AUSTRALIA'S NORTHERN TERRITORY

Management of Australian Water Buffalo in South East Asian Cattle Feedlots

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Supplementary to Manual for South-East Asian Cattle Feedlots, MLA

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List of acronyms

ASEL	Australian Standards for the Export of Livestock
BPM	Breaths Per Minute
DAWR	Department of Agriculture and Water Resources
DM	Dry Matter
ESCAS	Exporter Supply Chain Assurance System
LPA	Livestock Production Assurance
LW	Live Weight
NLIS	The National Livestock Identification System
NT	Northern Territory
MLA	Meat and Livestock Australia
OIE	World Organisation for Animal Health
SOPs	Standard Operational Procedures

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1. Introduction

Australian Commercial Water Buffalo for the live export trade are mainly Swamp buffalo that are sourced from domestic and feral herds in the Top End of the Northern Territory (NT). Prior to shipment, feral buffalo are domesticated by hand feeding and handling in yards for at least a month, and during this time any intemperate animals are removed from the shipment. Smaller numbers of Riverine crossbred and purebred buffalo are also available for export mainly for dairy production and breeding programs.

Figure 1: Riverine buffalo

Swamp buffalo

Two classes of Swamp buffalo are usually shipped to SE Asian markets: Young bulls, 250-350 kg live weight (LW) for lot-feeding, and mature bulls, ±450 kg LW, for slaughter. Young Riverine crossbred buffalo heifers and bulls are mainly sourced by dairy farms in other parts of Australia and in New Zealand. Heifers must have been determined not to be pregnant via having been pregnancy tested during the 30-day period before export with certification in writing by a registered veterinarian or competent pregnancy tester.

Historically, the main export markets for live buffalo were Brunei, Sabah and Indonesia mostly as slaughter stock (see Table 1). Some breeder stock have been shipped to Sabah and more recently there has been increasing demand for buffalo feeders as well as slaughter stock from Vietnam.

Table 1: Total buffalo exports from Northern Territory to SE Asia from 2008-2017 (heads/year)

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
4,637	3,022	2,541	1,841	482	800	5,055	5,093*	5,792	9,916

*11 months recorded.

Australia's buffalo herd disease status is the same as for cattle. During the late 70s and early 80s, buffalo were directly targeted for the eradication of bovine brucellosis and tuberculosis and were declared free in 1997.

The National Livestock Identification System (NLIS) enables the traceability of disease and product integrity from birth to slaughter of domestic livestock, including buffalo and also applies to livestock export supply chain. Likewise, buffalo are also covered by the Livestock Production Assurance (LPA) program and the Australian Standards for the Export of Livestock (ASEL).

The Department of Agriculture and Water Resources (DAWR) regulates the live export process to manage animal health risks and animal welfare compliance along the export supply chain. Exporters must provide DAWR with all the necessary documentation (Import Permit, Health Protocols, Exporter Supply Chain Assurance System (ESCAS) (feeder, slaughter stock only), Notice of Intent to Export (NOI),), to get approval to export live cattle or buffalo. DAWR also checks animals against the relevant Health Protocol before embarkation and will reject animals that do not meet the Protocol or are unfit to travel.

Under the Australian Standards for the Export of Livestock (ASEL) all export buffalo must have horns that are no longer than the spread of the ears and are blunt. If dehorned, the wounds must be fully healed prior to export. Buffalo with horns greater than the ASEL requirements (up to a maximum length of 5 centimetres past the ear) are called 'long horns' and exporters are required to submit a long-horn management plan on a case by case basis.

Under the ESCAS regulation, the in-country supply chain for imported Australian feeder and slaughter livestock must be a closed system, meaning that animals have to stay within the importer's accredited supply chain and cannot be sold to third parties. This ensures that the health and welfare of each live buffalo consignment to SE Asia can be monitored throughout the supply chain up to the point of slaughter. It is the exporter's responsibility to make sure that, at each stage in the operation (from discharge at the port, transportation to the feedlot, feedlot management, transportation to the abattoir and slaughter process), buffalo are managed by the importers, transport companies and slaughterhouses according to the standards of the animal welfare offset by the World Organisation for Animal Health (OIE).

Exporters sign contracts with importers, transport companies, and abattoirs, so that training can be provided to stockmen, truck drivers and slaughtermen on buffalo handling and husbandry consistent with OIE requirements. Facilities and operational procedures must also be accredited and regularly audited by approved independent auditors. The exporter must also account for each animal at the point of feedlot entry and exit, and at slaughter, by recording the NLIS ear tag number and reporting any irregularities. Where there are serious breaches of the regulation by the importer (or exporter) then further exports permits can be withheld by the authorities until the matter is investigated and future compliance can be assured by the exporter.

Australian buffalo exported to SE Asian markets are normally held in cattle feedlot facilities and managed in the same way as cattle. However, there are important physiological and behavioural differences between the two species that should be taken into account to optimise buffalo productivity and welfare.

The aim of this manual is to point out these differences and provide best practice management advice on buffalo husbandry where it substantially differs from cattle. These differences are also highlighted in summarised standard operational procedures (SOPs).

Key Points

- Australian commercial buffalo, which are usually only available from the Northern Territory (NT) of Australia, are in increasing demand for live export to SE Asia.
- Australia's livestock disease status for cattle and buffalo is the same.
- Industry standards for production and live export of buffalo and cattle are the same.
- The National Livestock Identification System (NLIS) applies to domesticated and captured feral buffalo for live export.
- The Exporters Supply Chain Assurance System (ESCAS) regulation for feedlot and slaughter buffalo is designed to monitor the health and welfare of animals throughout the in-country supply chain.
- Cattle feedlot facilities can also be used for buffalo however there are important differences between the two species that need to be considered by feedlot managers and cattlemen for best practice management of buffalo.

2. Feedlot Design

Cattle feedlots in South East Asia are normally used for holding buffalo however the physical, behavioural and physiological differences in buffalo should be taken in to account to optimise husbandry best practice and productivity.

