



# Mangrove forest management planning in coastal buffer and conservation zones, Vietnam: A multimethodological approach incorporating multiple stakeholders

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## ABSTRACT

A multiple of stakeholder goals, regarding natural resource utilisation, are integrated into an overall provincial strategic forest and fisheries utilisation decision support system providing a platform for defining tactical forest planning objectives within a 10-year planning horizon. The case study area is a 5362 ha mangrove forest enterprise, divided into a buffer zone and a full protection zone, which has 46 permanent staff, 575 farming households, 450 near-shore fishing families, and 200 landless families. The analyses are based on a modification of the forest management planning package PEB, which incorporates multi-objective (political, economic, and biological) linear programming using a 10-year planning horizon based on stand data. Numerous stakeholders' goals are included in the forest management plan. A revenue of US\$ 2.6 million in the 10-year planning period is achieved of which 46% is generated from forestry in the full protection zone, 33% from non-farm forestry, and 21% from farm forestry in the buffer zone. The full protection zone forest has the potential to generate the highest revenue and, therefore, a discussion is made on allowing limited forestry in the zone. If the firewood value is included, the revenues would increase to US\$ 3.4 million. Findings suggest that firewood collection for landless, fishermen, and farmers is sustainable and, therefore, ought to be legalized. The value of on-farm silviculture and firewood collection accounts for 10% of net revenues, which can be compared to the other income generators: tiger shrimp (8%), mud crab (6%), sluice-gate fishery (44%), animal husbandry (5%), and off-farm activities (27%). The ecological linkage between mangroves and fisheries provides a major additional gross margin of between US\$ 4 and 12 million from fisheries alone. A discussion on the general applicability, strengths, and shortcomings of the system is made.

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## 1. Introduction

The multifaceted approach to the management of coastal resources has become known as integrated coastal management [46]. Pernetta and Elder [42] use the term 'holistic coastal management' to emphasise that 'careful planning and management of all sectoral activities simultaneously will result in greater overall benefits than pursuing sectoral development plans independently of one another.' Most land-use planning systems rely on designated areas (zones) in which only certain specified activities or land-uses (e.g. agriculture) will be permitted [46]. Zoning is regarded as a proactive mechanism and can be useful in coastal management if plans are regularly updated and development restrictions enforced. This implies that the natural protection provided by coastal

mangrove forest systems against seismic sea waves (tsunamis) is a major environmental issue that should be incorporated in sustainable planning, management, and cost-benefit analysis. The socio-economic importance of coastal protection has been clearly illustrated by the recent disastrous tsunami in Indonesia.

As populations increase and forest areas decline, protected areas are being demarcated in an attempt to preserve remnants of original flora and fauna. This is problematic where local populations exist within or close to protected area boundaries [30]. Natural resource management in protected areas and buffer zones involves conflicts between environmental protection and economic development [35]. The management of such systems may be very complex. The complexity involves interactions between political, cultural, biological, and economic issues and aspects, which the various actors may perceive highly differently depending on individual perspectives and interests. In a critical review regarding the failure of people-oriented conservation approaches, Wilshusen et al. [52] conclude that the overall arguments of the approaches' shortcomings are incomplete because they largely ignore key

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aspects of social and political processes that shape how conservation interventions happen in a specific context. Brechin et al. [5] contend that ‘focusing on the human organisational process associated with nature protection, the conservation community will necessarily have to reflect internally on the fundamental concepts, methods, and modes of organisation that govern collective action. Fundamentally, both the ‘what’ (the ends) and the ‘how’ (the means) need to be negotiated and applied in this context.’ Conflict is intrinsic to coastal zone management, yet relative few peer-reviewed studies have examined how coastal managers might apply conflict resolution processes in the coastal zone management context [35]. Hjortsø et al. [23] suggest a rapid stakeholder and conflict assessment methodology for natural resource management in which critical questions are addressed, thereby providing a comprehensive, holistic, and critical understanding of a complex natural resource management situation.

Integrated coastal management takes place at two levels: the national and/or regional in which the national goals, and strategies, institutional arrangements, and legislation may be determined and put into place; and the local, or area level, where area specific goals, objectives, plans and their implementation are the focus of attention [46]. Ensuring vertical linkages amongst various hierarchical levels of government (e.g. central, regional, and local) and horizontal within a specific level of a hierarchy such as the local level among local government, sectors, and various stakeholders is considered essential for the successful implementation of the intervention. Billé and Mermet [4] state that the focus on the local level and the general national framework – at the expense of integration at the regional (provincial) level – can be found in numerous other settings, which may be a great obstacle in implementation of integrated coastal management since the regional level plays a central role in the process.

