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Environmental Management and Development

An Economic Valuation of Wetlands in Vietnam's Mekong Delta: a case study of direct use values in Camau Province.

Thang Nam Do
Jeff Bennett

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Asia Pacific School of Economics and Government
THE AUSTRALIAN NATIONAL UNIVERSITY

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About the authors

Thang Nam Do is a PhD student in the Environmental Management and Development Program, Asia Pacific School of Economics and Government, Australian National University.

Jeff Bennett is a Professor and Director, Environmental Management and Development Program, Asia Pacific School of Economics and Government, Australian National University.

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These papers present the provisional findings of research projects being undertaken within the Environmental Management and Development Programme by staff, students and visiting fellows.

Any comments on the papers will be gratefully received and should be directed in the first instance to:

Professor Jeff Bennett
Asia Pacific School of Economics and Government
The Australian National University
Canberra ACT 0200
Australia.
Telephone: +61 2 6125 0154.
Facsimile: +61 2 6125 8448.
Email: jeff.bennett@anu.edu.au

Abstract

This research paper is aimed at partially filling an information gap relating to economic values of wetlands in the Mekong River Delta by estimating the direct use values of wetlands in Camau Province, using a market-based approach. It is found that wetlands in Camau have the direct uses of capture fisheries, aquaculture, timber, fuelwood, *Nypa fruticans1* and medicinal plants, with the estimated average value of VND7,549,824 or AUD982 per ha per annum. Among these uses, aquaculture has the highest value, accounting for 48 per cent of the total direct use values.
An integrated approach to wetland management that includes the establishment of a well-defined property rights regime and due consideration of wetland values in cost and benefit analyses of land use options is recommended. In particular, the impacts of water flow on wetlands and their values to the local people should be integrated into policies concerning the allocation of water from the Mekong River. These findings confirm the need for further research. This would involve the estimation of

indirect and non-use wetland values, and the examination of linkages between water flow regimes and wetland values, using bioeconomic modelling.

Key words: Mekong River Delta, wetland management, economic valuation, direct use values.

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Email: jeff.bennett@anu.edu.au

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List of abbreviations

ANU	Australian National University
CBA	Cost-benefit analysis
CBM	Community-based management
CAC	Command and control
DOSTE	Department of Science, Technology and Environment
DONRE	Department of Natural Resources and Environment
GEF	Global Environment Facility
GSO	General Statistics Office
Ha	Hectare
IUCN	International Union of Nature Conservation
kg	Kilogram
m	Million
MBI	Market-based instruments
MRB	Mekong River Basin
MRD	Mekong River Delta
MONRE	Ministry of Natural Resources and Environment
MOSTE	Ministry of Science, Technology and Environment
PDS	Provincial Department of Statistics
TEV	Total Economic Value
UNEP	United Nations Environment Program
AUD	Australian dollar
VND	Vietnamese dong
WB	World Bank

Abstract

This research paper is aimed at partially filling an information gap relating to economic values of wetlands in the Mekong River Delta by estimating the direct use values of wetlands in Camau Province, using a market-based approach. It is found that wetlands in Camau have the direct uses of capture fisheries, aquaculture, timber, fuelwood, *Nypa fruticans*[1] and medicinal plants, with the estimated average value of VND7,549,824 or AUD982 per ha per annum. Among these uses, aquaculture has the highest value, accounting for 48 per cent of the total direct use values.

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Key words: Mekong River Delta, wetland management, economic valuation, direct use values.

[1] One kind of palm trees in wetlands in the Mekong River Basin (Vietnam NEA 2003).

1 Introduction

1.1 Background

There are many growing and conflicting demands for Mekong River water. These include the instream uses of hydropower, navigation, wetlands and fisheries and maintenance of the environment, and the offstream uses of irrigation, livestock, household and industrial uses (Ringler and Cai 2003:1). Environmental water uses, an example of instream water use, include direct use for fishing or harvesting timber and non-timber forest products from wetlands, and indirect use of ecological function values. Water supplies in the Mekong River Basin (MRB) have often been allocated without due regard for environmental water use in part because of a lack of information on different values of environmental water uses, including wetlands (Ringler and Cai 2003:1).

The Ramsar Convention defines wetlands as

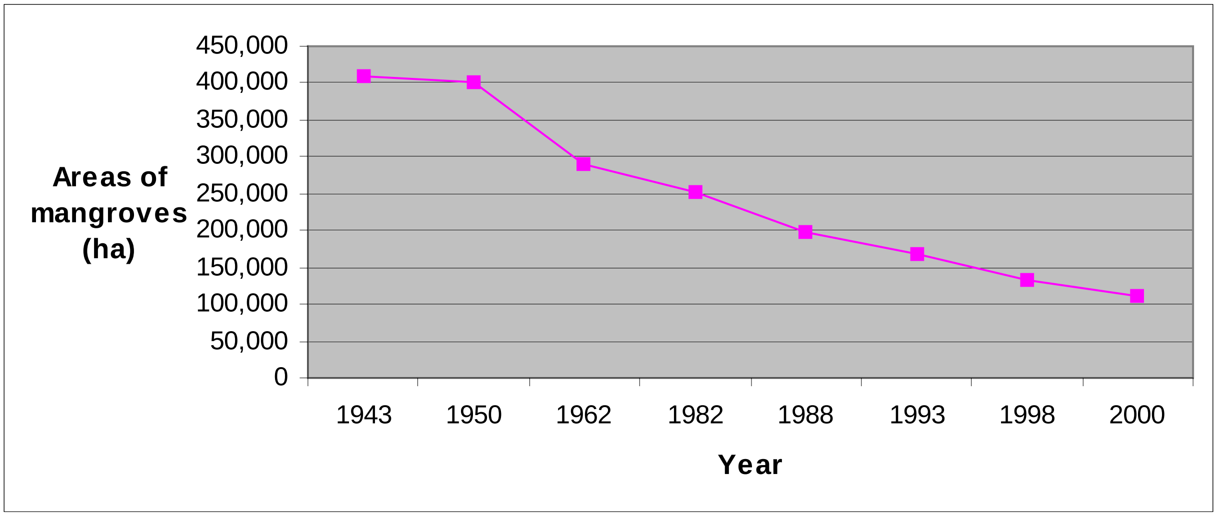
> areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters
>
> (Ramsar Convention Bureau 2004)

The largest area of wetland in Vietnam is found in the Mekong River Delta (MRD) (Vietnam National Environment Agency NEA 2002:1). According to the above definition, about 90 per cent of Vietnam's MRD can be classified as wetlands (Long 2003:2). These wetlands can be broadly divided into two categories: inland and coastal wetlands (Torell and Salamanca 2003:3). Inland wetlands are dominated by floodplain paddy fields, seasonally flooded grasses and *Melaleuca* forest, while coastal wetlands are generally dominated by mangrove forest (Torell and Salamanca 2003:4).

Wetlands in Vietnam have experienced serious loss and degradation. The area of mangrove forest has decreased about 80 per cent over the last 50 years (World Bank 2002:17). The area of mangroves decreased from 408,500 hectares in 1943 to 110,700 hectares in 2000 (Vietnam Ministry of Natural Resources and Environment MONRE 2002:32) (Figure 1). While some authors point out a number of causes for the mangrove losses (Baker 1998; IUCN 1998:29), the World Bank (2002:18) and UNEP (2001:22) affirm that the increase in shrimp farming is the leading cause of this loss.

Other causes of mangrove loss in the MRD include the conversion of mangroves to agriculture and construction land, war destruction and fuel wood collection (World Bank 2002:17). In addition, overexploitation of aquatic resources has threatened some endangered species and decreased biodiversity. Acidification and salt intrusion are also problems in coastal wetland areas. Furthermore, decreased Mekong River water flow due to upstream developments worsens the acidification and salt intrusion problems (Petersen 2003:2). Last, the *ad hoc* development of dykes throughout the delta, which intentionally are designed to protect agricultural land and villages from floods, has had some negative impacts on wetland ecosystems (Petersen and Bennett 2003:4).

Figure 1 **Decrease in mangrove areas in Vietnam 1943-2000**
Source: Vietnam, MONRE (Ministry of Natural Resources and Environment), 2002. '*Cac khia*



canh ve dieu kien tu nhien dat ngap nuoc o Vietnam (Issues of Natural Conditions of Wetlands in Vietnam', Vietnam Ministry of Natural Resources and Environment, Hanoi, Vietnam.

Melaleuca forest, another wetland component, has also experienced loss over the past few decades. Pressure on forestland for firewood, construction material, rice cultivation and non-rice production have led to a rapid decline in *Melaleuca* forests (Nam *et al.* 2001:3) from 241,000 ha in 1960s to 110,000 ha in 1984 (Miller *et al.* 1999). The biodiversity of *Melaleuca* forests has been seriously affected in terms of number and quantity of species (Nam *et al.* 2001:3).

1.2 Research issues

Information on wetland values is useful to wetland management. Effective wetlands management requires data on the rate of harvest of the natural resources, harvesting methods over time to determine the level of exploitation and the overall status of natural resources (Torell *et al.* 2001:3). This information helps to manage and conserve these resources in a sustainable way. Specifically, information on economic values of wetland goods and services is integral to estimating the costs and benefits of development projects (Lambert 2003). Also, the information is important in determining how much wetland resources contribute to a country's gross domestic product (Torell *et al.* 2001:3). The information on wetland values provides inputs for policymakers so that the policies they develop reflect the value of the resources and the issues related to their management and conservation.

In particular, information on wetlands' economic values could provide important inputs into the determination of water allocation in the Mekong River. The policies of water allocation by one riparian country may have an influence on wetlands in other countries. For example, logging in watersheds in China may be partially responsible for increasing the severity of floods in the MRB (Buxton *et al.* 2003: 110). Similarly, the construction of dams in China has resulted in decreased flow downstream and consequently salt intrusion and acidification of downstream wetlands (Minh 2003:5). The estimation of the economic values of wetland would provide useful input for the decision-making process of wetland management and water allocation for the Mekong River.

