NON-CONFORMITY IN AQUACULTURE SOCIAL AUDITS

A Study on Labour Rights using Predictive Models

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Abstract

This thesis seeks to understand the likelihood of compliance with labour rights standards in aquaculture farms.

Aquaculture Stewardship Council (ASC) audit data was used to create a dataset, which formed the basis of a series of XGBoost prediction models. These models predict the likelihood of an audit having a non-conformity in a grouped series of standard indicators measuring each of the five fundamental rights at work, with two different models for each different right, for a total of 10 models. To analyse how different variables influence the predictions created by the XGBoost models, a SHAP analysis was done, which found the one overwhelming variable which influences whether an audit is compliant or non-conforming is the country in which the aquaculture farm is located.

Further analysis was done on the six countries where most audits were conducted: Ecuador, Chile, Vietnam, India, Norway, and the UK. Results of this analysis found that, generally across all models the UK was the biggest indicator of non-conformity, closely followed by India and then Ecuador. This is except for the model for the right to freedom of association and collective bargaining, where all countries all were indicators of compliance. Norway was generally the biggest indicator for compliance, Chile is the only other country which was not an indicator of non-conformity in any model, while Vietnam was an indicator of non-conformity in the forced labour models.

The results of what each country indicates in the different models was compared to existing research to understand how well the models' indications correlate with other knowledge and be able to understand where more research is needed. This showed no clear correlation between the models and existing research. In particular, indications for compliance in several models, especially for freedom of association, contradicted case evidence of labour rights violations, though some of the research was at country level, not aquaculture industry level. The discrepancies between the results of the models and existing evidence could be due to the farms in the dataset being best-case-scenario farms, as they are ASC certified, or conversely it could be due to a lack of ability to find non-conformities when auditing.

Next a sociological theory framework of Standing's precariat and Grimshaw et al.'s protective gaps was used to analyse the situation of labour rights in the countries, aiming to explain the results of the models. The theoretical framework seems to partially explain the results but align more with the existing research than the results of the model. Standing's theory of the precariat can only be used to explain the clearest cases, while protective gaps can explain more of the models' results. This may be due to more available research documenting protective gaps in the countries though.

In general, the models have low precision and recall, showing a need for more data to acquire more accurate models. More data could lead to different results than the results in this thesis. Finally, several areas of research to better understand labour rights in the aquaculture industry, and how well audits uncover labour rights abuses, are suggested.

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1 Introduction

Seafood is a major source of protein for millions of people around the world and one of the most globally traded goods. Fisheries, aquaculture and seafood processing also provides employment and income for millions of people globally. Aquaculture farming alone employed an estimated 22.1 million people in 2022 and is a global growth industry. Aquaculture farming spans broadly from small-scale production for own consumption and local markets to large-scale, industrial sites producing almost exclusively for export (FAO 2024).

Nevertheless, labour rights in the aquaculture industry is a poorly researched phenomenon, (ILO 2021A) but the limited available research suggests that serious violations of labour rights occur in parts of the industry, needing more study (CAL 2024; Fuentes et al. 2021; MBA 2023A, 2023B, 2024; ELEVATE et al. 2023, Nakamura 2024; FAO 2021).

1.1 Defining labour rights: Fundamental Principles and Rights at Work

To understand what defines labour rights abuses, we must first define labour rights. The most commonly used definition, and industry standard in the aquaculture industry, is ILO's five fundamental principles and rights at work (ILO 2022), and I will therefore use this definition of labour rights in this paper. The principles are defined as:

- Freedom of association and the effective recognition of the right to collective bargaining;

- Elimination of all forms of forced or compulsory labour;

- Effective abolition of child labour;

- Elimination of discrimination in respect of employment and occupation; and

- A safe and healthy working environment.

As such, labour rights abuses occur when a worker is not ensured all these rights, legally and in practice. Determining whether a practice is an actual infringement on a person's labour rights can be difficult, however. Therefore, ILO has expanded upon these rights, to better define them or to better understand what might indicate the presence of labour rights abuses. Child labour is defined as work depriving children of their childhood, potential, or dignity, and of work that is harmful physically and mentally to the child (ILO 2024). It is further defined as work which *"is mentally, physically, socially or morally dangerous and harmful to children"* (ILO 2024) and work which "*interferes with their schooling by: depriving them of the opportunity to attend school; obliging them to leave school prematurely; or requiring them to attempt to combine school attendance with excessively long and heavy work"* (ILO 2024). As such, whether work conducted by a minor is classified as child labour depends on the amount and type of work, as well as the conditions under which it is performed, and varies on a case-by-case basis.

To understand and identify forced labour, ILO has created 11 indicators of forced labour (ILO 2012). None of the indicators can necessarily prove forced labour on their own, but the

likelihood of forced labour being present increases when the indicators are present. These indicators are:

- Abuse of vulnerability: for example, abusing illiteracy or the lack of knowledge of the local language to enforce poor working conditions or retain wages and documents.

- Deception: this includes recruitment through deception, where the wage, working conditions, living conditions, type of work, or other is lied about to attract workers.

- Restriction of movement: where workers movement is restricted without good reason, such as being locked in the workplace to prevent escape.

- Isolation: this includes physical isolation, as well as confiscating phones and other means of communication, so workers cannot seek help.

- Physical and sexual violence: other than serious violence, this includes forcing 'extra', often domestic, work on workers, as well as forcing workers to take drugs, to better control them.

- Intimidation and threats: this includes threats to report migrant workers to police, threatening to withhold wages or other worker rights, as well as insulting and undermining workers to increase their sense of vulnerability.

- Retention of identity documents: retaining ID or other personal documents can restrict workers movement, ensure they cannot seek other work, or keep them from accessing essential services and help.

- Withholding of wages: this is when wages are deliberately withheld to compel workers to remain at their work and not seek other employment.

- Debt bondage: when labour is exchanged for the clearing of a debt, this is often coupled with the undervaluing of work, or charging workers inflated sums for obligatory room and board at the worksite.

- Abusive working and living conditions: this includes degrading and hazardous conditions at both worksites, as well as provided living sites.

- Excessive overtime: this is when workers must work longer than legally allowed to achieve a minimum wage, or under threats, for example of dismissal.

Freedom of association and the right to collective bargaining entails that workers as well as employers can freely form and join organisations which empower and defend their interests in the workplace, without interference from the other party or the state (ILO Undated). To be effective, it is important for workers organisations to be independent, especially from employers and their organisations, and important for workers organisations to be protected by the state and not be subject to state interference in membership through, for example, prohibitions of unionisation for certain categories of workers.

Discrimination in the workplace is when a worker or prospective worker is treated differently due to characteristics unrelated to the job (ILO 2018). These characteristics of course include

race, gender, and sexual orientation, discrimination is also seen, for example, against people living with HIV/AIDS, or due to age or migration status. The effects of discrimination manifest, among other things, through recruitment, remuneration, job advancement, and social rights such as parental leave.

A safe and healthy working environment was added as a fundamental principle and right at work in 2022 (ILO 2022). It was added to ensure workers' health, and mandates national-level occupational health and safety standards, which employers must adhere to.

1.2 Recent research and evidence on Fundamental Principles and Rights at work in aquaculture

With an understanding of what labour rights entail, we can now look at the currently identified cases of labour rights infringements in the aquaculture industry. There are no overall studies covering the entire industry, but credible case studies point to particular violations of fundamental principles and rights. While the case studies are place-based and limited in scope, some violations seem to appear across different types of productions and in different countries around the world. The shrimp-farming industry has been especially scrutinised, finding credible cases of forced labour, child labour, and discrimination, as well as related human rights abuses, such as human trafficking (CAL 2024; MBA 2023A, 2024; ELEVATE et al. 2023; Nakamura 2024).

Corporate Accountability Lab (CAL) has conducted a comprehensive study on the working conditions in the shrimp farming and seafood processing industry in Andhra Pradesh in India. In this study, CAL found evidence of severe breaches of labour rights, including discrimination, forced labour, child labour, and an unsafe working environment (CAL 2024). Discrimination in the industry is seen in three separate ways: gender-based discrimination, caste-based discrimination, and discrimination based on migration status. Though CAL does not report gender-based discrimination regarding job opportunities or remuneration, they have found credible evidence of gender-based violence, with women being victims of sexual harassment, and the victims having little recourse to protect themselves, due to stigma, reprisals, or fear of losing their job. Furthermore, gender-based verbal abuse has been found, with all-male supervisors verbally harassing women for speaking or, in the eyes of the supervisors, using the bathroom for too long.

CAL has uncovered intersecting caste-based and migration-based discrimination in India. Dalits and Adivasi, being low-caste, are denied well-paying jobs, and face difficulties in asserting their rights (CAL 2024). These difficulties include social exclusion and physical violence. The lack of job prospects has forced many Dalits to migrate internally within India to seek work, and as such they may also face discrimination due to their migration status. Despite being internal migrants, there still exists a language barrier, due to the large number of mutually unintelligible languages in India. CAL quotes one woman worker as saying she cannot communicate with migrant workers, as they have no shared language (CAL 2024). These language barriers and accompanying social isolation enforce the risk of discrimination and forced labour of migrant workers.

A study on salmon farming in Chile corroborates many of the findings CAL have made in India regarding discrimination (Fuentes et al. 2021). Gender-based discrimination was also found in Chile, with issues such as no regards for pregnant workers, difficulty in attaining promotions due to gender, and women being disproportionately affected by the shift system in regard to childcare (Fuentes et al. 2021). The report also corroborates CAL's findings of sexual violence and controlling bathroom breaks (Fuentes et al. 2021).

The CAL report has also found several severe breaches of the ILO forced labour indicators, leading to the conclusion that there is credible evidence of forced labour in the Indian shrimp industry (CAL 2024). Debt-bondage has been found to be prevalent, with middlemen recruiters offering loans to, often vulnerable, workers, and having the workers pay off their loans through work. This forces workers to stay at their jobs until the loan and interest are paid back, removing their possibility of finding other work. Sometimes, these loans are given to groups of people, and if one person in the group defaults on their part of the debt, the debt is then spread among the rest of the group (CAL 2024). This then encourages social control, to make sure no one defaults. The middlemen also commonly charge recruiting fees from workers before the workers can start a job, putting them further in debt.

The use of migrant and low-caste workers can easily lead to abuse of vulnerability, due to their lack of other employment opportunities. This is exacerbated by the informal way many workers are employed. Few workers have contracts or pay slips and have few benefits or protections (CAL 2024). This also results in no formal bookkeeping on wages paid, and workers have no opportunity to dispute whether they are paid enough. This is directly related to another two of the ILO forced labour indicators: Excessive overtime and withholding of wages. Overtime is often forced, and seldom paid, especially not at the legally mandated double hourly salary (CAL 2024). Some workers report working 80-hour work weeks, and some report working up to 30 days in a row (CAL 2024). The lack of contracts and excessive, no-paid overtime is also found in Vietnam (Nakamura 2024).

Workers, especially migrant workers, often live in company-provided housing, which can be of appalling standards (CAL 2024). The accommodations are unsanitary and overcrowded, sometimes doubling as storerooms for equipment or feed, and often on-site. Furthermore, workers living in these accommodations are often tightly monitored, and are not allowed to leave the site without permission from their employers, including during rest hours. They are often only permitted to leave once or twice a month and may be observed when they do (CAL 2024). A CAL source describes conditions the workers face as "*like captured slaves*" (CAL 2024: 53). The workplaces are often remotely located, and have several rings of security, restricting entry and exit into and from the workplace. Beyond physical restriction of movement, CAL has found cases where workers' access to their phones is restricted, and where surveillance cameras are present even in the workers' accommodations (CAL 2024).

Beyond the housing, CAL has found hazardous working conditions, e.g. workers are not given protective gear when working with potentially harmful chemicals or when working in the cold (CAL 2024). This is both an indicator of forced labour as well as its own labour rights abuse. The lack of personal protective equipment (PPE) has caused, among other symptoms, chemical-induced rashes and frostbite (CAL 2024). These symptoms require time off work to treat, which workers can often not afford. Other than the lack of PPE, CAL also found cases of

workers, especially women, fainting in the middle of work, most likely due to malnourishment or dehydration, as well as sometimes deadly cases of ammonia leaks (CAL 2024). As mentioned before, workers also report being verbally abused for not working fast enough, taking too long in the bathroom, or talking too much (CAL 2024). In Chile, reports show that diving operations can be lethal, and are more dangerous due to a lack of supervision by employers and a lack of quality training of divers (Fuentes et al. 2021)

Also, as earlier mentioned, there are documented cases of physical and sexual violence, especially against women. Furthermore, there is clear evidence of harassment and threatening behaviour from supervisors, guards, and other company employees towards workers (CAL 2024). Workers are afraid to speak to outsiders, including CAL's field investigators and union representatives. Some workers interviewed by CAL were threatened by their supervisor after participating in the interview and had to hide their interviews from the company.

The intimidation tactics used by the companies in the study tie in directly to another labour rights abuse, namely the restriction of the freedom to organise and bargain collectively. Workers in India are intimidated into not speaking with union organisers, and unions are denied access to the workers (CAL 2024). CAL quotes one union member saying "*Workers will get admitted to the hospital. The company won't allow us to talk to them. The police will also deny [us] the opportunity ... to talk to workers*" (CAL 2024: 38). In Chile, Fuentes et al. found that there are often not many other jobs where the salmon industry offers work, which leads to a de facto job monopoly in areas (Fuentes et al. 2021). This leads to an uneven power balance between employers and unions and makes it harder for workers to bargain for better labour conditions (Fuentes et al. 2021).

Child labour is also a concern in the aquaculture sector, with reports of children as young as 12 working full-time (CAL 2024). In India, CAL reports children starting work in abusive and hazardous conditions due to financial pressure, with many girls working either to support their families or to afford dowry (CAL 2024). In Bangladesh, much of the shrimp aquaculture industry is unregistered operating in the informal sector, which the Bangladesh Labor Act does not apply to (MBA 2023A). This results in no laws banning child labour, and with social acceptance of children aiding their family's work, child labour, i.e. children performing hazardous tasks or working during school hours, is a common occurrence (MBA 2023A).

While the current research into labour rights in the aquaculture industry paints a grim picture in parts of the shrimp and salmon industry and in seafood processing, not much research has been done, especially outside the global south. As such, we do not know much about the state of labour rights in the aquaculture industry globally. The evidence base is particularly weak for geographical areas traditionally seen as safer for the workers. Therefore, much more research on the topic is needed to analyse the standards of labour rights globally.

When looking at research conducted in adjacent industries such as the agriculture and fishing industries, as well as studies on migrant workers, we see there is reason to believe that labour rights abuses can be found in places such as Western Europe (MBA 2022A, 2022B; Palumbo 2022; Carpenter et al. 2020; Lewis et al. 2014). Indicators of risk, such as not understanding the local labour market mechanisms or local laws, suggest migrant workers in Western Europe are at risk of labour rights abuses (Simkunas & Thomsen 2018; Refslund 2021). This could be

through threats of deportation or abusing workers' vulnerabilities of not speaking the local language or understanding local customs to ensure a low wage. There are concrete examples of this in Denmark, Ireland, and the United Kingdom (Djohari & White 2021; Murphy 2017; Arnholz & Hansen 2012). Furthermore, visa laws often result in situations where migrant workers are dependent on their employers to be able to stay in the country, and as such are vulnerable to abuse (Carpenter et al 2020). In some cases, this also restricts migrant workers from seeking other employment opportunities in the country, though this is often due to the specific nature of the fishing industry and may not be reproducible in the aquaculture industry. Furthermore, research shows that some labour rights abuses may go unnoticed, as they are not seen as anything serious (Djohari & White 2021). As such, more research on labour rights in the aquaculture industry is essential to understand the phenomena and protect workers.

