Monetary Green Accounting at a Regional Scale in Sweden

Lina Isacs

SLU, Department of Economics
Degree Thesis in Economics
(Version - final)
D-level, 30 ECTS credits

Thesis No 465
Uppsala, 2007

ISSN 1401-4084
ISRN SLU-EKON-EX-No.465-SE

Monetary Green Accounting at a Regional Scale in Sweden

Regionala miljöräkenskaper och tillväxt i Sverige

Lina Isacs

Supervisor: Ing-Marie Gren

Sveriges lantbruksuniversitet
Institutionen för ekonomi
Box 7013
750 07 UPPSALA

ISSN 1401-4084
ISRN SLU-EKON-EX-No.465-SE

Tryck: SLU, Institutionen för ekonomi, Uppsala, 2007

Abstract

In this thesis environmentally adjusted regional products (EDPRs) are calculated by introducing non-marketed values of natural capital assets into conventional GDPR (Gross Domestic Product of regions) figures for the years 1995 and 2000, following welfare based green accounting theoretical guidelines. The EDPRs of Sweden's 21 counties presented are partially adjusted in the sense that values of two natural capital outputs in the form of ecosystem services, pollution sequestration and recreational services, from three types of ecosystems, forests, agricultural landscape and wetlands, are calculated and added to GDPRs using secondary data of resource quantities and value estimates from existing studies. The empirical demonstration shows that the net welfare contribution from these assets is positive, but that in several counties the use of the assets has been unsustainable. When comparing the EDPRs and conventional GDPRs it is shown that the two measurements of growth provide significantly different pictures of regional wealth and productivity; regions that are traditionally considered as relatively less growth promoting are shown to hold important sources of wealth, with high EDPRs per capita, while on the other hand counties that are rich in conventional terms fall behind when adjusting for values of natural capital. Moreover, it is shown that growth in EDPR and GDPR can show opposite signs.

Key terms: *Natural capital, green accounting, regional, non-marketed, ecosystem services, sustainability, Sweden.*

Sammanfattning

Med utgångspunkt i modern miljöekonomisk teori beräknas i denna uppsats miljöjusterade bruttoregionalprodukter (EDPR) för Sveriges 21 län åren 1995 och 2000 genom att värdet av icke marknadsförda tjänster från naturkapital introduceras i konventionella regionala produktionsmått (BRP). EDPR justeras partiellt genom att två typer av tjänster, utsläppsminskning och rekreation, från de tre ekosystemen skog, jordbrukslandskap och våtmarker värderas och läggs till BRP med hjälp av befintlig resursdata och tillgängliga värderingstudier. Den empiriska studien visar att dessa naturtillgångar bidrar positivt till regional välfärd, men att tillgångarna i flera av länen inte använts eller förvaltats på ett hållbart sätt. Vid en jämförelse mellan tillväxten i EDPR och konventionella BRP framgår att de två måtten ger olika bilder av regional förmögenhet och produktivitet; regioner som traditionellt inte anses framgångsrika vad gäller tillväxt och rikedom uppvisar höga EDPR-värden per capita, medan län som är rika med konventionella mått mätt halkar efter när hänsyn tas till värdet av naturkapital. Studien visar också att tillväxten i EDPR och konventionell BRP kan förändras i motsatta riktningar.

Key terms: *Naturkapital, gröna miljöräkenskaper, regional, län, icke-marknadsförda, ekosystemtjänster, hållbar utveckling, Sverige.*

Abbreviatons

GDPR	Gross Domestic Product of regions
EDPR	Environmentally adjusted Domestic Product of regions

Table of Contents

1. Introduction

> [...] we deplete resources without trying to determine the consequences of depleting them, sometimes because we haven't the time to find out, but sometimes because we may not wish to know, since the answer may prove to be unpalatable to us.
>
> Partha Dasgupta 2003

When measuring welfare, a usual practice is to look at indices of aggregated economic activity assumed to be based on production depending mainly on factor inputs like manufactured capital and labor. Ultimately, standard welfare or income measures, like the gross domestic product (GDP), account for marketed consumption and production goods. International comparisons of GDP and GDP growth figures are consequently used to tell how well countries or regions are off in relation to each other, and GDP growth is also the standard measurement used by policy makers for intertemporal comparisons aimed at telling whether a nation is developing successfully.

