrating into the taps of the darkness to give strong support, and with its crown, striding towards the light with his unfolding branches. Ancient man could still open up in trust to this knowledge of the tree, for the shamans it was the most important place because it helped them in their breakthrough into the realm of the gods."

If we were to reflect on the same discourse within the context of postcolonial modernism, this description would likely change and its meaning, or is diluted, or its deep meaning blanketed or hidden behind Western science interpretation of holistic traditional relationships. This is a bit of a double-edged sword, as divergent worldviews, by virtue of the fact that we are struggling with the development process into and with trying to hold on to traditional ways of knowing indigenous cultures. Many authors consider blending modern Western or Eurocentric science with traditional knowledge, may be the only way to justify these rapid and unprecedented changes. There is probably a compromise to be made but there are likely to be some connective points made between these two divergent worldviews.

The author views these relationships from a more integrated, pragmatic approach (Figure 4). Cultural Ecological Knowledge or CEK is a subset of LK or local knowledge (LK), and considered an emergent-property^{31,32,33} that encompasses the cultural context, practice, and beliefs, emphasizing the qualities and attributes of places that have aesthetic, historic, scientific or social-value for past, present, or future generations. Immersed in this are the processes of production, diffusion, and application of knowledge systems. Teaero (2010) also places CEK within the concept of cultural forms of expression³⁴, which, according to UNESCO³⁵, are traditional cultural expressions (TCEs), such as folklore (or traditional and popular culture) comprising the totality of traditional-

³¹ Basically, a philosophical term taking into consideration systems theory, science, and art. Emergence is the way complex systems and patterns arise out of a multiplicity of relatively simple interactions. <<http://www.google.com/search?q=define%3A%20emergent-property>> accessed on 30 March 2023.

³² Mercer, P. M., 'Oral tradition in the Pacific: Problems of interpretation', (1979) 14 Journal of Pacific History 130–53.

³³ Gunson, N., 'Understanding Polynesian traditional history' (1993) 28 Journal of Pacific History 139.

³⁴ Cultural forms of expression are traditional cultural expressions (TCE's), are creations of the cultural community, expressed by a group or individuals and recognized as reflecting expectations of the community insofar as they reflect its cultural and social identity. Its standards and values are transmitted orally, by imitation or by other means. CE (cultural expressions) is among others, language, literature, music, dance, games, mythology, rituals, customs, handicrafts, architecture, and other arts (PIC/CE/34/8, 2011). This includes the notion of biocultural heritage, previously outlined.

³⁵ UNESCO, 'Local and Indigenous knowledge system' (2011) <<http://www.unesco.org/new/en/natural-sciences/priority-areas/links>> accessed on 3 March 2023.

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based creations of the cultural community³⁶. Aboriginal world-views are in an appropriate balance with components of scientific rigor, validation, and ethics, coinciding in some ways with the academic (compartmentalized or disciplinary) structure of Western Science. In the real-world however, attempts to integrate the two types of science have only been covered by a few theoretical papers, and often have left the bearers of CEK out of the discussion.

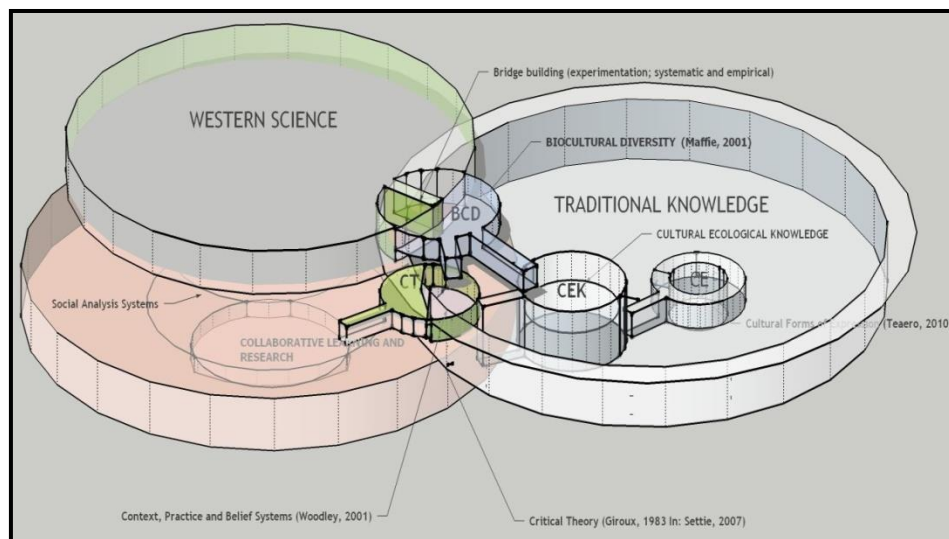


Figure 5: Schematic representation of two worldview "pools" and differences between Western Science, Traditional Knowledge, and CEK. A third (pink) pool is collaborative learning (CL), participatory research and social analysis systems (SAS)³⁷