Handling yards

Cattle yards and races are generally suitable for handling imported Australian Swamp buffalo with tipped horns. It should be noted that when handling very heavy bulls (>650 kg LW), especially Riverine crossbreds bulls which can achieve live weights of 1 tonne, these animals are too large to pass through standard 700 mm-wide cattle races. Therefore, a wider race (>750-800 mm) is required and can be made by using adjustable panels on one-side of the race (Lemcke., 2017).

Feedlot pen capacity and trough Spaces

The feed trough length divided by the recommended feed trough space for each class of livestock animal (see Table 2) provides a base number for pen capacity. The floor area (m^2) of the pen is calculated by multiplying together the length of the pen (usually the same as the trough length) and the pen width. The floor area divided by estimated pen capacity (using the base number above) calculates the stocking density (m^2/hd)[1]. This value should be checked against recommended stocking densities for different livestock classes (light feeders, heavy feeders, slaughter bulls etc) and other factors such as the roof shelter and shade footprint and continuous or interval[2] feeding systems.

Buffalo that are confined in handling yards or feedlot pens are easier to manage when given more space than cattle (7.5 vs 2.5 m^2/hd), together with recommended trough space (Table 2) for interval feeding systems. Apart from being easier to handle in smaller pen groups, penned buffalo tend to defecate in a common area and this should be encouraged for ease of cleaning.

[1] *Metre squares per head (m^2/hd).*

[2] *Interval system refers to feeding 3 times daily (normal) compared with continuous feeding (>3 times/day).*

Table 2: Recommended feed trough space for cattle and buffalo with interval feeding

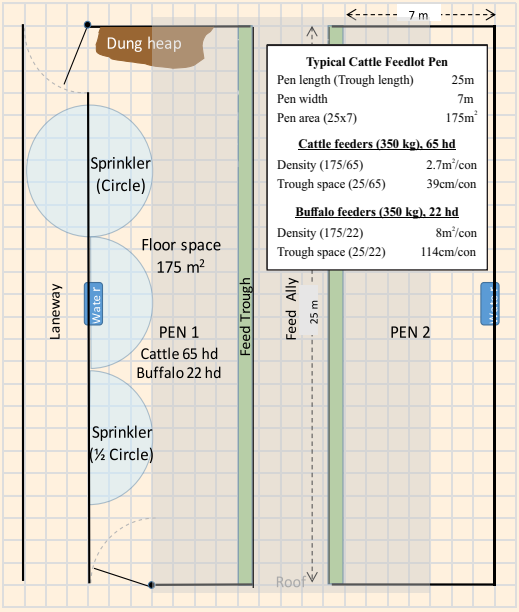
Stock classes	Head space (cm/head)
Light Feeders (<325 kg)	25 - 40
Heavy Feeders (325–450 kg)	40 - 50
Bulls (>450 kg)	50 - 60

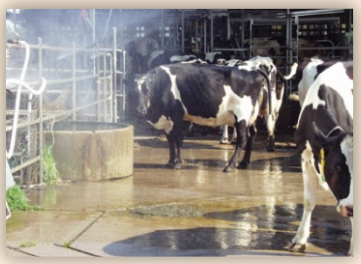
An example of allocating buffalo to cattle feedlot pens is shown in Figure 1 (below). A typical feed trough length is 25 m and the total floor space of a pen is 175 m^2, with a roof cover of 100 m^2. For this pen, optimum pen capacity for a group of Brahman cattle feeders (average 350 kg LW = 39 cm/head trough space) is 65 head. Using the recommended stocking density of 7. 5 m^2 for buffalo, this equates to 23 head (about 1/3 of cattle), providing 100 cm of trough space and 4.5 m^2 of shelter space for each animal. In this case, a pen capacity of 25 head (7 m^2/hd) which is slightly more than recommended is not likely affect performance of buffalo in the short term.

Shade and Sprinklers

Buffalo are less tolerant than Brahman cattle to direct sunshine during hot and humid summer days and may quickly become heat stressed. For this reason, handling yards and pens require adequate shade and clean drinking water. There should also be a pressurised water hose on hand to manually spray the animals to cool them down. Manual spraying ensures animals that are showing signs of heat stress are directly targeted for treatment. A secondary benefit is the quietening effect achieved by the stock handlers hosing the animals in relatively close proximity.

In feedlots where consignments of buffalo are routinely held for several weeks, managers should consider installing sprinkler systems in handling yards and outer fences of feedlot pens to control heat stress. Sprinkler systems are commonly used in dairies to cool milking cows during the summer (Cool Cows, 2016). The sprinklers should have a moderate droplet size and can be manually or automatically operated for 15 minutes in every hour during the middle of the day; good air movement is also essential for effective evaporation (see Figure 2 and adjacent photos).





Evaporative cooling using sprinklers (for dairy cattle) or manual spraying of buffalo to alleviate heat stress.

Figure 2: Typical cattle feedlot pen with floor space of (25 m x 7 m) 175 m^2, holding optimum numbers of feeder cattle or buffalo, showing positioning of sprinklers and likely area of buffalo defecation

Summary of SOPs of feedlot design and maintenance

- Australian buffalo kept in SE Asian cattle feedlots require adjustments to existing infrastructure.
- Buffalo are less tolerant than cattle to hot conditions, and need a well ventilated holding area with adequate shade and water spray (pressure hose or sprinklers) to manage heat stress.
- Buffalo that are confined in yards and pens are easier to manage than cattle when given more space. The rule of thumb is to give buffalo three times more space than cattle, or 1/3 of optimal capacity of cattle handling yards or feedlot pens.
- Feedlot inspections should be done before the arrival of new buffalo consignments to ensure there are no animal welfare issues.
- Check for damaged or defective infrastructure such as faulty gates, broken railings and drain covers, trip hazards and protrusions, and leaking water pipes and water troughs. Make repairs before holding animals in the area of damaged items.
- Check that pens, water and feed troughs, and alleyways are cleaned and there are no plastic bags, string etc within reach of curious animals.
- Provide a layer of sawdust on the pen floor to reduce slipping and to absorb urine and faeces.
- Ensure that stocking rate of pens allows sufficient access to feed trough, roof shelter and shade for all the buffalo in the pen group at the same time.