However, at present, there is a lack of information on the total economic values of wetlands in the MRD. Only a few of the numerous wetland benefits in the MRB have been quantified (Ringler and Cai 2003). No study on the total economic value of wetlands has been carried out in the MRD. That leaves a gap in knowledge of total economic values of wetlands in the Delta. This gap of information, together with a lack of appropriate institutions and a lack of funding for wetland management, poses a big challenge to wetland management in the MRD (Torell *et al.* 2001:4).

1.3 Research objectives and scope

This research helps fill this information gap by conducting a partial economic valuation of direct use values of some forms of wetlands in the Vietnam's MRD. Specifically, it estimates the direct use values of wetlands in the MRD province of Camau, using a market-based approach. The hypothesis investigating whether wetlands in the Vietnam's MRD provide direct use values to local people is tested. In this research, wetlands are defined as areas with mangrove and *Melalueca* forests These are the dominant ecosystems in Vietnam's MRD wetlands (Nam *et al.* 2001:3).

Due to time and resource constraints, the research uses secondary data from some related studies in this region. Additional data from the literature and government reports are also analysed but no field survey data are included. To deal with the difference in the timing of collected data on prices and production outputs, the GDP deflator is used to convert the prices in different years to the prices of the year in which the data production outputs are available. Data are calibrated to estimate the direct use values in 2001.

A number of assumptions are made. The first assumption is that market prices are not distorted by market imperfection including government intervention policies. The second assumption is that 70 per cent of capture fisheries and 50 per cent of aquaculture production depends on mangrove and *Melaleuca* forests. The third assumption is that Camau has similar characteristics to other provinces in the MRD so that the benefit transfer method can be used. The results of this research must be considered in the light of these assumptions. The results provide some indicative input for wetland management and water allocation among different users in the MRB.

2 Theoretical framework

This section starts by reviewing theories of property rights and their implications for wetlands. It then analyses different alternatives of government intervention in addressing wetland degradation. As government intervention needs information on wetland values, this section also reviews issues related to total economic values of wetlands.

2.1 Property rights

Central to any discussion of natural resources degradation is an analysis of property rights (Turner *et al*. 2003:74). Tietenberg (1996:41) defines property rights as 'a bundle of entitlements defining the owner's rights, privileges and limitations for use of the resource'. A well-defined property rights regime has the following four characteristics:

- Universality: all resources are privately owned and all the entitlements are completely specified.
- Exclusivity: all the benefits and costs arising from ownership of the resource must accrue to the owner.

- Transferability: owners must be able to transfer property rights to another owner in voluntary exchange.
- Enforceability: property rights must be secure from involuntary seizure or encroachment by others.

(Tietenberg 1996:41)

The various types of property rights regimes include open access property, common property, private property and state property (Turner *et al.* 2003:75). In open access property, rights to the resources are not defined and individuals have no incentive to conserve the resource because they are concerned that their efforts to conserve will be undermined by others' exploitation. In common property, resources are owned and managed by a well-defined group of people with usage rules to exclude non-members. In private property, individuals have rights to undertake socially acceptable uses and a duty to refrain from unacceptable uses. For state property, resource rights are held by the state and individuals have a duty to observe the rules of use as determined by the controlling agency. Turner *et al.* (2003:75) argue that no one system is capable of dealing with all the necessary conditions of a well-defined property rights regime. On the contrary, the use of each system may depend on the specific socioeconomic and environmental conditions.

Like other environmental goods, wetland products and services often have two characteristics of public goods: indivisibility (non-rivalry) and non-excludability (Turner *et al.* 2000:10). Indivisibility means that the consumption of the goods by one person does not diminish the amount available to others. Non-excludability means that once the goods are put in use, no one can be stopped from using them. In other words, the property right over the non-excludable public good is inadequately defined and/or defended. For this reason, public goods often face the free rider problem, whereby a person can benefit from wetland resources without contributing to their supply (Tietenberg 1996:41). This happens because there is no incentive to contribute to the supply of the public goods resulting from the inability to stop those who do not pay. As a result, the contribution is not sufficiently large to finance the efficient amount of the public goods and they remain undersupplied.

A well-defined property rights regime can play a crucial role in wetland management. In a well-defined property rights regime, resource owners have a powerful incentive to use resources efficiently because failure to do so results in personal loss (Tietenberg 1996:63). They also have rights to safeguard their resources from being used by others who do not pay for them. In addition, the resources can be transferred from low value users to high value users so that marginal benefits are equalised among all users and both sellers and buyers gain from this trade. In brief, a well-defined property rights regime can enable efficient uses of wetland resources.

However, due to the complex nature, it is costly to establish well-defined property rights for wetlands. Turner *et al.* (2000:10) and Adger and Luttrell (2000:77) share the view that the indivisibility of many resources such as land, water, fish and the seasonally and daily altering habitats of wetlands pose big challenged to defining and enforcing property rights. This is especially true in the wetlands in Vietnam's MRD, as all types of wetlands are present in the area. In addition, existing property rights over wetland resources in Vietnam are a mixture of state, private and common property regimes (Adger *et al.* 2001:82). This makes it more difficult for the four above-mentioned conditions for a well-defined property rights structure to be met. As a result, problems of open access have arisen (Turner *et al.* 2000:10; Sathirathai 1997:1).

Under an open access regime, none of the four conditions for a well-defined property rights regime is met (Turner *et al.* 2003:76). Open access represents situations of unowned resources, in which resources can be exploited on a first-come, first-serve basis (Bromley 1997). Open access goods are non-excludable in that anyone can use them without payment. Therefore, they have that characteristic of a public good. However, they may not be non-rival as a public good. Individuals make use of scarce resources without regard for the interests of others and have no incentives to conserve the resources. As a result, the resources will be overexploited and scarcity rent dissipated (Tietenberg 1996:51).

In the MRD, a number of problems of property rights exist. First, wetlands are not recognised as one type of land under the current Land Law (Vietnam NEA 2002:19; Baker 1998), which specifies six categories of land: farm land, forestry land, land for residential areas, urban land, specialised land and unused land (Baker 1998). As a result, property rights are not clearly and effectively assigned to wetlands as they are for other types of land.

Second, there is no clear division of responsibilities and coordination among government agencies involved in wetland management (Baker 1998). Wetland management tasks are assigned to various agencies, such as the Ministry of Natural Resources and Environment, the Ministry of Agriculture and Rural Development, the Ministry of Fisheries and the Provincial People's Committees (Vietnam NEA 2002). Technically, each of these agencies has its own mandate and responsibilities. However, in reality, it is not easy to coordinate these various agencies (Torell *et al*. 2001). For example, a wetland management unit is assigned the task of looking after wetland resources but not the right to punish illegal exploitation (Kinh 1996). It has to rely on the local People's Committees to make sanction against the violations. This can be a slow and ineffective process that often results in inadequate enforcement over wetland resources and so triggers the open access problem. That is, property rights are poorly defined and defended.

A third problem is the common pool nature of the Mekong River resource. Recognising the importance of ecological concerns and the need to incorporate an environmental flow regime to maintain the river's productivity, the Mekong River Commission was established in 1995 to coordinate activities by riparian countries that can affect water flow of the river. However, weak enforcement and incomplete basin wide membership prevent the Commission from meeting its environmental goals (World Resources Institute 2002:159). This also leads to an open access problem. As a result, each country pursues its own benefit without adequate consideration to the total benefit. Consequently, for example, upstream development projects have lead to degradation of wetlands in the MRD.

In short, there is a lack of well-defined property rights regimes for wetlands in the MRD. This results in the open access problem leading to wetland degradation. Government intervention is an alternative to address this problem.

2.2 Government intervention

Governments can act to define and defend property rights and/or institute specific policies to overcome the problem associated with defining rights. The three main kinds of policy instruments are 1) market-based instruments, 2) community-based and 3) management and command and control. If a strong property right system is in place, market trading generates information needed to ensure efficient use of the wetland resources. In case where such a system is absent, government intervention needs to be directed by information it collects on the value of wetlands relative to other uses. Therefore, if property rights cannot be well established, for government intervention to be successful in an efficient context, it needs to be based on value information.

Command and control

The Command and Control (CAC) approach has been widely applied in environmental protection and resource management (Tietenberg 1996:354). Under this approach, government agencies set up rules about the use of resources and use their legal rights to enforce regulated parties to follow the rules. In the MRD, CAC has been widely applied in the management of wetlands protected areas and other resources through licences and permits to harvest (Buckton *et al.* 1999). This approach has also been implemented worldwide due to its advantages of relative ease in establishment and implementation and low transaction costs. In the meantime, it has been widely criticised for its relative inefficiency and the absence of explicit incentives for innovation (Bishop and Vorhies 1998:2).

Despite these weaknesses, CAC is the prevailing approach to environmental management in Vietnam. The National Strategy for Environmental Protection 2001-2010 stresses the need for strengthening the institutional framework and legislation as the highest priority task. In proposing solutions to wetland degradation, Kinh (1996:70) ranks reviewing and revising legislation as the first task to be accomplished.

Market-based instruments

Market-based instruments (MBIs) are policy tools that 'harness market incentives in support of environmental objectives, by making environmental protection a more profitable or lower cost option for producers and/or consumers' (Bishop and Vorhies 1998:2). There are two main advantages of MBI. First, they are more cost-effective than conventional CAC policies. Second, they can encourage innovation and diffusion of environmentally friendly technologies. In general, all MBIs attempt to internalise non-market environmental values into private economic decision making (Bishop and Vorhies 1998:3).

MBIs have been used in wetland management in some developed countries such as the US and Australia (Whitten *et al.* 2003:4) A common form of MBIs in wetland management is a wetland credit trading system. In this system, a party is allowed to alter a wetland only if they purchase the credits earned by another party for protection, restoration and/or enhancement of another wetland (Bari 2002:21). The credits can be traded through a wetland bank. The objective is to ensure there is no net reduction in the ecosystem as a result of land use changes (Bari 2002:21).

These instruments have not been applied in wetland resource management in the MRB. In reviewing wetland environmental problems and solutions in the MRB, authors have mentioned different approaches but not MBIs (Torrel *et al.* 2001; IUCN 1998). This may be due to the current debate as to whether the benefits of MBIs justify the costs of their establishment. Similarly, in various Vietnamese government policies on wetland management such as Decree No. 109 about Wetland Conservation and Sustainable Use (Vietnam Government 2003) and Draft Strategy on Wetland Management (Vietnam NEA 2002), MBIs are not mentioned. This may imply that there is a need for more research on the application of MBIs in wetland management in developing countries.