Another factor considered to determine both economic prosperity and welfare, absent from traditional accounts, is part of the natural resource base; namely those natural capital products that are not traded on the market. Apart from providing us with important raw materials, which are already marketed and considered in traditional accounts, natural resources can be significant for national wealth and welfare in a way usually not accounted for. Not only does it influence people's welfare via its mere existence by being available for recreational activities, our natural resource base provides us with services necessary for our very survival. The broad spectrum of these non-marketed ecosystem services include supply and regulation of water, food production systems, climate maintenance, nutrient cycling, enhanced biological productivity and pollution abatement (Daily 1997, Heal & Barbier 2006). Furthermore, hardly any ecosystem is nowadays unaffected by human activities, and so the acknowledgement of the mutual dependence between human societies and the functioning of the natural resource base is the core condition for the achievement of a sustainabile development (Daily 1997).

Now, on the one hand, when looking at specific resources and services of importance for human well-being, like, for example, fish stocks or the atmosphere as a carbon sink, there is convincing evidence that the utilization is unsustainable (Millenium Ecosystem Assessment 2005). On the other hand, looking at historical trends of marketed resources and recorded growth in GDP per capita in countries that are currently rich provides no such picture, but rather a one of an almost unremitting success (Dasgupta 2003). Indeed, there is a broad consensus that the measurements usually applied when evaluating welfare are highly incomplete, and the need for better instruments has lead to research aiming at developing more comprehensive measurements (Dasgupta & Mäler 2001, Perman et al. 2003).

One reason why a lot of the services provided by nature are simply taken for granted, stems from the fact that they are free, so called common goods, not traded on any market. Without market prices, their values go unrecorded in current economic accounts, and its base can thus be exploited and even depleted freely, without clear detection in the financial records (Harris & Fraser 2002). Although their true economic values, like for many other of our welfare constituents, is hard to establish, including approximations of them in records already accepted could be valuable. Since human welfare tend to be equated with economic prosperity, monetarising even the intangible determinants of human welfare might be one way to make us better equipped to manage and monitor it.

GDP adjusted for the non-marketed part of natural capital might give us a suggestion to one of the many parts that has been missing. A broad research field within economics is now dedicated to the question of green accounting and sustainability issues, and both theoretical and empirical works have made progress during the last decades[1]. The effort has been backed up by an accelerating political interest boosted not the least by the recognition of modern threats to welfare like climate change and biodiversity loss (Perman et al. 2003). But environmental economic accounting raises a number of difficult questions on how to quantify environmental resources, evaluate human impact on their functioning and value their functions for human well-being. Although the methods used in the empirical studies made so far suffer from being more or less provisional, they can be seen as necessary steps towards a better understanding of nature's influence on human welfare, and, vice versa (Solow 1992).

Evaluations and comparisons of income and welfare are also made at the level of regions and sub-national regions, since interregional differences in endowments, preferences and/or institutions determining welfare can be significant. Since about a decade, each member state in the European Union publishes regional accounts measuring the Gross Domestic Products of regions (GDPR) at different levels which correspond to the national GDP of entire nations. The accounts provide information on productive structures of the European regions and sub-regions and form the basis for the European regional policies (Decand 2000a). Regional statistics are vital in order to improve the regional policy instruments and enable proficient evaluations of thier outcomes. Gilles Decand, the Eurostat Head of Unit in charge of regional statistics in 2000, expresses it in the following manner:

> If Europe's wealth lies in the diversity of its regions, the task of regional statistics is to reveal this wealth. (Decand 2000b, p. 3).

Just like in the accounting systems at the national levels, the main concern has, this far, not been to consider wealth components outside the marketed economy.

From this point of view, and given that geographical differences inside the borders of a single nation can be considerable, adjusting regional accounts for non-marketed environmental resources of importance to human welfare seems like a relevant step to take. Such adjusted regional measurements might provide a picture of regional welfare and productive structures that is different from that given by conventional GDPRs. Sweden forms a good example for doing this. Situated at the north west end of an immense continent, environmental characteristics vary a lot in both north-south and east-west directions along with its elongated shape, reaching from polar regions of high mountains and taiga well above the Arctic Circle in the north, to mild climate agricultural landscape in the south (Wastenson & Helmfrid 1996).

