6. WATER QUALITY FOR LIVESTOCK AND POULTRY

6.1 INTRODUCTION

Irrigation canals frequently serve as sources for livestock drinking water but other sources, including poor quality supplies, are often used. Salinity requirements for irrigation are more restrictive than those for animals but highly saline water or water containing toxic elements may be hazardous to animal health and may even render the milk or meat unfit for consumption. In such cases, providing an alternate good quality supply should minimize the problem.

6.2 USE OF SALINE WATER FOR LIVESTOCK

In the arid and semi-arid regions of the world, livestock commonly use poor or marginal quality drinking water for several months of the year. These supplies originate from small wells, canals, streams or 'water holes', only the better of which are also used for irrigation. Occasionally such water is high in salt which may cause physiological upset or even death in livestock. The main reported effect is depression of appetite, which is usually caused by a water imbalance rather than related to any specific ion. The most common exception is water containing a high level of magnesium which is known to cause scouring and diarrhoea.

In evaluating the usability of any particular water, local conditions and availability of alternate supplies will play an important role, and a number of factors should be considered:

- Water source: Small shallow wells and streams are more likely to become contaminated or produce poor quality water than are the larger wells and flowing streams. Also groundwater is likely to be more chemically imbalanced than surface water.

- Seasonal changes: Marginal quality water may become unsuitable in hot dry periods because of: (a) increases in natural salinity due to evaporation during these periods; (b) increased water consumption by the animal due to the heat and increased intake of dry feed; (c) very high evaporation from stock watering ponds or tanks during these periods with the resulting higher salt concentration; and (d) increased water temperature.

- Age and condition of the animal: Lactating, young and weak animals are normally more susceptible.

- Feed composition: Dry pastures and high protein supplementary feed in place of previously green pastures may reduce the salinity tolerance of the animal due to the lower moisture content of the feed and higher salt content (intake of some feed supplements are purposely controlled by additions of salt to slow consumption).

- Species: Variation in tolerance to water salinity is considerable between animal species.

Considering the above factors and the need to avoid any risk of economic loss, the National Academy of Sciences (1972) established that, from a salinity standpoint, livestock drinking water with an electrical conductivity (ECw) less than 5 dS/m should be satisfactory under almost any circumstances. This recognized that minor physiological upset might occur with water near this limit, but there was little chance that economic losses or serious physiological disturbances would occur.

Table 28 WATER QUALITY GUIDE FOR LIVESTOCK AND POULTRY USES[1]

Water Salinity (EC) (dS/m)	Rating	Remarks
<1.5	Excellent	Usable for all classes of livestock and poultry.
1.5 – 5.0	Very Satisfactory	Usable for all classes of livestock and poultry. May cause temporary diarrhoea in livestock not accustomed to such water; watery droppings in poultry.
5.0 – 8.0	Satisfactory for Livestock	May cause temporary diarrhoea or be refused at first by animals not accustomed to such water.
	Unfit for Poultry	Often causes watery faeces, increased mortality and decreased growth, especially in turkeys.
8.0 – 11.0	Limited Use for Livestock	Usable with reasonable safety for dairy and beef cattle, sheep, swine and horses. Avoid use for pregnant or lactating animals.
	Unfit for Poultry	Not acceptable for poultry.
11.0 – 16.0	Very Limited Use	Unfit for poultry and probably unfit for swine. Considerable risk in using for pregnant or lactating cows, horses or sheep, or for the young of these species. In general, use should be avoided although older ruminants, horses, poultry and swine may subsist on waters such as these under certain conditions.
>16.0	Not Recommended	Risks with such highly saline water are so great that it cannot be recommended for use under any conditions.

[1] Adapted from National Academy of Sciences (1972; 1974).

Table 29 SUGGESTED LIMITS FOR MAGNESIUM IN DRINKING WATER FOR LIVESTOCK[1]

Livestock	Magnesium (mg/l)	Concentration (me/l)
Poultry[2]	<250	<21
Swine[2]	<250	<21
Horses	250	<21
Cows (lactating)	250	<21
Ewes with lambs	250	<21
Beef cattle	400	33
Adult sheep on dry feed	500	41

[1] Adapted from Australian Water Resources Council (1969).

[2] The tolerance of swine and poultry for magnesium is unknown but could well be less than 250 mg/l.

It is often necessary in arid and semi-arid regions to use water which exceeds this

recommended limit. While all attempts should be made to stay within the criteria suggested above, there are situations where it will be necessary to use poorer quality water for short or long periods of time. Table 28 gives guidelines for those situations where poorer quality supplies must be used. These guidelines have a small margin of safety but their use probably does not eliminate all risk of economic loss. However, with sound judgement, they should provide a framework within which decisions can be made.

The National Academy of Sciences pointed out that among other things, several key items should be considered when using Table 28. They are:

- animals drink little, if any, highly saline water if low salt content water is available to them;
- unless they have been previously deprived of water, animals can consume moderate amounts of highly saline water for a few days without being harmed;
- abrupt changes from water of low salinity to highly saline water cause more problems than a gradual change;
- depressed water intake is very likely to be accompanied by depressed feed intake.

The guides in Table 28 assume that the effect is from the total salt content (osmotic effect) rather than from any specific toxic ion. The ions largely responsible for water salinity are in themselves not very toxic. However, magnesium is of major concern. Australian standards recommend that it be taken into account, particularly if the ECw exceeds 6.6 dS/m (4000 mg/l) for cattle and 10.0 dS/m (6000 mg/l) for sheep. No actual limits have been established due to varying conditions of use but Table 29 can be used as a guide. Animals using water near or above these values should be watched closely for ill effects.