Community-based management

Another way of managing wetland resources is Community-based management (CBM). It seeks to establish a common property rights regime, in which resources are owned and managed by a well-defined group of people (Turner *el al.* 2003:75). Recently, CBM has gained more attention in resource management in Vietnam. It is mentioned as an important approach in many guiding policies of environmental management such as Political Bureau Directive No. 36/CT-TW on Environmental Protection in the Industrialisation and Modernisation period (Vietnam Political Bureau 1998) and the National Strategy for Environmental Protection 2001-2010 (Vietnam MOSTE 2001). CBM has been applied in wetland management in the MRD for the buffer zones of some protected areas in Kien Giang, Camau and Dong Thap (Nam *et al.* 2001:7).

However, CBM is not always successful. In many cases, community properties face a free riding problem in which an individual does not contribute to the supply of the good and gets benefits from others paying for the good (Tietenberg 1996:53). In addition, weak coordination and enforcement of common property rights may lead to the open access problem. The critical condition for the success of CBM is that the size of the community needs to be small enough to achieve a close link among members and identify free riders (Soderqvist and Lindahl 2003:232).

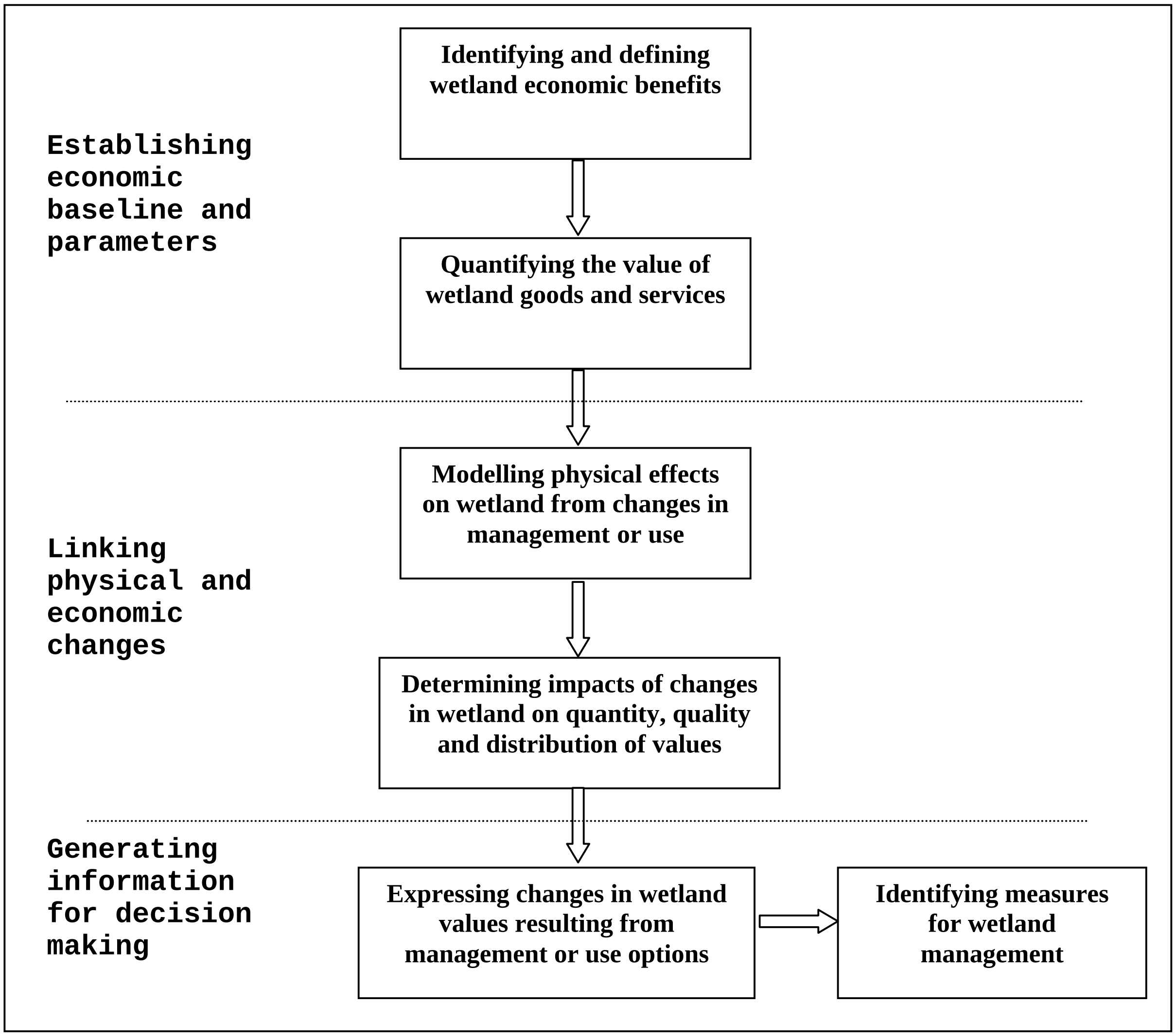
Although Adger *et al.* (2001:81) support the collective management of wetlands in Vietnam, they underscore some strict conditions for the success of this approach such as clearly defined boundaries and well-defined user groups. These conditions are demanding for the Vietnam wetland management context because, as discussed above, wetlands in Vietnam have the complexity of various types and various property rights regimes. Nam *et al*. (2001:7) conclude that CBM is not the most effective system in terms of conserving wetland resources and generating high incomes for the local people in the MRD. Therefore, an effective wetland management cannot be based only on CBM.

Importance of value information

In all three types of policy, information is useful in the decision-making processes. Given information, a suitable policy tool can be applied to each specific situation. A common tool for structuring information for wetland decision making is cost-benefit analysis (CBA). It is aimed at calculating the net impact of a project on the economic welfare of society by measuring all the costs and benefits of the project. Based on the economic efficiency criterion, CBA offers one method to aid decision makers in selecting alternative uses (Turner *et al.* 2000:14). To make the CBA of wetland policies more reliable, the economic valuation of wetland goods and services has to be as comprehensive as possible. This poses the need for integrated modelling of linkages between wetland ecology and economics.

Such bioeconomic modelling has been suggested as an effective framework for integrating information for wetland decision making (Turner *et al.* 2000:15; Whitten and Bennett 2000:15). The basic model has three components: establishing economic baseline and parameters, linking physical and economic changes, and generating information for decision making (Figure 2). To establish an economic baseline and parameters for bioeconomic modelling, information on wetland total economic value is needed. Relevant theories of total economic value of wetlands will be discussed in the next section.

Figure 2 **Expressing wetland values for decision making**



Source: IUCN (The World Conservation Union) 2003. 'Valuing wetlands in decision-making: where are we now?', *Wetland Valuation Issues Paper* #1:May 2003, http://www.wetlandnature.org/v1.html (10/4/2004).

2.3 Total economic value

Total economic value (TEV) includes use and non-use values (Barbier *et al.* 1997:82). Use values represent goods and services of use to human population. These are classified into direct, indirect and option values (Lambert 2003:6). Direct use values relate to the value derived from direct use or interaction with a wetland's resources and services. Indirect use values refer to values provided by wetlands that maintain and protect natural and human systems such as maintenance of water quality and flow and storm protection. Option values are premiums placed on maintaining wetland resources for future possible use (IUCN 2003).

Non-use values refer to current or future values associated with wetland resources that rely merely on their continued existence and are unrelated to use (Barbier *et al.* 1997:82). Non-use values include biodiversity, culture, heritage and bequest values. In general, use values involve some human interaction with the resource whereas non-use values do not (Barbier *et al.* 1997:82). Examples of the TEV of wetlands are presented in Table 1.

Table 1 **Total economic value of wetlands**

Use Values			**Non-Use Values**
Direct Values	**Indirect Values**	**Option Values**	
• Fish harvest • Agricultural production • Fuelwood collection • Recreation • Transport • Wildlife harvesting • Peat/energy	• Nutrient retention • Flood control • Storm protection • Groundwater recharge • External ecosystem support • Microclimatic stabilisation • Shoreline stabilisation	• Potential future uses (as per direct and indirect uses) • Future value of information	• Biodiversity • Culture, heritage • Bequest values

Source: Barbier, E.B., Acreman, M. and Knowler, D., 1997. 'Economic valuation of wetlands: a guide for policy makers and planners', http://biodiversityeconomics.org/pdf/topics-02-01.pdf (5/4/2004).

Information on TEV can be derived through an economic valuation. This is defined as 'the attempt to assign quantitative values to the environmental goods and services, whether or not market prices are available to assist us' (Lambert 2003:1). Mitsch and Gosselink (2004:571) note that the term 'value' often imposes an anthropocentric orientation on a discussion of wetlands, where emphasis is placed on wetland aspects that are worthy, desirable and useful to humans. With this view, Barbier *et al.* (1997:78) define the value of the resource as people's 'willingness to pay' for the goods and services, given that the environmental goods and services are provided at no cost. The main objective of valuation is to allow an assessment using CBA of the relative economic efficiency for various competing uses of wetland resources (Barbier *et al.* 1997:80).

This section has reviewed some theories explaining the cause of wetland degradation in the MRD. It is concluded that the absence of a well-defined property rights regime is a reason for wetland degradation. To address problems associated with the lack of a well-defined property rights regime, MBIs and CAC need information on wetland values. The most common economic value framework is TEV. This includes use values, which comprise direct use, indirect use and option values, and non-use values. In the following section, a research hypothesis and methodology are discussed.

3 Hypothesis and methodology

This section presents the hypothesis of the research. It then discusses the methodology used in testing the hypothesis. Specifically, the methodology section covers discussion of the market-based price approach to valuing wetland benefits and a case study of Camau Province.

3.1 Hypothesis

Section One detailed the problem of degradation of wetlands in the MRD. The causes of wetland degradation were explained in Section Two by analysing the theoretical frameworks of property rights. To address the problem of wetland degradation, government intervention may be justified. To be successful, all types of government intervention require information on values of wetlands that can be estimated using economic valuation techniques.