The purpose of this study is to measure environmentally adjusted regional growth (EDPR) and to compare this with growth in conventional GDPR. In this thesis, Swedish regional accounts are calculated by introducing non-marketed values of natural capital into the conventional GDPR figures, following modern theoretical guidelines for green accounting, where natural capital is valued by its current and future streams of ecosystem outputs. The EDPRs presented are partially adjusted in the sense that values of two selected outputs, *pollution sequestration* and *recreational services*, from three types of ecosystems, *forests*, *agricultural landscape* and *wetlands*, are calculated and added to conventional GDPR using secondary data of resource quantities and value estimates from existing studies. The analysis is made at the level of counties[2], and the EDPR growth records of Sweden's 21 counties for the years 1995 and 2000 are compared with respect to both to their conventional equivalences and in relation to each other. Such regional level application can serve as an example of how results from interregional comparisons might change given alternative assumptions about the

[1] See for example Heal & Kriström (2001) for an overview.
[2] "Län" in Swedish.

constituents or determinants of social well-being and wealth. Moreover, the natural capital values developed in the study are used for evaluating whether regional natural assets have been used in a sustainable way.

Similar empirical studies have approached the environmental adjustment issue by correcting national accounts for the depletion of non-renewable resources and/or for the degradation of renewable resources by deducting negative values of pollution impacts (e.g. Hamilton & Clemens 1999, Ahlroth 2000, Skånberg 2001). Amenity values and other non-marketed values of ecosystems are less explored. In Sweden, some empirical attempts have been made, where natural capital has been valued by their contribution of non-marketed outputs in the form of ecosystem services (Gren 2003, 2006a, Gren & Svensson 2004), but like most other green accounting studies around the world, they have a national scope. This thesis, contributes to the existing literature by presenting monetary green accountings made at a regional level within the same country, where natural capital, unlike in most other studies, is treated as entire ecosystems as inputs in the production of non-marketed ecosystem services.

The outline of the paper is as follows; Chapter 2 provides the theoretical framework of the study by breifly going through the development of green accounting theory and the mathematical model underlying the empirical calculations. In Chapter 3 a literature review presents some of the empirical work made in green accounting this far, and in Chapter 4 the retrieval of the data for this thesis is explained. Chapter 4 is divided into three subsections, which, before presenting the regional estimates, describe the connections between each natural asset and their respective ecosystem outputs as well as the method of valuation. The analysis is then made in Chapter 5, where the estimates achieved in Chapter 4 are used to calculate adjusted GDPRs for Sweden, enabling comparisons between conventional GDPR and EDPR. The thesis ends with a summary and some concluding thoughts in Chapter 6.

2. Green accounting and wealth in theory

In order to be able to measure and introduce non-market values of natural capital appropriately into standard economic accounting models, the traditional income accounting theory has been extended and developed. The result is often referred to what is called green accounting.

2.1 Theoretical background

The theoretical field of green accounting has grown during the last decades, but its base was founded already in the beginning of the last century by theorists emphasising national income as the return on the *total* capital stock (e.g. Hicks 1939). The explicit inclusion of natural capital in accounting models, emphasising it as one of the main contributors to national prosperity along with standard production factors like reproducible manmade capital and labor, was further developed during the 1970s (Perman et al. 2003). The idea is that by adding to the reproducible capital stock an amount equal to the depreciation of the total resource stock, total wealth would be kept intact in order not to adventure the foundations of social well-being of both current and future generations. Consumption as the interest earned on this stock of wealth, the net national product (NNP), which is the domestic gross product less depreciation of the total stock of capital, has in this way been interpreted as the proper index for measuring both welfare and sustainable welfare[3].