3. Transport and Induction at the Feedlot

Discharge from ship

Unloading buffalo from the ship may take longer than cattle. The most important thing to note is that buffalo respond best to quiet and gentle handling, therefore caution and patience are essential for moving buffalo from the ship's holding pens to awaiting trucks efficiently by using a few well trained buffalo handlers.

In addition to normal handling practices, buffalo may also be unsettled by the new surroundings, smells and noise at the port, and/or affected by the side effects of increasing body heat load (such as loss of appetite) during the voyage.

It is important to talk to the ship's stockman about the health status of the buffalo before unloading so that these animals can be monitored during discharge and treated at the feedlot on arrival. In relation to this and general best practice, the importer should ask to have the pre-ordered consignment of pelleted feed (part of the induction ration) unloaded and transported to the feedlot before unloading the livestock.

At this point, the importer should offer some of his trained buffalo stockmen to help the crew discharge the buffalo.

Transportation

Ensure that there is plenty of sawdust or straw on the floor of the truck before loading. For longer distances (>3 hours), loading densities of 2 m^2/head (or more for heavy bulls) should be sufficient for buffalo to lie down. For shorter distances, higher loading densities (1.0-1.25 m^2/head) can be used for feeder/slaughter buffalo while ensuring that all animals are standing before departure and unloading. A few larger bulls in a group may need to be tethered to the truck by the horns to avoid injuries to the other animals.

Transporters should inspect the buffalo being transported hourly for the first three hours of the journey. Transporters should have contingency arrangements in place for the humane destruction of animals in the event of a traffic incident or some other unforeseen emergency.

Arrival at feedlot

Prior to the arrival of the buffalo at the feedlot, ensure that pens are clean, water troughs are full with fresh water (addition of electrolytes[3] is recommended), and forage should be available in the feed trough.

On arrival, the NLIS tag numbers of each animal are recorded as they are unloaded from trucks; at this point injured or sick animals need to be separated and sent to the hospital pen, while the rest of the mob can be walked quietly to their allotted pens. Allow newly arrived buffalo to rest and recover for 2-3 days before the induction processing takes place. This includes delaying any required blood samples taken for quarantine purposes. Blood sampling should be done using suitable crush facilities

Figure 3: Newly arrived buffalo feeding on induction rations

Induction rations

Feed new arrivals with fresh green chopped forage (4-5 kg/hd) mixed with salt (30 g/hd), and supplement with ship's pelleted feed[4] (2-3 kg/hd, poured on top of forage) for the first few feeds (add more forage if pellets are not available).

From Day 2, gradually introduce the feedlot ration[5], as a proportion of the arrival ration, in stages 25%, 50%, 75%, 100%) over the next 4-5 days, or longer if there are high levels of residue. Always monitor intakes and adjust feed levels accordingly so that there are minimum leftovers before the next feed.

[3] *Electrolyte supplement should include glucose, sodium chloride, sodium bicarbonate, and potassium chloride (LiveCorp, 2001).*

[4] *Do not feed local pellets or compound feeds to buffalo containing Rumensin® (active ingredient: Monensin) (see Animal Health section).*

[5] *65% forage, 35% concentrate (DM basis). See the Buffalo Nutrition section for more information on formulating the feedlot ration for buffalo.*

Summary of SOPs for discharge of buffalo (unloading, transportation, arrival at feedlot)

- The discharge of buffalo is likely to take longer than cattle, and should be done with quiet and gentle handling by experienced stockman.
- Before unloading begins check that all unloading equipment and gates are secure and that the trucks and drivers are ready according to a planned unloading schedule.
- Check with the ship's stockman on the health status of the buffalo before disembarkation so that these animals can be monitored and treated on arrival at the feedlot.
- It is best practice to have the pre-ordered feed pellets from the ship unloaded and transported to the feedlot before discharging the livestock (if allowed by the ship's captain).
- Offer experienced buffalo stockmen from the feedlot to help with discharge as the crew and truck drivers may not be trained to handling buffalo.
- SOPs for Animal Handling of cattle also applies to buffaloes, by moving small groups of animals at a time in a quiet and gentle manner, and only using pressure when necessary. Where possible leave the group leaders to make their own way down ramps and into trucks and allow the natural behaviour of other buffaloes in the group to follow the leader.
- Before moving a group of buffalo, ensure that there is a clear pathway for the animals to make their way to the truck and that personnel and visitors are cleared from the unloading area.
- Make sure the back of the truck is aligned with the ramp so that there is no gap.
- Buffalo loading densities on trucks are different according to distance and travel time between port and feedlot, so ensure that drivers and loaders know the number of animals that should be loaded onto each truck.

- Prior to the arrival of the buffalo at the feedlot, ensure that clean water is available and feed troughs contain fresh forage (supplemented with ship's pellets, if available).
- At this stage do not feed concentrate feeds or local pellets, and do not provide any feeds or supplements that might contain Rumensin® (monensin) as this is poisonous to buffalo.
- On arrival at feedlot and before unloading, check that the ramp gates are secure and stockmen are in position to receive the buffalo.
- The electronic ear tags of each buffalo should be recorded as they are unloaded from the truck and injured or sick animals need to be separated and move to a nearby hospital pen. Leave new arrivals to rest in the pens for a few days before further induction processing, and during this time gradually replace the arrival ration with the feedlot ration.