However, there is a lack of information on the total economic values of wetlands in the MRD. The effort by the international development community has been directed to wetland conservation and sustainable use but not to wetland economic valuation. Only one study, by Hang and An (1999), has been conducted to estimate some direct use values of the Cangio mangroves (Petersen 2003:9). Within the project 'Reversing Environmental Degradation Trends in the South China Sea and the Gulf of Thailand' by the United Nations Environment Program and the Global Environment Facility (UNEP/GEF 2003), a wetland socioeconomic assessment in Vietnam was conducted for 11 sites, including some sites in the MRD, but this was limited to direct and indirect use values only. Also, this study does not incorporate production costs of harvesting wetland products. Moreover, both studies by Hang and An (1999) and UNEP and GEF (2003) failed to estimate some benefits of *Melaleuca* forests, which are a dominant wetland ecosystem in the MRD. The lack of rigorous data on total economic values of wetlands is common in the region (Ringler and Cai 2003:6).

In addition, data on the wetlands' values have not been compiled in a useful format for decision making. The research seems to focus on either economic components or biophysical aspects. It seems that no research linking the policy impacts to biophysical and then socioeconomic changes has been carried out. Therefore, the overall picture of impacts of policies on biophysical and socioeconomic settings is not presented for policymakers so that they can optimise the policies to maximise social welfare.

Due to the lack of the information on wetland protection values, policies are likely to favour development projects over wetland conservation. For example, policies to promote shrimp farming have been approved without adequate consideration of wetland values (World Bank 1999a). Also, the development of *ad hoc* dyke systems along the Mekong River in the Delta has been promoted without scientific information on the impacts on wetlands and other ecosystems or their values to society (Petersen and Bennett 2003).

In summary, at present, there is a lack of information on wetland values. No study on TEV of wetlands in the MRD has been conducted. That leaves a gap in knowledge of total economic values of wetlands in the Delta. To bridge this gap, studies on direct use values, indirect use values, option use values and non-use values are needed. This research partly fills in this gap by focusing on the direct use values of wetlands in the MRD. To this end, the following hypothesis is formulated for testing this research:

'The wetlands in Vietnam's MRD provide direct use values to local people'.

While the definition of wetlands is important in their management, there seems to be no definition that can be suitable for all management purposes. There are many different kinds of wetland definitions (Mitsch and Gosselink 2004:25). Although the Ramsar definition is widely used, its practicality in real life situations is questionable. As noted by some authors, the definition lacks 'guidance on generic characteristics of wetlands that influence how wetlands actually function'

(Turner *et al*. 2000:8) and is too broad when 'compared to a common understanding of wetlands as being swamps, marshes and the like' (Torell *et al.* 2001:5).

In this research, wetlands are defined as areas with mangrove and *Melalueca* forests. This definition helps the research focus on natural products from wetlands and not on cultivated agricultural products, including rice, which are common in the Melkong Delta wetlands. Direct use values are values derived from direct use or interaction with a wetland's resources and services (IUCN 2003). Local people are those who live on the MRD's wetlands.

To test this hypothesis, the following two sub-questions are answered:
- What are the direct uses of wetlands in the MRD?
- What are the values of these direct uses?

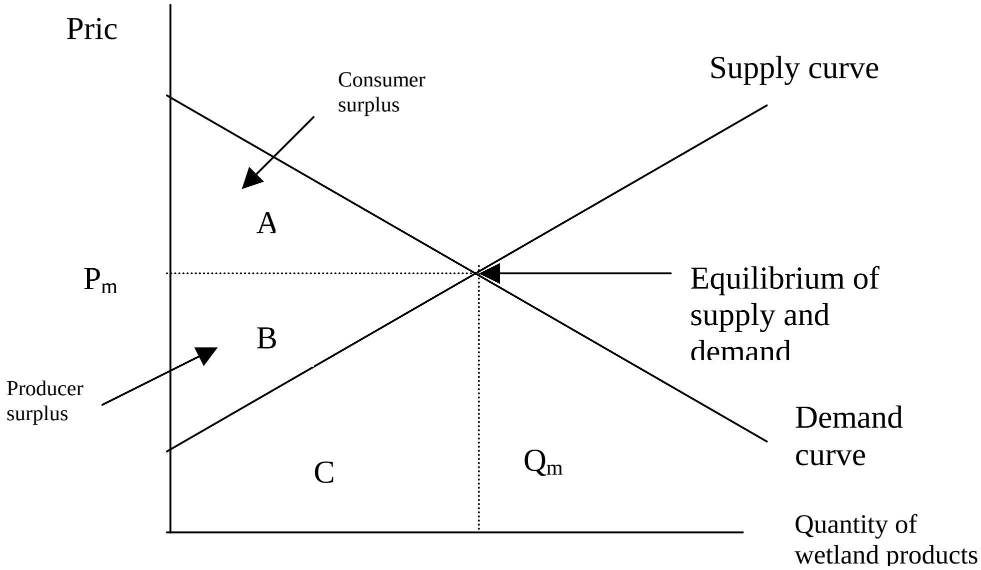
3.2 Methodology

This section discusses the strategy employed in this research to test the hypothesis, including a market-based approach and a case study of Camau Province. It then describes data collection and analysis process of and assumptions made for the research.

3.2.1 Market-based approach

There are two types of wetland valuation techniques: market and non-market approaches. The approaches have both advantages and disadvantages and can be applied in different circumstances. In this research, the market-based approach is used to estimate wetland values for wetland goods and services, where markets for these goods or services exist. In an efficient market with many buyers and sellers, all of whom have perfect information about the market, goods and services will be priced at their marginal value product and reflect the full opportunity cost of resource use (Bann 1998:4). An efficient price, which is the market price P_m in Figure 3 is achieved when demand is equal to supply at quantity $Q_{m,}$ where the net benefit to society from resource use is maximised.

Figure 3 **Estimation of wetland values using market price approach**



Source: Adapted from Mitsch, W. J. and Gosselink, J.G., 2004. *Wetlands*, 3rd edition, John Wiley and Sons, New York.

The consumer demand curve reflects how much consumers are willing to consume a product at different prices while the producer supply curve reflects how much producers are willing to supply a product at different prices (Taylor and Frost 2002). Consumer surplus is the area A, under the demand curve and above the market price whereas producer surplus is the area B, under market price and above the supply curve. Whilst TEV is the sum of consumer surplus (A), and producer surplus (B) (Turner *et al.* 2003:79), in this research, only producer surplus is estimated.

The producer surplus of wetlands is calculated from the formula:

$$V = \Sigma (Pi*Qi - Ci)$$

where V: local direct use value (VND)
Pi: prices of product i (VND)
Qi: amounts of product i being collected
Ci: cost involved in collection of product i (VND)

However, in this research, due to a lack of data, a single cost for all producers is used. That is, the average producer surplus across all producers of each wetland product is estimated. The direct use value of the wetlands based on local use can be assessed from the net income generated by locals from wetland products. If the products are sold, market prices are used to calculate the gross income generated. When the products are used for subsistence purposes, the gross income is estimated based on surrogate prices, which are the market prices for the closest substitute for the products. The cost of extraction is deducted from gross income to derive the direct use value.

3.2.2 Case study of Camau Province

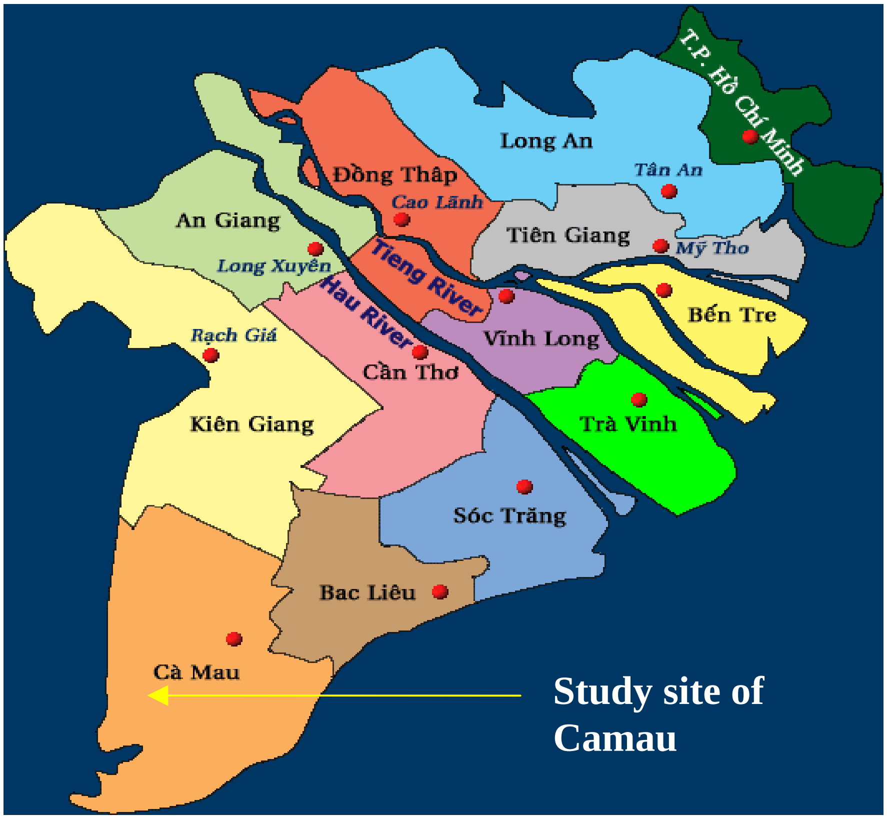
A case study approach is used in this research to analyse wetland direct use values for the local people. The case study is a preferable approach when research questions are 'why' and 'how' (Yin 1984:20). It is useful in examining and explaining contemporary events. In this research, the main question is how important wetlands in the MRD are to the local people. Therefore, a case study approach is appropriate.

The Camau Province (Figure 4) is selected as a study site for a number of reasons. First, it is the MRD province that has various types of wetlands such as riverine, estuary and coastal wetlands. Therefore, its wetlands have a high representativeness of wetlands in the MRD that can enable generalisation of its wetland values into values of wetlands in the whole Delta. Second, it is the province that has the highest percentage of wetland losses over the past few decades. Third, Camau has the largest area of mangroves in Vietnam and the only significant areas of old growth mangrove ecosystems remaining in the country (World Bank 1999a:4). Last, although data on wetland values are scattered, some studies have been done in this province that can provide input for this research.

