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Shrimp aquaculture as a vehicle for Climate Compatible Development in Sri Lanka. The case of Puttalam Lagoon

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ABSTRACT

At present, aquaculture of black tiger shrimp (*Penaeus monodon*) in the Puttalam district of Sri Lanka is unsustainable with more than 90% of the former shrimp ponds laying abandoned as a result of shrimp disease and improper management. Between 1992 and 1998, over 50% of the mangrove cover was removed in order to establish shrimp aquaculture. This severely affected the functioning of coastal ecosystems, reducing their provision of useful services and increasing coastal vulnerability to climate change. Changes in the hydrology and polluted residual matter make the soil unsuitable for other agricultural purposes without costly restoration. The root of the problem was inappropriate management and a focus on short term economic gains. Despite this previous failure, the national development plan, Mahinda Chinthana, now promotes aquaculture as an avenue for development. This will only be possible if aquaculture is regulated in a sustainable and well-managed manner, and does not increase local vulnerability to climate change effects.

The current paper discusses the possible costs and benefits in applying the concept of Climate Compatible Development (CCD) to shrimp aquaculture in Puttalam, Sri Lanka. It suggests how the sector can support mitigation of Green House Gas (GHG) emissions and adaptation to climate change effects, whilst stimulating development that will also benefit rural societies. Mechanisms that could enable this change include subsidies, insurance and bank loans which will also facilitate investment by foreign private enterprises and subsequent export. The development of a specific aquaculture policy and master plan would facilitate the process further.

1. Introduction

Shrimp farming was introduced to Sri Lanka in 1985. By the early 90s the industry was booming with production rates of up to 9000 kg/ha/year [20]. High export volumes contributed significantly (48–70%) to the total foreign exchange earnings during this period [40]. However, in 1993 the first outbreak of the White Spot Syndrome Virus (WSSV) dealt a heavy blow to many farmers [39,18]. The industry revived, but a second disease outbreak in 1998 caused severe economic losses to all shrimp farmers in Sri Lanka. The final and most devastating outbreak came in 2004 and caused a permanent reduction in the productivity of the industry [19,48]. Production reduced to under 4000 kg/ha/year (Jayasinghe pers. comm.) and export of shrimps in 2012 (volume and value) dropped by more than 65% compared to 1999 [51]. Currently, an estimated 90% of the shrimp farms are abandoned [3], leaving the coast dotted with areas that are unsuitable for other forms of agricultural/aquaculture production, mainly due to changes in the hydrology and polluted residual matter [48].

The environmental costs that accompanied the establishment of shrimp farming in Sri Lanka are significant [33]. For the establishment of shrimp farms in Puttalam District, over 50% of healthy mangrove forest in the area was removed [7]. With the loss of mangroves, an important buffer zone and habitat for marine life has disappeared [1,9]. The construction of shrimp farms also led to the removal of above and below ground carbon, along with the potential for future carbon sequestration [17,3,64]. Other impacts include pollution of surface and ground water, in addition to the depletion of wild stocks and healthy broodstocks for coastal fisheries [12,25,32,47,57,7,69]. As a result, rather than providing permanent economic benefits, the establishment of shrimp farms has

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led to unstable livelihoods and has increased the vulnerability of coastal populations to climate change impacts [5,10,8].

The *Climate Change Vulnerability Data Book,* published by authors in Ref. [45], acknowledges the high vulnerability of shrimp aquaculture farms to climate change effects, particularly in Puttalam District. Changes in rain patterns and increasing temperatures are already being observed by shrimp farmers and other stakeholders [60]. Rapid changes in temperature, salinity and oxygen can pose a shock to the immune system of shrimp triggering disease (particularly White Spot Syndrome Virus) to become active [55,67,16,61]). As climate related stressors increase, the risk of disease outbreaks becomes larger and there is very little prospect of maintaining or increasing the current area or levels of production. To address climate change adaptation and increase the resilience of shrimp farming to these changes, a fundamentally different approach to shrimp farming is required.

The current study investigates the potential for a new future for shrimp aquaculture in Puttalam Lagoon, in the light of these challenges, as a vehicle for Climate Compatible Development (CCD). CCD is a policy framework that aims to identify those actions that could enhance adaptation to current and anticipated climate change impacts, whilst also mitigating the production of greenhouse gases and leading to increases in human welfare [46]. It represents an attempt to learn from past mistakes and ensure that consideration of likely impacts of climate change is embedded in current planning. It also emphasises a broad definition of development, one that endorses human welfare rather than economic growth. The sorry legacy of intensive shrimp farming in Puttalam combines enhanced greenhouse gas production, loss of natural carbon sinks, increased vulnerability of coastal populations to anticipated climate impacts and economic benefits to a wealthy elite with costs borne by the local poor; a veritable case study in the opposite of CCD. Hence most alternative futures will be preferable to the status quo, but fully transforming this damaging industry provides a particularly challenging (and therefore useful) test of the CCD concept. Here, we consider which financial, technical and regulatory mechanisms are required as at least a start towards the application of CCD in the shrimp farming industry.