1.3 Third-party certification in the aquaculture industry

Currently, one of the most used methods of protecting aquaculture workers' labour rights is through third-party certifications. Third-party certifications are intended to provide assurance to market actors and consumers that the products they buy are ethically sourced, environmentally or socially, according to what the certification measures, through independent certifiers not beholden to the supplier of the product being certified (CAL 2024). Examples are Fairtrade certification and Rainforest Alliance. In the aquaculture industry, the main certifiers are the Aquaculture Stewardship Council (ASC) and the Global Seafood Alliance's (GSA) Best Aquaculture Practices (BAP), awarding certification based on independent third-party audits. These two certifications cover the environmental impacts of aquaculture, as well as the social and labour impacts. Certifications are granted through audits of company worksites, where the company pays ASC or BAP to be certified (CAL 2024; ASC 2024; BAP 2024A). While BAP audits aquaculture farms, feed mills, hatcheries, and processors (BAP 2024B), ASC only audits the farms (CAL 2024), but the results of their audits are publicly available to ensure transparency (ASC 2024). Due to the publicly available data, I will work with and discuss ASC audits and certification.

While the certification standards are robust and well-encompassing regarding labour rights, actually enforcing them can be difficult (CAL 2024). Firstly, it can be difficult for auditors to uncover labour rights abuses due to the unwillingness of workers to speak with and air grievances to auditors, due to the fear of reprisal (CAL 2024). False records can also be a hindrance to effective auditing (CAL 2024).

The certification setup, where companies wishing to be certified pay for their audit, can also create a conflict of interest, due to the need for continued payment from the companies (CAL 2024). This may lead to auditors turning a blind eye to non-compliances, due to effectively having their wage paid by the companies they are auditing. CAL cites an auditor saying, "*Ultimately everybody wants money in the industry; nobody is working for the sake of betterment of workers*" (CAL 2024:71).

Lastly, audits are often scheduled in advance, with notice given to companies (CAL 2024; BAP 2024A). This gives the companies being audited the possibility of hiding away their worst non-compliances and ensuring that their workers do not share information on labour rights abuses with auditors (CAL 2024).

The required payment for audits also means that it is not feasible for small-scale aquaculture farms to be certified (Kruijssen et al. 2021). This means that while large-scale aquaculture operations can use the, sometimes lax, enforcement of the certifications they have acquired to hide their labour rights abuses and still retain consumer satisfaction, small-scale farms can be left behind, due to consumers being unwilling to buy non-certified products, as well as labour rights not being enforced on small-scale farms. This is especially a problem in the aquaculture industry, where a large portion of production is from small-scale producers (ILO 2021A).

With these problems, is there any use for audit based third party certifications? Critics urge the use of worker-driven initiatives and better enforcement of national labour laws as more effective alternatives to audits (Sparks et al. 2022; CAL 2024). However, certifications are already an integral part of the seafood industry and likely to remain a main visible market assurance that consumers can use to identify ethical products, which means they will continue to have a place. As such, it is vital to further strengthen and improve audit-based certifications, so that they, in combination with worker-driven initiatives and local law, can help ensure that labour rights are upheld.

Beyond the further usage of audits for certifications, certifications have historically been a main industry-led effort to limit labour rights abuses, and as such have produced a wealth of data which cannot be matched in its wide scope by the case studies that have been conducted. The wide nature of this data may lend itself to detecting identifiers of labour rights abuses not easily visible in case-studies. This could include correlations across environmental and labour rights dynamics, similar to the dynamic found in industrial fisheries, where forced labour is commonly found where there are cases of illegal, unreported, and unregulated fishing (EJF 2019). Using the extensive data from historical aquaculture audits to further improve the audits, as well as understanding, more generally, where and why labour rights abuses occur seems obvious. In this paper, I will therefore pose the following research question:

What variables can predict labour rights non-compliances in ASC audits, do these results match existing data, and can the results be explained through sociological theory?

Beyond the publicly available ASC audit data, I am collaborating with ASC, and have been granted access to their internal, more detailed data. This access to detailed data is also why I have chosen to work with ASC data instead of BAP data, despite ASC only focusing on farms. Limiting my scope to just farms rather than including processing facilities makes more sense due to the time constraints inherent to my thesis.

2 Method

To study the research question, I have decided to employ an inductive framework. I will create a prediction model based on the ASC dataset I have received, using XGBoost. Afterwards, I will use SHAP to see which variables in the dataset have the strongest influence on the predictions created by my model, and whether they predict compliance or non-conformity. After seeing the results, I will find appropriate sociological theory to analyse and explain why the most important variables may have the effect they do. Finally, if this does not give an adequately thorough explanation of the causal links between the variables and their effect on the prediction of compliance and non-conformity, I will in the discussion bring forth possible hypotheses explaining the connection, which I believe should be tested.

2.1 Data collection

The data I have used to examine my research question is ASC's data on the audit results of certified farms. As previously mentioned, ASC is a third-party standard holder, certifying aquaculture farms according to legal, environmental, and social parameters.

To understand the data, a quick explanation of ASC certifications and standards are required. Each ASC certification is conducted through an audit of the farm or farms covered by the certification. If they pass, the certification lasts for three years, with an annual inspection. Each audit is conducted according to an ASC 'standard', which lists the requirements which need to be fulfilled for a certification. These requirements are then graded on a scale of 'compliant', 'minor non-conformity', 'major non-conformity', 'critical non-conformity', and 'not audited/not applicable' (ASC 2025). 'Compliance' is when all the requirements are met. ASC defines a minor non-conformity as when a non-conformity does not bring the integrity of the certified problem into question (ASC 2025). This could be if the non-conformity is a singular occurrence or if it is non-systemic, and there is low risk of shipping non-conforming products. Major non-conformities can be classified as:

- A complete breakdown or absence of systems likely leading to failing to achieve the objective of the standard
- Resulting in the likely shipping of non-conforming products
- Hindering the ability of clients to assure the product's integrity
- Happening over a long period of time
- Is repeated or systematic
- Affecting a large area or creates significant damage

Critical non-conformities are if employees' lives are at risk, banned substances or medicine is found to have been used, or if non-certified products are sold as certified (ASC 2023).

A minor non-conformity can also be upgraded to a major non-conformity if they are not addressed within 3 months, or if the same minor non-conformity is found in two consecutive audits (ASC 2023). This applies if the non-compliance is found after the farm is certified, as if the non-conformity is found during the initial certification audit and not addressed within three months, the audit will be failed. Addressing a non-conformity within three months entails either effective corrections have been implemented to ensure conformity, or by applying for an

extension to how long they have to fix the non-conformity. Extensions are granted if the deadline to show improvement is too short, due to production cycle requirements, or if the non-conformity is due to circumstances outside the control of the farm (ASC 2023). Minor non-conformities can be extended a year, major non-conformities six months, and critical non-conformities 14 days, but only in exceptional cases. If a major non-compliance is found during the certification period, the certification will be suspended if the non-conformity is not addressed within three months. For major non-conformities found in the initial audit, they must be corrected within three months, or the audit is failed. As such, certifications can be granted before a major or minor non-conformity is corrected but will be retracted if there is no correction. This is not the case for critical non-conformities, where if found during the initial audit they must be corrected before certification is granted, and if found during the certification period, the certification will be suspended immediately and withdrawn if the non-conformity is not corrected within three months (ASC 2023). There are no critical non-conformities in the dataset.

Within each standard are many 'indicators'. These indicators are the specific individual requirements which are audited. Indicators are usually named along the convention of '1.1.1'. Not all indicators may necessarily apply to each farm. This will be explained further later. In this project I have used exclusively the 11 standards tied to different types of fish and shellfish, as well as the 'RAS Module' standard, which covers the requirements for a specific type of farm using a so-called 'recirculating aquaculture system' (RAS). These are used due to them being the most comparable, and the main focus of ASC. There are some further standards, such as a seaweed standard, which are not used in this dataset. This is because these standards are different from other standards, with very few aligned indicators. Other standards have been excluded due to insufficient data.

ASC is its own independent industry actor, and not directly related to other market stakeholders, as seen in some other certifications. This means ASC is not directly beholden to farm owners and helps ensure that bad grades are not as easily swept under the rug.

ASC uses independent certification bodies to conduct the audits, as it is not feasible to do this on their own. These certification bodies are commercial enterprises, earning money by being paid by the farms to conduct audits. This results in them walking a tightrope between diligently investigating compliance of the standards, so ASC, and certifier watchdog organisation Assurance Services International (ASI), will continue to keep their company on as certifiers, while not being so harsh that the farms do not rehire them. While not as bad as an industry stakeholder certification, this dependency on the farms by the certifiers can lead to less reliable audits.

Another source of unreliability of audits, is that audits are a snapshot picture of the situation on a farm. As previously stated, the CAL report has shown it was possible to obfuscate serious labour rights abuses, so auditors could not report on the non-conformities. This is made easier due to ASC regulations wherein the farms know of the audits before they are conducted. ASC states they do this to "*allow stakeholders to indicate their interest to be heard in audit process*" (ASC 2018:2). However, as seen in the CAL report, workers can be distrustful of auditors, or fear reprisals from employers after the auditor has left. This, along with examples of union representatives being obstructed from being interviewed, can also lead to incorrect audits.

There is also an inherent sampling bias in the audit data. As the data comes from ASC's certification audits, only farms where there is an attempt to comply, or at least appear to comply with the standards will request an audit to begin with. This means that the farms with the worst cases of labour rights abuses likely do not figure meaningfully in the dataset. Furthermore, due to the costs involved in being audited, most small-scale farms, especially family-owned farms, rarely have the money to pay for an audit, and as such do not figure in the data. Lastly, the dataset only includes data from certified farms, farms which have passed their audit, and excludes farms which have failed their audits. This further skews the sampling bias of the dataset, with the farms becoming almost a case study of the farms with the best conditions to eliminate labour rights abuses.

There are several different types of audits conducted by ASC, each conducted with a different purpose. 'Initial Audit' and 'Re-certification' are the initial full reviews of a certification cycle, determining whether a farm or group of farms will be certified for the next three years. The next two audit types, 'Surveillance 1' and 'Surveillance 2', are the annual sample audits, which check a smaller selection of indicators than the full audits conducted in the beginning of the cycle. Figure 2.1 below illustrates the overall steps of the audit process used to issue and maintain certifications.
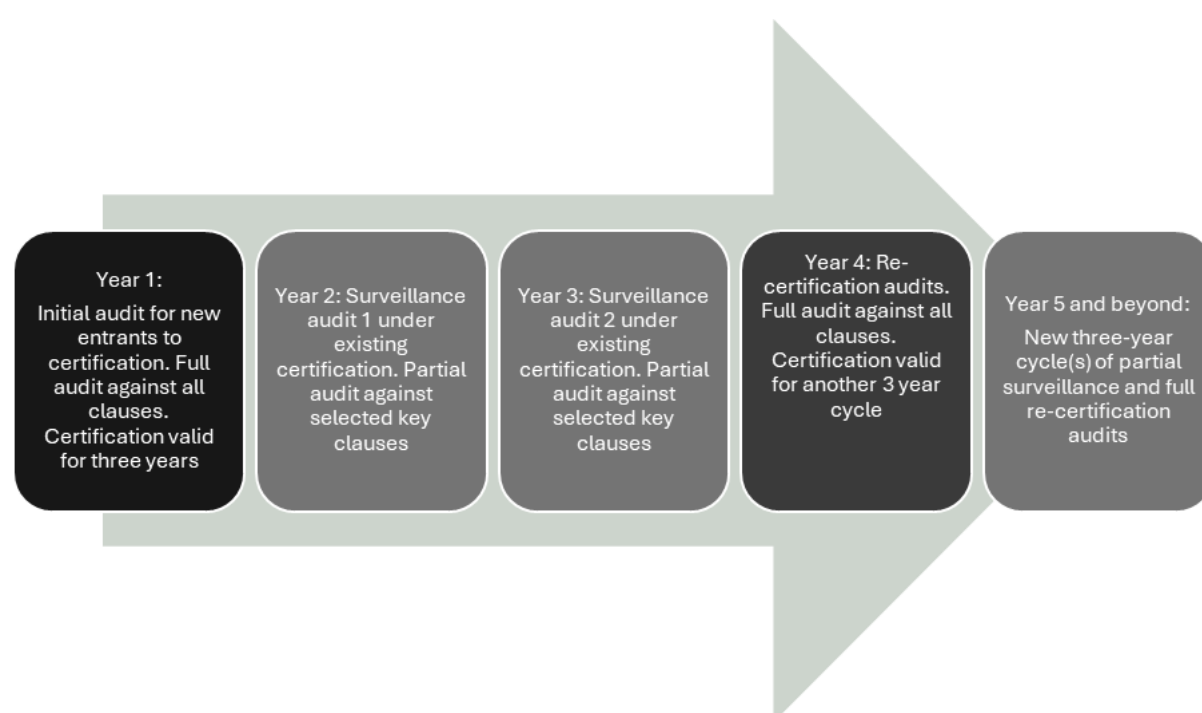
Fig. 2.1, ASC audit cycle

These different types of audits, where not all indicators within the standards are audited in each audit visit, creates a dataset with many missing variables. How this was handled will be discussed later.

The data collected is from the time period 2020 until the middle of 2024. It starts in 2020 due to the low amount of data recorded by ASC before this time period. This is both due to the number of farms certified, as well as the way in which ASC collected the data. Beyond more audits being conducted, my consultation with ASC revealed that the bookkeeping of audit data

has changed, which is one of the reasons for the lower amount of data. Further, the migration of data from one bookkeeping method to the other may have resulted in the corruption of some data entries. 2020 to 2024 of course includes the time period affected by the COVID-19 pandemic. The lockdowns resulted in different procedures used for the pandemic, which may have affected the integrity of the audits, though this is not certain. These procedures were allowances for remote audits, following International Accreditation Forum standards, or ASC's own in-house assisted remote auditing standard (ASC 2020). While the requirements for remote auditing are rigorous, it is still possible that shifting from in-person audits to remote audits could have an impact on the data collected through the auditing process.

2.2 Data Management

As mentioned previously, the way ASC migrated the data from one format to another may have damaged some of the data. This is likely why some datapoints had indicators which did not match with any indicators used in any standard. All data points which had indicators, which did not match indicators in the standards, as well as data from standards I decided not to use, was deleted. This resulted in cutting the amount of datapoints from 503.316 to 479.822 datapoints, organised in a long format.