Figure 4: Australian Commercial Water Buffalo on board ship and discharging at port of arrival

4. Animal Handling

It is mandatory for all feedlot operations with imported Australia livestock to have duty of care for animal welfare and handle livestock in a way that minimises stress and danger to both animals and personnel. Feedlot workers that work closely with cattle and buffalo should be trained in the basic skills of animal handling using low stress stock handling techniques (see MLA, 2010), before they are allowed to handle stock or work in the yards. Apart from the welfare of the animals, there are operational and commercial benefits as follows:

- Easier to handle animals therefore quicker to finish stock movements, resulting in less stressed and healthier animals.
- Fewer injuries and mortalities of animals and safer environment for workers.
- Less stressed animals produce better quality meat products.

Handling of buffalo

Experienced handlers say that buffalo appear to learn quicker than cattle and have a better memory. They are better managed in smaller groups and respond best to quiet and gentle handling. The use of excess pressure (i.e. getting too close) is the greatest cause of bad handling with buffalo.

The principles of low-stress handling for cattle also apply to buffalo, however there are some differences in behaviour between the species which are outlined below.

- Buffalo should be given time to adjust to unfamiliar surroundings and management routines.
- Allow plenty of room for yarded buffalo to move around and avoid putting too much pressure on individual animals. Rule-of-thumb for handling buffalo in yards, or hold in feedlot pens, is to use only 1/3 of the cattle yard or pen capacity (Lemcke, 2017).
- Routine hand feeding and patient handling of buffalo by the same handlers will hasten their domestication and trust between the both parties.
- Keep visitors at a distance to avoid 'spooking' and stirring up the buffalo.
- Normal processing of buffalo in yards is likely to take longer, but smoother if handlers adhere to quiet and gentle handling.

- Avoid working buffalo through the yards during hot summer days as they can over-heat more quickly than cattle. If necessary, any yard work should be scheduled for cooler parts of the day (early morning or late afternoon) followed by a spray of water over the animals to cool them down if required.
- Keep older bulls separate from younger bulls in pens and handling yards.
- Striking buffalo with sticks or having dogs near the yards should not be allowed.

However, buffalo can become aggressive if they have been upset by something or heat stressed and will stand their ground or charge someone that comes too close. This is a dangerous scenario especially when dealing with an angry 1 tonne beast. The situation should be quickly defused by backing off (reducing pressure) and leaving the animal to quieten down. A spray with a water hose and offering some hay will hasten the calming process.

When handling buffalo in yards, use smaller groups than cattle and just one or two familiar stockmen to handle them slowly and quietly through the yards and races. In the races, 'cattle' talkers can be used to encourage buffalo to move forward if necessary. Unfamiliar stockmen should keep a good distance until the animals get used to them. Keep other people well away from the yards and races to ensure a smooth yard operation.

Summary of SOPs for handling buffalo

- It is mandatory for feedlot operators to abide by animal welfare standards and train their stockmen to handle Australian livestock in a way that minimises stress and danger to both animals and personnel.
- The principles of animal handling are for stockman to understand the natural behaviour of livestock and use this in a low stress environment to manage cattle movements.
- A low stress environment also means having suitable facilities and aides such as 'cattle talkers' that guide the animal's movements smoothly from one location to another.
- There are also commercial benefits to low-stress stock handling in terms of quicker and safer stock movements, higher productivity and better-quality meat.
- The principles of low-stress handling for cattle (see MLA, 2012) also apply to buffalo.
- Stockmen should be aware of environmental factors that could affect the movement of livestock such as, bright reflections from metal or water, loose chains or rope, banging noises (metal on metal) or high pitched noises (pneumatics), clothes hanging on race or fence, fertilizer bags on the ground, people moving, drain covers, uneven floor or texture, moving from light to dark areas, and dead ends. Eliminating these types of obstacles will make stock movements much easier.
- Stockmen should be aware of animal behaviour characteristics such as vision and reaction to movement and noise, the animal's (or group of animals) flight zone and its fear reaction to the closeness of humans.
- Stockmen should use to their advantage the herding instinct of buffalo to follow each other and should be mindful of the animal's size and strength, and temperament, particularly if it has been separated from a group.
- Buffalo are better managed in smaller groups and respond best to quiet gentle handling by familiar handlers.

- Buffalo can become aggressive if treated roughly or are already stressed. The best course of action is to back off and leave the animal to calm down, helped by a hosing down with water.
- Keep visitors and unfamiliar people away from buffalo yard operations.
- The use of 'cattle talkers' must completely replace other methods of moving buffalo such as electric prodders, sticks, whips, tail twisting etc. which are contrary to SOPs and cause increased animal stress and make animals more difficult to handle.
- The 'cattle talker' helps to get a baulking animal moving again in a clear race or gateway and should only touch the hindquarters of the animal. Other methods include using fresh forage as a lure or moving and waving hands when standing in the correct position near or just inside the animal's flight zone.

5. Animal Health

Shipboard health issues

Prior to the export of Water buffalo, Australian veterinarians administer health protocol requirements and remove animals considered unfit for shipment. During the voyage, the exporter's stockman manages the husbandry and health of the livestock with particular emphasis on stress-related issues. Such issues are not uncommon during sea voyages, such as physical injuries due to fighting or rough seas, heat stress, loss of appetite and other nutritional disorders, or infection. Since sea voyage transit times in SE Asia are relatively short (5-9 days), on-board mortality, if any, is low. Where health issues have occurred during shipping, they are mostly presented on arrival as well. The affected stock should be unloaded and transported to the feedlot with care, and then separated into the hospital pen for ongoing treatment.

Heat stress

Buffalo are particularly susceptible to heat stress from increasing body heat load. This can occur when temperatures and humidity, especially if housed on the lower decks of the ship, reach a critical point whereby net body heat loss through evaporative cooling is less than heat gained over several days, causing moderate to serious heat stress in the buffalo. Wherever possible buffalo should be loaded onto the top deck(s) of the ship. As the heat load increases, food intake decreases and the animals become weak and even more distressed. On arrival at the feedlot, they should be hosed down with water and provided with freshly chopped green forage supplemented with salt (30 g/hd), ensuring that all affected animals have access to the feed trough. Clean water should be available and the addition of electrolytes will also be beneficial (see footnote on page 5).