The overlapping spheres illustrated (conceptually) in figure 4 describe CEK as a sub-set of the traditional knowledge "pool". Biocultural Diversity³⁸ (BCD) has a more direct (functional) relation with Western Science and Traditional Knowledge (TK) as an emergent property³⁹. CT (Critical theory) is a tool of inquiry to illuminate pertinent and complex issues addressing Indigenous Knowledge (40, In:^{41,42}).

³⁶ Orchardton, D., 'Raising the bar: Recognizing the intricacies of cultural ecological knowledge in natural resource management' (2012) 12(3) BC Journal of Ecosystems and Management 55–82. <<http://jem.forrex.org/index.php/jem/article/view/48/102>> accessed on 30 March 2023.

³⁷ Ibid.

³⁸ This includes the notion of biocultural heritage, previously outlined.

³⁹ Woodley, E., 'Local and Indigenous ecological knowledge as an emergent property of a complex system: A case study in the Solomon Islands'. Thesis, University of Guelph, Guelph (2002) <[http://westernsolomons.uib.no/docs/Woodley,%20Ellen/Woodley%20\(2002\)%20Local%20K](http://westernsolomons.uib.no/docs/Woodley,%20Ellen/Woodley%20(2002)%20Local%20K)> accessed on 30 March 2023.

⁴⁰ Giroux, H.A., 'Theory and resistance in education: A pedagogy for the opposition'. Bergin & Garvey Publishers, New York (1983).

⁴¹ Settee, P., 'Pimatisiwin: Indigenous knowledge systems, our time has come'. PhD. Thesis. The University of Saskatchewan (2007) <<https://harvest.usask.ca/handle/10388/etd-04302007-084445>> accessed on 30 March 2023.

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of Expression)⁴³ are traditional cultural expressions which is folklore, traditional and popular culture, comprising the totality of traditional-based creations of the cultural community. Even though divergent worldviews exist, there are interconnecting “bridges” or “linkages” between these different ways of knowing. Biocultural Diversity (BCD) and Critical Theory (CT) and collaborative learning (CL) are the three main connective points between Western Science and TK.⁴⁴

8. TOWARDS PRACTICAL APPROACHES TO MERGING CEK AND WESTERN SCIENCE

Bannister and Hardison⁴⁵ (2006) describe the merger of CEK and Western Science as:

“adequately and potentially detrimental to both biological diversity and those indigenous, traditions and local communities whose existences and well-being are interdependent with biological and ecological systems”^{46,47}.

Within a more practical description of cultural heritage and indigenous knowledge, there are many inter-related social and cultural complexities regarding natural resource management, especially when Aboriginal groups try to implement or bring about positive change to the sustainable management of their resources. Conflict usually arises based on divergent viewpoints or other misrepresentation with Western thought. Vilsoni Herenko, a Maori (New Zealander) researcher, adequately describes what has happened culturally over the years, which resonates with some First Nation’s realities:

“Chief among the reasons for pushing indigenous sources of knowledge to the margins is the process of colonization and acculturation, particularly the usurpation of oral narratives by the dominant culture’s narrative fiction; fairy tales, myths and legends, short stories novels and biblical stories: The school and church are institutions that work “hand-in-hand” to colonized and acculturated

⁴² Chapin III, F Stuart & Cochran, Patricia & Huntington, Orville & Knapp, Corrine & Brinkman, Todd & Ray, L., ‘Traditional Knowledge and Wisdom: A Guide for Understanding and Shaping Alaskan Social-Ecological Change’, (2013). https://doi.org/10.1007/978-94-007-7470-4_4.

⁴³ Teaero, T., ‘Weaving a living from living cultures: challenges and opportunities. In: Koya, C.F.; Nabobo-Baba, U. and Teaero, T. (editors). Education for Sustainable Development: Continuity for Sustainable Development. Volume 1’. Suva, Fiji: School of Education, the University of the South Pacific and Asia/Pacific Cultural Centre for UNESCO: 149–165 (2010).