After the initial pruning of the dataset, I needed to make the different standards comparable with each other. This is due to the indicators within the different standards not matching each other. As an example, 3.3.3 in the 'Seabass, Seabream, Meagre Standard' denotes the requirements for the allowable amount of fish escapes, while in the 'Pangasius Standard' 3.3.3 specifies the requirements for the amount of dissolved oxygen in the water, and in the 'Salmon Standard' 3.3.3 does not exist. To compare the different standards, I decided to use 'impact categories', which define what each indicator within the different standards measure. Information on how indicators are categorised into impact categories is included in appendix 10 These impact categories have been made, and are used by, ASC, and for the impact categories regarding the non-social compliance indicators, I decided to use them unchanged, as I have no technical knowledge of running or auditing aquaculture farms. These impact categories are:

- Legal

- Water quality

- Fish health management

- Community relations

- Impacts on the Seafloor

- Waste Management

- Habitat

- Wildlife & escapes

- Feed origins and Traceability

- Energy use & GHG

- Feed use efficiency

For the social impact categories, I decided to streamline the different categories into five categories, one for each of ILO's fundamental principles and rights at work. 'Forced labour', 'Child labour', and 'Health & safety' already existed as impact categories, however I created new categories for 'Discrimination' and 'Freedom of association'. To create these new impact categories, I went through the social indicators of each standard, to reassign them from the existing impact categories to more fitting ones. This was a minor exercise, as the indicators covering discrimination and freedom of association in most standards are similar to indicator 7.6.1 in the Pangasius Standard: "*Workers do not suffer any discrimination from the employer or other workers*". Beyond creating new social impact categories, there were several social impact categories beyond the five I have used, and as such the indicators they contained were redistributed into my five social impact categories. These redistributed social impact categories were:

- Fair and transparent wages

- Farmer well being

- Workplace discipline

- Working hours & overtime

- Labour contracts

While a few of the indicators within these impact categories were moved to one of the other four social impact categories, most were moved to 'Forced labour'. 'Forced labour' became in some ways a catch-all impact category for social indicators that did not fit specifically within one of the other social impact categories, This is the case, as while there are indicators specifically calling for no forced labour, most of the standard indicators not directly regulating one of ILO's five fundamental principles and rights at work are also forced labour indicators according to the ILO indicators of forced labour introduced above. An example is indicator 7.7.1 in the Bivalve Standard "*Incidences of abusive disciplinary practices occurring on the farm*". This indicator does not directly ban forced labour, but it bans one of the 11 ILO indicators of forced labour, and such falls under the 'Forced labour' impact category.

After the creation of the impact categories, the dataset was aggregated and flipped to a wide format, grouping by 'Audit ID' and using the impact categories as variables measured through the worst compliance grade achieved for each individual audit. This is also where I anonymised the 'Audit ID', by changing the identifying ID to an anonymous one, as requested by ASC. This also means, to ensure anonymity of farms, that 'Audit ID' is seen as a variable in the dataset used in the models, seen in appendix 8, while in the original data I received from ASC, seen in appendix 9, 'Audit ID' has been removed.

As previously mentioned, there were several instances of audits where only some of the indicators were audited, resulting in missing data. These audits were kept in the data set, to preserve as many audits as possible, and prevent the data set from becoming too small for analysis. Therefore, I decided to use data from previous audits to fill missing values where possible. As such, if a surveillance audit from 2022 is missing a value for 'Habitat', I would

see if the same farm had an audit in 2021 where 'Habitat' has been audited and has a value. If so, I use the 2021 value in the 2022 results. If there are no previous values, as seen in many audits from 2020, I left the value as missing. I decided that using the last known impact category value from a farm in later audits was acceptable, as I am not studying the farms' changes across time compared to themselves but using the audits as essentially independent observations to study correlations between variables.

Even after filling missing audit data with data from previous years, there were still many audits with many missing variables. To ensure missing variables would not affect my models too much, I decided to drop any audits with more than two missing variables, excluding the social impact category variables and 'Feed use efficiency'. For the latter, it is because 'Feed use efficiency' has so many missing variables I decided to exclude it from my models entirely.

I have decided to use the social impact categories only as dependent variables as they are likely to have the same underlying causes for non-conformity. This could influence the model negatively through internal feedback loops between social impact categories, simply reaffirming known correlations, for example between discrimination and forced labour. Therefore, I have only dropped audits missing values in social impact categories for the appropriate model. For example, if an audit is missing a value for 'Discrimination', but has a value for 'Forced labour', I would only drop the audit for the discrimination models.

To ease the use of the impact category variables, I changed them from string variables to float variables, by changing the text to a number. I changed 'missing' and 'N/A' to '0', 'compliant' to '1', 'minor' to '2' and 'major' to '3'. When used in the models, this was further converted to 'pd.NA' instead of '0' and only using '0' and '1', where 'compliant' is '0', major is '1', and 'minor' is '0' or '1' depending on which model is being run.

2.3 XGBoost

To create the prediction models, I used XGBoost. I have decided to use XGBoost, as it is a very effective supervised machine learning software library, which works best on structured data, such as my dataset (Mitchell 2017, NVIDIA 2025, Brownlee 2024). XGBoost is an "*optimized distributed gradient boosting library*" (XGBoost 2025), which uses algorithms derived from gradient boosting.

Gradient boosting is a type of ensemble machine learning, where many weak learner models, i.e. models which are just slightly more accurate than guessing (Brownlee 2024), are combined to create one strong model (Mitchell 2017). XGBoost defaults to using decision trees as its weak model (Brownlee 2024). Another example of ensemble machine learning is random forests. The difference between random forests and gradient boosting is how they use the many weak learner models. Random forests use 'bagging', where the weak learner models are constructed as parallels to each other, while gradient boosting uses 'boosting', where the weak learner models are constructed sequentially (NVIDIA 2025). This allows gradient boosting to have each weak model account for residual errors of the previous weak model (Mitchell 2017). When comparing the sum of squared errors, the error decreases with each weak model added (Mitchell 2017). This is because the residual is the negative gradient of the loss function, and when weak models adjust to these residuals, it is a "*gradient descent algorithm on the squared*

error loss function for the given training instances" (Mitchell 2017), minimising the loss function to the minimum possible with a given dataset.

XGBoost has several optimisations, which differ from other gradient boosting. The first is that it uses parallel processing on the individual decision trees, allowing it to train the prediction model faster (Brownlee 2024). A second major improvement is in the loss function used, which in XGBoost includes regularisation terms, where the loss function adds a penalty for each added leaf in a decision tree (Mitchell 2017). This is done to reduce overfitting of the prediction model.

2.4 SHAP

After the construction of the prediction models, I used SHAP to find which of the variables used in the prediction models had the highest feature importance. Feature importance is a measure of each inputted variable's importance to the model's prediction (Brownlee 2024). I then used SHAP to see what influence the different answers within a variable had, whether they indicated compliance or non-conformity in the output for each prediction model.

SHAP uses Shapley values, a method of measurement originally from coalition game theory (Molnar 2025). Shapley values measure "*the average marginal contribution of a feature value across all possible coalitions*" (Molnar 2025). A coalition is a group of fixed features, where the features outside the coalition are randomised. For each feature in the model, to determine the marginal contribution, every possible coalition is used to get a prediction from the machine learning model, once where the measured feature is set and once where it is randomised (Molnar 2025). The marginal contribution is the difference between the predictions for each coalition when the measured feature is set and randomised, and the Shapley value is the average of all the marginal contributions for a feature and shows what effect the different features had on the prediction model (Molnar 2025).

When using SHAP, it is important to remember that it shows correlations found in the prediction model, and not causations (SHAP et al. 2025). For this project, it means the variables which have a strong influence on the model are indicators of either compliance or non-conformity in the given social impact category but does not necessarily cause compliance or non-conformity. The causal link between the indicator and the social impact category must be found through theory and existing research.

3 Results

The predictions of the classifier models have proven not to be very accurate. The overall precision and recall scores of the models are low. Recall measures how many actual 'positives' in the data are classified as 'positives' (Kashyap 2024). Precision measures how many positive predictions are actually positive, i.e. how many predicted non-conformities are actual non-conformities. F1-scores are a combined score of precision and recall (Kashyap 2024). These are all scored between 0 and 1, with 1 indicating better performance of the model.

The worst performers are the two models on child labour, as well as the models on discrimination and freedom of association, counting only major non-compliances. These four models have precision and recall scores for non-compliances of 0.00, which means they categorise everything as compliant, and as such are not useful at all. As such, further analysis of the impacts from variables in these models cannot accurately be done, and the results of the models will be excluded from here on out.

The precision and recall scores for non-compliances of the other models are also quite low, with only the models for forced labour and health and safety which include minor non-compliances having higher recall scores than 0.50 for their non-compliances. The remaining models have F1-scores of 0.42 for the forced labour and health and safety models counting only major non-compliances, 0.35 for the discrimination model including minor non-compliances, and lastly 0.25 for the freedom of association including minor non-compliances. The full results can be seen in table 3.1. This table also shows why some of the models failed, which was due to the low percentage of non-compliant grades in the dataset. The models which completely failed to identify non-compliances had less than two percent non-compliant audits in the dataset, while the best two models had 35 and 43 percent non-compliance rate.

These low model precision and recall scores mean that analysis of what variables have a large impact is rather speculative, and as such I will focus mainly on the one variable which in all models has been found to have the largest impact by a significant margin, namely 'Country'. The impact of each variable for each classification model is shown in summary plots. An example of these plots can be seen in model 3.1, showing the summary plot for the model for forced labour with minor non-compliances. The summary plots for the rest of the models can be found in appendices 1 to 6, which are organised by prediction model.

Model	Non-compliant %	Accuracy	Compliant precision	Non-compliant precision	Compliant recall	Non-compliant recall	Compliant F1-score	Non-compliant F1-score
Forced labour (minor)	35,28	0,71	0,73	0,67	0,84	0,52	0,78	0,59
Forced labour (major)	12,47	0,84	0,89	0,50	0,93	0,36	0,91	0,42
Discrimination (minor)	7,87	0,90	0,92	0,51	0,97	0,26	0,94	0,34
Discrimination (major)	1,12	0,98	0,98	0,00	1,00	0,00	0,99	0,00
Child labour (minor)	1,74	0,98	0,98	0,00	1,00	0,00	0,99	0,00
Child labour (major)	0,24	0,98	0,98	0,00	1,00	0,00	0,99	0,00
Health and safety (minor)	42,70	0,67	0,66	0,68	0,77	0,55	0,71	0,61
Health and safety (major)	14,12	0,82	0,87	0,48	0,91	0,37	0,89	0,42
Freedom of association (minor)	4,54	0,94	0,96	0,39	0,98	0,18	0,97	0,25
Freedom of association (major)	0,49	0,99	0,99	0,00	1,00	0,00	1,00	0,00

Tabel 3.1 shows the percentage of audits which were non-compliant in the dataset for each prediction model, the overall accuracy of the prediction models, as well as the precision, recall, and F1-scores for compliant and non-compliant labels in the prediction model.
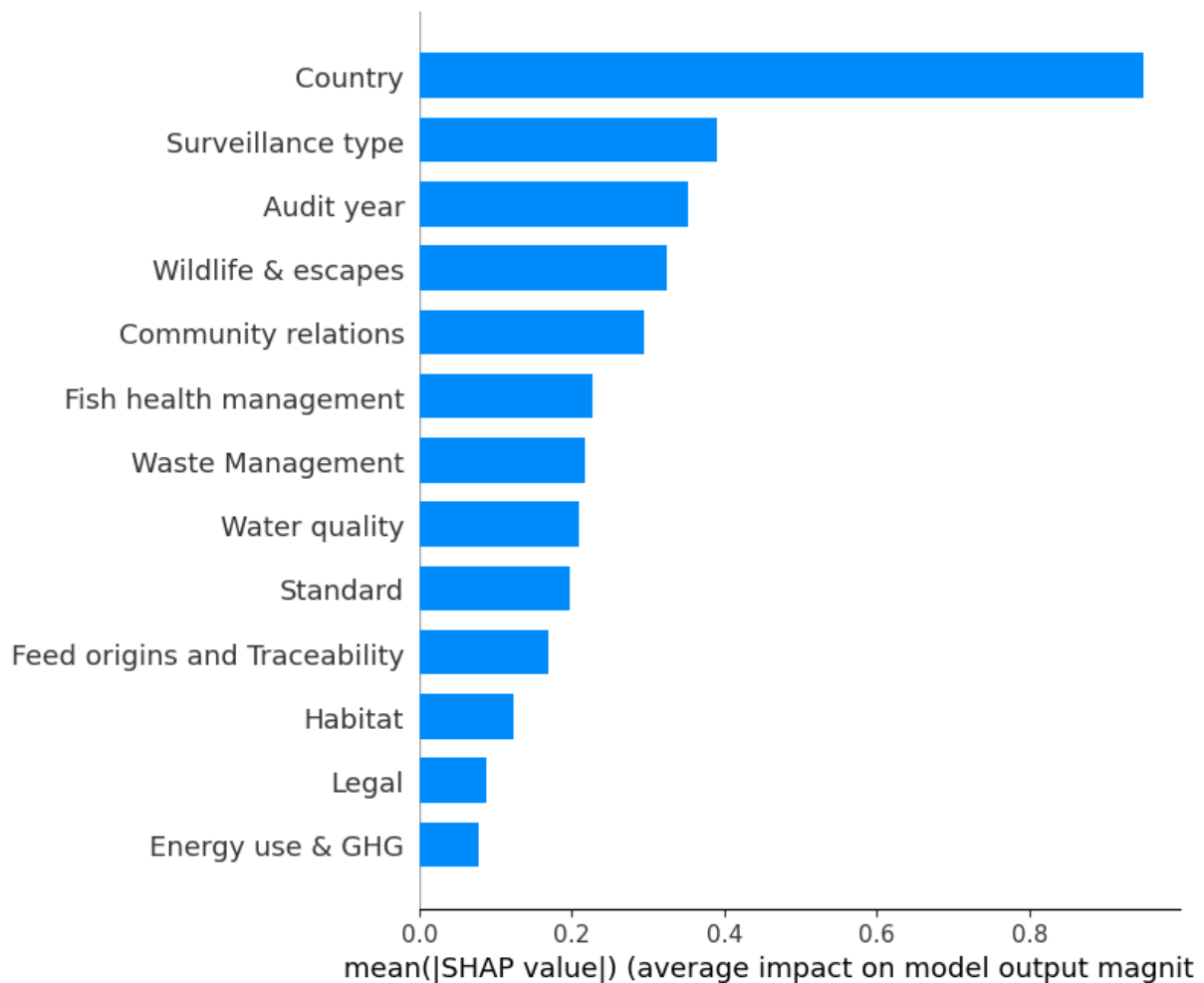
Model 3.1 shows the SHAP values of each variable, measuring the impact of each variable on the predictions of whether an audit is compliant within the impact category 'Forced labour', when counting minor non-compliances as non-compliant.

Beyond the most important variable, 'Country', two other variables are shown to often be among the most important variables. 'Audit year' and 'Surveillance type' are the third and second most important variables respectively in the two forced labour models and the freedom of association model including minor non-compliances, with 'Audit year' being second most important for the discrimination model including minor non-compliances and the health and safety using only major non-compliances. 'Surveillance type' is also the third most important variable in the health and safety model including minor non-compliances. Beyond these, the model for discrimination with minor non-compliances weighs 'Wildlife & escapes' as the third most important variable, the health and safety model with minor non-compliances weighs 'Water quality' as the second most important variable, while the health and safety model with only major non-compliances weighs 'Waste management' as the third most important variable. Due to 'Country' being the overwhelmingly most important variable, I will focus on that aspect in the results and analysis. I will also describe 'Audit year' and 'Surveillance type' later in the results paragraph. Finally, it is worth noting that if enough of the less important variables all pull the prediction one way, it can become more important as a group than just 'Country'.

There are 57 different countries present in the original dataset, which is cut down to 47 after data management. Most of these countries, however, have less than ten audits, and only five

have more than 100. As such, I will focus my results and analysis on those five: Norway, Chile, Vietnam, India, and Ecuador. I will also include the United Kingdom (UK) as a sixth, so I have another Western European nation in the analysis, to compare with Norway. There are 98 audits from the UK in the dataset. The impacts of all countries can be seen in SHAP models, such as model 3.2 showing the impact of different countries on the discrimination model which includes minor non-compliances. The rest of the models can be seen in appendices 1 to 6.

