Comments/Clarifications

( M.A. Juinio-Meñez June 28, 2019)

### 4.2 Aquaculture

#### 4.2.2 Impacts of climate change on ocean aquaculture

*Increasing storm strength and frequency poses a risk to infrastructure (De Silva 2012), and increased weather variability has been associated with lower profits (Li et al. 2014).*

*Increasing rainfall will increase the turbidity and nutrient loading of rivers, potentially causing more harmful algal blooms (HABs) that reduce production and threaten human health (Himes-Cornell et al. 2013; Rosa et al. 2014).*

These are very critical factors not considered in assumptions for suitable ocean farming e.g. g effects of monsoon throughout Asia/ tropical ; seasonality of favourable sea conditions may not be sufficient for growing to marketable size of finfish and other species, even with higher temperatures. For example, if growing period is six months, sea and weather conditions related to monsoons/typhoon season is shorter, this constraining optimal production (see related major comment below)

#### 4.2.3 Adaptation to climate change through selective breeding

*benefits of selective breeding must be evaluated against the potential ecological costs of escapement when considering breeding as a tool for climate adaptation.*

Yes.

Worth considering also – impacts of hatchery releases on genetic variability as well (related to both capture and mariculture production).

Genetic diversity is important in maintaining productivity ( locally adapted populations) and resilience (broader scale, longer-term environmental changes). Importance of conserving genetic diversity/ genetic management specially for restocking, sea ranching where there is explicit interaction between the cultured ( hatchery produced) and wild populations; ( see Kitada et al. 2018, Grant et al, 2017). Genetic management is fundamental to good practices /responsible restocking, precautionary approach ( e.g. *H. scabra* restocking , sea ranching in the Philippines, Juinio-Meñez, 2017). Essential to determine genetic population structure of fishery stocks (e.g. von der Heyden et al. 2014- Indo Pacific examples) .

#### 4.2.4 Forecasted impacts of climate change on the potential for ocean aquaculture

**Assumptions needs to be qualified with respect to biogeographic areas. Many generalizations cited are not applicable to areas within the jurisdiction of developing states. Particularly those located in areas most vulnerable to threats of climate change.**

*Open ocean aquaculture appears to have several advantages over the more traditional culturing methods, including fewer spatial conflicts and a higher nutrient assimilation capacity.( Gentry 2017)*

*Unsuitable areas: eliminated areas at > 200 m depth because they are generally too deep (and thus expensive) to anchor farms, and areas already allocated to other uses, including marine protected areas, oil rigs and high density shipping areas….unsuitable growing conditions due to low dissolved oxygen (fish only) and low phytoplanktonic food availability (bivalves only).*

…*some economic and social constraints of aquaculture may limit production, and their inclusion in future research will help further refine realistic production potential*

Yes is good these were mentioned, but needs more emphasis even in recommendations.

**Major comment:**

But the current production for ocean aquaculture ( both offshore and nearshore) estimates based on Gentry 2017, and the new analysis extending the analysis of Gentry,do not consider variability in weather and sea conditions e.g. affected by storminess, rainfall ( seasonal and biogeographical) which are major factors (as noted in 4.2.2) . Even without climate change, these are factors that primarily constrain mariculture production at least in the tropics , aside from economic considerations. Rather than *:*

- ***If the potential for production is so large, why is current mariculture production so low?*** *This gap is likely driven by prohibitive regulatory barriers for developing mariculture operations in many countries (Wardle 2017; Sea Grant 2019). For example, the United States has one of the largest EEZs and longest coastlines, but prohibitive mariculture regulations means that it produces only 1% of global mariculture (FAO 2018).*

**This general conclusion is not substantially supported and should be qualified (e.g. for some temperate developed countries such as the US);** given that direct effects of climatic factors on location and duration of production areas were not factored in; aside from the overall, forecast declines in the biological potential and impacts on marine ecosystems.

Wardle 2017 states that *aquaculture is generally considered to be a low-impact contributor to environmental problems, at least relative to other anthropogenic sources of environmental degradation…*

But this is not the case in the tropics e.g.intensive milkfish mariculture - Bolinao, Pangasinan) has been well documented , including effects on associated reef organisms and fisheries. Environmental costs are not considered in valuation, nor are economic losses due to storms and HABs.

Even with inclusion of economic constraints :**Figure 4** ( note location of high underages in production)-

Potential mariculture maybe considerably overestimated specially in the tropical areas affected by seasonal changes ( monsoon) as well as episodic severe atmospheric and sea conditions. This is also where many developing countries with poor governance and regulatory systems (e.g. small island states) are found. No one pays for environmental costs/degradation of ecosystems except the poor small fishers.

Whether production from mariculture can offset the productivity of multispecies fisheries if better managed may not be likely.

#### 4.2.5 Recommendations and key conclusions

1. Qualify given inherent weather related biogeographic constraints ; vulnerability of ocean culture systems.

3. *Developing feeds that replace fish ingredients with alternative sources of starch and protein and that more efficiently convert feed to fish would therefore increase the potential for finfish mariculture.*

Yes if less pollutive. Implementation of best mariculture practices that will mitigate organic pollution is fundamental.

References:

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