2. Methodological approach

The current functioning of shrimp farming in the Puttalam Lagoon was assessed through a sector analysis and literature review. To identify the current activity levels of shrimp farms, their typical mode of operation and management practices, an initial qualitative research project was conducted involving interviews with a range of local stakeholders [60]. In addition, changes in land use patterns and mangrove cover were identified by means of high resolution satellite imagery of Puttalam Lagoon in 1997 and 2007 and SPOT images in 2012 provided by Planet Action [3] The information was processed and uploaded onto an interactive web-based mapping tool *Our Ecosystem* that has been developed as part of this research project.[2] The tool can be used in the decision-making process.

A visioning exercise was performed to develop a 'Business as Usual' (BAU) scenario as well as a future scenario where shrimp farming would be in line with CCD [50]. During an expert meeting held in Colombo in December 2013, attended by representatives from relevant NGOs, government departments and academia, international sustainability standards [68] and their applicability for shrimp farming in Puttalam Lagoon were discussed. To reach these standards and support the objectives of CCD, a set of technical interventions was identified as well as a number of Best Management Practices and mechanisms required to make the shift. A policy workshop served to identify the policy framework that would support CCD aquaculture in Sri Lanka. This information was collectively synthesised and resulted in the proposed course of action presented in this article.

3. Setting the scene

3.1. Sri Lanka

Sri Lanka has a total surface area of 65,610 km^2 with a coastline of around 1338 km length [58]. With some 121,000 ha of lagoons and estuaries, it presents perfect opportunities for aquaculture [20].

In 2009, the 26-year conflict with the Liberation Tigers of Tamil Eelam ended, internally displaced persons were resettled and Sri Lanka improved its macro-economic situation. It is now a middle-income country with an average monthly household income of US $280 (Statistics Unit, Chief Secretary's Office[3]). Sri Lanka has a total population of 20.2 million people with a literacy rate of 95% [6]. The poverty headcount index 2009/10 for Sri Lanka is 8.9% (Statistics Unit, Chief Secretary's Office). The contribution of fisheries and aquaculture to the GDP is 1.7%. Aquaculture and related activities directly and indirectly benefit over a million people [30].

3.2. Puttalam Lagoon

The focus of the current paper is on the area around Puttalam Lagoon, a site that has been particularly impacted by the recent history of aquaculture in Sri Lanka [3]. The lagoon area consists of three Secretariat Divisions (SD), i.e. Puttalam, Kalpitiya and Wanathawilluwa [37], (Fig. 1). In 2012, the population in Puttalam District was 759,800 with a population density of 264 persons/km^2 (2012 Census). The majority of people were engaged in fishing and related activities (40%) and agriculture (29%); a smaller proportion (15%) worked in salt production or government services [54]. The unemployment rate in the North Western Province, of which Puttalam is a district, was 4.8%. The percentage of poor households in Puttalam based on the Household Income and Expenditure survey 2012/13 is 5.1% [13].

3.3. Policy framework

The National development plan *Mahinda Chintana* sets out priorities for economic development [14,15]. The focus for 2014–2016 is on economic development, infrastructure, and education. The plan does not, however, mention sustainability and climate change as priority influences on planning. Therefore, these issues need to be addressed through other policy instruments. The Coast Conservation and Coastal Resources Management Department (CC&CRMD), responsible for the implementation of the Coastal Zone Management Plan, acknowledges the need to include climate change in coastal planning and it supports ecosystem restoration. As part of the plan, Special Area Management (SAM) of aquaculture sites has been designated. The Central Environmental Authority (CEA), responsible for the implementation of the Sri Lanka National Strategy Action Plan (NSAP), advocates an integrated

[2] Our Ecosystem is an interactive web-based tool developed by Ecometrica and one of the outputs of the iCOAST project (www.icoast.our-ecosystem.com). It is available for policy makers and other stakeholders.

[3] http://www.cs.nw.gov.lk/cs/index.php?option=com_content&view=article&id=98&Itemid=236&lang=en.