Camau has an area of 5,211 sq km, accounting for about 13.1 per cent of the area of the MRD and 1.57 per cent of the area of Vietnam (Camau Department of Science, Technology and Environment DOSTE 2002:5). According to the Ramsar definition, 98 per cent of the area of Camau is wetlands, with a relatively flat topography and a height ranging from 0.6 to 1.5 m above sea level (Camau DOSTE 2002:40). However, taking the definition of wetlands as mangrove and *Melaleuca* forestlands in this research, the wetland area of Camau is 103,563 ha (Camau DOSTE 2002:39).

There are two main types of forests in Camau: mangrove and *Melaleuca* (Camau DOSTE 2002). With an area of mangrove of 66,370 ha, Camau has the largest share, about 70 per cent of the total mangrove area in the MRD (Vietnam NEA 2003:143). Thirty-one per cent of mangrove forests in Camau are natural forest. The remainder is planted forest (Vietnam NEA 2003:143). The area of *Melaleuca* forests in Camau is 37,193 ha (Camau DOSTE 2002:39). The *Melaleuca* forests are being restored within the framework of a Government funded project of VND200 billion (Camau DONRE 2004:10).

Figure 4 **Location of the study site of Camau.**



Source: Wikipedia: the free media, 2004. 'Maps related to the Mekong Delta', http://cantho.cool.ne.jp/ameder/map/blank8.jpg (15/9/04).

In brief, in this section, the hypothesis that wetlands in the MRD provide direct use values has been formulated. To test this hypothesis, a market-based approach applied in a case study of Camau Province is used. The next section provides detail on the application of these methods in this research.

3.2.3 Data collection and analysis

This research focuses on the direct use benefits from fisheries and forest products. The values of the following wetland use benefits are estimated:

- capture fisheries
- aquaculture

- fuelwood
- timber
- medicine
- *Nypa fruticans.*

To deal with the limited availability of data, this research uses the benefit transfer method. Benefit transfer is defined as 'the transfer of existing estimates of nonmarket values to a new study which is different from the study for which the original values were estimated' (Boyle and Bergstrom 1992). It is a method of obtaining data when researchers face time and monetary constraints (Stuip *et al.* 2002:22). Although there are different views on the validity of using benefit transfer, when properly done the benefit transfer can produce meaningful results (Stuip *et al.* 2002:22; Morrison *et al.* 1996:1). Morrison *et al.* (1996:18) also argue that transfers across sites with similar characteristics tend to produce fewer errors than transfer between populations.

To deal with the difference in the time at which data on prices and production outputs were collected, a GDP is used deflator to convert the prices in different years to the prices of the year in which the data production outputs are available. The GDP deflator is the ratio of nominal GDP to real GDP (Blanchard and Sheen 2004: 32). It gives the average price of the final goods produced in the economy. Another method of adjusting prices in different years is to use the consumer price index, which gives the average price of the final goods consumed (Blanchard and Sheen 2004: 32). Although these two methods may produce slightly different results, given the availability of the data, this research uses the GDP deflator method to adjust prices in different years. All prices are adjusted to the prices of 2001.

Secondary quantitative data are used. Data on fishery products are from the annual reports of the Ministry of Fisheries. Data on prices of products are derived from Statistic Year Books of Camau Provincial Department of Statistics (PDS) and Vietnam General Statistics Office (GSO). Data on production costs, which are the costs of gathering wetlands products, are taken from previous surveys in the MRD provinces including research by Hang and An (1999) in Cangio and Be and Dung (1999) in Soc Trang. Data on timber are from research on forest management systems in the MRD by Nam *et al.* (2001) whereas data on medicinal plants and *Nypa fruticans* are from a study in Cangio by Tri (2004).

Some values of wetlands from Cangio were transferred to Camau for a number of reasons. First, wetlands in Cangio and Camau share common characteristics of being coastal wetlands within the MRD (Hang and An 1999). Second, statistical data show that both sites have common demographic characteristics. Third, environmental and climate conditions in the two sites are similar that enables the assumption that direct use values of the two sites are similar. Also, some data from adjacent provinces in the MRD, such as Soc Trang and Tra Vinh were used, with the assumption that conditions are similar in Camau province.

Other main sources of data included the State of Environment reports of Camau, reports of the Ministry of Natural Resources and Environment, reports from some workshops on Vietnam's wetlands management and economic valuation and documents of the World Bank Project 'Coastal Wetlands Development and Protection' (World Bank 1999).

3.2.4 Assumptions on capture fishery and aqualculture production

There are no data on the proportion of fish production that is sold in markets to what is subsistence food. The Camau PDS, Vietnam GSO and Ministry of Fisheries do not state whether their data on fisheries production are total production or production that is marketable. As Trong and Binh (2004) note, there are inconsistencies and inadequacies in collection of data on fisheries in Vietnam. Data on subsistence fisheries are often hard to collect because of the nature of family-based fishing activities and incomplete control of fishing licence systems (Trong and Binh 2004). Therefore, in this research, it is assumed that data on the output of fisheries production include both marketed and non-marketed subsistence fisheries.

One of the important steps in estimating benefits of wetlands is to identify the production function relationship between the area of wetlands and the fish catch dependent on the wetlands. This is a complex task because, as Bann (1998:2) points out in a guide for economic valuation of mangroves, while a positive correlation between mangrove areas and fish productivity is acknowledged, the scientific information on this relationship is lacking. Also, the linkage between *Melaleuca* forests and fish productivity is acknowledged (Sinh 2004:78), but scientific data on this linkage are unavailable.

As Ronnback (1999:245) argues, economic valuation is context-specific. From a standard economic perspective, it is not meaningful to estimate the value of a hectare of wetlands without relating it to a specific situation (Barbier 1994). It is, therefore, important to get scientific information on linkages between mangrove/*Melalueca* forests and fisheries production in the study site of Camau. However, as in other parts of the Mekong region, data on the linkages between mangrove/*Melaleuca* forests and fisheries production in Camau are unavailable.

To deal with the lack of scientific information on the linkages between mangrove/*Melaleuca* forests and fisheries production, some measures need to be taken. The first measure is identifying the correlation between mangrove/*Melaleuca* areas and fisheries capture. The data on the areas of mangrove and *Melaleuca* forests and the total capture fisheries production in Camau over four years, 1995, 1999, 2000 and 2001, are used (Table 2). The null hypothesis that fish production and forest areas are independent is rejected with the P-value < 0.05. Also, the correlation coefficient between the area of mangroves/*Melaleuca* forests and fisheries production is estimated at 0.98. With these results, it can be said that the correlation coefficient is 0.98 with a significant level of 5 per cent.

Table 2 **Data on the areas of mangrove and *Melaleuca* forests, and capture fisheries production**

Year	Mangroves and *Melaleuca* areas (ha)	Capture fish production (tonnes)
1995	85,058	71,638
1999	99,469	124,687
2000	102,990	124,697
2001	103,563	127,054

Sources: Camau DOSTE 2002. *State of Environment Report*, Camau Department of Science, Technology and Environment, Camau, Vietnam.
Vietnam GSO 2003. *Statistical Yearbook 2002*, Statistical Publishing House, Hanoi, Vietnam.

However, the number of observations is only four, which is too small to provide a reliable result. Furthermore, this model does not account for other causal variables, which are variables that may affect the correlation but are not included in the model. Therefore, the model only has an indicative implication that there is a correlation between fish production and mangrove/*Melaleuca* forests.

The second measure is to look for the correlation used in other research. One of the first studies that explicitly establish the mangrove-fishery linkage is Ruitenbeek's research on the mangrove-fishery linkage in Bintuni Bay, Indonesia (Barbier 2000:530). Ruitenbeek (1994) classifies two main types of linkages: biophysical and socioeconomic. The linkages can be divided into four scenarios, ranging from no linkages to very strong linkages, based on an impact intensity parameter and an impact delay parameter. Unlike Ruitenbeek's and some other research in the Mekong region such as Bann (1997) and Sathirathai (1997), this research focuses on a static analysis and does not analyse the values of wetlands over a period of time. Therefore, the estimated correlations that are used in these analyses are not suitable in this research.

It is therefore assumed that the fishery and mangrove/*Melaleuca* linkage in the MRD is that one ha of mangrove forest provides rearing habitat for 0.7 tonnes of capture fisheries yield. That is, a loss of 100 ha of mangroves would cause fish harvest to fall by 70 tonnes. This correlation is estimated by the World Bank in a study that estimates the linkage between loss in mangroves and reduction in capture fisheries (World Bank 1996:57).

Because data on linkages between aquaculture productivity and mangrove/*Melaleuca* forests in Camau are unavailable, it is assumed that 50 per cent of aquaculture depends on the area of mangrove/*Melaleuca* forests. Also, due to the unavailability of data on fisheries and aquaculture production of each system of mangrove and *Melaleuca* forests, it is assumed that the production relationship holds for both forest systems. Methods of data collection and analysis for other direct use values are discussed together with the results in Section Five. Exchange rate in 2001 of one AUD equal to VND7,683 (Vietnam State Bank 2001:76) is used to convert from VND to AUD.

This section has presented problems in valuing wetland benefits and methods used in this research to deal with these problems. In particular, it has discussed the methods to estimate wetland values when data are unavailable. The following section presents results of the research into direct use values of wetlands in Camau.

4 Direct use values of wetlands in Camau

This section details the direct use benefits from fisheries and forest products from the mangrove and *Melaleuca* forests of Camau. These include capture fisheries, aquaculture, timber, fuelwood, medicinal materials, and *Nypa fruticans*.

4.1 Capture fisheries

There are two main types of fishing in Camau: freshwater fishing and maritime fishing. Although mangrove forests have effects on both freshwater and marine fisheries, this research focuses on fishery products from freshwater fishing.

