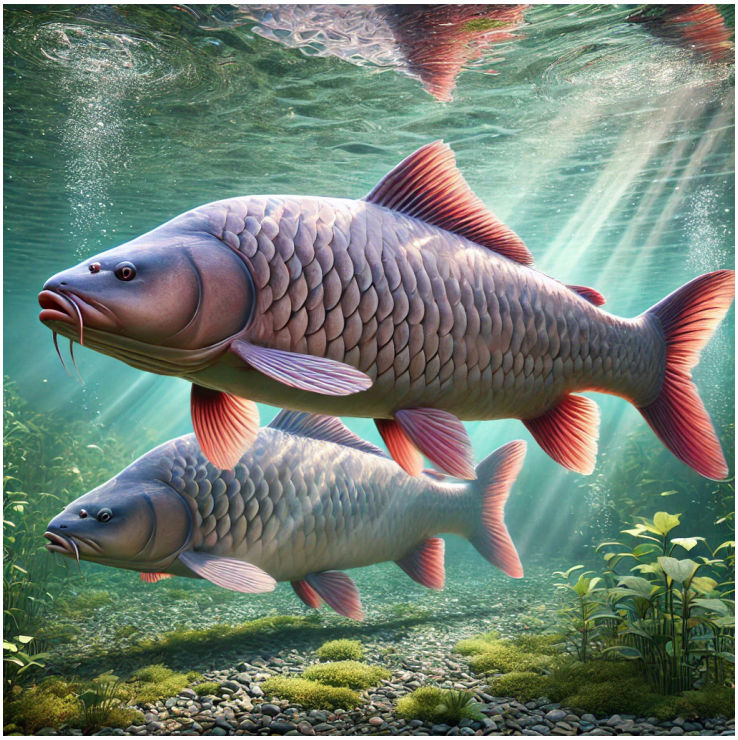
ARA Stocking Density Limits

This document explains why we chose the respective stocking density limits at the Alliance for Responsible Aquaculture.

The Alliance for Responsible Aquaculture (ARA) is a farmer alliance initiated and run by Fish Welfare Initiative. Upon joining the ARA farmers commit to a stocking density limit and keeping water quality within required ranges for higher fish welfare. The stocking density limits at the ARA depend on the life stage of the fishes and are based on secondary research evaluating stress responses under various stocking densities.

See our region-specific classification of life stages.



AI-generated depiction of a rohu (back) and catla (front), the most common species farmed in Indian Major Carp culture in India—the systems the ARA focuses on.

Grow-Out Stocking Density Limit

Limit: 3,000

Literature availability: Medium

Overview
This is the final life cycle of farmed carps where juvenile fish remain until they attain commercial size. These farms are the largest of all life cycles and are designed to promote rapid growth and weight gain. As such, average growth may indicate welfare: if the fishes grow well, some and, potentially, most of their welfare needs have likely been met. By now, a growing body of literature focuses on other welfare indicators, for example, physiological and behavioural ones.

Since the carps are already bigger, the stocking density is lower than in previous life stages. Carps remain in this life stage for 7-10 months on average. These farms are usually at least 5 acres and can be as big as 100 acres.

Insights from The Literature
At the end of the 20th century, existing experiments on Indian Major Carp (IMC) stocking densities concluded limits between 1,600-4,000 fishes/acre to be most common (Nandeesha, 1993 as cited in Ayyappan & Jenna, 2003). The Global Seafood Alliance also mentions that a stocking density of 3,000 fishes/acre is common for Indian Major Carp (Murthy, 2002) and in Andhra Pradesh common stocking density appears to be 3,200-4,000 fishes/acre (Nair & Salin, 2007). Even though these limits were based on optimal growth, they may indicate welfare, taking growth and survival as indirect indicators of fishes' well-being.

From the literature, two resources recommend a stocking density of 3,200 fishes/acre (FAO, 2014; Mohanty et al., 2017). Another paper suggests 2,000 as the ideal stocking density, closely followed by 3,200 (Mohanty, 2004).

Few papers recommend higher stocking densities but most of these appear to have varying definitions of life stages making them mostly inappropriate for our context.

Various papers suggest that higher stocking densities are associated with reduced feeding activity (Hassan & Naeem, 2017), growth, and immune functions (Hoseini, et al., 2019). While carps living in crowded environments may not always be more at risk of dying, their growth and immune functions are affected (Hassan & Naeem, 2017), thus likely affecting their welfare.

> *"Although the higher stocking density might be economically justified in the short term, due to impaired welfare it brings risks in the long run. The higher rate of artificial aeration showed a negative effect on meat and water quality; however, its cooling effect might be helpful in tackling issues with extreme water temperature." (Stanivuk et al., 2024)*

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Breed-Out Stocking Density Limit

Limit:

- 20,000 for target harvest weight of <150g
- 12,000 for target harvest weight of 151-250g
- 8,500 for target harvest weight of 251-350g
- 6,000 for target harvest weight of 351-500g

Literature availability: Low

Overview

This is the second-last life cycle of farmed fishes where fry are grown until they reach the fingerling stage (upon which they're transferred to grow-out farms). Carps stay on these farms for three to ten months on average. Breed-out ponds are smaller than grow-out ponds and typically don't exceed ten acres.

Fishes are much smaller (between 150-350 grams) and thus stocked at a higher density than fishes in grow-out farms.

Insights from The Literature

There is very limited literature available. The few existing papers suggest reduced growth with increased stocking density from 60,700 to 240,000 (Jean et al., 2005) and better feeding activity, growth, and water quality in stocking densities of 8,000 fishes/acre as opposed to 14,000 and 20,000 (Bag et al., 2016). The FAO suggests that at 20-80,000 fishes/acre the average survival is 40-50% which suggests that welfare infringements (FAO, 2009). As such, we would want to aim for 20,000 as the maximum in this life stage. Another 2013 paper by the FAO suggests 20-40,000 fishes/acre if they are stunted to 100-150g (Nandeesha et al., 2013). The limit of 40,000 fishes/acre is further supported by other authors (Paswan et al., 2021). This variability is due to the wide range of fish weight and cycle length. The ideal stocking density is thus dependent on the target harvest weight.

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Rearing and Nursery Limits

While we have a few rearing and nursery farms, we will not define a limit for stocking densities in these life cycles because

1. There are frequent partial harvests and farmers are generally aware of not overstocking these systems.
2. These frequent partial harvests make it difficult to set a clear limit that would apply throughout the entire cycle. The limit decreases as fishes grow.
3. Likely due to the point above, there is very limited data on limits for the entire rearing and nursery cycles, making it difficult to determine a specific limit.

Shrimp Stocking Density Limit

While FWI primarily focuses on fishes, we work with some polyculture farms that also have shrimps. We thus included a shrimp stocking density limit on our commitment in areas where these polyculture farms are present.

Given our limited work on shrimps, we have based our stocking density limit on Shrimp Welfare Project's recommendation of a maximum of 15 shrimps per m^2 (= 60,000 shrimps/acre).