Other diseases such as Haemorrhagic septicaemia, Pneumonia, Ketosis and other diseases associated with feedlots, and 'how to recognise sick animals', can be found in the Animal Health section of the Manual for South-Eastern Asian Cattle Feedlots (MLA 2010).

Important buffalo diseases

Malignant catarrhal fever

This is an acute viral infectious disease in buffalo characterised by high fever and severe mucous nasal discharge, eye infection, sometimes mouth lesions and diarrhoea. Contact with sheep which hosts the virus (without symptoms) is the main risk to Australian buffalo exported to SE Asia. There is no treatment of this disease for buffalo.

Clostridia and parasitic diseases

As with cattle, buffalo are usually vaccinated against a range of clostridial diseases as part of the Australian health protocol for live export. A similar vaccine is available for botulism. Similarly, treatment against worm infestations with multi-spectrum anthelminthic pour-ons or oral drenches are dispensed prior to export or during processing of new feedlot arrivals.

Vaccination against leptospirosis is not common practice in Australia however all livestock workers should practice good hygiene when coming into contact with urine and /or faeces.

External parasites

Buffalo fly does not seem to annoy buffalo as much as cattle and they rarely develop the same skin lesions, probably due to their thicker skin. Control methods include ear tags impregnated with insecticide, chemical pour-ons or sprays, and back rubber systems that use oil mixed with chemical

in a container with a drip-feed to rolled up matting suspended across two posts. The back rubber is very effective and more convenient to use.

Figure 5: Cattle utilising the buffalo fly rubber

Bladder stones (Urolithiasis)

These are bladder stones formed by aggregates of mineral salts which can obstruct the urinary tract of buffalo and to a lesser extent cattle and smaller domestic ruminants. Castrated bulls are particularly susceptible because the urinary tract remains relatively narrow. Clinical signs of an imminent blockage of the urethra with a stone are; observed abdominal pain, thrashing tail, straining to urinate, and dribbling blood-stained urine. The blockage is likely to result in the rupture of the urethra or bladder causing blood-stained urine to leak into the body cavity. At this stage, measures should be taken to drain the urinary bladder to provide temporary relief to the animal, however without surgery to remove the stone, the only alternative is to market the animal for slaughter and salvage of the carcass (Jensen and Mackey, 1971).

Grain-based feedlot diets and some forages when fed with mineral imbalances (e.g. high levels of phosphorous and magnesium, or low calcium) are predisposed to forming bladder stones. Other contributing factors are seasonal intakes of water, with less water intake in cooler weather, or greater water loss in hot weather, producing more concentrated urine, especially where drinking water has a high mineral content. Feral buffalo populations may have a higher incidence of bladder stones because of the harsher nutritional and climatic conditions they endure in the wild especially during dry seasons. Subclinical presence of bladder stones can be managed nutritionally by balancing mineral levels in the diet, supplementing with salt and ammonium chloride, and filtration of water with high concentrations of minerals.

Rumensin® intolerance

Rumensin® (active ingredient: sodium monensin) is often included in cattle feed pellets at a rate of 25 mg/kg to improve dietary energy availability and feed efficiency, to control coccidiosis, and to reduce acidosis and bloat. Buffalo have much lower tolerance to Rumensin® than cattle and should not be offered compound feeds containing monensin. Symptoms include loss of appetite, muscular weakness, reduced feed intake, laboured breathing, recumbency and death.

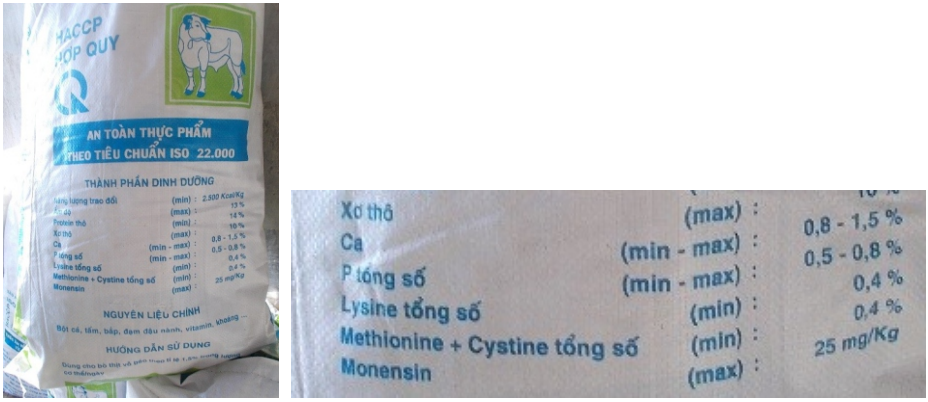


Figure 6: Cattle feed pellets containing Monensin

Summary of SOPs to manage and treat sick and injured buffalo

- Prior to export, all buffalo are administered a health protocol and any animals considered unfit for shipment are removed from the consignment.
- Shipboard health issues are mainly physical injuries or stress related, particularly heat stress, which are also presented at port of arrival and need to be treated at the feedlot.
- Feedlot operations should have an animal health plan and experienced personnel to administer health care to animals in the feedlot.
- Establish hospital pens for separating and treating sick or injured animals.

- Downer animals (animals that cannot stand up or walk) may need to be humanely killed in situ (see MLA 2010, 2012), or if recoverable and can be moved without causing further pain or distress, should be taken to a hospital pen and treated as soon as possible.
- Ensure that Australian buffalo do not come into contact with local livestock and contaminated soil to prevent risk of Haemhorragic septicaemia infection.
- Malignant catarrhal fever is an acute viral infectious disease in buffalo and transmitted by sheep in SE Asia and there is not treatment for this fatal disease.
- Major internal and external parasites that affect buffalo are usually treated prior to export or at the feedlot depending on export health protocols.
- Bladder stones are aggregates of mineral salts which can obstruct the urinary tract of buffalo, especially castrated males. Subclinical presence of the stones in buffalo can be managed nutritionally with balanced mineral levels, salt and ammonium chloride supplements, and filtration of water with high mineral content.
- Buffalo have a low tolerance to Rumensin® (active ingredient: sodium monensin) and should not be offered compound feeds containing monensin.