In today's green accounting framework, many different interpretations of the correct way to measure welfare and sustainability are under use[4]. The differences depend mainly on underlying theoretical assumptions of preferences and prospects of the economy, and looking into these, two approaches seem to have been established (Heal & Kriström 2001). Both are based on the above idea about national income as the return on total wealth, but while one is defining sustainability as non-declining consumption during time along a sustainable path (e.g. Hartwick 2001), the other defines it as non-declining total wealth (Dasgupta & Mäler 2000, 2001). The latter thus recognises the importance of the production potential of the resource base and puts emphasis on the welfare consequences of changes in that base, and not only on changes in what is directly consumed by society (Gren 2003). It is also regarded as the more appropriate measure for both welfare and sustainability evaluations, given its emphasis on the use of accounting prices (Dasgupta & Mäler 2000, Heal & Kriström 2001, Arrow et al. 2004). To get closer to a measure suitable for social welfare comparisons across time and space, welfare components like consumption and investment should namely, preferably, be valued by their contribution to both current and future social well-being[5]. Specifically, an accounting price is defined as the impact on current and future social well-being resulting from a marginal change in an asset. Thus, *wealth* according to the latter approach is defined as the aggregate social worth of *all* capital assets, where the social worth of an asset is defined as the net discounted flow of benefits it can generate to society over time. Discounting means putting a non-discriminative value on the preferences of generations ahead of us, making it possible to compare welfare constituents across time on an equal basis. What is more, this wealth theory is developed to suit short run evaluations, even when an economy is not acting optimally (Dasgupta & Mäler 2000). This makes it more practical, and perhaps, more realistic, given that most real economys actually are more or less distorted (ibid, Gren & Svensson 2004).

In theory, natural capital have often been divided into three broad categories; renewable and non-renewable natural resources, pollution and ecosystems. Of these, the two first are the more empirically explored (Gren 2006a). A common way is to adjust for the depletion, degradation and defensive costs associated with these different forms of natural capital, treating them as negative wealth changes (Perman et al. 2003)[6]. Non-marketed components of natural capital have often been approximated by pollution impacts whose value estimates are deducted from net national product (e.g. Ahlroth 2000). Another approach, advocated by for example Arrow et al. (2003), Gren (2003, 2006a) and Gren & Svensson (2004), is to look at the non-marketed production of outputs from natural capital, where entire ecosystems are treated as inputs in the production of ecosystem goods and services. These outputs yield a flow of benefits free to society, such as food provision, recreational values and pollution sequestration. With this approach, negative welfare impacts due to pollution or quality degradation enter indirectly via their influence on the functioning of ecosystems and hence on the value of the ecosystem outputs. The argument for not including negative value items of pollutions, is that it is rarely the pollution itself that brings about disutility (unless you can physically sense the discomfort of for example air pollutions), but rather the effect it has upon the ecosystems which usually would counteract the distress upon humans (Gren 2006a).

[3] See Perman et al. (2003) for an overview and Dasgupta & Mäler (2000) for a critical discussion.

[4] See e.g. Harris & Fraser (2002) for an overview.

[5] That is to say, if one adopts the now well-established definition of sustainable development introduced by the Bruntland Commission Report in 1987, saying that a sustainable development is a one that meets the needs of the present without jeopardising the ability of the future generations to meet their needs (World Commission 1987).

[6] See e.g. Hamilton & Clemens (1999), for an international level application, or Skånberg (2001) for Sweden.

Intuitively, when making adjustments for natural capital values in welfare accounts, it seems reasonable to maintain such a perspective where the state of the nature itself and its influence upon human welfare is the focal point. Furthermore, since pollution impacts on already marketed goods and services are included in conventional NNP, the risk of double counting is avoided (ibid).

When approaching the task of making adjustments of existing income or product measures, it is important to keep in mind what the adjustments of conventional measures are aiming at assess. Valuation is ultimately a question of to what degree an item is able to live up to a specific goal. For example, conventional economic values are based on their contribution to individual utility maximisation, mostly expressed in terms of willingness to pay. If an additional goal is sustainability, the values should be based on to what extent the components of the measurement achieve that goal (Costanza & Folke 1997). In the subsequent, a model making it possible to interpret the income measure as an index of social well-being and sustainability is presented.

2.2 The model

In order to find the terms needed for making the adjustments of conventional income measurements we will look at a dynamic model based on theoretical work developed by, among others, Arrow et al. (2003), Dasgupta and Mäler (2000, 2001). It is a simplified version of the model presented in Gren (2006a). The model connects natural capital stock levels and their production of ecosystem services to human welfare.

