

# **Instilling a Culture of Safety in Aquaculture**

Published by [North Central Regional Aquaculture Center \(NCRAC\)](#), Iowa State University

**Alvaro Garcia**

## **Introduction**

Agriculture is one of the riskiest worker occupation in the US and aquaculture is no exception. In 2016, the number of people working in fishing and aquaculture in the world amounted to around 40.3 million. Some 19.3 million worldwide were in aquaculture alone in 2016 up from 11.3 million in 2004. Aquaculture is thus a rapidly emerging food-producing sector and with it, an increasing source of employment. As of 2018 nearly 18 million workers worldwide work in the different segments of the aquaculture industry. A recent report (2018) by the Occupational and Environmental Health Research Group of the University of Stirling, Scotland, found the hazards in this industry range from those in stock-holding units (e.g. ponds, racks and cages), as well as feeding, harvesting, processing, and transport. Other workplace injuries in the sector were associated with machinery, tools, boats, vehicles, drowning, falls, electrocution and bites. This article will address the most common hazards identified in this industry and ways to prevent them.

## **Safety Risks Associated With Aquaculture**

Let us look first at some definitions. According to the USDA most recent definition, an aquaculture farm is any place that sells or distributes \$1,000 or more in aquaculture products, for conservation, enhancement or recreation during a particular census year. The USDA also defines aquaculture as the “farming of aquatic organisms, including: baitfish, crustaceans, food fish, mollusks, ornamental fish, sport or game fish and other aquaculture products”. Aquaculture farming involves some form of intervention in the rearing process, such as seeding, stocking, feeding or protection from predators. In this definition, aquaculture farming implies ownership of the stock being cultivated in a controlled environment, at least part of their productive life. Any other aquatic products caught or harvested from non-controlled waterbeds are termed wild caught.

Although agriculture and aquaculture share some common safety risks, there are other more specific to each sector. Crops and livestock farm workers have numerous safety, health, environmental, biological, and respiratory hazards. These include vehicle rollovers (e.g. tractors and four wheelers), heat exposure, falls, musculoskeletal injuries, hazardous equipment, silos, unsanitary conditions, chemicals, and many others. In 2011 for example accidents with vehicles caused close to half (276) of the 570 fatalities in agriculture. These injuries could be debilitating in nature or more serious, and oftentimes fatal. Deaths and injuries from falls remain a major hazard for farmworkers according to OSHA, with non-fatal, falls-related injury rate of 48.2 per 10,000 workers in 2011. Other activities characterized by prolonged repetitive motions in awkward positions can result in musculoskeletal injuries in both general agricultural workers and aquaculture employees. One other example shared by both type of employees are the use of hazardous chemicals.

Aquaculture though entails unique and risky chores that pose added danger, including working around water and working at night. A quick review of worldwide fatalities associated with aquaculture while writing this article, revealed a high incidence of electrocutions as cause of death. This is to expect, since water and electricity is a deadly combination. There are no in-depth studies however, that reveal the incidence of these accidents. A relatively recent review (Myers, M. L., 2010) looked at the fatal accidents and nonfatal injuries associated with aquaculture. As mentioned above electrocution was a relatively frequent cause of death, but also were drowning, crushing-related injuries, hydrogen sulfide poisoning, and fatal head injuries. The non-fatal injuries were similar to those happening in other agricultural settings, such as slips, trips, and falls. Also reported were machines/equipment, strains and sprains, chemicals, and fires. In this same review, there was an assessment of risk factors that led to these safety issues. These included cranes and their potential for contact with power lines. In addition, tractors and all-terrain vehicles can be prone to overturn particularly when driven over eroded levees or berms. There are also safety risks strictly related to water issues such as rushing water, slippery surfaces, and high-pressure sprayers. Management-related mishaps are also prevalent and associated with poorly illuminated areas where nightshifts work, employees working alone, poor/lack of on-the-workplace training, and absence of personal flotation devices. The Occupational Safety and Health Administration (OSHA) requires that employers provide a safe workplace. Employers must correct hazardous working conditions that could cause injury or death of their employees. Here are some of the most common risks and ways to prevent them.