⁴⁴ Orchardton, D., ‘Raising the bar: Recognizing the intricacies of cultural ecological knowledge in natural resource management’ (2012) 12(3) BC Journal of Ecosystems and Management 55–82. <http://jem.forrex.org/index.php/jem/article/view/48/102>> accessed on 12 July 2023.

⁴⁵ Bannister, K., and Hardison, P., ‘Re-envisioning the nature of useful knowledge: A perspective from indigenous knowledge systems’ (2006) 77(6) The Journal of Higher Education 1046-1068.

⁴⁶ Orchardton, D., ‘Raising the bar: Recognizing the intricacies of cultural ecological knowledge in natural resource management’ (2012) 12(3) BC Journal of Ecosystems and Management 55–82. <<http://jem.forrex.org/index.php/jem/article/view/48/102>> accessed on 12 July 2023.

⁴⁷ Woodley, E., ‘Local and Indigenous ecological knowledge as an emergent property of a complex system: A case study in the Solomon Islands’. Thesis, University of Guelph, Guelph (2002). <[http://westernsolomons.uib.no/docs/Woodley,%20Ellen/Woodley%20\(2002\)%20Local%20K](http://westernsolomons.uib.no/docs/Woodley,%20Ellen/Woodley%20(2002)%20Local%20K)> accessed on 12 July 2023.

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the mind. As native people we are taught to read and write... they paid less and less attention to oratory, and historians marginalized emotional truth..."⁴⁸ (p. 82–83).



Photo2: BriBri Spiritual Leader) explaining the importance of plant diversity; (BriBri Talamanca, Costa Rica, December 2004). Photo: Orchardton (2012)⁴⁹

Recent PhD thesis work by a First Nations Swampy Cree woman, Precilla Settee⁵⁰ (2007), also partially explains the dilemma faced by indigenous researchers:

"I found that legitimated discourses of power privilege what books may be read by students, validate what instructional methods may be utilized, and authorize what belief systems and views of achievement may be taught. In so doing, power discourses undermine the cultural interpretations of language establishing one correct reading that implants a particular hegemonic message into the consciousness of Indigenous readers"⁵¹.

The oral history of northwestern Pacific Coast of British Columbia for example, was used to enhance archaeological research in the Dundas

⁴⁸ Hereniko, V., 'Indigenous knowledge and academic imperialism. In: Remembrance of Pacific pasts: An invitation to remake history.' R. Borofsky (editor). University of Hawaii Press, Honolulu, HI (2000). <<http://www.hawaii.edu/cpis/files/IndigKnow.pdf>> accessed on 12 July 2023.

⁴⁹ Orchardton, D, 'Raising the bar: Recognizing the intricacies of cultural ecological knowledge in natural resource management' (2012) 12(3) BC Journal of Ecosystems and Management 55–82.

⁵⁰ Settee, P., 'Pimatisiwin: Indigenous knowledge systems, our time has come'. PhD. Thesis. The University of Saskatchewan (2007) <<https://harvest.usask.ca/handle/10388/etd-04302007-084445>> accessed on 12 July 2023.

⁵¹ Ibid

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Islands situated in the mouth of the Skeena River⁵². The Tsimshian cultural landscape as defined was seen as important in order to help “dispel the myth that social complexity arose here [on the Northwest Coast] in the absence of food production by demonstrating that the ‘hunter-gatherers’ of the region were not simple ‘affluent foragers,’ but active managers who have cultivated, sustained, overseen, and promoted culturally valued plant resources”⁵³).

Hunn (1999)⁵⁴ writes in a chapter titled “*The Value of Subsistence for the Future of the World*” that “no longer can we take refuge behind the myth of the superiority of Western Civilization as the source of all science.” He goes on to describe the importance of documenting and learning from the CEK of indigenous peoples the world over, knowledge that enabled them to adapt to diverse local environments. Hunn muses that this maybe the key to the future sustained subsistence of the human species⁵⁵.