Consider an economy whose welfare is determined by the consumption of both marketed and non-marketed goods and services, *C* and *E*, respectively. Here, non-marketed consumption, *E*, represents the output provided by natural capital as ecosystems, for example cleaning of air and water or recreation. The production functions of *C* and *E* are then simply defined as $C = C(K, N)$ and $E = E(N)$, where *K* stands for man-made capital and *N* is the stock of natural capital, which in turn are assumed to be the only capital assets of the economy.

The utility function of a typical member in the society is then written as $U = U(C, E)$, which is assumed to be non-decreasing in all its arguments. Then, with an unlimited time perspective, social welfare, *W*, can be expressed as

$$W_t = \int_t^{\infty} U(C_t, E_t) e^{-\theta(\tau - t)} d\tau, \qquad (1)$$

which defines welfare in time *t* as the integral of the discounted stream of utilities received from consumption of *C* and *E* from t to ∞. $e^{-\theta(\tau-t)}$ is the discount factor, and *Θ* represents a constant discount rate, indicating that society's preferences are to be unchanged over time. *W* is thus an expression of the intergenerational well-being at any given moment in time. To be able to uncover the welfare contribution of each wealth component to society's welfare, we need to recognise *W*'s dependence on all assets, *K* and *N*, and (1) can thus be written in terms of initial stock parameters

$$W_t(K_t, N_t) = \int_t^{\infty} U(C_t, E_t) e^{-\theta(\tau - t)} d\tau, \qquad (1')$$

where *W* is assumed to be time-independent, continuous and differentiable.

According to the sustainability criterion discussed above, sustainable development is now defined as non-declining dynamic welfare, $(dW/dt) \geq 0$, since this embodies the concern of bequeathing at least as large a productive base (*W*) to the next generation as the one the current generation has inherited from its predecessors.

In order to find sustainable welfare at a certain date in time, we differentiate (1') with respect to *t* and impose the sustainability criterion. After some rearrangement this gives us

$$(\partial U/\partial C_t)C_t + (\partial U/\partial E_t)E_t + p^K(dK/dt) + p^N(dN/dt) = \theta W \qquad (2)$$

where $p^K = (\partial W/\partial K_t)$ and $p^N = (\partial W/\partial N_t)$ are the accounting prices of man-made and natural capital respectively, reflecting the social worth change owed to a marginal change in the assets at time *t*.

Studying (2), it can be seen that the non-marketed components of natural capital must enter the second and the fourth term on the left hand side. Hence, in order to adjust income with respect to non-marketed ecosystem outputs, what is needed is the value of the ecosystem service *consumed* during the period, which equals the second term, $(\partial U/\partial E_t)E_t$. This term, which in the subsequent will be referred to as the *consumption term*, is a flow component, which affects the aggregated product even if *N* is unchanged over time.

As for the term $p^N(dN/dt)$, the fourth term of the left hand side which represents the value of the change or investment in natural capital, it comprises the value of both marketed and non-marketed natural capital components. More specifically, the value of the change in the natural capital stocks is determined by the value of the output this change is able to generate to society over time. Of this, marketed outputs like timber and agricultural products are already included in national accounts, but the value of the non-marketed outputs have to be determined by the relationship between the ecosystem input, *N*, and the non-marketed ecosystem output, *E*, specifically. Given $U = U(E(N))$, the accounting price of the non-marketed ecosystem service in time *t*, can then be expressed as

$$p_t^{NE} = (\partial W/\partial E(N)_t) = \int_t^{\infty} (\partial U/\partial E_t)(\partial E/\partial N_t)e^{-\theta(\tau - t)}d\tau \qquad (3)$$

which is the social worth of a marginal change in natural capital, with respect to only its non-marketed service output[7].

The second adjustment term needed is thus the value of the investment or change in natural capital occured at the time, with regard to only the non-marketed outputs that can be realised from it, that is $p_t^{NE}(dN/dt)$. In the following, this term is called the *investment term*.

In order to track whether the economy is acting sustainably, some rearrangement of equation (2) is needed. The terms (dK/dt) and (dN/dt) are simply the investment in the stocks in each period. Replacing them by I^K and I^N, and differentiating once again with respect to time, the sustainability criterion will be expressed in terms of changes in income,

$$(\partial U/\partial C_t)(dC/dt) + (\partial U/\partial E_t)(dE/dt) + p^K(dI^K/dt) + p^N(dI^N/dt) = \theta W(p^K I^K + p^N I^N) \quad (4)$$

showing that for welfare not to decline, net investment (the sum of the changes in all capital stocks, *K* and *N*) needs to be positive.