1. Electrocution.
2. Drowning.
3. Crushing-related injuries.
4. Hydrogen sulfide poisoning
5. Fatal head injuries.
6. Non-fatal injuries slips, trips, and falls.
7. Machines/equipment accidents.
8. Noise
9. Strains and sprains
10. Chemicals
11. Fires.
12. Tractors, all-terrain vehicles, and forklifts
13. Rushing water, slippery surfaces, and high-pressure sprayers.
14. Faulty management-related mishaps

## **1. Electrocution.**

Electricity and water are not a good combination and, regrettably, we have both in aquaculture oftentimes in close proximity. One of the aquaculture systems where OSHA identified electrocution as a hazard was in pond fish culture. A pond is any small artificial body of water used to raise fish commercially. Electrocution can happen from direct contact from overhead

power lines but also from equipment close to, or even in the water. In addition, OSHA considers the presence of power cords laying around a potential risk in any fish culture system. Workers should exercise caution when working around power lines or live electrical wires, they should also be aware of potential risks around wet areas, including ponds and tanks. This is particularly true when working outside and evaluating damages after a storm. Downed power lines constitute a very dangerous hazard that could have happened elsewhere in the farm. These accidents may only be weather related but also created by accidentally downing a power line. Federal regulations require that when circulating under power lines there should be at least 10 feet of clearance. It is safer to work with a coworker who checks your progress and makes sure you have adequate clearance. If you happen to hit a power line or electric wire, remain in the vehicle since the tires will help insulate you and your partner. Alert other coworkers to stay clear of the area until someone turns off the power. This is key and one should always turn off the power before leaving the vehicle or attempting any repairs. Employees should always pay attention to potential hazards and report them to management.

*On July 25 2013, three workers died electrocuted at a Kibbutz fishpond in Northern Israel. One of the men deployed a new device for feeding fish and entered the water. A colleague entered the water to help him but suffered the same fate, as also a third individual.*

## **2. Drowning**

This is a risk undoubtedly inherent to working in aquaculture systems. According to OSHA, this is one of the three most frequent hazards in pond cultures (the other two being the electrocution mentioned above and crushing). Although ponds and tanks can have variable depths, they can be more than six feet deep in order to limit algae growth. It is not just the result of an individual falling in a tank or pond. A tractor or all-terrain vehicle flipping over on a soil berm or concrete wall for example, can end up in the water, maybe knocking the worker unconscious or pinning him under its weight. A situation that could result in a non-fatal injury for an agricultural employee on land can rapidly turn in a drowning fatality when working in aquaculture. In tank systems, OSHA has identified additional risks that may result in drowning such as walking raceways alone at night, poor flooring, and absence of railings, algae growth and trip hazards.

*In 2006, a 49-year-old fish farmer died in Scotland when he drowned in a tank used to rear trout. He was apparently grading fish and was found floating face down in a*

Drowning is not also a hazard for aquaculture operators but also individuals not affiliated with the operation, such as visitors, technicians, family and particularly young children who may venture

close to the tanks or ponds out of curiosity. It is very important to surround fish-rearing bodies of water with a perimeter fence that limits the access of unsupervised and/or unintended visitors.

*In 2016, workers rescued a one-year old near drowned child from a backyard tilapia farm after he fell into a 55-gallon drum of water in Pinellas County Florida.*

### **3. Crushing-related injuries.**

Crushing happens when a part of your body is caught between two surfaces that being pushed together with high pressure. Crushing can result in broken bones, lacerations, bruising, bleeding, shock, and eventually death. They are common when structures or vehicles fall on the worker or when equipment traps part of the body. Since some crushing injuries can interrupt blood flow to the area, it is possible to result of permanent nerve damage or an infection, which might require amputation of the extremity. When the crushing incident is minor, it may just be enough to wash thoroughly any wounds in the affected area to avoid infection. Ice applied to the affected area can reduce inflammation and pain. In severe cases, do not dismiss the possibility of a fracture and have the employee attend a clinic for a more thorough medical evaluation, which might include x-rays. More severe accidents require immediate medical attention.