In general, Norway is an indicator of compliance with the social indicators of the standards, with only the predictions from the health and safety model including minor non-conformities giving a roughly even spread of whether Norwegian audits are compliant or not.

As opposed to Norway, the UK is consistently an indicator of non-conformity, with the exception of the model for freedom of association including minor non-conformities. In the other five models, the SHAP analysis shows the UK as the biggest indicator of non-conformity of the six countries, except in the forced labour model including minor non-compliances, where India and Ecuador are the biggest indicators of non-conformity.

India is also an indicator of non-conformity in every model, except the model for freedom of association including minor non-conformities. Ecuador, on the other hand, varies more, often has a relatively even spread in the SHAP models, though often leaning slightly towards non-conformity.

Chile mainly skews towards being compliant, except when Chile is a clear indicator for compliance, i.e. it indicates compliance to a greater degree than the country does in general. Clear indication of compliance concerns the freedom of association model and the health and safety model for major non-conformities.

Lastly, Vietnam mostly has an even spread of results around 0 in the SHAP models, which means there is little effect on the prediction, and as such Vietnam does not indicate either compliance or non-conformity. There is an exception with regards to the forced labour models, where Vietnam is a slight indicator of non-conformity. In the discrimination model, Vietnam has a very wide spread in the SHAP model, which on the whole leans toward compliant.

The results showing the impact of the six countries was somewhat surprising, especially comparing the UK to India, given the findings of existing research done into aquaculture in India. As such, to double check the results, I made simple crosstables, found in appendix 11, to see the numbers of compliant, minor non-compliant, and major non-compliant grades each of the six countries have received, for each of the social impact categories. The numbers seen in these tables match the results of the SHAP analysis of the countries' effect on the model. This will therefore be one of my main focus areas in the analysis.
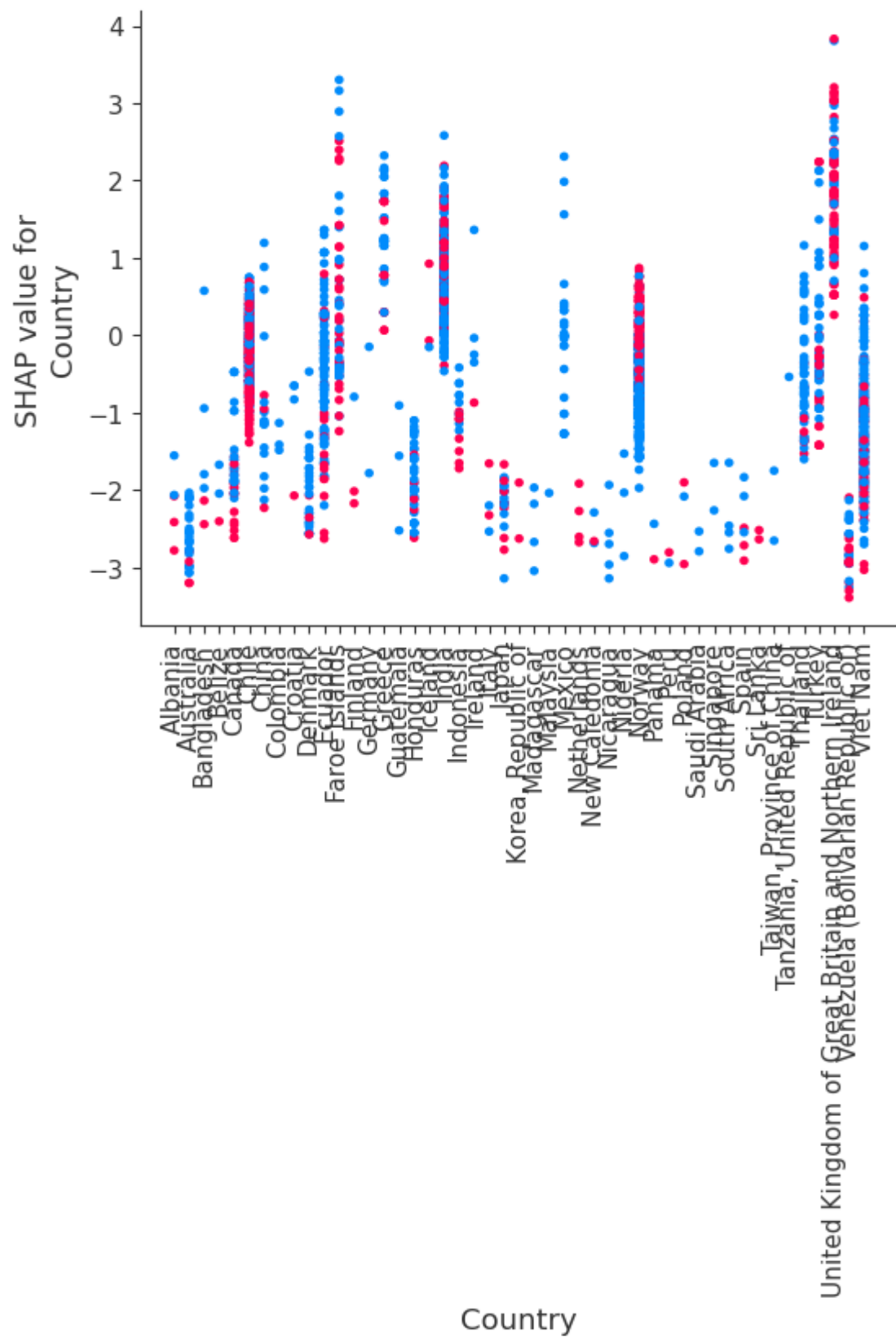
Model 3.2 shows the distribution of SHAP values for each audit, organised by country. Each dot represents an audit, if the number is high, then the audit was more likely non-compliant in the 'Discrimination' impact category. The colours of the dots do not matter.

In general, there does not appear to be as clear a pattern in the impacts of 'year', as there is from the counties. 2020 indicates non-conformity in the health and safety models and the discrimination model, while it indicates compliance in the model on major forced labour non-conformities, as well as in the freedom of association model. The SHAP values are roughly equal in the forced labour model including minor non-conformities.

2021 is an indicator of compliance in all models except for freedom of association, where the SHAP values were equally spread around 0. This is the only model where there seems to be a consensus across the models.

2022 saw compliance in the freedom of association model and the forced labour model including minor non-conformities. The health and safety models and the major forced labour non-conformities model predicted non-conformity for 2022 audits, and the discrimination model had an even spread of predictions.

The models for major forced labour non-conformities, discrimination, and health and safety including minor non-conformities had an even spread of predictions in 2023, while 2023 was a predictor of compliance in the model for major health and safety non-conformities as well as the freedom of association model. 2023 is only a predictor or non-conformity in the model for forced labour including minor non-conformities.

Lastly, 2024 is a predictor of compliance in the models for major health and safety non-conformities, discrimination, and forced labour including minor non-conformities. The predictions are even in the model for major forced labour non-conformities, while 2024 is a predictor for non-conformity in the freedom of association model and the model for health and safety including minor non-conformities.

Beyond these results, the SHAP models show that the audits in 2021, 2022, and 2023 appear to be more grouped than those in 2020 and 2024, with especially 2024 being very spread out. This could be because there are fewer audits in these two years in the dataset. The data management cut off many audits in 2020, and the dataset only runs to mid-2024, resulting in 244 and 236 audits from 2020 and 2024 respectively. 2021, 2022, and 2023 each respectively have 739, 861, and 1015 audits in the dataset.

I will not conduct further analysis on the variable 'year', as it would need a better dataset and different data management to fully understand the impact of 'year'. While the results show some importance, we cannot know for certain if this is accurate due to my choices in data management. My choice to reuse data from previous years to fill out missing data means results for 'year' are inherently compromised and are not likely to be accurate. The extent of the inaccuracies is unknown and would require another study with different data management.

Regarding 'Surveillance type', I will only look at the values for 'Initial Audit', 'Re-certification', 'Surveillance 1' and 'Surveillance 2', as none of the other values have more than 12 occurrences in the dataset. The SHAP results show that the initial audits are more likely to be non-conforming in all four models which include minor non-conformities, while being compliant in the health and safety model featuring only major non-conformities and being equally likely to be compliant and non-conforming in the model for major forced labour non-conformities. This is almost matched by the SHAP results for re-certification audits, where the

model for major forced labour non-conformity and the freedom of association model joins the health and safety model featuring only major non-conformities as being indicative of compliance. In the other models, re-certification is indicative of non-conformity.

The two surveillance audits seem to have a less pronounced impact on the predictions. For surveillance 1 audits, audits are equally likely to be compliant and non-conforming in the health and safety model featuring only major non-conformities and the forced labour including minor non-conformities model. The models for health and safety, including minor non-conformities and freedom of association, show surveillance 1 as more likely to be compliant, while surveillance 1 is more likely to be non-conforming in the discrimination and major forced labour non-conformity models.

The results for surveillance 2 are even less pronounced, with both forced labour models, the freedom of association model, and the health and safety model featuring only major non-conformities all viewing surveillance 2 audits as equally likely to be compliant and non-conforming. Only in the discrimination model is surveillance 2 is a predictor of compliance, and only the health and safety including minor non-compliances is a predictor of non-conformity.

As such, we can see a stark difference between initial and re-certification audits, and surveillance audits in how much of an impact they have on predictions in the XGBoost models. It is, however, quite likely that the data collection and management has played a role in this difference. This is, again, due to the filling-in of missing data with data from other years, as the missing data is mostly found in the surveillance audits. As mentioned, surveillance audits only audit a set number of indicators in the standards, while certification and re-certification audits go through all indicators in the standards. As such, much like analysing 'year', a new study with different data management is required to properly research the impact of 'Surveillance type'.

Lastly, the independent variables which have values of compliance and non-conformity, such as 'Water quality' and 'Wildlife & escapes', can largely be grouped together. A majority of the SHAP models for these variables, across the results from the different classification models, show that compliance in the indicators within each impact category is an indicator of compliance with the social impact category. An example is 'Water quality' results from the health and safety including minor non-conformities model, as seen in model 3.3. All other SHAP dependence plots can be seen in appendices 1 to 6. As mentioned, enough of these smaller impact variables all indicating compliance can stack up to negate the non-conformity indication from 'Country', or vice versa.
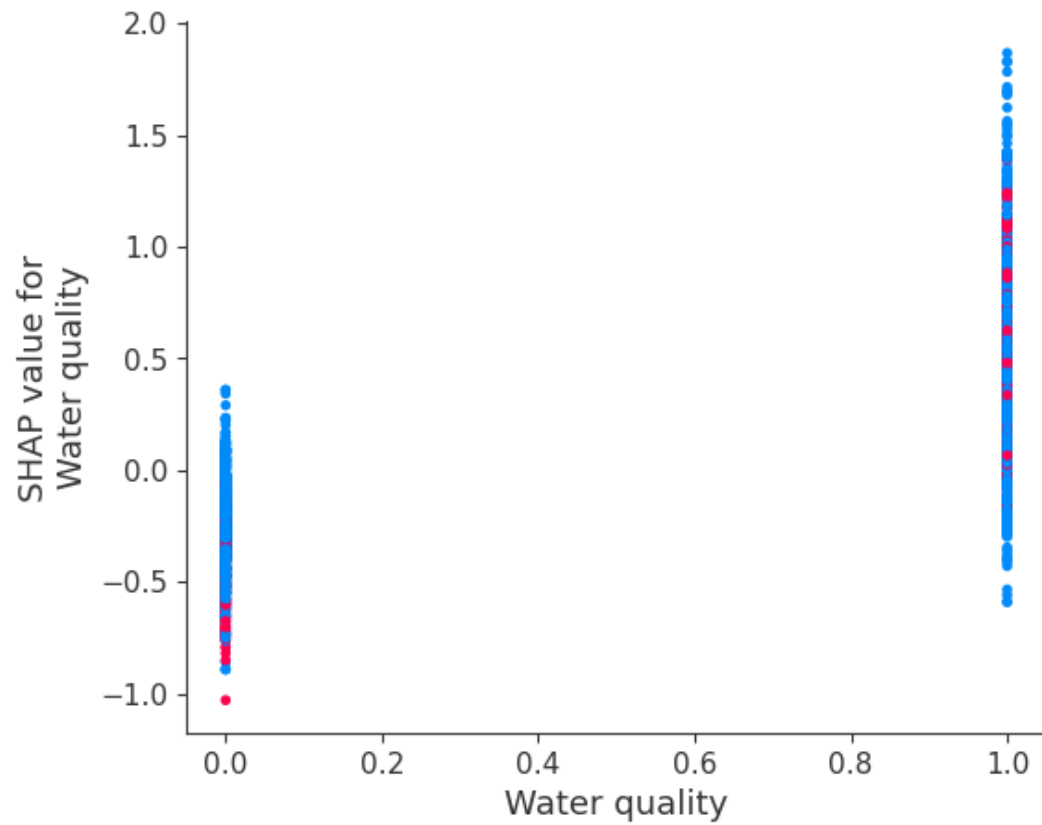
Model 3.3 shows the distribution of SHAP values for each audit, organised by the audit result for the 'Water quality' impact category. Each dot represents an audit, if the number is high, then the audit was more likely non-compliant in the 'OHS' impact category. The colour of the dots does not matter.

4 Sociological theory

To analyse the results and help understand why different countries have a given effect on the chances of non-conformity with social standards, I will use Guy Standing's theory on the precariat (Standing 2011; 2014), and Damian Grimshaw's work on protective gaps (Grimshaw et al. 2015). Research and theory have shown that members of the precariat are more vulnerable to labour rights abuses and have less recourses to address labour rights abuses. As such, I will use Standing's work to help identify the risk of a precariat working class in the aquaculture industry, and to define how a possible precariat is likely vulnerable in the aquaculture industry. To help understand what the sources of precariousness are, I will use Grimshaw et al.'s four protective gaps.

4.1 Standing's theory on the precariat

Standing has identified 10 characteristics of the precariat class, which describes how the unique situation of the precariat, and show some of the vulnerabilities, as well as some of the strengths, of the class (Standing 2014). A member of the precariat does not necessarily have to conform to all 10 characteristics, and several of the characteristics can lead workers to be vulnerable to labour rights abuses in and of themselves.

The first characteristic of the precariat is an unstable relation to labour. The precariat is often employed on short-term contracts and has few guarantees of long-term work. This leads to members of the precariat often experiencing unemployment. This labour insecurity goes hand in hand with unstable living conditions, such as unstable housing access. As such, the precariat is in a constant state of transiency, which leads them to seek stability and security outside the workplace, unlike the proletariat who gained stability from long-term employment (Standing 2015). Day labourers are a clear example of this characteristic, not knowing whether they will earn any money one day to the next.

Secondly, when members of the precariat are employed, their forms of remuneration have been reduced to just wages (Standing 2014). This means that the precariat has lost access to employment benefits such as paid vacation, pensions, parental leave, or sick leave. Beyond the labour market, the precariat is also unable to gain economic capital through other means than work, for example from accruing interests.

The precariat usually also has fewer de facto rights within society than other social classes (Standing 2014). The state often does not support the precariat at all, cutting access to public services. Standing describes the precariat as 'denizens' rather than 'citizens'.

These first three characteristics can be a direct reason for the next characteristic, which is uncertainty (Standing 2014). The precariat is not protected by social insurance against risks, such as sickness or unemployment, and it is difficult for members of the precariat to prepare themselves for these risks. Uncertainty is "unknown unknowns" (Standing 2014:26), where the precariat "*cannot calculate the probability of an adverse event*" (Standing 2014:26). The precariat class is thus subject to more uncertainty than other social classes and has less ability to weather unforeseen risks.