It invariably comes down to *how* the dominant culture (non-Aboriginal) is attempting to rationalize and integrate distinct world views based on diverse cultural values and beliefs. What we often *see* are Aboriginal people’s manifested (or indoctrinated) examples of resilience to change at the community level. Human-ecological resilience at this level encompasses an entire community (physical infrastructure, economic, cultural, and social capital, natural environment, and systems/essential services) and its ability to resist and/or rapidly recover from extreme events^{56,57}. This has profound effects on *how* Aboriginal people view or rationalize non-Aboriginal involvement (and *visa-versa*) in natural resource management. According to Berry⁵⁸, this is initiated by the conjunction of two or more autonomous cultural systems; termed *Acculturation*.⁵⁹

⁵² This research project by Northwest Community College and UBC scientists use the oral history of the Tsimshian and what are now the Tahltan, was undertaken to explain the sequence of events about village constructions in the estuary of the Skeena River some 7,000 years ago (JEM Reviewers personal comments, June 2011).

⁵³ Downs, K., ‘The Tsimshian homeland: An ancient cultural landscape’. Thesis. Athabasca University, Athabasca, AB (2006).

⁵⁴ Hunn, E., ‘The value of subsistence for the future of the world. In: *Ethnobiology: Situated knowledge/located lives.*’ V. Nazarea (editor), University of Arizona Press, Tucson, AZ (1999).

⁵⁵ *Ibid.*, n.52

⁵⁶ Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J., ‘A place-based model for understanding community resilience to natural disasters’ (2008) 18(4) *Global Environmental Change* 598-606.

⁵⁷ This is often as a result of because of shocks or stresses within a dominant Western Science (or Eurocentrism). Western Science contends that knowledge of Eurocentrism’s history is a necessary component a new cultural politics of difference (36, 204). Academics and others are accustomed to ethnographic encounters that reveal the cultural belief-sets of Aboriginal and other peoples. They are unaccustomed, however, to the application of similar analysis to the “White way” (36: 24).

⁵⁸ Berry, J., ‘Conceptual approaches to acculturation. In: *Acculturation: Advances in theory, measurement and applied research.* In: K.M. Chun., P.B. Organista, and G. Marin (editors), *Decade of behaviour 2000–2010.* American Psychological Association, Washington, DC (2003).

⁵⁹ Acculturation within an anthropological context describes is a process in which members of one cultural group adopt the beliefs and behaviours of another group.

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According to Hazuda et al (1988)⁶⁰, although acculturation is usually in the direction of a minority group adopting habits and language patterns of the dominant group, acculturation can be reciprocal--that is, the dominant group also adopts patterns typical of the minority group. Assimilation of one cultural group into another may be evidenced by changes in language preference, adoption of common attitudes and values, members' hip in common social groups and institutions, and loss of separate political or ethnic identification (p.34). Berry and Orcherton^{61,62} also describe acculturative "change" as the consequence of direct cultural transmission or derived from non-cultural causes, such as ecological or demographic modification induced by a dominant or impinging culture (Social Science Research Council, 1954: In⁶³). Though interesting and indirectly related to how we interpret CEK, this theme falls outside the scope of this article. Coincidental theoretical (and some practical) work on resilience analysis⁶⁴ shows us there is a partial explanation for these differences. Dyer & Mc Guinness, reiterate however that 'resilience analysis describes a process whereby people bounce back from adversity and go on with their lives. It is a dynamic process highly influenced by protective factors. Protective factors are specific competencies that are necessary for the process of resilience to occur' (p.277).

Whether the description is "aboriginal or non-aboriginal", what seems to be on most resource managers' minds is *how* can we better understand these complexities and *what* are the tools and techniques that can be used to facilitate or understand and putting into practice mutually acceptable or cooperative relationships based on these two distinct types of science. What we are witnessing (as mentioned) are contrasting world-views and notable differences in the way these resources are perceived, interpreted, and managed. Lynam et al.,⁶⁵ and Hoffman⁶⁶ explain some of the tools and methods to incorporate community and indigenous knowledge into decision-making in natural resources management, which break-away from the conventional thinking (technical or scientific approach) on natural resource management and provide holistic

⁶⁰ Hazuda, H. P., Stern, M. P., & Haffner, S. M., 'Acculturation and assimilation among Mexican Americans: Scales and population-based data', (1988) 69(3) Social Science Quarterly 687-705.

⁶¹ Berry, J., 'Conceptual approaches to acculturation. In: Acculturation: Advances in theory, measurement and applied research. In: K.M. Chun., P.B. Organista, and G. Marin (editors), Decade of behaviour 2000–2010. American Psychological Association, Washington, DC (2003).