*On 23 August 2018, a worker died in a salmon processing plant of “Compañía Pesquera Camanchaca” in Tome, Chile trapped by a conveyor belt. The conveyor hooked first the right arm then trapping the worker’s neck in the mechanism. Crushing accidents are common with tractor’s PTO and flip overs.*

### **4. Hydrogen sulfide poisoning**

Hydrogen sulfide can occasionally present toxicity risks in aquaculture settings. Its presence is the result of some sulfate-reducing bacteria (e.g. Desulfovibrio) commonly found in aquatic environments (usually sediment) with high levels of organic material, as well as in waterlogged soils. While considered anaerobes in the past, Desulfovibrio and other sulfate-reducing bacteria are facultative anaerobes (“aero-tolerant”). They can survive in oxygen-rich environments but grow more efficiently in its absence. However, when there is no oxygen, they use for their metabolism the one present in the sulfate molecule, reducing it to hydrogen sulfide. Hydrogen sulfide is toxic to both animals and humans since it interferes with respiration. In aquaculture, its presence is associated with high concentrations of organic sediment (e.g. uneaten food and excreta), which allows these bacteria to proliferate.

Its health effects in humans vary depending on the susceptibility of the individual (pre-existing conditions), its concentration in the air, and duration to its exposure. If the exposure is constant, it can affect health at lower concentrations. Those that suffer from acute or chronic respiratory conditions should not work even sporadically in areas where there is hydrogen sulfide production potential (e.g. cleaning sediment, etc.). At low concentrations the first signs are irritation of the

eyes, nose, throat and the respiratory system (e.g. tearing of eyes, cough, shortness of breath) however the effects can be delayed or even days. Moderate concentrations can cause severe eye and respiratory irritation (e.g. cough, difficulty breathing, etc.), headache, dizziness, nausea, vomiting, staggering and excitability.

According to OSHA entering an atmosphere with concentration of hydrogen above 100 ppm is immediately dangerous to health and potentially life threatening. If there is absolute need to work under these environmental conditions, workers should wear a full face-piece pressure demand self-contained breathing apparatus, with a minimum service life of thirty minutes. An alternative is a combination of a full face-piece pressure demand supplied-air respirator with an auxiliary self-contained air supply. At concentrations below 100 ppm, an air-purifying respirator may be used, that is fitted with a filter cartridge/canister appropriate for hydrogen sulfide. If using only a half-mask respirator then there is a need to wear also tight fitting goggles.



Hydrogen sulfide portable sensors that alert workers of dangerous air concentrations are available nowadays. The smallest and affordable type are the size of a key fob and weigh less than 1 oz. Their range is from 0.0 – 50.0 ppm with a first alarm sounding at 10ppm, and the second at 20ppm. They also have an 8-hour time weighted average alarm (TWA) at 10ppm, which allows the worker to assess how long he was under lower concentrations.

*Deaths associated with workers overcome by gases are oftentimes associated with more than one individual at a time. NEVER attempt a rescue if there is hydrogen sulfide without first placing the appropriate respiratory protection on yourself.*

## **5. Fatal head injuries.**

Fatal head injuries can happen as a secondary outcome of almost any of the accidents reported above. Any instance where an employee falls from a height, or slips and hits its head against a hard object, or when a moving hard object hits his/her head, and/or when loss of consciousness has him/her falling to the ground. Just keep always in mind that a hard blow to the head has always the potential of turning in a fatality, even if not immediately. If an employee loses consciousness after hitting his head, it needs further medical evaluation to make sure it does not progress to something more serious. Do not take the “I am fine” statement, and his willingness to return to work immediately, take him/her to the closest clinic ASAP.