The fifth characteristic is that the precariat has little control over their time (Standing 2014). This includes both the inability to plan out when those belonging to the precariat can use their

time, and for what, as well as having to do a lot of unpaid work to be able to find paid work. Day labourers are once again an example, as they never know when they have to work. Moreover, day labourers have to be able to work at any time they are called upon. Unpaid work which is needed to find paid work could be continuous networking for job opportunities.

Next, the precariat has very low social mobility (Standing 2014). This is a characteristic shared with the proletariat, and exists despite the seventh characteristic, over-qualification. Many members of the precariat are educated to a degree much higher than needed for the jobs they work and cannot bring their skills to bear in the workplace (Standing 2014). An example could be migrant workers and refugees whose education is not certified in their new country, resulting in them being unable to use their education to find relevant jobs.

Standing finds that members of the precariat have a lack of occupational identity, where their occupation gives no anchor in life, no status, and no understanding of one's lifetime trajectory (Standing 2014). This can lead to frustrations, anxiety, and uncertainty about the future, even amongst the employed precariat. This goes hand in hand with the ninth characteristic, a detachment from labour, where the precariat is alienated from the notion of their work being something commendable or a route to happiness. Rather, work is seen as something just done for the money (Standing 2014). Standing claims this can actually be a liberating feeling for the precariat, a good thing which leads the precariat to find their life and sense of worth outside of their work.

Finally, the last characteristic is the presence of poverty and precarity traps in the life of the precariat (Standing 2014). These traps occur when members of the precariat find that accepting jobs actually makes their situation worse and creates a vicious cycle enforcing their vulnerabilities and keeping them within the precariat. A poverty trap could be acquiring a low-paying job, which results in the worker taking home less money than if they had stayed on unemployment benefits. This can happen despite the job paying more in wages than benefits, due to the costs associated with having work, such as transport to the worksite. Often, the precariat must accept these jobs, as they will lose their benefits if they decline the job. This can also become a precarity trap, where low-paying, low-status jobs on the resume leads to difficulty later when trying to apply for higher-status jobs (Standing 2014). Another precarity trap is the inability to move for jobs, due to the inability to acquire housing.

In the analysis, I will apply Standings definitions of the precariat to the results to explore whether aquaculture workers belong to the precariat in the six countries included in the analysis.

4.2 Grimshaw's protective gaps

Grimshaw et al. (2015) described 4 protective gaps which can contribute to workers being more vulnerable to labour rights abuses. These gaps relate to employment rights, representation, enforcement, and social protection and integration. This is another way to try to uncover precariousness for workers.

The first protective gap is the employment rights gap. This refers to legislation, or lack of legislation, which results in workers, who are often part of the precariat, being more vulnerable to exploitation (Grimshaw et al. 2015). An example of this could be different minimum wages

for local and migrant workers, as seen in the Taiwanese fishing industry (Yen & Liuhuang 2021).

Representation gaps exist when workers have no representation, such as through labour unions (Grimshaw et al. 2015). A lack of representation can result in a weakened ability to call attention to labour rights abuses, and less help in righting abuse.

The third protective gap, enforcement gaps, are the inability to effectively enforce legislation (Grimshaw et al. 2015). This could be due to insufficient coverage by enforcement agencies, or lack of power to enforce laws. Examples of insufficient coverage are corrupt officials, covering up labour rights abuses, or a lack of labour inspectors, leading to the inability to sufficiently uncover labour rights abuses at all worksites. Lack of power to enforce laws is exemplified by the agencies conducting inspections being legally unable to levy sanctions on abusers, or the justice system being unable to prosecute abusers.

Lastly, social protection and integration gaps refer to situations where people are left outside social welfare protections, such as limited or no access to the healthcare system, or lack of employment benefits.

5 Analysis of the results

5.1 Comparison of model results with other findings from other research

To analyse the results and answer the research question, I will start by analysing how the results of the models match existing research on labour rights in each country's aquaculture industry. As previously discussed, aquaculture is a relatively under-researched industry, especially in regard to labour rights, so research from the agriculture and fishing industries will be used to cover gaps in knowledge. These two industries are the two which are most comparable to the aquaculture industry in terms of economic structures and the nature of work. Moreover, in statistical classifications these three sectors are commonly combined into one "primary economic sector" (UNESA 2008). In the presentation of other research at country level, I focus on evidence related specifically to the fundamental principles and rights at work as defined in the introduction, namely:

- Freedom of association and the effective recognition of the right to collective bargaining;

- Elimination of all forms of forced or compulsory labour;

- Effective abolition of child labour;

- Elimination of discrimination in respect of employment and occupation; and

- A safe and healthy working environment.

5.1.1 Ecuador

Research on labour rights in Ecuador has documented multiple cases of child labour, especially in rural areas. Moreover, research has found major breaches to the right to freedom of association and collective bargaining. This is exacerbated by poor law enforcement and high levels of organised crime, as well as limited resources to combat labour rights abuses, including a lack of labour inspectors. Furthermore, there are several credible allegations of corruption among government officials, including labour inspectors accepting bribes to overlook labour rights abuses (MBA 2025).

A 2022 study found that over 270,000 children are currently engaged in child labour in Ecuador (Machado & Castillo 2022), which amounts to 7.1% of children between five and 14 years of age. The study found a stark urban and rural divide, with 1.5% of urban children engaged in child labour, while 18.5% of rural children are (Machado & Castillo). This confirms findings in a 2012 study, which found around 360,000 children age five to 17 years, or 8.56% of all children in Ecuador, engaged in child labour. This study also found a five times higher rate of child labour rural areas, compared to urban areas. More than half of the child labourers in 2012 were involved in hazardous work. The agriculture and livestock industries are the two sectors with the highest child labour rates and, with 90% of children working in those sectors not receiving payments.

A possible indicator of forced labour and discrimination found in Ecuador is the low pay and informal work status of migrant workers. Venezuelans in Ecuador are informally employed at a rate of 79%, and 86% earn 84 US dollars per month or below, which is the 2020 Ecuador national poverty line (MBA 2025).

In 2024, the Global Rights Index named Ecuador as one of the ten worst countries in the world for workers. There are several incidents of workers trying to join or form unions being fired, with some even receiving death threats, showing definite violations to the right to freedom of association and the effective recognition of the right to collective bargaining (ITUC 2025).

There is very little information pertaining specifically to the Ecuadorian aquaculture industry. The US Department of State 2024 TIP report claims to have found forced labour in the Ecuadorian shrimp farming industry; however, the report does not provide detail on these violations but rather violations found in the fishing industry. Hence it is hard to draw conclusions on the accuracy of the claim. Beyond the TIP report, there are only anecdotal testimonies from 32 unionised shrimp farm workers linking the industry to labour rights abuses. These testimonies, from 2021, tell of excessive working hours and low pay, and that women in the industry face sexual harassment (MBA 2025).

Lastly, studies have found that criminal organisations in Ecuador have been preying on the shrimp industry. This has led to extortion, assaults, and even murder of shrimp farmers, who have little protection from the underequipped national authorities (MBA 2025).

Summing up, evidence of labour rights abuses in the aquaculture industry is scarce and the picture therefore incomplete. There is however evidence of violations to fundamental rights at work in adjacent industries and Ecuador as a whole, which combined with anecdotal evidence from the aquaculture industry suggest the presence of labour rights violations in aquaculture workplaces. As such, the results seen in the models do seem to match what is known about labour rights in the Ecuadorian aquaculture industry, with the exception of the model on freedom of association, where Ecuador does not indicate non-conformity, contradicting ITUC reports. Further, the presence of child labour in Ecuador suggests there should be more cases than what is present in the dataset.

Impact category	Research and evidence	ASC audit minor NCs	ASC audit major NCs
Elimination of forced labour	Refugees and migrant workers vulnerable to exploitation, indicators of forced labour present	Heavy indication of non-conformity, grouped between 1,5 and 4	Indication of non-conformity, grouped between -0,25 and 2
Elimination of child labour	Child labour documented in rural areas. No specific information available for aquaculture	N/A	N/A
Non-discrimination	Limited evidence, but possibly discrimination of migrant workers	No clear indication either way, grouped between -1 and 1, but with more outliers indicating compliance than non-conformity	N/A
Freedom of association and collective bargaining	Persecution of union members and representatives at severe level	No clear indication either way, grouped between -1 and 1, with more outliers towards 2 than -2	N/A
Safe work/OSH	No information found	Indication of non-conformity, with main group between 0 and 2, and much smaller group around -0,25	No indication either way, grouped between -1 and 1, but with outliers towards 2

Table 5.1 shows existing evidence from other research in Ecuador, and results of the models.

5.1.2 Chile

There is very limited research and evidence on working conditions and labour rights in the aquaculture industry in Chile.

The US Department of State and the US Department of Labor have found cases of forced labour and child labour in the fishing and aquaculture industries, but there is little corroborating evidence (USDOS 2024A). There is no direct evidence for forced labour or child labour in Chilean salmon farming, the major product of Chilean aquaculture, and the main farmed species in the dataset used for this thesis. The labour right infringements in the industry are mostly in regard to discrimination and health and safety, as described in the introduction (Fuentes et al. 2021). There is evidence of some forced labour indicators as well, regarding working hours, sexual harassment, violence, and verbal threats though these cannot, in isolation, be equated to the actual presence of forced labour. The workers are often subcontracted or on temporary contracts, which also leaves them more vulnerable to labour rights abuses (Fuentes et al. 2021).

The ITUC Global Rights Index rates Chile as "3" on a scale from 1 to 5. "3" corresponds to regular violations of workers' rights (ITUC 2025), indicating breaches to workers' rights in general, though not specifically in the aquaculture industry.

There is also some research on occupational safety and health in salmon farming in Chile. A recent publication (Cavalli 2025) points to risks associated with diving in the industry, such as drowning and illness, and exposure to toxic substances, particularly in the event of algae blooms and salmon mass mortality events, occurring from time to time in the salmon aquaculture in Chile. Fatal incidents among divers removing dead fish from net pens in open waters are also documented by Fuentes et al. (2021).

Summing up, there is limited evidence of vulnerable workers, notably migrant workers and informally employed workers outside coverage of the labour laws, being subject to labour rights violations. Violations include violence, sexual harassment, discrimination and unsafe working conditions in the Chilean salmon industry. The evidence on forced labour is inconclusive and there is no evidence pointing to widespread existence if child labour in the industry. Hence, the most clearly documented rights breaches concern safe work. As the models in this thesis show Chile as a clear indicator for compliance on OSH, the limited available evidence and the models contradict each other. On other impact categories, Chile mostly skews slightly towards compliance, and given the limited evidence available it is not possible to test the accuracy of the models against the available evidence.

Impact category	Research and evidence	ASC audit minor NCs	ASC audit major NCs
Elimination of forced labour	Indicators of forced labour among vulnerable migrant workers from, e.g. Haiti, documented in one study	Slight indication of compliance, grouped between -1 and 0.5	Slight indication of compliance, grouped between -1.5 and 0.75
Elimination of child labour	No information found	N/A	N/A
Non-discrimination	Possible discrimination against migrant workers	Slight indication of compliance, grouped between -1.5 and 1	N/A
Freedom of association and collective bargaining	Some restrictions on the right to organise	No clear indication either way, grouped between -1.75 and 1.75	N/A
Safe work/OSH	Occupational accidents, including drowning; exposure to harmful substances	Clear indication of compliance, grouped between -1.75 and 0.25	Heavy indication of compliance, grouped between -2 and 0

Table 5.2 shows existing evidence from other research in Chile, and results of the models.

5.1.3 Vietnam

Vietnam is a country which has seen improvement in some areas of workers' rights but still has significant issues in combating labour rights abuses. While a relatively low poverty rate helps safeguard against high numbers of vulnerable workers, there have been several examples of human trafficking leading to forced labour and child labour in Vietnam, resulting in Vietnam being downgraded to tier 3 in the US Department of States 2022 TIP report (USDOS 2022). Forced labour is mostly seen in the informal sector as well as rural industries, such as agriculture, but there is no direct evidence of forced labour in the aquaculture industry (ILAB 2025).

In response to these problems, the Government of Vietnam has attempted to end trafficking and labour rights abuses by updating legislation in 2021 and introducing a nationwide programme to safeguard vulnerable workers in 2023. These initiatives, among others, have resulted in Vietnam's tier 2 status being restored in the 2023 TIP report (USDOS 2023).

Vietnam has conducted two national child labour surveys, which show a decrease in child labourers involved with hazardous work from 1.3 million in 2012 to half a million in 2018. Of these children, almost 15,000 work in the aquaculture sector. The number of child labourers in aquaculture fell by 18% from 2012 to 2018. Child labourers are often seen in family-owned, small-scale farms, which rarely have the economical capacity to apply for ASC certification, and as such are not part of the dataset (ILO & MOLISA 2020).

According to the ITUC Global Rights index, there are restrictions on workers' rights to freely form and join trade unions and to bargain collectively, amounting to systemic violations of rights, corresponding to a "4" rating on the scale from 1 to 5+ (ITUC 2025).

Research from shrimp aquaculture in Vietnam tends to focus on environmental impacts of farming practices, e.g. effluents, rather than the occupational safety and health implications of farming practices. I was unable to identify research or other evidence on safe work in aquaculture in Vietnam.

Evidence from Vietnam related to child labour is thus relatively robust, but concerns activities not included in the dataset used for this thesis. Hence, there is no evidence of widespread child labour in large commercial aquaculture farms in Vietnam and as such, there is no evidence that child labour is widespread enough to register in the models. Evidence related to other fundamental principles and rights at work is scarcer, but suggests challenges related to informal migration and human trafficking, and poor governance, something both the Government and the private sector has attempted to address in recent years. The limited available evidence seems to correlate with the model's finding indication of non-conformity on forced labour. There is no evidence regarding OSH, meaning it is not possible to compare to the models' findings of no indication towards compliance nor non-conformity. The same goes for discrimination. However, for freedom of association, the models skew towards compliance which might be contradictory to ITUC's rating, though the rating is not specific to aquaculture and hence, I can't draw firm conclusions.

Impact category	Research and evidence	ASC audit minor NCs	ASC audit major NCs
Elimination of forced labour	Possible trafficking for forced labour in rural areas, but no evidence from aquaculture.	Indication of non-conformity, grouped between -0.5 and 2	Indication of non-conformity, grouped between -0.5 and 2
Elimination of child labour	Possible child labour in agriculture and small-scale aquaculture, but no evidence from large-scale aquaculture	N/A	N/A
Non-discrimination	No information found	Clear indication of compliance, grouped between -2.5 and 0, with significant outliers from 0 to 1	N/A
Freedom of association and collective bargaining	Systemic restrictions on the right to form and join trade unions	Slight indication of compliance, grouped between -1.5 and 1, with more compliant outliers than -non-conforming	N/A
Safe work/OSH	No information found	No clear indication either way, grouped between -1 and 1	No clear indication either way, grouped between -1 and 1

Table 5.3 shows existing evidence from other research in Vietnam, and results of the models.

5.1.4 India

India has several reported instances of labour rights abuses in the aquaculture industry, as also described in the introduction. Reports, including the recent study by CAL (2024) found multiple indicators of forced labour present in the shrimp farming and processing industry in India. These include excessive working hours, including forced and unpaid overtime, debt bondage and payment of recruitment fees by workers, verbal abuse and physical violence, movement restrictions, unsafe working and living conditions, and sexual harassment, particularly in the processing sector. Some of these indicators also double as abuses to the rights to a safe and healthy work environment as well as a workplace without discrimination. Internal migrant workers from other Indian states were documented to be particularly vulnerable to these abuses.