6. Buffalo Nutrition

Key differences between rumen digestibility in buffalo and cattle

Buffalo fed forage based diets generally have higher feed intakes than cattle, because they ruminate (chew the cud) for a longer time, and this repeated chewing action breaks down fibrous digesta into smaller pieces. This is retained in the rumen for less time, resulting in faster turnover rates of digesta and carrying with it more microbial protein into the intestine to be digested. This indicates that digestion of fibrous feedstuffs in buffalo appears to be more efficient than cattle. With protein supplementation, levels of rumen ammonia and blood urea are higher, and urea recycling via saliva is much greater in buffalo (Kennedy et al, 1992).

On feedlot rations, growth rates of Australian Swamp buffalo do not appear to improve above 35% dry matter (DM) intake of concentrate when included with forage-based diet (Ffoulkes and Smith, 1992), suggesting that this type of diet is optimal for the genetic potential for growth in buffalo.

Feedlot rations for buffalo

A range of forages that are fed to cattle in feedlots can also be fed to buffalo, including chopped fresh Elephant (Napier) grass, forage maize, sugarcane leaves, pressed (pelleted) oil palm leaves, and rice hay. Total daily DM intake of fresh forage for Swamp buffalo is about 1.8-2.0 % LW of live weight (LW)[6] (or about 22-24 kg of fresh forage daily. A 65%/35% mix of forage and concentrate (dry matter basis) will optimise growth rate of the buffalo under feedlot conditions.

The energy component of the concentrate feed, typically crushed corn grain, wheat pollard or rice bran, comprises 25% of the total ration. Protein feeds such as palm kernel cake, copra meal, and soyabean meal, make up the remaining 10% of the ration (see table below). Salt and ammonium chloride (NH_4Cl) are also added to the ration mix to maintain metabolic function and manage urolithiasis (see below).

[6] *Younger buffalo tend to have higher feed intakes (±2.0% LW) than older animals (±1.8% LW).*

Table 3: Basic composition of buffalo feedlot rations for optimal growth (consult nutritionist for specific feeds)

Buffalo (300 kg Live Weight)	Proportion of Ration	Feed Intake (kg DM[1]/d)	As Fed (kg FM[2]/d)
Total feed intake	100%	6.0[3]	17.9
Forage (25% DM)	65%	3.9	15.6[4]
Concentrate feeds (90% DM):	35%	2.1	2.3
Energy feed	25%	1.5	1.7
Protein feeds	10%	0.6	0.6

1. Dry matter
2. Fresh matter
3. (300 kg x 2% LW) = 6 kg
4. (3.9 kg/25%) = 15.6 kg FM

Nutritional management of subclinical Urolthiasis

- Ensure calcium (C) in the ration is providing about 25 g C per day and its ratio with Phosphorus (P) in the total ration is about 2:1. Avoid adding excess calcium to balance the ratio.
- Include ammonium chloride in the ration mix at a rate of 50-80 g/hd/d; it is an acidifying agent which helps prevent further growth of subclinical bladder stones.
- Add 30 g/hd/d of salt in the ration mix and also provide salt blocks in the feed troughs. A higher salt intake encourages buffalo to drink water and dilutes their urine which also helps to prevent existing bladder stones from getting larger.
- Provide ample clean water and have the water analysed for high mineral levels, in particular magnesium. If mineral levels are high, consider installing water filtration technology.

Summary of SOPs for feed management of buffalo

- The process of digestion in buffalo is similar to cattle however buffalo ruminate longer and the rate of passage of digesta through the gut is quicker, allowing buffalo to digest fibrous feeds more efficiently than cattle.
- Buffalo perform best on forage-based diets supplemented with concentrate feed at about 1/3 of total DM intake.
- Check that all animals have access to sufficient quantity and quality of feed, which is fed on a regular basis at least 3 times daily or continuously. Ideally, the trough should have minimal feed residue before the next feed, and any residue should be removed, and the troughs cleaned daily.
- Do not leave feed troughs empty for long periods of time as this affects productivity and the health and welfare of the animal.
- With interval feeding of unmixed forage and concentrate rations, forage should be delivered to the feed trough first, before adding concentrate feed on top of the forage residue and mixed in by hand.
- It is important to have a balanced C:P ratio of 2:1 in the total ration and avoid excess calcium levels.
- Provide salt and ammonium chloride in the daily ration and place salt blocks in the feed trough.
- Drinking water with high levels of phosphorus and magnesium compounds may need to be filtered to avoid mineral imbalance in the ration.
- Ensure that there is clean water always available and regularly check water troughs for defects and dung or feed residue in the water.
- Do not feed compound feeds or additives containing Rumensin® (Monensin)

7. Feedlot Management

Managing Heat Stress in buffalo

Heat stress in livestock confined in a feedlot situation is caused by a number factors, namely ambient temperature, humidity, air movement, solar radiation, thermal radiation (e.g. from overcrowding), and metabolism. These factors can combine together to increase the heat load of the animal's body. If the animal is unable to lose sufficient body heat (e.g. through evaporative heat loss), then heat load increases overtime until the animal reaches a state of acute hyperthermia resulting in death.

Physiological differences between buffalo and cattle

In the absence of shade or water to immerse their body, buffaloes are more susceptible to heat stress than cattle due to physiological differences in body temperature control (thermoregulation) compared with cattle. Body heat loss through evaporation for buffalo is mostly by panting whereas cattle lose much of their body heat by sweating (see Table 4). Buffalo are poorly adapted to sweating because the skin has only 1/6th of sweat cell density than tropical cattle, and its black skin readily absorbs solar radiation, and the thin covering of hair is little protection against a hot sun.