## **6. Non-Fatal Injuries Slips, Trips, and Falls.**

These are the most common source of injuries in the workplace, which make up the greatest number of workers' compensation claims. Serious injuries include sprains and strains. Water spills, algae build-up on concrete surfaces, oil spills in machine shop buildings, can all make surfaces slippery. Tripping happens with different floor levels, broken concrete, and obstacles – including uneven walking surfaces, and protruding pipes and hoses. In addition, people working on roofs and platforms or climbing on equipment are at risk for falls. Some prevention rules to avoid slips, trips, and falls are

- a. Cover drains or drainage holes with a firm, flush fitting grate.
- b. When spills occur, clean them up immediately.
- c. Updating lighting and ventilation in older facilities increases visibility, aids in floor drying, and inhibits algae growth.
- d. Secure hoses and other obstacles to the walls and out of the way.
- e. Discourage using the bucket of a frontend loader instead of a ladder.

## **7. Machines/equipment accidents**

Accidents with equipment happen in every farm and aquaculture is no exception. Employees working with equipment should receive proper training before operating any type of machinery. In addition, workers should be in proper mental and physical conditions to do so. Their impairment because of either drugs or alcohol consumption could result in otherwise preventable accidents. Workers should also work protective clothing adequate for the type of equipment operated. Machines rotating parts can easily catch loose clothing (e.g. tractor PTO) and pull the employee into the mechanism. If we are dealing with rideable vehicles, remember they are most of the time for one person to drive and operate them. Avoid having additional individuals riding alone. Never use the bucket of a skid loader or tractor as a ladder to lift up a second operator.

Workers or visitors that have no business operating certain equipment should not be hanging around. Always remember that they have not had the training on the potential risks of that piece of equipment, and are maybe not wearing protective clothing or equipment.

All employees should know how to operate and perform maintenance on the equipment of their responsibility. Even if they have worked on them for a long time, there is no excuse for shortcuts or modifications to the established protocol. Turn-off all pieces of equipment when they are going to be serviced or repaired. If a motorized vehicle, park it on leveled terrain, turn the engine off, engage the brakes, and make sure the transmission is not in neutral. We addressed the importance of having rollover protection elsewhere in this article.

## **8. Noise**

Continued high noise exposure results in hearing loss and the development of other auditory impairments such as ringing in the ears (tinnitus), difficulty of hearing conversations in the presence of background noise, or localizing where the sound comes from (May. 1999). Exposure to persistent high noise levels is also associated with stress, cardiovascular disease, and reduced job performance. In addition, some chemicals pose toxicity to the ear or increase its sensitivity to noise such as heavy metals, organic solvents, and exhausts. Quandt et al. (2013) identified

chemical exposures in aquaculture, including pesticides, which may be ototoxic (e.g. organophosphates, paraquat, pyrethroids, and hexachlorobenzene)

To make matters worse, 27% of workers in the Agriculture, Forestry, Fishing, and Hunting (AFFH) sectors reported not wearing hearing protection when working in loud noise areas. National Health Interview Survey (NHIS) data has shown that among AFFH workers, hearing difficulty (20%), tinnitus (13%), and both conditions (2%) were the highest (78.9%) of all industries combined. Aquaculture by itself had the highest adjusted risk of all AFFH.