A human rights impact assessment in shrimp farming areas in Andhra Pradesh (ELEVATE 2023), undertaken for retailers in Europe and the US in 2023 include similar findings. The assessment concludes that workers, especially young women, in shrimp processing facilities are vulnerable to discrimination, sexual harassment and working conditions indicative of possible forced labour. Evidence from shrimp farming points to the existence of forced labour indicators, such as payment of recruitment fees. Overall, the assessment found high numbers

of vulnerable migrant workers from other states in the shrimp farms in Andhra Pradesh (the largest shrimp farming area in India).

Child labour has been a longstanding challenge across multiple industries in India. A recent publication by UNICEF (Santhya 2024) concluded that Government efforts to improve access to education has resulted in higher education participation and completion rates and lower child labour participation rates between 2011/12 and 2018/19 in India overall. There are, however, differences between states and children from disadvantaged communities and poor households, and migrant children are less likely to attend school and more likely to be engaged in child labour. In 2018, most of the child labour in India was found in industry, followed by agriculture. There is no available research on child labour specifically in the aquaculture farming in India, however.

The ITUC Global Rights Index highlights a number of restrictions on forming and joining a trade union in India along with limitations on collective bargaining. ITUC (2025) rates India 5, no guarantee of rights. Furthermore, CAL (2024) has found cases of companies in the aquaculture industry barring union representatives' access to workplaces.

Moreover, shrimp farm workers may be exposed to potentially harmful chemicals, such as lime and antibiotics with limited use of personal protective equipment (MBA 2025). Research by Sharma et al. (2023) found occupational hazards among Indian shrimp farm workers similar to those documented by CAL (2024). Sharma et al. interviewed 60 male shrimp farm workers between 23 and 53 years of age, 58% of whom were internal migrant workers. The study found that farm workers reported exposure to multiple hazards causing injury and illness similar to what the research found in global literature. In India, 93% of respondents were exposed to physical hazards such as slips and falls or electric shocks, 82% were exposed to biological hazards like skin infections and snake bites, 77% reported exposure to chemicals causing issues such as skin and eye irritation or breathing problems, 71% to ergonomic hazards like muscle aches and 75% faced psycho-social hazards including stress and depression.

Overall, there is evidence of violations of fundamental principles and rights at work in the Indian shrimp industry. This includes unsafe work, limitations on the right to organise and bargain collectively and indications of discrimination and forced labour in the sector. This corresponds to the models clearly indicating non-conformity against all impact categories, except child labour, which was excluded from the models, and the model for freedom of association. There is no direct evidence of child labour in Indian aquaculture but given the high risks of child labour in adjacent industries, it is surprising that the child labour models do not register. The freedom of association model shows a clear indication of compliance, which contradicts the findings of the ITUC and CAL.

Impact category	Research and evidence	ASC audit minor NCs	ASC audit major NCs
Elimination of forced labour	Multiple forced labour indicators present in the Indian shrimp farming industry and in seafood processing, including high numbers of informally recruited and employed seasonal migrant workers.	Heavy indication of non-conformity, grouped between 0.5 and 2.5, with significant outliers from 2.5 to 4	Clear indication of non-conformity, grouped between 0 and 2
Elimination of child labour	Child labour recognised as a concern in rural areas in India, prevalence rates are likely declining with increased education participation. No evidence of child labour in aquaculture found.	N/A	N/A
Non-discriminatio n	Discrimination against women workers in seafood processing and against internal migrant workers	Clear indication of non-conformity, grouped between -0.25 and 2	N/A
Freedom of association and collective bargaining	ITUC reports significant restrictions on workers' rights to form and join trade unions	Heavy indication of compliance, grouped between -3 and -1	N/A
Safe work/OSH	Farm workers exposed to multiple hazards	Clear indication of non-conformity, grouped between -0.5 and 2, with some outliers towards -1	Clear indication of non-conformity, grouped between 0 and 2, with some outliers towards -0.5

Table 5.4 shows existing evidence from other research in India, and results of the models.

5.1.5 Norway

There is no evidence of forced labour or child labour in the Norwegian aquaculture industry. The US Department of State claims agriculture as a high-risk sector for forced labour, with victims trafficked into forced labour, but does not include evidence of the actual occurrence of forced labour (USDOS 2024B). They also claim forced labour is present in the fishing industry, where workers are vulnerable due to the nature of the work, with small, isolated and mobile workplaces making oversight and enforcement of labour rights difficult. There is no evidence cited in the TIP report, however. Still forced labour in fishing is a documented problem seen across the world, including nearby countries such as Ireland and Scotland (Murphy 2017; Carpenter et al. 2020).

ITUC (2025) reports only sporadic violations of workers' rights in Norway, corresponding to a "1", the best possible rating on the Global Rights Index.

The main documented labour rights issue in the Norwegian aquaculture industry is occupational health and safety. In a recent study, 28% of workers found that poor maintenance has reduced safety at the worksite, and 31% feel uncomfortable reporting safety rule non-compliance (Kongsvik et al. 2025). Another study (Thorvaldsen et.al. 2020) found that the Norwegian fish farming industry has high levels of occupational injuries, with physical and ergonomic exposures the most common. The study also reports the presence of psycho-social exposures, resulting in e.g. stress conditions. Despite the exposures and the resulting health impact, workers generally considered themselves in good health (85%) and 97% of the respondents in the study report satisfaction with their work.

In summary, evidence from Norway revolves around occupational safety and health. This could possibly be a reflection of the nature of research. There seems to be substantial research efforts around safe work and limited research efforts related to other fundamental principles and rights at work in Norway. While no evidence does not prove there are absolutely no violations, it does suggest a low amount given the lack of evidence in adjacent industries as well. This does correlate with the models for all impact areas, indicating compliance for forced labour, discrimination and freedom of association. The models' indications for safe work are less clear, with no clear indication of either compliance or non-conformity. This correlates also with the higher number of OSH cases in Norway, showing this to be the weakest fundamental right at work in the country. It is not possible to determine, however, whether safe work deficits in Norway are more severe, at par with or less severe than in other countries with documented OSH challenges, such as Chile.

Impact category	Research and evidence	ASC audit minor NCs	ASC audit major NCs
Elimination of forced labour	Limited information and no documented cases of forced labour in aquaculture in Norway. One source claims high risk of forced labour in fisheries and agriculture, though shows no evidence.	Indication of compliance, grouped between -1 and 0.5	Heavy indication of compliance, grouped between -4 and -2
Elimination of child labour	No evidence of child labour found in aquaculture in Norway	N/A	N/A
Non-discrimination	No information	Slight indication of compliance, grouped between -1,5 and 1	N/A
Freedom of association and collective bargaining	Only sporadic violations, the highest ITUC grade	Clear indication of compliance, grouped from -3 to 1	N/A
Safe work/OSH	Farm workers exposed to risks and hazards, resulting in high levels of physical injuries, particularly related to physical hazards	No clear indication either way, grouped between -0.5 and 0.5	Clear indication of compliance, grouped from -0.5 to -0.5

Table 5.5 shows existing evidence from other research in Norway, and results of the models.

5.1.6 The UK

Literature on labour rights in the United Kingdom focuses, like most other nations, more on fishing than aquaculture. For example, Sparks (2022) documented extensive exploitation of migrant fishers in the UK fishing industry, including extremely low wages and long working hours, and widespread physical violence (35% of the respondents reporting experiencing physical violence). 60% of the fishers interviewed reported that they would not report a grievance. The exploitation of migrant fishers is closely linked with legal loopholes and poor enforcement of legislation, leading parts of the UK fishing industry to set up their own programmes to protect migrant fishers on UK vessels (Cundry 2024).

There is no available evidence of forced labour and child labour in the UK aquaculture industry, but the Home Affairs Committee evaluating the UK Government's response to human trafficking expressed general concern over an increasing number of modern slavery cases involving children in the 2023 review of national governance, as well as policy responses to human trafficking (Home Affairs Committee 2023).

ITUC (2025) rates the UK "4", corresponding to systematic violations of rights in their Global Rights Index, mostly due to restrictions on union's rights to administer their affairs and on strike action. Fundamental rights to organise appear to be upheld.

Research on working conditions in aquaculture farming in the UK seems to focus on occupational safety and Health. Williams (2023) documents risks of occupational accidents and exposure to harmful chemicals, such as pesticides and disinfectants, in mussel, seaweed and salmon farming in the UK.

In summary, there is very little research and documentation on working conditions in the UK aquaculture industry, but there is research and documentation from the adjacent industry fishing, and a concern over persistent human trafficking, including of children, in the country, despite government programmes to address human trafficking in and into the UK. Over the past decade, the UK Government has continuously expanded its program to increase awareness on human trafficking and forced labour, for example through adoption of a national strategy on human trafficking in 2011 (UK Government 2011) and providing information and a grievance hotline for migrant workers, and others, through the Gangmasters' and Labour Abuse Authority (GLAA 2025).

Though there is no case evidence from aquaculture, documentation from adjacent industries underpin the models' indications for non-conformities against forced labour and discrimination. Evidence from the aquaculture industry shows OSH violations, correlating to the models' results. Indication for compliance on freedom of association contradicts the ITUC '4'-rating. Hence, overall, the models' results for the UK warrant more analysis in particular.

Impact category	Research and evidence	ASC audit minor NCs	ASC audit major NCs
Elimination of forced labour	Evidence of forced labour in the UK fishing industry. No evidence found specifically relating to aquaculture	Indication of non-conformity, loosely grouped between 0 and 2.5	Clear indication of non-conformity, loosely grouped between 0.5 and 3.5
Elimination of child labour	No evidence found relating to aquaculture, but the Government recognises child trafficking as a concern	N/A	N/A
Non-discrimination	Migrant fishers can be subject to discriminatory practices, e.g. lower pay. No evidence from aquaculture found	Clear indication of non-conformity, loosely grouped between 1 and 3.5	N/A
Freedom of association and collective bargaining	Some restrictions, though workers can form and join trade unions	Clear indication of compliance, grouped between -2.5 and 0	N/A
Safe work/OSH	Aquaculture farm workers exposed to physical risks and hazards and to pesticides and other harmful substances	Heavy indication of non-conformity, grouped between 4 and 6	Heavy indication of non-conformity, grouped between 2 and 4

Table 5.6 shows existing evidence from other research in the UK, and results of the models.

5.1.7 Conclusion on existing research compared to model results

Summing up the comparison of case evidence and model results, there is no clear correlation between available evidence and results in many cases. Some of this discrepancy may be caused by limited data and evidence, by the methodology used, or other factors. This will be discussed below.

The widest gap between model results and available evidence concerns freedom of association. In four out of six countries, the models indicate compliance for countries that were poorly rated by the ITUC. In Ecuador and India there is strong evidence suggesting widespread use of child labour and therefore, it is interesting that audits identified so few cases that the models for child labour did not work. There are cases of severe safe work rights breaches in Chile, yet the models indicate compliance. Finally, it may be surprising that the UK models generally indicate non-conformity to a heavy degree as it is commonly believed that labour rights in the UK are not violated more than they would be in India.

The rest of this analysis will focus on understanding model results through sociological theory, by understanding whether aquaculture workers constitute a vulnerable precariat and whether they are subject to protection gaps.

5.2 Analysis of precariousness and protection gaps across countries

In this part of the analysis, I will draw on Standing's theory of precariat and Grimshaw et al.'s framework on protection gaps to analyse existing research to further explain compliance and non-conformity with fundamental labour rights in the six countries in turn.

5.2.1 Ecuador

As discussed above, there is very little research regarding aquaculture and aquaculture workers in Ecuador, and as such the make-up of the workforce is largely unknown (MBA 2025). This means that more research is needed to understand exactly how precarious aquaculture workers in Ecuador are.

As briefly described above, it is likely that large numbers of migrant workers and refugees are employed in the aquaculture industry in Ecuador, though there is no firm evidence of numbers in the industry. An estimated 444,800 Venezuelan refugees are present in Ecuador (MBA 2025), along with a further circa 200,000 Colombian migrants (Jokisch 2023) A survey of Venezuelan refugees in Ecuador found that 79% are informally employed, and 86% earn $84 per month or less. This equals the adjusted poverty line for Ecuador, and the workers have difficulty accessing basic needs such as food and housing (MBA 2025) Many refugees live in the provinces of Guayas and Manabi, where much of the aquaculture industry is located (MBA 2025). Shrimp is the main aquaculture product, and around 60% of Ecuador's shrimp farms are located in Guayas (MBA 2025). Lastly, there are reports of migrant workers and refugees, including children, employed in the fishing industry (MBA 2025), which is often geographically located in the same areas as shrimp aquaculture and hence it is not unlikely that refugees and migrant workers are also working in the adjacent industry of aquaculture.

With the majority of Venezuelan refugees in Ecuador living in poverty, lacking basic needs, and being informally employed, it is quite likely that they can be considered part of the precariat. As such, it is also likely that at least some of the workforce in the Ecuadorian aquaculture industry are a part of the precariat, but more research on working conditions and workforce composition is needed to draw a clear and comprehensive picture of precariousness in Ecuador.

Similarly, there is also limited knowledge on what protective gaps exist and how they impact aquaculture workers in Ecuador specifically. There is, however, available knowledge about severe protective gaps that affect much of the Ecuadorian workforce, including aquaculture workers.

While there seems to be no legislative gaps in the prohibitions of forced labour and child labour, there are significant enforcement gaps hindering effective protection of precarious workers, notably a shortage of labour inspectors. It is estimated that there is a need for three or four times more labour inspectors, than the number employed in 2023, to ensure enforcement of legislation to protect workers (MBA 2025). Enforcement is further hindered by corruption, with allegations of officials taking bribes to not report labour infractions (MBA 2025). Beyond labour laws, the weak enforcement of laws against organised crime has resulted in violent crime conducted against aquaculture workers, including extortion, assault, and murder (MBA 2025).

There are also gaps in legislative protection for workers in Ecuador, notably a legislation gap regarding unionisation, with restrictive laws on when a union can be established (MBA 2025; ITUC 2025). This leads to representation gaps, where workers who attempt to unionise are fired and some receive death threats. The perpetrators are rarely prosecuted due to the aforementioned enforcement gaps.

Hence, available evidence points to the existence of a large and vulnerable precariat working in the aquaculture industry in Ecuador. This precariat is mainly migrant workers and refugees from other countries in the region. Aquaculture workers are further vulnerable to labour rights abuses due to the severe enforcement and representation gaps. Hence, the theories of precariat and protection gaps may provide some of the explanation as to why Ecuador is an indicator of non-conformity in the forced labour models as well as the OSH model with minor non-conformities. It also further solidifies the contradiction between not showing any indication of compliance or non-conformity in the freedom of association model and the case evidence presented from Ecuador.

5.2.2 Chile

Similar to Ecuador, not much is known about aquaculture workers and their working conditions in Chile, with only one study available. Fuentes et al. (2021) found that there are refugees and migrants working in the aquaculture industry, many from Haiti and Venezuela, but neither their share of the workforce nor the total number is known.

Migrant worker visas in Chile are tied to a specific job (Fuentes et al. 2021), leaving migrant workers dependent on their employers to stay in the country. This leaves them in a very precarious position, where they are forced to accept conditions that other workers would not accept. Furthermore, inferring from employment statistics in agriculture and fisheries, where 55% of the workers are informally employed (INE 2025) large numbers of workers in the

aquaculture industry are also likely to be informally employed. Informal employment leaves workers with no job security, a characteristic of the precariat. Finally, Haitian migrant workers are in a precarious situation due to language barriers, as most Haitian migrant workers speak only Haitian Creole and sometimes French, but not Spanish when they arrive in Chile.