Table 4: Relative Contributions (%) of sweating and panting to evaporative heat loss in Buffalo and Cattle

Method	Buffalo	Cattle
Sweating	12	85
Panting	88	15

Source: Anjali Aggarwai and Ramesh Upadhyay (2013)

Heat Stress risk management planning

During the hottest part of the year, feedlot managers should have a proactive risk management plan for reducing heat stress in their livestock. This involves routinely monitoring the weather forecast for conditions that could lead to heat stress, and having a management plan to help the animals maintain their normal body heat. There are a range of indicators that can be used to predict heat stress in cattle, and these methods can also be used for buffalo.

There is a simple and practical method that uses temperature and humidity readings to estimate heat stress values from weather hazard charts, and these are commonly used by dairy farmers to monitor heat stress in cows, particularly during the summer. The combined temperature and humidity value is called the Temperature Humidity Index (THI). When the THI reaches 72 (see Table 5), this alerts dairy farmers to the risk of heat stress in their cows and prompts them to initiate a management plan to keep the cows cool with water spray and shade, and in some cases providing modified rations by increasing energy concentrate level.

In the same way, the weather hazard charts can also be used to monitor the heat stress risk in feedlot buffalo (see Chart 1). Mild to moderate heat stress affects food intake and growth rates as the animals become distracted by their discomfort. Evaporative cooling with water spray is the most effective way to dissipate body heat load and cool them down. This works better if done outside where there is some air movement or inside a shed where there are fans.

Table 5: Temperature Humidity Index (THI) heat stress thresholds and symptoms in buffalo and tropical cattle

THI	Buffalo	Cattle *(Bos indicus)*
<72	No heat stress	No-heat stress
72-79	Mild heat stress	Mild heat stress
80-89	Moderate to Serious heat stress	Moderate heat stress (THI 78-82) Serious heat stress (THI 83-89)
>90	Severe stress towards death	Severe stress towards death

Source: Dash et al (2016)

Chart 1: Weather Hazard Chart of Temperature Humidity Index (THI) values for cattle and buffalo Heat Stress thresholds

Temp	Humidity (%)																			
°C	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
24.0	66	67	67	68	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75
24.5	67	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76	76
25.0	67	68	68	69	69	70	70	71	71	72	72	73	73	74	74	75	75	76	76	77
25.5	68	68	69	69	70	70	71	71	72	73	73	74	74	75	75	76	76	77	77	78
26.0	68	69	69	70	70	71	71	72	73	73	74	74	75	76	76	77	77	78	78	79
26.5	69	69	70	70	71	72	72	73	74	74	75	75	76	76	77	78	78	79	79	80
27.0	69	70	70	71	72	72	73	73	74	75	75	76	77	77	78	78	79	80	80	81
27.5	69	70	71	71	72	73	73	74	75	75	76	77	77	78	79	79	80	81	81	82
28.5	70	71	71	72	73	73	74	75	75	76	77	78	78	79	80	80	81	82	82	83
29.0	70	71	72	72	73	74	75	75	76	77	78	78	79	80	80	81	82	83	83	84
29.5	71	72	72	73	74	75	75	76	77	78	78	79	80	81	81	82	83	84	84	85
30.0	71	72	73	74	74	75	76	77	78	78	79	80	81	81	82	83	84	85	85	86
30.5	72	73	73	74	75	76	77	77	78	79	80	81	81	82	83	84	85	85	86	87
31.0	72	73	74	75	76	76	77	78	79	80	81	81	82	83	84	85	86	86	87	88
31.5	73	74	75	75	76	77	78	79	80	80	81	82	83	84	85	86	86	87	88	89
32.0	73	74	75	76	77	78	79	79	80	81	82	83	84	85	86	86	87	88	89	90
33.0	74	75	76	76	77	78	79	80	81	82	83	84	85	86	86	87	88	89	90	91
33.5	74	75	76	77	78	79	80	81	82	83	84	85	85	86	87	88	89	90	91	92
34.0	75	76	77	78	79	80	80	81	82	83	85	85	85	87	88	89	90	91	92	93
34.5	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94
35.0	76	77	78	79	80	81	82	83	84	85	85	87	88	89	90	91	92	93	94	95
35.5	76	77	78	79	80	81	82	83	85	86	87	88	89	90	91	92	93	94	95	96
36.0	77	78	79	80	81	82	83	84	85	86	97	88	89	91	92	93	94	95	96	97
36.5	77	78	80	80	82	83	83	85	86	87	88	89	90	91	92	93	94	95	96	98
37.0	78	79	80	81	82	83	84	85	87	88	89	90	91	92	93	94	95	96	98	
38.0	78	79	81	82	83	84	85	85	87	88	90	91	92	93	94	95	96	98		
38.5	79	80	81	82	83	84	85	87	88	89	90	92	93	94	95	96	98			
39.0	79	80	82	83	84	85	86	87	89	90	91	92	94	95	96	97	98			
39.5	79	81	82	83	84	86	87	88	89	91	92	93	94	96	97	98				
40.0	80	81	83	84	85	86	88	89	90	91	93	94	95	96	98					
40.5	80	82	83	84	86	87	88	89	91	92	93	95	96	97	99					

Death

Unstressed | Mild stress | Moderate/Serious | Severe stress

Source: Dairy Australia (2016)

Summary of SOPs for heat stress management of buffalo

- Heat stress in livestock confined in a feedlot situation is mainly caused by increasing temperature and humidity, together with other factors which raises the heat load of the animal's body.
- Buffalo are more prone to heat stress than cattle because of physiological differences between the species in controlling body temperature.
- There should be enough shaded area in holding pens to protect all the animals from direct sunlight.
- The installation of water hoses or sprinklers for buffalo feedlots is essential for management of heat stress by evaporative cooling.
- Check for signs of heat stress by observing the breathing rates of buffalo. Normal breathing rates in cattle are 24-40 breaths per minute (BPM), severely heat stressed cattle have around 150 BPM.
- Buffalo breathing rates are more sensitive to heat stress; rates of 75-85 BPM indicates mild to moderate stress and water spray or sprinklers for 15 minutes per hour should be used to manage the animal's heat load.
- Check water troughs more frequently to ensure there is plenty of fresh water.
- During seasons of hot weather, a hazard chart should be used to plan the risk heat stress and the use of evaporation cooling methods to reduce heat load in buffalo (e.g. water spray).