With the notable exception of the work of Barnes et al. (2015), most studies on the effects of noise in aquaculture are European. In Barnes study, noise levels in a salmon building rose from 43.2 dB without any flowing water to 77.5 dB with water flowing to all six in-ground tanks. Ambient noise levels in the hatchery tank room ranged from 50 dB when water was not flowing more than 73 dB with water flowing to all 35 tanks. On average, noise exposures ranged from 64 to 68 dBA (depending on the rearing facility) routinely peaking to 73 to 77 dBA intermittently, with no noise controls implemented. These noise levels may not cause hearing loss by themselves, but may change worker's behavior such as using high volume headsets to reduce the background noise. Other aspects that can alter the noise is the presence of more fish tanks or variations in building construction. Inexpensive control solutions that reduce noise exposures include partially covering fish tanks and using standpipe covers. Placing partial tank covers over the top of the tanks above the water inlet significantly reduced noise levels. For the greatest noise reductions, the authors reported the use of covers for both tanks and standpipes.

In spite of all these measures, it is highly recommended for employees to wear noise-cancelling headsets at all times when working in noisy areas. Employers should discourage the use of headsets that play music since prolonged high volumes to offset the background noise is likely in hearing impairment in time. One other helpful tip is for workers in those areas not to exceed eight-hour shifts and whenever possible rotate workers often to areas where there is less noise contamination.

*Of workers in the Agriculture, Forestry, Fishing, and Hunting (AFFH) sectors 27% reported not wearing hearing protection in loud noise areas. National Health Interview Survey data has shown that among AFFH workers, hearing difficulty (20%), tinnitus (13%), and both (2%) were the highest (78.9%) of all industries combined. Aquaculture by itself had the highest adjusted risk of all AFFH.*

## **9. Strains and sprains**

Sprains and strains are a frequent injury in both the street and the workplace. They are common injuries with similar signs and symptoms, but occur in different parts of the body. A sprain occurs when there is a stretched or torn ligament. A strain on the other hand is an injury to a muscle or tendon that connects a muscle to a bone. The most frequent location for strains is the lower back or the hamstring in your leg; sprains on the other hand frequently are located in the ankle.

Uneven and/or slippery surfaces as well as items scattered on the floor are frequent causes of strains. Sprains happen when a sudden, unexpected movement occurs or when carrying

excessively heavy loads. In both cases, the recommendation is to apply cold to the affected area until the inflammation subsides. When the s

## **10. Chemicals**

In one visit to an aquaculture facility with tanks used for culture, OSHA identified chemicals such as hydrogen peroxide, open drums of hazardous chemicals. Other chemicals that posed hazard for potential exposure were lime, liquid oxygen, oxyacetylene, fuels and solvents, and muriatic acid. Granted this can happen in any other culture system where chemicals are stored. When working with chemicals, personnel should take the time and protect themselves with the proper attire (e.g. coveralls, rubber gloves, goggles or face shields, respirators, appropriate footwear).

### **Transport and Storage**

- All chemicals should be stored in a locked chemical locker or shed (apart from the work area) when not in use. This storage area should provide spill containment and ventilation.
- Chemicals used should always be inaccessible to children (childproof barrier), visitors, and inexperienced personnel.
- Store veterinary chemicals that require refrigeration in a separate refrigerator not used for drinks or food.
- Clearly label acids and alkalis and distinguished them from each other. Never mix them together because mixing causes a violent reaction.
- Have chemicals delivered to the farm by a professional; avoid farm personnel from being involved in this task.

### **Decanting, Mixing & Use**

- Mix chemicals in a ventilated area on a non-porous surface easy to clean, and with close access to clean water for washing spills, personal cleaning, or first aid.
- Pouring chemicals from a drum risks spills and splashing. It is far safer to use pumps, siphons, or gravity taps. There are also closed automated delivery systems.
- Install hand-held soft water showers. Place them where detergents are decanted and use them for removing chemicals from the eyes.
- Employer: responsible for providing, maintaining, and replacing, when necessary, all protective equipment.
- Employees: responsible for wearing protective equipment when working with chemicals. They should exercise care with equipment, maintain it, and return it to its original location.