Freshwater capture fisheries in the MRD are important to people's livelihood. Most farmers in the MRD undertake fishing during flood seasons. The captured fish are either used for household consumption or sold at local markets (Trong and Binh 2004; Hang and An 1999). Freshwater fisheries are considered to be the most accessible and inexpensive source of protein for rural communities in Vietnam's MRD. About 62 per cent of farmer households in the MRD are involved in fishing activities (Trong and Binh 2004).

Data on freshwater fishing productivity in the MRD are inconsistent across different sources, varying from 50,000 to 200,000 tonnes per year. Data from PDS and Fisheries Departments and Departments of Agriculture and Rural Development in the provinces are quite different (Trong and Binh 2004). Similarly, data from international and domestic sources differ. For example, surveys by the Mekong River Committee Fisheries Programme in An Giang and Tra Vinh provinces in 2001 revealed an estimated freshwater fisheries productivity of 194,000 and 70,000 tonnes per year respectively. On the other hand, PDS data show that production is only 60,000 to 70,000 tonnes in the two provinces (Trong and Binh 2004).

While data on total capture fisheries in Camau are available, no data on the proportion of freshwater and maritime capture fisheries are available to enable the estimation of freshwater capture fisheries benefits in Camau. Therefore, it is assumed that freshwater capture fisheries production in Camau is the average number of that in the MRD. According to research by the Vietnam Ministry of Fisheries, the average production of capture fisheries in the MRD was 500 kg/household/year in 2001 (Trong and Binh 2004). In 2001, there were 108,170 households conducting capture fisheries in Camau (Camau PDS 2004:18), accounting for 45.9 per cent of the total number of households of 235,599. Therefore, the production of freshwater capture fisheries is estimated at 54,085 tonnes per year in Camau in 2001. Using the assumption of 70 per cent of fish dependent on mangrove/*Melaleuca*, the mangrove/*Melaleuca* dependent fishery production was 37,859.5 tonnes per year in 2001. The market price of fish was VND12,000/kg in 2001 (Nam *et al.* 2001:21). Therefore, the gross benefit from fisheries was VND454,314m in 2001.

The annual costs of investment (after being depreciated) and operation of boats and fishing equipment are about VND3,000,000 per household (Anh, N.M. pers.comm in an email dated 15/9/04) and the opportunity costs of labour were VND1,020,938 per household per year in 1999 (Hang and An 1999:245). Fishing costs with and without opportunity costs of labour are thus VND4,020,938 and 3,000,000 per household per year respectively. Using this figure, the costs for fishing by 108,170 households in Camau with and without opportunity costs of labour are estimated at VND434,945m and VND324,510m respectively in 1999. GDP deflators for fisheries in 1999 and 2001 were 211.3 and 225.2 respectively (World Bank 2003:102). Using a GDP deflator, fishing costs in 2001 are estimated atVND463,557m with labour costs and VND345,857m without labour costs.

However, these costs are the costs for total capture fisheries. Because, as assumed above, only 70 per cent of total capture fisheries is accounted for here, the fishing costs need to be adjusted accordingly. Although the costs of catching fish dependent on mangrove/*Melaleuca* forests may differ from the costs of catching mangrove/*Melaleuca* independent fish, in this research it is assumed that these two costs are the same. Therefore, the costs of catching mangrove/*Melaleuca* dependent fish are assumed to be 70 per cent of total fishing cost. Based on this assumption, fishing costs in 2001 are estimated at VND324,490m with labour costs and VND242,100m without labour costs.

The net benefit from fishing is determined by subtracting costs from benefits. Net benefits with and without opportunity costs of labour therefore are VND129,824m and VND212,214m respectively per annum in 2001.

By dividing this figure by the total area of mangroves and *Melaleuca* forests of 103,563 ha in 2001, the net benefits from capture fisheries per ha are estimated. These net benefits with and without opportunity costs of labour are VND1,253,575 or AUD163 and VND2,049,129 or AUD266.7 per ha per year respectively (Table 3).

Table 3 **Summary of benefits from capture fisheries**

Year	Benefits	Costs		Net benefits		Net benefit per ha of wetlands♣	
		Fishing equipment	Labour costs and fishing equipment	With labour cost	Without labour cost	With labour cost	Without labour cost
2001 (VNDm)	454,314	345,857	463,557	129,824	212,214	1,253,575	2,049,129
2001 (AUD)	59.5	45	60.3	17	27.6	163	266.7

♣ adjusted with the assumption of fish/forest correlation of 0.7.

4.2 Aquaculture

As in other provinces in the MRD, one of the important direct use values of wetlands in Camau is aquaculture. Most aquaculture activities are shrimp farming but some are fish farming. Because data on the percentages of shrimp and fish farming are unavailable, in this research it is assumed that all aquaculture activities are shrimp farming. There are two main aquaculture systems: traditional extensive aquaculture and improved extensive aquaculture (World Bank 1996:53). Traditional extensive aquaculture accounts for about 76 per cent of aquaculture area and has an average productivity of 250 kg per ha per year (World Bank 1999b:92). Despite efforts to search for information on specific productivity and prices of shrimps for each system in Camau, no such data were found. Therefore, it is assumed that the productivity of 250 kg per ha per year is true for the study year of 2001 for both traditional and improved extensive farming systems.

The price of a kilogram of shrimps ranged from VND16,200 for natural shrimps to VND74,300 for tiger shrimps in 1996 (Be and Dung 1999:232). The average price of this range, which was VND45,250, is used. With the GDP deflators of 178.4 and 225.2 in 1996 and 2001 respectively (World Bank 2003:102), the average price of shrimps in 2001 was estimated at VND57,133 per kg. With a productivity of 250 kg per ha per year, the total benefit from aquaculture was VND 14,283,250 per ha per year in 2001.

Total costs for aquaculture include costs of production, construction and sedimentation (Be and Dung 1999:234). Production costs involve seeds, feed, fertiliser, chemicals, machinery, and labour. The average production cost of both traditional extensive and improved extensive aquaculture systems was 2,060,000 per ha per year in 1996 (Be and Dung 1999:233), of which expenditure on shrimp seed and feed accounted for 57.1 per cent of production costs. The cost of construction of ponds depreciated per year was estimated at VND397,000 per ha in 1996. The sedimentation cost is the expenditure of farmers to remove sediment deposited on the filed surface and trench systems of the ponds. The total cost was VND3,289,000 per ha per year in 1996 (Be and Dung 1999:234). With the GDP deflators of 178.4 and 225.2 in 1996 and 2001 respectively (World Bank 2003:102), the estimated total cost in 2001 was VND4,151,809.

However, this total cost does not account for labour costs. Shrimp farming requires a lot of labour and labour costs usually account for 50.2 per cent of the total production cost (Be and Dung 1999:234). Taking into account labour costs, the total cost is estimated at VND6,236,017 per ha per year.

From the total benefit of VND14,283,250 and the total cost of VND4,151,809 without labour costs and VND6,236,017 with labour costs, the net benefits from aquaculture with and without labour costs are determined at VND8,047233 and VND10,131441 per ha per year respectively. With the assumed correlation of 0.5 between aquaculture productivity and area of mangroves/*Melaleuca*, these benefits are VND4,023,616.5 or AUD523.6 and VND5,065,720.5 or AUD659.3 (Table 4).

Table 4 **Summary of aquaculture net benefit per ha per year**

Year	**Benefit**	**Total production cost**		**Net benefit**♣	
		Without labour costs	**With labour costs**	**Without labour costs**	**With labour costs**
1996 (VND)	-	3,289,000	-		
2001 (VND)	14,283,250	4,151,809	6,236,017	5,065,720.5	4,023,616.5
2001 (AUD)	1,858.8	540.3	811.6	659.3	523.6

♣ after adjusted to the correlation of 50 per cent aquaculture dependent on mangrove/*Melalueca*

4.3 Fuelwood

Fuelwood is a product of wetlands in Camau. The burning of wood comprises about 90 per cent of domestic energy consumption nationally (World Bank 1996:52).

A review of literature suggests that no data on the fuelwood collection from wetlands in Camau are available. Therefore, it is assumed that the difference between demand for fuelwood and its supply from planted forests is the supply from seminatural mangrove and Melaleuca forests. Fuelwood requirements in the MRD average 0.3 cu meter per capita per year (World Bank 1996:52). With a population of 1,158,000 in 2001 (Vietnam GSO 2002:30), the demand for wood in the MRD is estimated at about 347,400 cu meters per year. However, there is about a 40 per cent shortfall in meeting demand for fuelwood in the MRD (World Bank 1996:52). That is, the supply from planted forests meets 60 per cent of this demand and the remaining 40 per cent is taken from other sources. According to this estimation, about 138,960 cu meters of fuelwood per year needs to be supplied from sources other than planted forests. It is assumed that these other sources are from seminatural mangrove and Melaleuca forests. Therefore, the output of fuelwood collection from wetlands in Camau is estimated at 138,960 cu meters per year.

The output of fuelwood exploitation in Camau in 2001 was 250,000 cu meters, worth VND 13,500m (Camau PDS 2004:82). Based on this information, the price of fuelwood was estimated at VND 54,000 per cu meters. By multiplying the output of fuelwood and its price, the gross revenue from wetland fuelwood is estimated at VND7,503.84m. By dividing this figure by the total area of mangroves and *Melaleuca* forests of 103,563 ha in 2001, the benefits from wetland fuelwood collection are estimated at VND72,456.8 or AUD9.4 per ha.

Data on labour for fuelwood collection, such as number of households involved and the time they spend on this activity are not available. Therefore, no estimation of the net benefit with labour costs is carried out.

4.4 Timber

Analysis of the values of timber can be divided into two types: values of timber of mangroves and values of timber of *Melaleuca.*

4.4.1 Mangrove timber

Mangroves in the MRD provide timber for house construction, building fishing boats and other local uses (for example, NEA 2003:139 and MONRE 2002). *Rhizophorza, Avicennia, Bruguiera, Lumnimea and Sonneratia* are the main species in mangrove forests. However, data on mangrove timber are unavailable for Camau. As discussed in Section 3.2.3, by using the benefit transfer method, the data on mangrove timber in Cangio are used to estimate the values of mangrove timber in Camau.