These three factors show that some of the Chilean aquaculture workforce is likely part of the precariat, but more research is needed to understand the extent of precariousness, the number of aquaculture workers who are part of the precariat, and how large a part of the aquaculture workforce is part of the precariat.

Looking at protective gaps, migrant workers in Chile face gaps in labour protection legislation. This is especially the case since 2019, when legislation was changed to limit migrant workers' rights, such as limiting access to social security to apply only to immigrants who have been in Chile for at least two years, leaving migrant workers at risk of rights violations (Doña-Reveco 2022) At the same time as migrant worker protections were weakened, general workers' rights have been strengthened by law, but only for formal labour (ILO 2021B). Informal labour is not covered by Chilean laws, resulting in a legislative gap for aquaculture workers, local or migrant, who are informally employed (USDOS 2022).

Despite general efficiency of labour laws, there are hindrances in the form of enforcement capacity and weak penalties (USDOS 2023). This has improved in later years, with new laws and reforms in 2020, 2021, 2022, and 2023. Labour inspection capacity also saw a rise in 2021 through increased funding, which however was reduced again in 2022 (ILAB 2022, 2023).

According to the ITUC there are some representation gaps in Chile, and the country is rated as a '3' (regular violation of rights). ITUC points to the limitations to formation of unions, with a minimum number of people required to form a union and limitation on the right to strike for some workers, including agricultural workers.

Finally, most known social integration gaps in the Chilean aquaculture industry mainly affect migrant workers, especially those in Chile informally. This includes difficulties accessing services for informal migrant workers as they lack legal status (Doña-Reveco 2022).

Considering the likelihood of a precariat, as well as the documented protection gaps, the theories on the precariat and protective gaps cannot be used to explain why Chile is an indicator of compliance. However, the research indicating a precariat, mainly of migrant workers, is limited and case based, and the extent to which it is characteristic of the entire aquaculture industry in Chile is not known. Therefore, a small precariat can exist in the research site while the aquaculture industry in general does not employ precarious workers, and further research might then show that the theories do in fact explain the results of the model.

5.2.3 Vietnam

There have been several studies of working conditions for aquaculture workers in Vietnam. However, these studies often apply a relatively narrow perspective, for example looking at cases of labour rights abuse on farms from a corporate perspective. This includes a report that maps labour rights abuses on farms supplying international companies (Impactt 2022). This study does not consider the wider impacts of whether a precariat workforce is more vulnerable to labour rights abuses. Other studies focus on small-scale aquaculture (ILO 2020; FAO 2023), where farms are mostly family owned and where workers face significantly different conditions

than workers at large, commercial farms. Only around 35% of shrimp, the most common form of aquaculture in Vietnam, is produced by large-scale commercial farms, the remaining 65% by small-scale farms (Rubel et al. 2019). Despite the relatively large number of studies on aquaculture in Vietnam, there is thus very little knowledge about the workforce of large commercial farms, which are more common in the dataset for this thesis and hence the focus of the analysis. Therefore, determining whether the workers are part of a precariat is very difficult.

Vietnam is primarily an emigration country and does not host significant numbers of international migrant workers in the country (World Bank 2025). There is however a significant rate of in-country migration, with 7.3% of the Vietnamese residents over 5 years old being internal migrants. Soc Trang Province hosts a large aquaculture sector (VASEP 2024), while it is also the province with the highest negative net migration in the country (UNFPA 2019), and as such it does not seem likely that internal migrants are moving for aquaculture jobs.

There is some attention to working conditions in the aquaculture industry in Vietnam. For example, a new initiative launched by five seafood producers to improve working conditions and remuneration for aquaculture workers to above minimum wage (IDH 2023), it is possible that commercial aquaculture farm jobs can be seen as desirable for a proletariat workforce. As such, there is no current research suggesting workers at large commercial aquaculture farms, such as those in the dataset, are part of a precariat, but more likely part of the proletariat, the traditional working class (Standing 2011). This is, however, a very tentative conclusion, drawn up more on the basis of assumptions than on studies of the aquaculture workforce. Thus, more research is needed to explore whether the Vietnamese aquaculture industry workforce can be characterised as proletariat, rather than precariat.

Knowledge of protection gaps that may impact workers at large commercial aquaculture farms is more substantial, though the knowledge is still generated through country level studies, rather than industry level research.

While Vietnam has been introducing new legislation, such as an amended labour code from 2021, to reduce labour rights gaps, there are significant enforcement gaps resulting in increased vulnerability of workers. The enforcement gaps are mainly in the form of corruption, with allegations of officials taking bribes to facilitate human trafficking (USDOS 2023), and generally high risk of corruption throughout the judicial system, police, and other public services (GAN Integrity 2020) In addition, Vietnamese law also restricts the forming and functioning of unions (ITUC 2025). Unions in Vietnam are not truly independent, as they are placed under the leadership of the one-party ruling Communist Party of Vietnam. ITUC also describes restrictions on the legalities of strikes, as well as restrictions on amendments to collective bargaining agreements. These representation gaps result in an ITUC grade of 4, "Systematic violations of rights".

Much like determining whether workers at large commercial aquaculture farms are part of a precariat, it is very difficult to find information to identify social protection and integration gaps affecting the workers due to a lack of research. If workers at large commercial aquaculture farms are internal migrant workers, they likely face a social protection and integration gap in the form of accessing public services as internal migrants in general face difficulties in accessing healthcare (IOM 2020). The 'ho khau' residential registration system, which governs legal permanent residence for internal migrants moving between different districts in Vietnam,

has stringent rules (De Luca 2017). The system leaves many internal Vietnamese migrants vulnerable due to their lack of registration, resulting in inability to access essential services (De Luca 2017). The impact of these protection gaps on workers at large commercial aquaculture farms are uncertain though, given the rural nature of aquaculture, and the rural-to-urban nature of migration.

The theory on the precariat thus cannot explain the model results of Vietnam as an indicator of forced labour as it seems likely that aquaculture workers on large commercial farms in Vietnam are not part of the precariat. Evidence is limited but may suggest that workers instead are part of the proletariat. The protection gaps documented in Vietnam could, however, contribute to the explanation of the indication of non-conformity on forced labour, but once again, the theory on representation gaps cannot explain the indication of compliance in the freedom of association model.

5.2.4 India

There is clear evidence that many workers in the Indian aquaculture industry are part of the precariat. Research from India shows workers in the aquaculture industry are often internal immigrants from other parts of the country, especially migrants from the provinces of Odisha and West Bengal to Andhra Pradesh (CAL 2024). Though they are internal migrants, not leaving their country, they face many of the same challenges that cross-border migrant workers face, for example language barriers. The main languages in the three provinces are all different, Odia in Odisha, Bangla, also called Bengali, in West Bengal, and Telugu in Andhra Pradesh. These languages are not all within the same language family, with Telugu being Dravidian and the two others Indo-Aryan, and as such far apart linguistically. The three languages also do not share the same writing system. In rural areas of India, just 22% of residents are bilingual and 5% trilingual, with the most common second and third languages being Hindi and English, and just 18% of all Bangla speakers are bilingual (Nagarajan 2018A, 2018B). Hence, it is likely common for internal migrant workers in the aquaculture industry not to speak the same language as the locals in their workplace. CAL also provides examples of this (CAL 2024). This communication barrier creates many possible vulnerabilities for the workers, and if not properly handled could result in workers not understanding contracts.

In addition to language barriers, internal migrant workers in the Indian aquaculture industry can be vulnerable in many other ways. Internal migrants often lack government documents, which can lead to difficulty accessing social services (MBA 2024) and many internal migrant workers belong to groups vulnerable to discriminatory practices based in the caste system.

The Dalit are the lowest group in the caste system and often work in aquaculture (CAL 2024). While discrimination against Dalits is officially outlawed, a study found 27% of Indians still discriminate against Dalits (Vij 2014). This discrimination may take on different forms, such as being denied access to public services, for instance schools or water facilities (Narula et al. 2007). This lack of access to water facilities, such as community wells, means more than 20% of Dalits lack clean drinking water (Narula et al. 2007). Social discrimination, and the failure of the state to protect Dalits, ensure Dalits do not have the same rights in India as non-Dalits (Narula et al. 2007), and become a true example of Standing's 'denizen', an archetype of the precariat. Adivasi is the term for a 'Scheduled Tribe'. This is a distinctive cultural community

in India which features "*primitivity [sic], shyness and economic backwardness [sic]*" (Bhengra et al. 1999). The Indian state has used its legal apparatus to acquire Adivasi land, leaving many Adivasi with little income, and forcing them into situations of poverty with little possibility of escape. Adivasi attempts to secure their rights have been met with state sanctioned violence (Bhengra et al. 1999), leaving many Adivasi in a precarious state.

When looking at protection gaps in India, there are also significant problems. While employment legislation outlaws forced labour and bonded labour, enforcement gaps such as too few labour inspectors and corruption amongst officials lead to a lack of prosecution of offenders, and little protection of workers (MBA 2024). As an example, 21 of 36 Indian states have not registered any cases of bonded labour, despite ample evidence suggesting the existence of such across the entire country (MBA 2024).

Moreover, there are gaps in the legislation intended to protect workers. While it likely does not impact the results of the models analysed in this thesis, due to the exclusion of the child labour models, minimum working age in India is 14 years, which is lower than compulsory education completion age, and hazardous work prohibition legislation does not cover all sectors with known child labourers (MBA 2024).

Furthermore, legislation was introduced in 2020, which directly hinders workers' rights to form or join unions (MBA 2024). This leads to the existence of significant representation gaps in India. Union representatives have been denied access to workplaces (CAL 2024), workers have been fired for striking, and union leaders prosecuted (MBA 2024). Beyond this, there have been instances of union busting, as well as physical attacks on protesting workers (MBA 2024). These reports show how workers in the Indian aquaculture industry have limited options for action and support to improve working conditions.

Finally, as mentioned in the section on precariousness, social protection gaps are common among Dalit, Adivasi, and other internal migrant workers. With the extensive protection gaps found in India, as well as the high likelihood of Indian aquaculture workers being part of the precariat, the theories match and appear to explain the result of the models, confirming that India is a clear indicator for non-conformity across all models, except freedom of association. Again, the theories of precariat and protection gaps cannot explain why India is a predictor for compliance on freedom of association.

5.2.5 Norway

Norway has a significant number of migrant workers in the aquaculture industry, often from countries within the European Union. Despite Norway's non-membership in the EU, these workers have extensive rights to staying in the country and searching for other jobs. EU citizens, or citizens from other EEA countries, can stay in Norway and search for a new job if they lose their job, either for six months if they have worked for less than a year, or indefinitely if they have worked in Norway for a year or longer, or if they cannot work due to medical reasons (UDI 2025). These rights are suspended if a migrant worker resigns from their job themselves. Residence in Norway is also not tied to the specific workplace, and migrant workers are free to search and leave for other jobs in Norway. This can, however, be difficult for migrant workers who often do not speak Norwegian, barring them from some jobs, as well as hindering their creation of a social network that can aid them in the search for jobs and navigating the peculiarities of the Nordic Model Labour Market. There is a social and

integration gap for migrants who come to Norway for work, as they, unlike refugees, do not have access to free Norwegian lessons (Tiller et al. 2015). Further, while migrant workers are willing to pay for their own lessons, the opportunities for lessons in the rural societies, where many aquaculture farms are located, are low (Tiller et al. 2015).

There may exist a representation gap for migrant workers in Norwegian aquaculture, which is due to a lack of understanding of the Nordic Labour Market Model among migrant workers, rather than gaps in legislation. Aquaculture workers are covered by the union 'Fællesforbundet', a trade union federation, but only 23% of Central and Eastern European workers are members of a union (Huseby & Ødegård 2024). A study in Denmark, which has a very similar labour market structure, shows Poles who are covered by a collective bargaining agreement earn 12% more than Poles who are not, and have shorter working hours (Arnholtz & Hansen 2012). This study also found over half of Poles did not know whether their work was covered by a collective bargaining agreement. While many studies show an increased understanding of the Danish labour market model, union membership, and being able to speak Danish are positive for migrant workers (Arnholtz & Hansen 2012; Refslund 2021; Rasmussen et al. 2016), one study found examples of migrant workers with "too much knowledge" being labelled *"a threat to the 'work relationship hierarchy'"* (Simkunas & Thomsen 2018: 47), sometimes resulting in firings. Given the similarities in the labour market models and worker demographics, it is likely these problems can be present in the Norwegian aquaculture industry too. These representation gaps are however quite minor when compared to other countries, and Norway maintains the best possible grade in the ITUC Global Rights Index (ITUC 2025).

Lastly, short-term contracts can cause instability and uncertainty for migrant workers. While seasonal workers who have yearly six-month contracts can stay in Norway, periods of unemployment can cause financial strain, and there is no guarantee of re-hiring the next year. This can lead to migrant workers, experiencing these difficulties, accepting worse working conditions, and fearing to speak out about it.

While these problems can lead to vulnerability and abuse of workers in the Norwegian aquaculture industry, they are minor issues compared to many other countries, and the general standard of protections for workers in Norway are high. This means the theories on the precariat and protection gaps can explain the model results showing Norway as an indicator for compliance.

5.2.6 United Kingdom

The level of precariousness among aquaculture workers in the UK is unknown, as there have been no studies of aquaculture workers. Furthermore, using research on workers in the adjacent fishing and agriculture industries to analyse the likelihood of aquaculture workers being part of the precariat is not possible for the UK, as research on fishing and agriculture workers focus on specific visa schemes applicable to those industries. The schemes do not apply to the aquaculture industry and therefore, it is not possible to infer conclusions on precariousness between the sectors. The research on workers and workers' rights in the British fishing industry focuses on migrant workers hired through 'transit visas'. These visas allow migrant workers to enter the UK for a short period of time, with the goal of working offshore where a visa is not needed (Mckinney & Meade 2023). These visas are easier to acquire than the 'Skilled Worker visa', which is the usual visa for migrant workers. The transit visa requires the worker to leave

the UK quickly, and to work at least 12 nautical miles from shore, meaning it is not relevant in the aquaculture industry. In agriculture, the research focuses on seasonal migrant workers entering the UK on a special 'Seasonal Worker visa', which is only available for migrant workers in horticulture for six months or poultry workers between the second October and 31st December (gov.uk 2025A). This again means that the research findings cannot be used to analyse conditions in the aquaculture industry.

The visa needed for migrant workers in the aquaculture industry is the 'Skilled Worker visa', which requires that workers are paid at least 38,700 pounds per year (gov.uk 2025B). This is considerably higher than the 27,000 to 30,000 pounds per year advertised for a 'Farm Technician' at Mowi, one of the main farm operators in the UK (Mowi 2025). This could indicate that the British aquaculture industry is likely not hiring migrant workers dependent on the aquaculture industry for legal residence in the UK, but rather local workers. These workers can, however, also be migrant workers in the UK on a separate visa, such as dependants of other migrant workers. There have been calls from the aquaculture industry to the British government to ease requirements for a visa, to increase the number of migrant workers in the industry (Fishfarmingexpert 2022), though this has not resulted in changed regulations yet.

Hence, neither research on aquaculture workers, nor fishers and agricultural workers, can be used to determine whether aquaculture workers are part of the precariat, and we must rely on research on the general protection gaps present in the UK.