### **Handling of chemicals**

Every aquaculture farm should have a formal management plan to deal with chemical emergencies or spills. This plan should include emergency and first aid contact phone numbers. Enact workplace rules for the use of chemicals, and make sure all workers follow them. Train workers who need to use chemicals, particularly restricted chemicals, through a suitable program. Always ask yourself if a particular chemical is necessary, or there is another safer and more environmentally friendly alternative. When dealing with chemicals Francesa et al. (2011)

suggested following what they labeled the “Hierarchy of Control”. It consists of an established process to identify the most effective way to control chemical risks (including hazardous substances) from most effective to least effective.

- i. **Elimination:** stop using and remove the chemical
- ii. **Substitution:** replace the chemical with less hazardous substance
- iii. **Isolation:** Separate the chemical from people (e.g. metal cabinets).
- iv. **Engineering controls:** Use automated equipment to reduce potential contamination
- v. **Administrative controls:** Specific procedures to handle the chemicals.
- vi. **Personal protection equipment:** Protective equipment (e.g. goggles, respirators, etc.)

***Monitoring workers health is an important way to ensure the control of chemical risks. Since chemical-related health issues can develop over long periods, keep monitoring or health surveillance records for 30 years.***

## 11. Fires

Three common sources of fires are cigarette smoking, improper storage of flammable liquids and/or their vapors, and electrical failures. Smoking in the workplace should be discouraged if not for health reasons (direct and indirect) because of the risk of causing a fire. There is always the risk of stray sparks or lit ashes to land on gasoline, paper, lint or some other easily flammable source that can initiate a fire.

Improper storage of flammable chemicals may also lead to fires. There are strict standards published by OSHA regarding storage, transportation, and handling of flammable chemicals to reduce the risk of fires in the workplace. Fish farm owners and managers should familiarize themselves with these standards to make sure they are on compliance.

Electrical failures are also a common cause of fires. Plugging too many devices into one outlet, using worn or non-suitable extension cords, not properly grounding electrical equipment may all result in fires in the farm. Protect electrical panels from workers touching them by accident or from water sprayed on them.

### Preventing fires

- Clean up spills of oil, gasoline, and other flammable liquids as soon as they happen.
- Keep an OSHA and *National Fire Prevention and Control Administration* (NFPCA) approved fire extinguisher in areas where there are potential risks (e.g. warehouses, deposits, fuel dispensing, etc).
- Prohibit cigarette smoking indoors.
- Have electrical wiring and equipment installed and maintained by a licensed electrician.
- Keep flammable chemicals and liquids in fireproof cabinets.

## 12. Tractors, all-terrain vehicles, and forklifts

**Tractor rollovers** are the most frequent accident in agriculture, and the major cause of deaths. It happens when a tractor in an incline tips sideways or backwards and turns upside down crushing the worker under it. This usually occurs during sharp turns at speeds greater than normal causing the tractor to lose its center of gravity. The center of gravity in a tractor is higher (top heavy) than in a car or pickup and a sharp turn makes them tip over more easily. Also depending on the type of tractor, its back half may represent up to 2/3 of its weight making flipping over more likely. This is even worse if the tractor is fitted with a raised front loader, which causes an even greater shift in the weight towards the rear. Tractors working on or near pond berms or levees in aquaculture settings pose an additional threat, since tractor and operator risk falling in the water. An otherwise non-fatal pin or unconsciousness while on land can result in drowning when in the water, even if shallow. Similarly, when driving too close to the water's edge, the bank can tear by the tractor's weight and cause it to fall in the water.