⁶² Orcherton, D., 'Raising the bar: Recognizing the intricacies of cultural ecological knowledge in natural resource management' (2012) 12(3) BC Journal of Ecosystems and Management 55–82. <<http://jem.forrex.org/index.php/jem/article/view/48/102>> accessed on 12 July 2023.

⁶³ Chun, K.M., P.B. Organista, and G. Marin (editors), 'Acculturation: Advances in theory, measurement and applied research. Decade of Behaviour 2000–2010'. American Psychological Association, Washington, DC (2003).

⁶⁴ Dyer, J.G. and T.M. McGuinness., 'Resilience: Analysis of the concept', (2004) 10(5) Archives of Psychiatric Nursing 276–282.

⁶⁵ Lynam, T., de Jong, W., Sheil, D., Kusumanto, T. and Evans, K., 'A review of tools for incorporating community knowledge, preferences and values into decision-making in natural resources management' (2007) 12(1) Ecology and Society 1–15.

⁶⁶ Hoffman, R., 'Rekindling the fire: The impact of Raymond Harris's work with the plains Cree' Doctoral Dissertation, Trent University, Peterborough, Ontario (2006).

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Aboriginal world-views, attitudes, beliefs, or preferences of the people managing or depending on their resources^{67,68}. This is especially true when looking at cultural/ecological values in forest resource and land-use management where some intrinsic differences exist between these types of management and the science behind these approaches.

As evidenced in these and other experiences, “aboriginal perspectives” can be incorporated in an atmosphere of mutual respect; cooperation and support for the values encompassed in the Indigenous world-view are firmly established in the hearts and minds of all participants⁶⁹. Openness to innovative programming compatible with Indigenous teaching and learning styles and strong commitment to a shared vision are characteristics, which lay the foundation for including Indigenous knowledge^{70,71}. To better understand these processes, we need to look at ways of bridging-the-gap between two distinct types of science; Western Science and Indigenous or Aboriginal Science. Though not definitive or exhaustive in scope by any means, the following five (5) approaches can be examined as a practical means of approaching, describing and/or finding a solution to this dichotomy:

1. Acknowledging aboriginal peoples' own perceptions and contributions to science.
2. Creating social-legitimacy through Collaborative Learning and integrating systems thinking and conflict management.
3. Design and implement intuitive valuations of CEK (transfer of Oral to Written cultural/ecological knowledge).
4. Designing clear objectives and outcomes and implementing systematic and culturally sensitive heritage assessments, and
5. Defining cultural pluralism (ideology of world-views) and problem-solving strategies within a continuous acculturation process.

Within the Western-viewed Stanford Dictionary of Philosophy⁷² (32):

“Information technology is now ubiquitous in the lives of people across the globe. These technologies take many forms such as personal computers, smart phones, the internet, web and mobile phone applications, digital assistants, and cloud computing. In fact, the list is growing constantly, and new forms of these technologies are

⁶⁷ Ibid, n.60

⁶⁸ Orcherton, D., ‘TEK/(Traditional Ecological Knowledge) and Biodiversity Conservation: Strengthening Community-Based Approaches (CBA) to conservation and building equitable partnerships in practice with indigenous peoples of Costa Rica’ (2012) 32 The Journal of Pacific Studies 87–90.

⁶⁹ Smith, L. T., ‘Decolonizing methodologies: Research and Indigenous peoples’. Zed Books (1999).

⁷⁰ Ibid.

⁷¹ Woodley, E., ‘Local and Indigenous ecological knowledge as an emergent property of a complex system: A case study in the Solomon Islands’. Thesis. University of Guelph, Guelph (2002) <[http://westernsolomons.uib.no/docs/Woodley,%20Ellen/Woodley%20\(2002\)%20Local%20K](http://westernsolomons.uib.no/docs/Woodley,%20Ellen/Woodley%20(2002)%20Local%20K)> accessed on 12 July 2023.

⁷² Stanford Encyclopedia of Philosophy. (2014). Information Technology <<https://plato.stanford.edu/>> accessed on 12 July 2023.