Tables 28 and 29 are the basic guides for determining the suitability of a particular water supply for drinking water for animals, but local factors, especially effects of evaporation and concentration, must be considered. There may be no alternative to using poor or marginal water for extended periods; therefore, efforts should be directed toward minimizing their effects on animal health.

Animals can subsist for short periods with very poor water. Longer periods will require more careful monitoring but in either case one of the following steps may prove helpful to minimize the problems:

- provide drains or overflows on throughs and tanks to flush them occasionally. This will prevent poor water concentrating further by evaporation;
- provide dilution water if available;
- increase rainfall collection for dilution purposes;
- reduce evaporation losses (various methods available);
- control high water-using vegetation along streams and around holding ponds, or spring sources of water;
- provide settling basins to remove sediment.

6.3 TOXIC SUBSTANCES IN LIVESTOCK WATER

There are a number of substances or toxic ions which cause toxicity in animals. These

sometimes occur naturally in water, but more frequently they are a result of man's activities, including waste disposal. Toxic substances in natural water are usually at concentrations well below the toxic levels. If unusually high and toxic levels are found, this often implies the existence of some outside contaminating source such as a wastewater and the use of the water should be restricted until the source of the toxic element is located and reduced or eliminated. The common toxicants include many inorganic elements, organic wastes, pathogenic organisms, and herbicides and pesticides and their residues. These may be directly toxic to the animal, cause the water to be unpalatable, or accumulate in the animal making its edible product unsafe or unfit for human consumption.

The National Academy of Sciences (1972 and 1974) has prepared guidelines on the safe level of many toxic inorganic elements in livestock drinking water. These are presented in Table 30. These guidelines have a wide safety margin. They are based on amounts normally found in usable surface and groundwater and are not necessarily the limits of animal tolerance. This approach is taken since the safe concentration of these substances is dependent upon many factors, including the quantity of water an animal consumes each day and the weight of the animal. The original discussions presented by the National Academy of Sciences publication and other sources should be consulted before using a water of questionable quality.

Table 30 GUIDELINES FOR LEVELS OF TOXIC SUBSTANCES IN LIVESTOCK DRINKING WATER[1]

Constituent (Symbol)	Upper Limit (mg/l)
Aluminium (Al)	5.0
Arsenic (As)	0.2
Beryllium (Be)[2]	0.1
Boron (B)	5.0
Cadmium (Cd)	0.05
Chromium (Cr)	1.0
Cobalt (Co)	1.0
Copper (Cu)	0.5
Fluoride (F)	2.0
Iron (Fe)	not needed
Lead (Pb)[3]	0.1
Manganese (Mn)[4]	0.05
Mercury (Hg)	0.01
Nitrate + Nitrite (NO_3-N + No_2-N)	100.0
Nitrite (NO_2-N)	10.0
Selenium (Se)	0.05
Vanadium (V)	0.10
Zinc (Zn)	24.0

[1] Adapted from National Academy of Sciences (1972).

[2] Insufficient data for livestock. Value for marine aquatic life is used here.

[3] Lead is accumulative and problems may begin at a threshold value of 0.05 mg/l.

[4] Insufficient data for livestock. Value for human drinking water used.

The most common management problems are related to fluoride, iron, nitrate, or hydrogen sulphide. Most of the fluoride problems noted are not actually toxicity; rather, fluoride causes tooth mottling and bone problems. In areas where fluoride water constitutes the sole source of livestock drinking water, attempts should be made to minimize evaporative concentration. If high fluoride water must be used in certain seasons, alternating the exposure of the animal to it will be helpful. An alternative approach would be retention of low fluoride water for the use of young stock since this is the most susceptible age, especially before eruption of the permanent teeth.

Toxicity problems are amplified when the forage used is also irrigated with the same potentially toxic water. The plants take up the salts, thus raising the toxicity risk to the animal when both the sources of feed and water combine to exceed the critical levels. This may also happen with an element such as selenium.

Livestock poisoning by nitrates or nitrites should not occur with levels less than the guideline values. This does not exclude all problems, however, as a high nitrate level may cause heavy growth of algae in watering points. No direct link has been established between heavy algae growths and livestock deaths. Researchers point to the possibility that the sudden decomposition of algae may produce circumstances conducive to the development of botulism. Blue-green algae have also been suggested as containing possible toxins although no concrete evidence is available at present. Care should be taken when animals are using watering points with heavy growths. Copper sulphate is effective in controlling algae growths even at concentrations of 1 mg/l but care and professional advice should be sought before using it, as the solution to one problem could be the start of another.

Not all unusual constituents in animal drinking water are toxic. Some only cause management problems or nuisances. For example, a common problem in using shallow groundwater is the high level of hydrogen sulphide. Although by itself it does not harm the animal, the odour influences the animals to reject the water. A common practice of first running such water down a splash board for aeration has proved very effective, because the greater part of the hydrogen sulphide is dissipated before entering the water trough or tank. Water containing hydrogen sulphide also presents a corrosion problem to watering tanks or equipment due to the formation of sulphuric acid.

No limits for iron are given in Table 30 because it has a low order of toxicity. At watering points, iron is rarely present in the water since, on contact with air, the ferrous salts are oxidized and they precipitate, rendering them essentially harmless to animals. However, even with a few milligrams per litre, iron can cause clogging of lines to watering troughs or an undesirable staining or deposit.