*On April 16<sup>th</sup> 2002, a 72-year-old part-time farmer died as result of a tractor overturn. The victim had been brush hogging the outer edge of a pasture when the tractor onto an embankment that gave way, causing the tractor to rollover. The tractor rolled down the embankment, crushing the operator during the initial 180 degrees of rolling.*

### Preventing Rear Rollovers

- *Never* hitch a towed load higher than the tractor drawbar.
- Use front chassis weights to counterbalance heavy rear-mounted implements.
- Always start forward motion slowly.
- Backing down a grade is risky, the faster the speed and steeper the slope, the greater the potential to flip over. Back down steep grades in a low gear, so the need to hit the brakes is less likely (causing the tractor to flip). If possible, ***back tractors up steep slopes, and come down forward.***
- If the tractor starts rolling backwards down a steep grade with the clutch disengaged, engaging is almost the same as braking, which could result in a backward flip. Just let the tractor roll to the bottom of the slope without applying the brakes or engaging the clutch.
- Never try to cross ditches, drive around them; if the drive wheels lodge in a ditch back the tractor out.
- Back the tractor out if stuck in the mud. Putting boards or logs in front of the drive wheels has been responsible for backward flips.

## Rollover Protective Structures (ROPS)

Modern farm tractors are fitted with rollover protective structures (ROPS). Their design minimizes injury potential in a rollover. In a ROPS-equipped tractor, it is *critical* to fasten the seatbelt securely. Should a rollover occur the belt is the safeguard that holds the driver within the protected area. **Do not wear a seatbelt** in tractors without ROPS since the belt eliminates any chance of jumping to security should an overturn happen.

### Power Take-Off Safety Practices (PTO)

Recognize the PTO shaft turns at speeds faster than our reaction time. It is easy to for a turning PTO shaft to snag a worker. Follow these guidelines to prevent entanglement:

- Keep all components of PTO systems shielded and guarded.
- Regularly test driveline guards by spinning or rotating them to ensure they have not become stuck to the shaft.
- Disengage the PTO and turn off the tractor before dismounting to clean, repair, service, or adjust equipment.
- Always walk around instead of stepping over a rotating shaft.
- Always use the driveline recommended for your machine.
- Position the tractor's drawbar properly for each machine used to help prevent driveline stress and separation on uneven terrain and during tight turns.
- Avoid tight turns that pinch rotating shafts between the tractor and machine; engage power gradually; avoid over-tightening of slip clutches on PTO-driven machines.
- Lock the PTO driveline securely to the tractor PTO stub shaft.
- Keep universal joints in phase. (Check the operator manual or talk with a farm implement dealer.)
- Wear adequate, close-fitting clothes (avoid loose clothing blowing in the wind).
- Stop the tractor and disengage the PTO to work on it.
- Secure long hair under a hat when working around a PTO.
- Instruct all operators about the hazards of a PTO.
- Keep children away from all turning parts of the machine not just a PTO.



### Forklift Hazards

OSHA has identified **forklift hazards** as frequent in aquaculture farms; the incidence however seems not as high compared to other industries. In a review of accidents that occurred between 1980 and 1994 (Collins et al. 1999), there were 1,021 deaths due to forklift accidents. The three

most common situations resulting in the death were forklift overturns (22%), pedestrian struck by forklifts (20%), and worker crushed by forklift (16%). Agriculture, Forestry, and Fishing only represented 7% of the total. (32.0).

### **13. Rushing water, slippery surfaces, and high-pressure sprayers.**

Falls on slippery surfaces are one of the most frequently occurring accidents that lead to personal injury. While these accidents can result minor bruising, they are not devoid of major risks, such as fractures, concussions, and even death in extreme circumstances. Slips happen when there is not enough traction between the footwear and the walking surface. Wet spots, ice or snow, oil or grease, or any other substance that reduces traction can further complicate it. It is easy to understand how can slippery surfaces can be all too frequent in fish farms. Objects scattered on the floor (e.g. hoses, brushes, etc.) and running water can increase the chances of losing our step.

The following are guidelines (modified from OSHA) to prevent slips and falls or minimize its consequences

- Wear personal protective equipment (hard hats, gloves, safety footwear, and eye protection).
- Be aware of hazards that may cause slipping or falling.
- Keep all work areas, runways, etc. tidy, and clear of oil, grease, tools, and debris.
- Use non-skid rubber or other surfaces if possible.
- Provide guardrails and guards around on areas prone to slips, trips, and falls.
- Install, inspect, and secure stairs and handrails.
- Keep cords and hoses clear of walking spaces.
- Conduct pre-job inspections to identify and correct hazardous work surfaces.
- Use waterproof footgear to decrease slip/fall hazards.