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8. Pre-slaughter and slaughter management

The exporter and importer of Australian Commercial Water Buffalo both have a duty of care to ensure that animals are slaughtered humanely according to standard operating procedures (see below). The main difference between buffalo and cattle is the greater thickness of the skull and skin in buffalo, making it difficult to achieve effective stunning and sticking (throat cut) especially with larger animals. Captive bolt pistols and percussion stunners need to be loaded with a heavy charge, and a large calibre rifle may need to be used for larger animals. After slaughter the electronic NLIS ear tags are recorded and numbers sent to the exporter, and all the ear tags from the same consignment of buffalo are kept until the final report has been approved by Biosecurity Australia.

Summary of standard operating procedures (SOPs) for buffalo slaughter

- SOPs for transportation from the feedlot to the slaughter facility, the pre-slaughter holding yard, and animal handling apply. Quiet and gentle handling is essential at unloading and walking animals to the holding yard. Water hosing or sprinklers are used to clean the animals and calm them down. There should be fresh drinking water available at all times, and if held overnight, forage should also be provided.
- Before the slaughter process of a group of animals begins, the restraining box used for buffalo slaughter is checked to see that its entry doors and side gate are working properly, and the inside of the box is well lit and the floors are dry. Ensure that animals have limited visual contact with people and are not able to see the slaughter or processing of other animals.
- The operator of the stunner or rifle should maintain the equipment properly and check them daily before using them.

- Make sure that the workers involved in the slaughter process are present and ready, and any outsiders are moved away from the area.
- When ready to start the slaughter process, animals can be walked quietly and gently from the holding yard into the race and up to the door of the restraint box. Races should not hold excessive numbers of animals at any time. It is better to hold the buffalo in a forcing yard and to enter the race in small groups as required to avoid stress due to the unfamiliar surroundings.
- If the slaughter process for some reason is stopped for ½ hour or more, the animals waiting in the race should be returned to the holding yard and not left in race.
- Only when each worker is in position for the slaughter process and the operator of the stunner or rifle has loaded (or electrical stunner is in hand), should an animal be moved into the restraining box.
- Check that the side gate of the restraining box is closed before opening the entry door. If the animal baulks, slips or falls in the race or box, always let it settle first before attempting to move it forward again.
- Let the animal walk into the retraining box by itself and only close the door when its body is fully inside. If it backs out again, let it settle in the race before trying again, if necessary use a 'cattle talker'.
- Do not leave animals in the restraining box for more than 60 seconds; always proceed with the slaughter process as quickly as possible.
- Ideally the animal's head is restrained as soon as it is in position, and the stunning/rifle operator is ready to stun or shoot when the animal is effectively restrained.
- When restraining the animal, avoid applying too much pressure and sudden jerky movements causing the animal to struggle and bellow. If the animal prostrates itself, release the pressure of the restraint and attempt to restrain again after allowing the animal to stand up and calm down. Don't pour water onto the animal.

- As soon as the animal is effectively stunned or shot and lying on the floor of the restraining box, the side gate can be opened to let the body fall out. The slaughterman checks for effective slaughter before sticking. For non-penetrating and electrically stunned animals, the throat should be cut within 20 seconds of stunning.
- The target for a rifle shot is similar to cattle; i.e. intersect of two diagonal lines from the eye sockets to the base of the horns on the opposite side (see Figure 7). The penetration bolt stunner is likely to be more effective in the pole position (behind the skull)

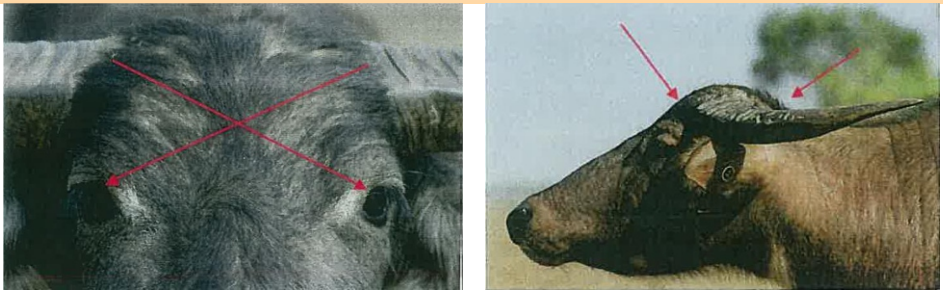

Figure 7: Targets and trajectory for stunning buffalo

- Effective stunning check list:
  - animal drops to the floor immediately after stunning/rifle shot
  - no sign of rhythmic breathing
  - no corneal reflex, i.e. eyes fixed and staring
- In the case of ineffective stunning, the animal should be re-stunned immediately using the backup stunner placed just above the first attempt. If the original stunner is not faulty, check the device before using it again.
- After effective stunning is confirmed for non-penetrating and electrical stunning, the slaughterman must cut the throat within 20 seconds of stunning using a long and sharp knife blade to sever both carotid arteries in a single stroke.
- The knife blade should be sharpened before a slaughter session begins and should be kept sharp between each animal slaughter. Always check for effective bleeding indicated by rapid and profuse bleeding from the cut. Take immediate action by re-sticking if the bleeding is not profuse.
- Keep a second pre-sharpened backup knife as a spare in case of blunting issues with the first knife and immediate re-sticking is required.

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