Mangrove timber is harvested through tree trimming activities. Tree trimming is usually carried out every five or six years, depending on tree quality (Hang and An 1999:212). Most of the harvested timber is sold in the market and only a very small proportion is used for domestic purposes. For simplicity in calculation of the revenue, it is therefore assumed that all harvested timber is sold in the market. The revenue is estimated by multiplying the volume of harvested timber by the market price.

To derive the net benefit from mangrove timber, it is necessary to determine harvesting costs. Harvesting costs include the cost of equipment, such as axes or knives, transportation to carry wood to the market, and labour. According to Hang and An (1999:214), the average annual net benefits per household from tree trimming, with and without accounting for labour costs, are estimated at VND1,209,923 and VND1,279,923 respectively. These benefits are for 1,200 ha of mangrove forests. Therefore, the benefits per household per ha of mangrove are about VND1,008 and VND1,066. With 134 households in the study site of Cangio involved in mangrove trimming, the benefits per ha of mangroves with and without labour costs are estimated at VND135,072 and VND142,844 in 1999.

GDP deflators for forest in 1999 and 2001 were 226.3 and 238.3 respectively (World Bank 2003:102). Using the GDP deflator adjustment, the benefits from mangrove timber per ha of mangroves with and without labour costs are estimated at VND142,234.5 or USD9.5 and VND150,418.6 or AUD18.5 in 2001.

4.4.2 Melaleuca timber

The principal forms of management of *Melaleuca* in Camau include joint ventures between the state and farmers, and commercial private farms. Since 1995, due to the government's policy of banning timber product harvesting in the state-owned forest sector, *Melaleuca* has been harvested only on commercial private farms (Nam *et al.* 2001:20). Therefore, in this research, the benefits of *Melaleuca* timber in commercial private farms are estimated with the assumption that they represent the benefits of *Melaleuca* forest in other farms.

Melalueca forests provide more timber values than mangrove forests. In a commercial private farms system, each household owns a plot of 0.5 ha to hundreds of ha *Melaleuca*. Variation in price depends on forest density and quality of harvested timber for construction. However, the average price was VND7m per cong (one cong=1,296 sq meter) in 2001 (Nam *et al.* 2001:27). Based on this figure, the price of one ha of *Melaleuca* was estimated at VND54m.

The production cycle was from five to seven years. The average amount of investment/ha/year was VND0.89m. Average wage rate for labour was VND20,000 per day per head (Nam *et al.* 2001:33). Forest plantation and maintenance labour involves such activities as land preparation, seed preparation, breeding, planting, trimming and harvesting. The net income per ha per year from *Melaleuca* was VND1,877,530 for 1999 (Nam *et al.* 2001:33). With GDP deflators for forest in 1999 and 2001 of 226.3 and 238.3 respectively, net income per hectare is estimated at VND1,977,089.7 or AUD257.3 per year.

4.5 Nypa fruticans

Products of *Nypa fruticans* are widely used in the MRD. Its leaves are used for roofing, thatched house walls and other household goods such as brooms, buckets, handbags and cake warapping (Vietnam NEA 2003:139). Mats are also made from *Nypa* palms. The palmate leaves are used to make buoys or processed to make ropes. Its pulp is used for cooking juice and syrup. As the concentration of sugar in *Nypa* is as high as 13 to 17 per cent, it can be used for producing sugar or alcohol. One hectare of *Nypa* can provide raw materials for manufacturing 10 tonnes of sugar per year (Vietnam NEA 2003:139).

Tri (2004:133) estimates the revenue from *Nypa* in Cangio mangrove forests as VND2.08m per year per 600 ha. From this study, the estimated benefit was VND3,466 per ha per year in 1999. With GDP deflators of forest in 1999 and 2001 of 226.3 and 238.3 respectively, the net benefit from *Nypa* is estimated at VND3,649.8 or AUD0.5 per ha per year. This is the value with labour costs. Because Tri’s study does not specify the net benefit without labour costs, this value without labour costs is not estimated.

4.6 Medicinal plants

Many fauna and flora species in mangrove forests can be used as traditional medicines (MONRE 2002:35) (Appendix 4). There are from 25 (MONRE 2002:49) to 34 (Tri 2004) plant species in the MRD that can be used as medicinal ingredients. However, little data on the monetary values of these resources are available. Acknowledging that it is difficult to quantify benefits from medicinal materials of the wetlands, Tri (2004:134) develops a model estimating pharmaceutical benefits of Cangio mangrove forests based on the substitution of mangrove medicinal products for Western medicine. The estimated net benefit is about VND3,000m per year for 39,217 ha in 2000, which is VND76,497 per ha per year. With GDP deflators for the healthcare sector in 2000 and 2001 of 152 and 153.4 respectively, the net benefit is estimated at VND77,201.6 or AUD10 per ha per year. This is the value with labour costs. Similar to *Nypa*’s value, because Tri’s study does not specify the net benefit without labour costs, the value of medicinal plants without labour costs is not estimated.

Total net benefit from direct use values of wetlands is estimated by summing up all values of fisheries, aquaculture, fuelwood, timber, *Nypa fruticans* and medicinal plants. The total net benefit of direct use values of wetlands in Camau is VND7,549,823.9 or AUD982.3 per ha, taking into account opportunity cost of labour (Table 5). Because of the lack of data on benefits without labour costs for harvesting some wetland products such as *Nypa fruticans* and medicinal plants, in this research, only total net benefit that includes labour cost is estimated.

Table 5 **Net benefit per ha of direct use values of wetlands in Camau for the year 2001**

No	Direct use values	Net benefit per ha with labour costs	
		Estimated value in VND	Estimated value in AUD
1.	Aquaculture	4,023,616.5	523.6
2.	Timber - Mangroves - *Melaleuca*	2,119,324.2 142,234.5 1,977,089.7	275.8 18.5 257.3
3.	Capture fisheries	1,253,575	163
4.	Medicinal plants	77,201.6	10
5.	Fuelwood	72,456.8	9.4
6.	*Nypa fruticans*	3,649.8	0.5
	TOTAL	**7,549,824**	**982.3**

With 218,000 ha of mangrove/*Melaleuca* forests (UNEP 2001:39), the estimated values of wetlands in the MRD are about VNV1,646 billion or AUD214,141,400. These indicate economic importance of wetlands to local people. However, it should be noted that the figures on wetland values in this research are indicative only. They are based on data on the margin, that is, at the amount of wetlands currently available. With reduction in the area and output of wetlands, values could be expected to be higher per unit.

4.7 Sensitivity analysis

Sensitivity analysis is undertaken to test the robustness of the results when assumptions on the correlation between mangrove/*Melaleuca* and fisheries/aquaculture change. A matrix of wetland values with different assumptions is established. The sensitivity analysis shows that wetland values remain relatively stable when assumptions change (Table 6).

Table 6 **Wetland values (VND/ha/year) remain relatively stable when assumptions of correlation change.**

% aquaculture dependent on forests \ % capture fish dependent on forests	**70%**	**90%**	**50%**
50%	**7,549,824**♣	7,907,988	7,122,179
70%	9,159,270	9,517,434	8,801,105
30%	5,870,897	6,298,540	5,582,212

♣ Values reported in the earlier section of this research

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This section has described direct use values of wetlands in Camau. The implications of these values for the hypothesis of this research and policies of wetland management and water allocation of the Mekong River are discussed in the following section.

5 Discussion and conclusion

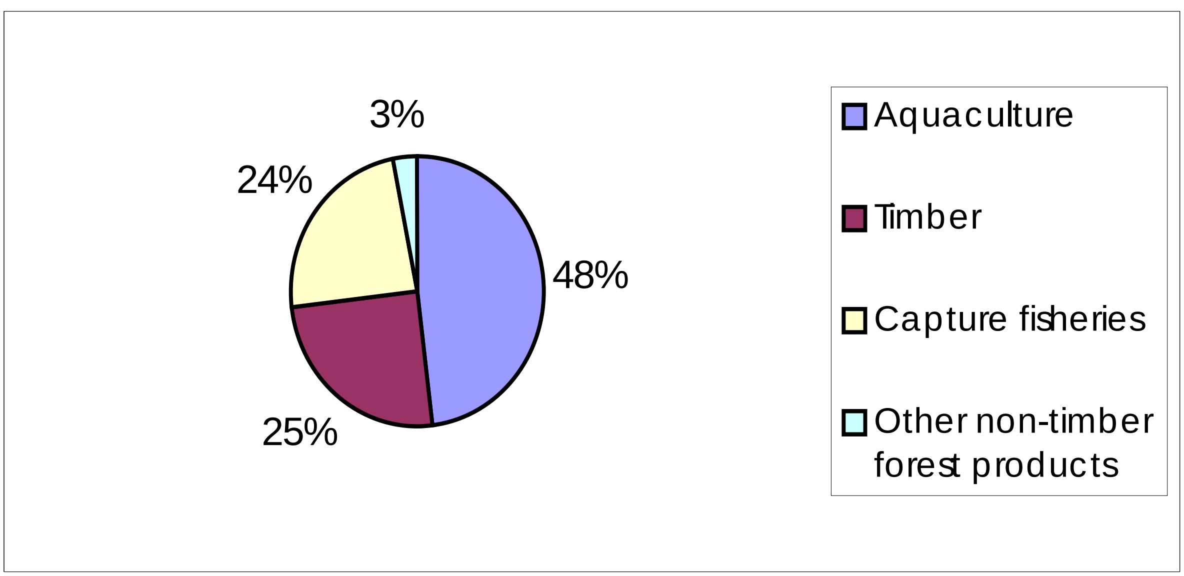
This section discusses the direct use values of wetlands in Camau with reference to the hypothesis of this research. It highlights the strengths and limitations of this research. In addition, some findings in terms of problems in data on wetland products are analysed. Importantly, the implications for decision making are discussed.

5.1 Discussion of the results

Based on the results discussed in Section Four, the hypothesis that wetlands in Vietnam's MRD provide direct use values to the local people is accepted. With various direct uses of fisheries, aquaculture, fuelwood, timber, *Nypa fruticans* and medicine, the values of wetlands are estimated at VND77,549,824 or AUD982 per ha per annum. This figure would have been higher if the values of a number of other direct uses, such as wildlife hunting, transport and tourism, had been estimated. Due to the unavailability of data on these values, the estimated values in this research only partially reflect direct use values of wetlands in the MRD. However, with this partial estimation alone, there is sufficient evidence to support the hypothesis that the wetlands provide direct use values to the local people.