Grimshaw et al. (2015) found in their study on protection gaps in the UK, that employment rights are considerably weaker in the UK compared to other European countries. There is a continuous employment requirement for maternity and sick leave, meaning newly employed workers, as well as seasonal or part-time workers can have difficulty acquiring these rights. This may not affect aquaculture workers much, as the work often involves more hours than standard full-time work. However, if workers are employed on zero-hours-contracts or as self-employed contractors, their rights may be reduced compared to permanent full-time workers (Grimshaw et al. 2015).

The legal protection gaps are further exacerbated by ineffectual enforcement, which has seen the industry watchdogs ensuring workers' rights weaken their ability to protect workers due to austerity budgeting, as well as narrow remits on who they can protect, and how (Grimshaw et al. 2015). Often, enforcement of labour laws requires workers to know their rights and bring cases to employment tribunals, which charge workers fees to submit cases (Grimshaw et al. 2015). This results in many workers not being able to receive remediation against labour rights abuses.

In 2015, approximately six out of every seven workers in the British private sector lacked formal representation, such as through a union (Grimshaw et al. 2015), while for both public and private sector workers 23.5% were members of unions in 2019 (Roper 2020). However, even those covered by unions face an anti-worker rights labour market, with an ITUC grade of 4 "systematic violations of rights" (ITUC 2025). The ITUC highlights inadequate protections for striking workers, including a defined maximum allowed time for strikes before dismissals are legal, stringent requirements to legally call a strike, and the ability for employers to seek claims for economic loss from unofficial or unlawful strikers (ITUC 2025).

Hence, workers in the UK in general face protection gaps that are likely to also impact workers in the aquaculture industry, but due to the limited knowledge base the extent of protection gaps, like the precariousness, is difficult to determine.

5.2.7 Conclusion on theories' explainability

Summing up, there is no conclusive evidence that workers in the aquaculture industry are part of the precariat. Therefore, Standing's theory on the precariat cannot explain the results of the models. On the other hand, Grimshaw et al.'s theory and research on protection gaps may explain some of the indications of non-conformity in the models. However, they can again not explain the clear indication of compliance in the freedom of association model.

Across all the six countries, it seems that Standing's theory on the precariat and Grimshaw et al.'s theory on protection gaps have a degree of explainability for the results of the models, except for Chile. The theory on the precariat appears to have higher degree of explainability in the more clear-cut cases, i.e. India and Norway. Some of this may be masked, however, by the lack of research and evidence in the aquaculture industry in most countries.

The theories, and especially representation gaps cannot explain the indication of compliance in the freedom of association models but rather seem to support the existing research on the topic concluding there should be more non-conformity indication in the models. However, most of the information on representation gaps, like the research on violations of freedom of association, is from sources studying country-wide phenomena, rather than aquaculture specific sources. As such it is possible that the aquaculture industry, and especially the farms in the dataset, is an outlier in terms of adherence to the right to freedom of association, compared to other industries.

6 Discussion

I have shown in the analysis that Standing's theory on the precariat and Grimshaw et al.'s theory on protective gaps can explain some of the results of the models but fail especially where there are discrepancies between the results of the model and the findings of qualitative research conducted in the six countries. To bridge these gaps, and explain the results of the models, there are several other explanations, which seem likely to contribute to the audit results. These are, however, outside the scope of this thesis, and require separate research to confirm. Below, I will briefly discuss potential additional explanations that could become the subject of further research. This would contribute to strengthening the model and refine the theoretical framework contained in Standing and Grimshaw et al.'s works as it relates to the global aquaculture industry.

6.1 Audits as a true reflection of best-case scenarios

The first possible explanation for the discrepancies between the model in this thesis and existing research, is that the audits used in the models accurately represent conditions on the farms in the dataset. Hence the differences between the model results and national data on working conditions and precariousness exist because the farms in the dataset represent a best-case-scenario, where ASC certified farms perform better than other workplaces in a country.

As discussed earlier, it is likely that the farms in the dataset are best case scenario farms, as their management are voluntarily spending money and other resources to become audited. This is costly, and farm management are likely to believe that they can show proof that they provide adequate working conditions, as opposed to non-certified farms. This scenario could possibly explain why research shows problems with diver safety in the Chilean salmon farming industry, but the models for organisational health and safety, based on ASC audit data, show Chile as an indicator for compliance, especially the model counting only major non-conformities. This could simply be caused by better diver safety in certified farms. The same can be said of the several countries which are indicators of compliance in the freedom of association models, where existing research and evidence of representation gaps show that it should likely not be the case.

To properly analyse whether this is a likely scenario, more research must be done on the working conditions on farms in the ASC framework. As shown by the CAL study in India, there is no certainty that an announced audit can pick up on labour rights abuses, as some of the farms in the CAL sample were in fact certified farms. Hence, different forms of investigation and research, besides announced audits, are needed to either confirm or reject the possibility of the audits giving a truthful view of the situation on the farms.

6.2 Auditors' varying access to information

An opposing view to the possibility of best-case scenarios, is the possibility of the audits not providing a true reflection of reality. Given the significant problems documented in auditing, this is also quite likely. If this is the case, one reason for inaccurate reflections of realities in

audits could be auditors' access to information. Information may simply not be available to auditors, leading to a skewed picture.

This could be one of the reasons that the UK is a bigger indicator for non-conformity than India according to the models developed in this thesis, while according to the theoretical framework on precariousness and protection gaps, India would be expected to be a bigger indicator for non-conformity. According to CAL, there are several examples of aquaculture workers in India not disclosing all possible labour rights abuses due to fear of reprisals. With the more comprehensive protections afforded to workers in the British aquaculture industry, they may be more willing to share information with auditors It is also possible that audits in Ecuador do not capture the full extent of labour rights violations, if workers are unwilling to divulge information to outsiders in an environment characterised by violence and intimidation.

To understand these dynamics requires further in-depth qualitative studies in the vein of the CAL study, focused on ASC farms. As the UK comes out as a significantly higher predictor for non-conformity than expected, such studies would be particularly pertinent in the UK, and comparative studies across several countries, particularly the countries like UK, Ecuador and India with high indications for non-conformity, would likely provide a greater understanding of the socio-cultural and governance impacts on audit dynamics and the accuracy of the audits.

Beyond the lack of reporting due to fear of reprisals, CAL also found deliberate attempts to hide non-conformities in India. This calls for more research as well, to understand if this is also the case in other countries. If deliberately hiding information in an attempt to cover up non-conformities is a common problem across multiple countries, looking at audit processes might be useful. For example, switching to unannounced audits could potentially increase resilience of audits in this scenario.

Moreover, if further research finds more cases in India, where workers do not inform auditors of labour rights abuses, or cases where non-conformities are hidden, than in the UK, it could explain why the UK, with a less precarious workforce and fewer protection gaps, is a bigger indicator of non-compliance than India, despite the theoretical framework suggesting it should be the other way around.

6.3 Expected auditor bias

Another possible explanation for why the model results do not match the theoretical framework is employers' expectations of auditors' bias against workers' rights in their countries. Even if auditors had no inherent biases, the expectation of auditors being negatively biased in a low-income country or a country previously flagged up for labour rights violations could cause employers in those countries to be more vigilant when enforcing the requirements to pass an audit. Conversely, in countries, where there is an expected bias towards good workers' rights, employers' expectations of positively biased auditors could lead to a more laissez-faire view on living up to the requirements of the certification standard. This could explain why India and Ecuador are less of an indicator of non-conformity than expected according to Standing and Grimshaw et al.'s theories, while the UK is a larger indicator of non-conformity than expected. Again, further research will be required to test this hypothesis.

6.4 Community and workplace cultures

Looking specifically at the UK may lend another possible explanation for unexpected predictions of the models. Available research finds a possible cultural phenomenon which can exacerbate the vulnerability of a possible precariat employed in the aquaculture industry, especially migrant workers. A cultural study of fishing communities in the UK has shown that workplace abuse can be unnoticed by employers due to local culture (Djohari & White 2022). While some findings from this study are very specific to the fishing industry, others may be applicable to the aquaculture industry as well, where the two industries are centred on the same types of communities. Djohari and White (2022) documents abuse in the form of 'micro-discipline', such excessive shouting at workers. Such verbal abuse may go unnoticed, also in settings where physical abuse would be considered unacceptable. Employers may simply not consider 'shouting' problematic, but to a migrant worker with a different cultural background where, for example, shouting may be viewed harshly, this can be very intimidating. This is exacerbated in the fishing industry by the view of a skipper being king of his vessel, and as such his word is law and others, both on the vessel and off, do not question the skipper. This, in turn, can lead to cases such as the 'Serenity' (Gray 2020) where abuse goes unnoticed in the community.

As aquaculture generally is not as isolated as fishing, and aquaculture farms do not have a skipper 'king' maintaining order, there is likely less possibility of abuse in aquaculture than in fishing. However, given that the industries often are located within communities that share the same culture, the 'alpha-male' fishing culture, shouting and other microaggression, could likely also be found in the aquaculture workplaces. More research on masculinity and workplace cultures in different aquaculture farm settings would be required to more comprehensively understand the dynamics that may impact audits.

In addition to cultural barriers around disciplinary methods and micro-aggressions, local employers may not realise the precariousness of their migrant workers. This can lead to employers interpreting issues from their own perspective, not realising that their migrant workers are inherently more vulnerable, and as such situations which may not harm employers, could harm their workers. Not recognising the abusive nature of micro-discipline, means that employers often see standards and definitions of forced labour as not pertaining to them (Djohari & White 2022).

A further factor which can result in situations being viewed as abusive on one side but not the other is a communication barrier between the two parties, due to a language barrier. This is especially true in Scotland, as most migrant workers speak English as a foreign language, if at all, and have severe difficulties understanding English spoken with Scottish accents (Djohari & White 2022).

Due to such cultural and communication barriers, some aquaculture employers may view some actions as normal and non-abusive, while workers view them as abusive. If workers are willing to share their perspectives with auditors when interviewed, this difference in cultural perceptions could result in audit non-conformities. This would require further cultural studies of aquaculture employers and workers, as well as of the communities in which farms are located.

6.5 Data limitations and gaps in the models

Unexpected predictions that match poorly with the theoretical framework may not only be due to shortcomings in the theoretical framework, but could also be due to data limitations, leading to shortcomings in the models developed in this thesis. Hence, the data and models must be improved so as to get more accurate results. These possible shortcomings and improvements needed are discussed here.

To truly compare audit results across species standards, a unified standard must be implemented where audits are carried out against the same labour rights clauses across species. ASC has developed a unified farm standard and is in the process of rolling it out, but the work in this thesis is undertaken based on historical audit data across multiple species standards that were not unified.

A unified standard helps eliminate differences between the specific standards where some indicators in one standard are combined to a single indicator in others, or where some indicators are present in one standard and not another, despite being relevant for both standards. An example is the requirement of freedom of movement after work. This is a specific indicator in the shrimp standard, while it does not exist as a specific indicator in the salmon standard. In the salmon standard, freedom of movement is part of a more general indicator regarding cases of forced or bonded labour.

A unified standard would remove the need to employ impact categories to compare standards. A unified standard would thus provide more specific data on non-conformities against the different indicators in the standard, than the impact categories, designed to allow comparison across different standards in this thesis. These impact categories mask the true extent and nature of non-conformities by taking one non-conformity within the category and counting it for the entire impact category. This masking of data could potentially explain the discrepancies between the models' predictions and the predictions one would have expected, based on Standing and Grimshaw's theories on the precariat and protection gaps.

Specifically, the unexpected results of the models, where the UK is a higher indicator for forced labour than India, despite known cases of forced labour in Indian aquaculture, high numbers of precarious workers and significant protection gaps in India, could be explained by masked data. As an example, a farm with a non-conformity in indicator 6.8.2 in the salmon standard, regarding the time limit for handling grievances, is included in the model with same weights as a farm with non-conformities in shrimp standard indicators 4.2.1, 4.5.1, and 4.8.2, regarding incidences of forced, bonded, or compulsory labour, payments below minimum wage, and freedom to leave jobsite after work. Repeating the research, using data from the new, unified ASC farm standard would uncover such cases and therefore provide more detailed, accurate and usable results.

As mentioned earlier, the results of the models come with the caveat of rather poor precision and recall scores. To improve these scores, and get more reliable model results, more data is needed to train the models. More data from initial and recertification audits would be especially useful, as these audits test all indicators within the standards, while the surveillance 1 and 2 audits only test a few indicators to get an interim idea of the state of the farms. If enough initial and recertification audits are added to the data, this would also allow the removal of the surveillance audits from the dataset. Data from these partial audits were used in the

development of the models due to a lack of data from initial and recertification audits only. Hence, the surveillance 1 and 2 audit data currently obscure the results, due to the lack of audit results for several impact categories. To use these audits, the impact categories without data use the results from previous audits of the same farm. This could lead to an inflated number of non-conformities, where farms may have corrected the non-conformity, but because it has not been audited since the recording of the non-conformity, it is counted again in the dataset.

Beyond just more audits conducted to add data to the dataset, adding failed audits to the dataset would be very valuable. This would likely lead to more non-conformities in the dataset, which could improve the training of the models and provide more reliable results. This would, however, require careful scrutiny and planning as failed audit reports are not made public by ASC and hence, this addition could potentially contravene data laws and policies.

Even with a much larger and more unified dataset, it remains an open question whether the results from a prediction model trained on audit data can be used to study labour rights abuses in a country. The inherent limitations in collecting audit data can result in models created on the data not giving an accurate picture of what is happening in the aquaculture industry. If, however, the aim is to see where audit non-conformities are, rather than use the model to study labour rights abuses, this would not matter. It would mean, though, that the exercise is limited to the internal logic of the audits, not seeking to understand whether the audits are a true reflection of realities. If prediction models created using audit data are to be used to study labour rights abuses, it must be done in conjunction with other research forms.

7 Conclusion

This thesis sought to answer this research question:

What variables can predict labour rights non-compliances in ASC audits, do these results match existing data, and can the results be explained through sociological theory?

Starting with the first part of the question, the models developed show clearly that 'country' is the most significant indicator for compliance and non-conformity against ASC certification labour standards. Country was so much more significant than other possible factors that the analysis focuses on understanding how 'country' as a predictive indicator works and how reliable indications may be.

The results of the analysis of what each country indicates in the different models, compared to available case evidence of labour rights in the countries, show there is not a thorough, clear correlation between the two. Especially the model for the rights to freedom of association shows no correlation with case evidence presented. This could be due to the general lack of research and evidence from the aquaculture industries in the six countries. It could also stem from inaccuracies in the collection of the audit data, or from the dataset consisting of best-case-scenario farms, where there are fewer labour rights abuses than on average in the country.

The theoretical framework of Standing's precariat and Grimshaw et al.'s protection gaps do appear to be able to explain some of the results of the models. However, Standing's theory on the precariat appears to only explain the most clear-cut cases, though this may be due to a lack of knowledge of the workforce in the aquaculture industry. The theory on protection gaps can explain more, but this can be due to knowledge of protection gaps being nationwide, rather than industry specific. Furthermore, both theories seem to be more aligned with the existing case research on labour rights abuses in the countries, rather than the results of the model. As an example, neither theory can explain why India, Ecuador, Vietnam, and the UK are indicators of compliance in the model on freedom of association, despite evidence suggesting significant representation gaps.

In general, the models have low precision and recall, suggesting the need for more data when creating the models. Especially more data on the farms which fail audits due to non-conformities are needed to have more accurate results from the prediction models.

Lastly, more research is needed to further study why the results of the models do not match existing research, and to be able to further analyse the use of my theoretical framework. Studies on whether ASC farms are better at upholding labour rights compared to other aquaculture sites in the country, as well as studies on whether there is a difference between the availability of information for auditors in different countries are needed.

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