Krumpe and McCoy [28] argue that successful long-term natural resource management requires a degree of trust between government agencies, private interests, and the public that can be developed through participatory approaches that are truly accessible, responsive, and interactive. Effective natural resource management requires a conviction on the part of those affected by future change that they can influence the process and that proposed management measures are equitable and fair. Without this perception of legitimacy or constituency building there is a strong likelihood that proposed management measures might fail [6,40]. Brechin et al. [5] propose that the planner should ask the following questions: (i) who benefits?; (ii) should biodiversity be granted moral superiority relative to human welfare?; (iii) is the process considered appropriate and just by those most affected?; (iv) who decides and based on what authority?; (v) who participate and how?; (vi) to what extent is each party holding up its end of the bargain and how effectively are participants perusing their goals?; (vii) how can we systematically adapt and learn from experiences?; and finally (viii) how do wider political economic processes drive local practices? However, before we ask ourselves these more ethical questions it would be highly relevant to have quantitative information, e.g. with regard to the current types (forest, fish, terrestrial animals, etc.) of natural resources on the location affected by planning, their production characteristics (species growth rates, productivity, etc.), current inventory (standing timber volume, fishery stocks, etc.), economic value of resources (US\$ kg<sup>-1</sup> or m<sup>-3</sup>), are there ecological links between various types of natural resources and what are their value, etc.

The main objective of this paper is to illustrate how the disclosure of stakeholders’ goals and conflicts regarding natural resource utilisation planning at the horizontal level of a state forest enterprise may be incorporated into an overall provincial strategic mangrove forest and fisheries utilisation decision support system providing a platform for defining tactical forest planning objectives within a 10-year planning horizon (see Fig. 1).

## 2. Materials and methods

### 2.1. Study area

Prior to the Second Indochina War, in the 1960s and early 1970s, it was estimated that there was 200,000 ha of highly diverse mangrove forest in Camau Province [38]. After the war, approximately 100,000 ha had been destroyed by spraying aerial defoliant [44]. In the 1980s and early 1990s the mangrove forest was again heavily destroyed due to the overexploitation of timber for construction and charcoal [49] and conversion of forest land into Silvo-Aquaculture-Fisheries Farming Systems (SAFS) [10,26].

State forest enterprises were established in the 1980s to ensure sustainable management and replanting but the pressure for SAFS land was too great and by 1992 the forest area in Camau was at its lowest level 51,000 ha [8]. The highly diverse mangrove forests of Camau had by the end of the 1980s been turned into monoculture forests consisting mainly of planted *Rhizophora apiculata* [13]. By the mid-1990s forest felling bans were imposed and the forest enterprises were now to replant and protect forest rather than utilise it [23], by 1999 the felling ban ceased.

Camau Province has 12 mangrove forest enterprises and depending on their location they are divided into two main land-use zones. A conservation zone named the full protection zone (FPZ) on which all land must be forested and conserved with no human settlement allowed except for fishing communities at river mouths. A buffer zone (BZ) with a forest cover of 60% and 40% for non-forest purposes, i.e. agricultural purposes [20]. Contrary to the majority of mangrove areas worldwide the mangrove forest in Camau Province has in this way maintained state owned management units as a strategic platform for integration of private commercial activities (farming) and nature conservation, constituting a unique mangrove management structure seen in a global perspective [24]. The forest enterprises are under the provincial Department of Agriculture and Rural Development (DARD) administration (Fig. 2). Farmers lease a 20-year land-use right on forest-farm land, which can be renewed provided they adequately protect the 60% forest on their land. Farmers perceive their main income generation activities as: tiger shrimp aquaculture and catch of natural shrimp and fish in tidal operated sluice-gates on the farms [10].

The case study area, Damdoi Forest Enterprise (DFE), covers 10,230 ha and is situated on the eastern coast, which is highly prone to erosion [25]. A forest area of 4156 ha in the southern part of DFE (total area 5362 ha) is included in the analysis. Within the BZ there are two types of mangrove forests, which are allowed to be utilised in a sustainable manner: (1) farm forest (BZFF) is situated behind a dike in which a sluice-gate controls the water level and hence the frequency of inundation and (2) traditional forest (BZTF) which resembles a natural forest in terms of its topographic gradient and inundation frequency (Table 1).

There are 575 farming households including DFE staffs’ farms within the BZ with an average farm size of 3.8 ha and a household size of 4.5 persons [10]. The predominant BZFF age-class is 0–5 years accounting for two-thirds, and one-third is age-class 6–10 years opposite the age-class distribution in BZTF. FPZ forest (FPZF) is managed as a conservation zone in which no forest utilisation is allowed currently but utilisation of aquatic species, by non-destructive collection methods, may commence, e.g. hand collection of mud crabs, snails, etc. The age-class distribution of FPZF is skewed, with half the forest being 6–10 years, the remaining 11–15 years. The main mangrove species cultivated in the BZ and FPZ is *R. apiculata*, planted at a density of 10,000 stems ha<sup>-1</sup> with a rotation period of 20 years but there are a minor number of mixed *R. apiculata* and *Avicennia marina* and *Avicennia officinalis* stands. The *Avicennia* sp. are not planted for commercial purposes, according to DFE, but they are mainly exposed directly to the open

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