Among direct uses of the wetlands, aquaculture provides the highest values to local people, followed by timber values. As shown in Table 5, the benefit from aquaculture is estimated at VND4,023,616.5 or AUD523.6 per ha per year, accounting for about 48 per cent of the direct use values estimated in this research (Figure 5). This may explain the trend to develop aquaculture in the MRD over the last few decades and supports Government Resolution 09/NQ/CP dated 15/10/2000 on promotion of the economy structure shift from ineffective agriculture to aquaculture (Vietnam Ministry of Fisheries 2002).

Figure 5 **Percentage of values of direct uses of wetlands in Camau**



However, a number of precautions should be taken when interpreting this high value for aquaculture. First, because the price of shrimps is higher than other aquaculture products, the assumption that all aquaculture systems in Camau are shrimp farming may overestimate the aquaculture values. Second, the problem of overestimation of aquaculture values may occur as a result of the assumption that the productivity of 250 kg per year is true for both traditional extensive and improved extensive systems, as opposed to the fact that the two systems may have different productivity. Third, negative environmental impacts from shrimp farming, which can result in a reduction in shrimp productivity (Be and Dung 1999), are not taken into account in this research. Therefore, the estimated values of shrimp farming may be higher than in reality. Fourth, as aquaculture products are mainly exported, the prices of aquaculture products reflect international demand whereas the prices of other direct use values such as capture fisheries and timber are based on local demand. This may result in biases in estimating aquaculture values. Last, the absence of the estimation of significant subsistence values of capture fisheries may significantly reduce the share of capture fisheries.

5.2 Some strengths and limitations of this research

For the first time, an economic valuation of wetlands, which seeks to incorporate many direct use values, has been conducted in the MRD. The values of *Melaleuca* timber are included to reflect the importance of *Melaleuca* wetland systems in the MRD. In addition, the values of *Nypa fruticans* and medicinal plants are quantified to provide a more comprehensive figure on wetland values. This confirms the economic significance of wetlands to local people and suggests the need for improving wetland management.

In addition to testing the hypothesis that wetlands provide direct use values to local people, it is found in this research that there is a lack of consistency in statistical data for fisheries in Vietnam. There are different data from the two main statistical systems: the system of the Ministry of Fisheries and the system of the GSO. For example, according to the former system, fisheries output in Camau is 46,000 tonnes in 2002 (Vietnam Fisheries Information Centre 2002) while the latter system shows that the output is 127,060 tonnes (Vietnam GSO 2002:179). This problem resulted from the lack of coordination between the two systems, the shortfall in qualifications of statistical staff and the complex nature of data collection (Trong and Binh 2004).

Regarding the statistical data, there is also no clear division between marketed fisheries and non-marketed subsistence fisheries. Neither statistical system addresses whether the data include non-marketed subsistence output. Therefore, unless field surveys are conducted, it is hard for researchers to analyse the values of marketed and non-marketed subsistence fisheries. As Trong and Binh (2004) argue, this may be due to the fact that freshwater fishing by households is often conducted on a small scale and without licences or registration. This problem is common in some other developing countries and often leads to underestimation of wetland values (Ronnback 1999:245).

Another strong point of this research is the way in which difficulties of unavailability of data are managed. As discussed earlier, many authors, for example, Ringler and Cai (2003) and IUCN (2003), have noted that there is a lack of data on economic values of wetlands not only in Vietnam's MRD but also in the MRB. This imposes a challenge to any research that attempts to conduct an evaluation based only on secondary data. However, in this research, this challenge has been met by analysing different data sources, using the benefit transfer method and making some assumptions.

Nevertheless, there remain some limitations in this research. These arise from two sources. The first is the use of market-based approach with the assumption that market prices are not distorted by government intervention. Only producer surplus are estimated, as discussed in Section 3.2.1. Therefore, only some parts of the total economic value of wetlands are reflected. In addition, the assumption that market prices are not distorted by market imperfection and government intervention may not hold true in reality. Perkins (1994:96) argues that market prices are often distorted in both developed and developing countries and the distortion in developing countries can be ten to twenty times higher than in developed countries. As a result, the economic valuation using the market-based approach may not reflect the true values of wetlands.

The second limitation is the assumptions used in this research due to a lack of primary data. For example, the assumption of fish productivity and the linkage between fish and mangrove/*Melaleuca* forests may not hold true in reality. This may considerably change the values of wetlands. Similarly, the assumption that Camau wetlands have similar biophysical characteristics to wetlands in other provinces in the MRD needs more verification. Also, the assumption that the data on fisheries output include both marketed and non-marketed subsistence products may not be valid. The output may have been higher if data on subsistence fisheries had been collected through field surveys.

5.3 Policy implications

Two main types of policy implications have been identified. The first type is related to wetland management and the second type deals with suggested further research.

5.3.1 Wetland management

Because wetlands in the MRD provide use values to local people, it is necessary to take measures to improve their management, when opportunity costs of providing the use values are lower than the benefits. The establishment of a well-defined property rights regime is the most important measure. The property rights regime can be in the forms of private property, state owned property and community based property, as long as the four conditions of universality, excludability, transferability, and enforceability are met. As wetlands in Vietnam are under various forms of property rights at present, it is hard to suggest a single suitable form of property rights regime. The selection of a property rights regime depends on the types of wetlands, the management capacity of a local authority and local socioeconomic characteristics.

However, there may be two options to establish a well-defined property rights regime. First, the current combined property rights regime can remain with strengthened enforcement to ensure the conditions for a well-defined property rights regime are met. This can be done through recognising wetlands as one type of lands in the Land Law and more clearly dividing roles and responsibilities of different ministries related to wetland management. Second, because among other types of forest management systems, a private property regime seems to generate the highest incomes for the local people in Camau, the expansion of private property rights in wetland management may facilitate the achievement of well defined property rights in the MRD.

In addition, it is necessary to consider economic values of wetlands in cost and benefit analysis of alternative land use options when making decisions about development projects. To this end, economic values of wetlands need to be well understood by decision makers. Ideally, the total economic value of wetlands should be identified. In a more common scenario, where only quantitative direct use and some indirect use values are estimated, qualitative assessment of other use and non-use values may be justified to provide greater input for decision making. The aim is for economic values of wetlands to be incorporated as much as possible in cost benefit analysis of wetland management strategies to assess alternative interventions to supply wetland values.

Moreover, policies for allocating Mekong River water need to take into account the impacts on wetlands and consequently the values they provide to the people. At present, decisions that affect water flow are not made with full consideration of wetlands and their resources. As a result, decisions may result in negative impacts on the wetlands and livelihood of local people. At a regional scale, the construction of dams in China has resulted in decreased downstream water flow and reduction in productivity of fisheries and other wetland products. At a national level, the development of *ad hoc* dyke systems in Vietnam's MRD, on one hand, has protected agricultural farms from floods, but on the other hand, has prevented wetlands from being connected to the river. The problem at a regional level can be solved by improved coordination among riparian countries, whereas the problem at a national level can be addressed by having more scientific information on impacts of water flow on wetlands and their values.

5.3.2 Suggested further research

The implications for wetland management suggests the need for further research on economic values of wetlands in Vietnam's MRD. Although the MRD is one of the major socioeconomic regions of the country, and wetlands are considered an essential ecosystem, very few economic analyses have been conducted. Most studies have been qualitative assessment rather than quantitative assessment. For example, among 19 discussion papers presented in the workshop on Environmental Economics and Evaluation of Wetlands held in Hanoi in June 2004, only two papers, by Hong (2004) and Tri (2004), provided some quantitative data on direct use values of wetlands. The rest provided some general and theoretical discussions that seem of limited use. In addition, no non-market valuation of wetlands that can provide estimation of option and non-use values have been conducted in the MRB. This suggests that further research on wetland values is needed to provide more comprehensive scientific information for decision making.

In this further research a bioeconomic model could be set up, first establishing biophysical characteristics of the relationship between water flows and wetlands, then estimating the economic values of the wetlands through an evaluation that incorporates both market and non-market valuation techniques. Next, the linkages between the water flows and the economic values of wetlands are established. Based on this, a model allowing the identification of an optimal level of water flows with regards to wetland values could be devised. This bioeconomic model would provide useful information for Vietnamese policymakers in their management of Mekong River water and wetlands in the MRD. In the meantime, this model would provide inputs for negotiation and discussion about Mekong River water allocation among the riparian countries.

5.4 Conclusion

Wetlands in Vietnam's the MRD have degraded due to development activities. This problem can be explained by the lack of a well-defined property rights regime. Information on the total economic value of wetlands is essential for policymaking regarding defining property rights and other issues related to wetland management. However, there exists a gap in information on values of the MRD wetlands because there has been no study on the wetlands' total economic value. Therefore, research on wetland direct use values, indirect use values, option values and non-use values - through which, the total economic value of the wetlands can be determined - is needed.

This research helps fill this gap by conducting an economic valuation of some direct use values of wetlands in the Vietnam's MRD. The market-based approach and the case study of direct use values of mangrove and *Melaleuca* forests in Camau Province are used. It is found that wetlands in Camau have direct uses of capture fisheries, aquaculture, timber, fuelwood, *Nypa fruticans* and medicinal plants, with the values of VND7,549,824 or AUD982 per ha per annum. Among these, aquaculture has the highest value.

An integrated approach that includes the establishment of a well-defined property rights regime and due consideration of wetland values in CBA analyses of land use options is recommended for wetland management. In particular, impacts of water flows on wetlands and their values to local people should be integrated into policies regarding water allocation of the Mekong River. These findings confirm the need for further research. This would involve the estimation of indirect and non-use wetland values, and the examination of linkages between water flow regimes and wetland values, using bioeconomic modelling.

In conclusion, it is found that wetlands in Vietnam's MRD contribute to the local people's livelihood. This result provides knowledge of wetland importance and is a useful input for decision making of wetland management and water allocation in the MRB. This research contributes to sustainable development in the MRD and the MRB. This is not only an objective of the governments of Vietnam and other countries in the region but also an overarching goal for humankind.

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