Name	**Maximum production while maintaining high water quality in farm**
DPSIR class	Impact
ECASA sub-group	Water quality
ECASA code	MAXPRODWQ
Proposed by participant	16 – University of Gothenburg, Sweden
Definition, computation,	The maximum production of fish, *TPF* (kg/yr), is determined so that the cages within the farm sustains acceptable concentration of oxygen and ammonium: $TPF = \min\left(TPF_{O_2}, TPF_{NH_4}\right);$ where $TPF_{O_2} = \frac{(O_{2In} - O_{2Min}) L_F D P_F U_{Min}}{DO_2}$ and $TPF_{NH_4} = \frac{\left(NH_{4Max} - NH_{4In}\right) L_F D P_F U_{Min}}{DNH_4}$ Here TPF_{O2} and TPF_{NH4} are the maximum production acceptable with respect to oxygen and ammonium, O_{2In} and NH_{4In} are the oxygen and ammonium concentrations in the water flowing in to the farm and O_{2Min} and NH_{2Max} are the minimum oxygen concentration and maximum ammonium concentrations acceptable to the grown species. The consumption of oxygen and production of ammonium per kg fish is given by DO_2 and DNH_4 respectively. The dimensions of the farm are defined by the parameters L_F (length of farm) and D (depth of cages). U_{Min} is the minimum mean current through the farm and P_F ($0<P_F<1$) the permeability of the farm.
Data required	NH_{4In} – the ammonium concentration in the water flowing into farm (needs to be measured) U_{Min} – the minimum mean current within the farm (needs to be measured) Salinity and temperature of water flowing in to the farm (needs to be measured) – the inflowing oxygen concentration is calculated assuming oxygen saturation of inflowing water (dependent on *S* and *T* , Weiss (1970)). Minimum oxygen and maximum ammonium concentrations acceptable by farmed species. Dimensions of farm (length, depth) The permeability of farm which causes a reduction in mean current due to resistance of flow by cages and floating devices. DO_2 and DNH_4. Calculated by MOM-system sub-model for fish metabolism and growth.

Summary, scientific meaning, implementation

Farmed species are sensitive to the water quality in their immediate surrounding. High water quality for fish is sufficiently high concentrations of oxygen and sufficiently low concentrations of ammonium. The concentrations of both substances are foremost determined by conditions in the surrounding environment in respect to well flushed farms being subject to moderate variations in oxygen and ammonium concentrations while farms with long residence time and sluggish flow could be subdued to harmful variations in concentration level. Approaching the problem with a 'worst case scenario' it is essential to know the minimum flushing rate of a farm site and it is this rate that must determine the maximum production possible at a site. The maximum production is also a function of farm design, so that for example a single row, 'long' farm have a higher flushing rate that a multi—rowed, 'wide' farm. The resistance of nets, cages and floating devices of a farm to water flow also affects the maximum possible production with respect to maintained high water quality within farm. Any changes in the above parameters may of course also have direct consequences on the sites holding capacity (Stigebrandt et al, 2004).

Range of validity

Class	Status	Description
I	TPF $<TPF_{Init}$	Maximum possible fish production has decreased relativ initial state (TPF_{Init}= Initial maximum possible productio at a farm site, TPF = maximum possible production due to alteration in environmental conditions)
II	$TPF=TPF_{Init}$	Maximum possible fish production unchanged
III	TPF $>TPF_{Init}$	Maximum possible fish production has increased relativ initial state

Species concerned (fishes/molluscs)

Only Fishes

Related type of aquaculture

Maximum production with maintaied high water quality within farm should be a relevant indicator to any type of aquaculture. The formulas are developed for farming in fish cages.

Relevant environments for this indicator

Maximum production with maintaied high water quality within farm is a relevant indicator of environmental impacts on the aquaculture and could as such be applied to farms in any type of environment.

Geographic scale

Regional and local

Direct relevance to objectives

A

Clarity in design.

A

Realistic collection or development costs

A

High quality and reliability	A
Appropriate spatial and temporal scale	A
Obvious significance	A
advantages	
disadvantages	
references	
State of validation	
Recommendations	