### **14. Faulty management-related mishaps**

---

*...“An ounce of prevention is worth a pound of cure”...Benjamin Franklin...*

---

Aquaculture owners and supervisors should avoid four key elements:

1. Poor/lack of on-the-workplace training.
2. Absence of personal flotation devices.
3. Poor illumination where nightshifts work.
4. Employees working alone.

### **First Aid and Emergency Response**

Since fish farming entails safety and health risks, it is important to put in place a plan for an effective response to any incident. Employees should know what to do and how to seek help in an emergency (e.g., fire, traumatizations, electrocution, drowning). Develop emergency response procedures, program occasional drills, and learn from them. Some basic items to look after when exploring emergency response procedure planning are:

- Clearly identify the location of fire extinguishers (have them regularly inspected!)
- Names(s) of first-response person(s)
- Avoid working alone, particularly at night
- Use reliable communications systems to transmit clear information where to locate injured personnel.
- Have at least one portable first-aid kit and a first-response person trained to assist someone hurt; everyone should know this individual's name.
- Have first-aid kits that include disposable resuscitation masks and nitrile gloves.
- Send employee(s) to first-aid training courses. A worker who is seriously injured has the best chance for surviving if assisted immediately.
- All workers must know how to contact the first-response person.

### **Cited literature**

Barnes, M.E., C. R. Hewitt, and T. M. Parker. 2015. Fish Hatchery Noise Levels and Noise Reduction Techniques. *Journal of Agricultural Safety and Health*. 21(3): 187--95. (doi: 10.13031/jash.21.11072) @2015

Collins, J. W., Kisner, S. M., Johnston, J. J., Chin, S. F., and Kennedy, R.D. 1999. Fatal occupational injuries associated with forklifts, United States, 1980–1994\* [https://doi.org/10.1002/\(SICI\)1097-0274\(199911\)36:5<504::AID-AJIM2>3.0.CO;2-P](https://doi.org/10.1002/(SICI)1097-0274(199911)36:5<504::AID-AJIM2>3.0.CO;2-P)  
Francesca, U.; Keown, J.; Endres, M.; Mondak, C., and Garcia, A. "Safety Risk Areas at the Dairy Farm". 2011. [http://openprairie.sdstate.edu/extension\\_fact/150](http://openprairie.sdstate.edu/extension_fact/150)

Masterson, E. A., C. L. Themann, and G. M. Calvert. 20017. Prevalence of hearing loss among noise-exposed workers within the agriculture, forestry, fishing, and hunting sector, 2003-2012. <https://doi.org/10.1002/ajim.22792>

May, J.J. 1999. Occupational hearing loss. The New York Center for Agricultural Medicine and Health, The Mary Imogene Bassett Hospital, Cooperstown, NY 13326 [https://doi.org/10.1002/\(SICI\)1097-0274\(200001\)37:1<112::AID-AJIM9>3.0.CO;2-#](https://doi.org/10.1002/(SICI)1097-0274(200001)37:1<112::AID-AJIM9>3.0.CO;2-#)

Myers M.L. 2010. Review of occupational hazards associated with aquaculture. *J Agromedicine*. Oct; 15(4):412-26.

Quandt SA, Kucera KL, and C. Haynes. 2013. Occupational health outcomes for workers in the Agriculture, Forestry and Fishing Sector: implications for immigrant workers in the Southeastern US. *Am J Ind Med*. 56:940–959.

Theman, C., Suter A. H., and M. R. Stephenson. 2013. National Research Agenda for the Prevention of Occupational Hearing Loss—Part 1. Thieme Medical Publishers 333 Seventh Avenue, New York, NY 10001, USA.