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working their way into every aspect of daily life. In some cases, such as can be seen in massive multiplayer online games, these technologies are even opening new ways of interacting with each other. Information technology at its basic level is technology that records, communicates, synthesizes, or organizes information. Information can be understood as any useful data, instructions, or meaningful message content. The word literally means to "give form to" or to shape one's thoughts. So, a basic type of information technology might be the proverbial string tied around one's finger to remind or inform you that you have some specific tasks to accomplish today. Here the string stands in for a more complex proposition such as "buy groceries before you come home." The string itself is not the information, it merely symbolizes the information and therefore this symbol must be correctly interpreted for it to be useful. Which raises the question, what is information itself?

Actions currently being taken by Indigenous people in communities throughout the world clearly demonstrate that a significant "paradigm shift" is under way in which indigenous knowledge and ways of knowing are beginning to be recognized as consisting of complex knowledge systems with an adaptive integrity of their own (cf. Winter, 2004 special issue of Cultural Survival Quarterly on indigenous education). As this shift evolves, it is not only indigenous people who are the beneficiaries since the issues that are being addressed are of equal significance in non-Indigenous contexts. Many of the problems that are manifested under conditions of marginalization have gravitated from the periphery⁷³ to the center of industrial societies, so the new (but old) insights that are emerging from indigenous societies may be of equal benefit to the broader educational community.

9. CONCLUSION: REFRAMING TK/LK TOWARDS A BLEND OF INDIGENOUS SCIENCE AND WESTERN SCIENCE

In this brief analysis, we have reviewed several salient points about TK/LK and its relation to climate change, and Western/Eurocentric Science, and how IS can be integrated effectively. The common-ground perspective identified overlap areas or coincidental areas of commonalities of two opposing worldviews. It was determined that coincidental areas of overlap must be identified and ways of knowing must be preserved for future generations. Pragmatically, there is a paradigm shift occurring with the younger generation, and TK/LK and IS being acculturated and gradually eroded. The Pacific Islands Ethnosphere (or PIE) is the landscape of tradition with complex cultural and ethnic identities of the various Indigenous peoples who are linked to Pacific Origin myths.

⁷³ Bates, P., Chiba, M., Kube, Sabine, K and Nakashima, D., ' Learning and knowing in indigenous societies today UNESCO publication (2009).

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This (in-part) explains the dichotomies that exist in explaining two-opposing worldviews. Nunn⁷⁴ described these relationships as “created or elaborated” and cultural transformations based on cosmology, worldviews and transmitted or shared between individuals, families, communities, and cultures, thereby, validating knowledge throughout the generations. Ancient ways of knowing need constant perpetuation, just as human survival is replicated by procreation, the constant pursuit of happiness, often manifested by personal and family well-being. The Medicine-wheel and Shamanic healing are examples of manifested Indigenous Science (IS), within a certain context, practice, and belief system, exemplifies cultural forms of expression. Aboriginal or Indigenous worldviews are usually in balance with components of scientific rigor, validation, and ethics, coinciding in some ways with the academic (compartmentalized or disciplinary) structure of Western or Eurocentric Science. Western Education has brought about significant paradigm shifts having impacted Indigenous populations in many areas of the Pacific and in the Americas. In most cases, it has marginalized Indigenous knowledge systems and dismissed or devalued LK, leading to a loss of confidence and interest in traditional knowledge among younger generations.

By exploring traditional knowledge and climate change, support was strengthened towards a better understanding of the complexities of the duality of ancient wisdom and modernity, and in doing so, created a better understanding of the importance of these opposing worldviews and how science ancient wisdom and technology/modernism can be better interpreted and understood. The author explored meaningful interdisciplinary perspectives and explained coincidental relationships, components of bridging TK/LK and transforming the compartmentalized view of science within a more holistic understanding of traditional ways of knowing.

Looking closer at LK/IK/IS and Western Science intersections require researchers to think more holistically and take a more practical approach to integrating two worldviews. This brief analysis also aided the reader to recognize and respect the value of traditional knowledge systems and the need to work closer with Indigenous communities to protect and promote their cultural practices and knowledge.

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⁷⁴ Nunn, P.D, 'Fished Up or Thrown Down: The Geography of Pacific Island Origin Myths', (2003) 93(2) *Annals of the Association of American Geographers* 350–364.

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AUTHOR'S DECLARATION AND ESSENTIAL ETHICAL COMPLIANCES

Author's Contributions (in accordance with ICMJE criteria for authorship)

This article is 100% contributed by the sole author. S/he conceived and designed the research or analysis, collected the data, contributed to data analysis & interpretation, wrote the article, performed critical revision of the article/paper, edited the article, and supervised and administered the field work.

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