[7] See Gren (2006a) for a more thorough derivation of this.

2.3 EDP – The Environmetally Adjusted Domestic Product

The results in 2.1 can be expressed with a simple capital theory model in line with the standard System of National Accounts, the international framework for economic statistical reporting on income and wealth developed by the United Nations (Perman et al. 2003). The starting point is a shortened version of the conventional GDP formula

$$GDP_t = C_t + I_t + (X_t - M_t)$$

where C_t and I_t stand for marketed private and governmental consumption and investment in man-made capital at time t respectively, and $(X_t - M_t)$ is the trade balance. Next, GDP is corrected for the depreciation of man-made capital to get a Net Domestic Product

$$NDP_t = GDP_t - dK_t$$

since this is the first step that need to be taken to get closer to a measurement of sustainable income[8].

In this, C and I correspond to the first and the third terms in equation (2), where the depreciation of man-made capital, dK, is comprised in the value of the change in K. As far as this, all terms are to be found in the official system of national accounts.

The Environmentally Adjusted Domestic Product, *EDP*, is then obtained by adding the two adjustment terms derived above, the non-marketed natural capital consumption and investment,

$$EDP_t = NDP_t + p^E E_t + p^{NE} dN_t \tag{5}$$

where the unit price of the ecosystem service equals $p^E = (\partial U / \partial E_t)$ and p^{NE} is the accounting price as expressed by equation (3) above. Both of these adjustment terms consist of a value and quantity parameter. In other words, the information needed in order to correct the conventional measure is *i)* quantitative estimates of the ecosystem stocks and their change during the period under study, *ii)* information about the relationship between stock levels and ecosystem service outputs and, *iii)* monetary estimates of unit values of the ecosystem outputs. In Chapter 4 we shall return to the adjustment terms in expression (5) and these three points when going through the data retrieval for making the environmental adjustments of the regional product accounts of Sweden.

[8] By subtracting the depreciation value, investments made in order to replace consumption of fixed capital is treated as defensive costs rather than as an increase in income. Thus, the lower the depreciation of capital, the more sustainable is the capital use. This net income/product definition and its welfare interpretation were developed by Weitzman (1976).

3. A brief literature review of empirical green accounting studies

In practice, environmental factors have been represented in a number of ways in economic modelling. Looking into the guidelines of OECD, a long list of indicators for the evaluation of human pressure on the environment can be recognised, where some of the most relevant environmental issues at present are connected to different types of natural resources or assets (OECD 1994). The most investigated issues concern air and water pollution and pressures on renewable resources like forests or fish stocks. The empirical valuation studies of natural capital and its role for wealth and sustainability mirror this. Corrections of national accounts are mostly made for depletion or degradation of natural assets with respect to the marketed outputs they yield, and non-marketed values of natural capital are often approximated by costs of pollution impacts.

In one of the first EDP studies made for Sweden, Skånberg (2001) estimates the negative external effects on the environment emerging from market production. The environmental adjustment terms enter in the form of depletion of non-renewable resources (metal ores), degradation or change in renewable resources (e.g. agricultural soil erosion and overfishing) and pollution damage (eutrophication and acidification). The value of these factors, mainly estimated production losses calculated by the use of market prices or defensive expenditures, are subtracted from conventional Swedish NDP, which then is found to decrease with approximately two per cent. Ahlroth (2000) obtains a modified Swedish national product by correcting for the impact of nitrogen and sulphur emissions on natural resource stocks and flows during one year. The environmental cost in her study results in a total adjustment of conventional NDP of around minus 1.6 per cent. Both these studies thus focus on non-marketed negative impacts on the environment, where pollution enters directly in the social utility function, creating a decline in welfare.

In contrast, Gren (2003, 2006a) and Gren and Svensson (2004), consider non-marketed values that have a positive influence on utility. In these studies, natural capital is valued by the current and future ecosystem service outputs yielded from ecosystem production, and negative parameters like pollution are here instead accounted for indirectly via the effects that emissions have upon the functioning of the ecosystems' production possibilities. In Gren and Svensson (2004), NDP adjustments for the values of the recreational services and pollution abatement supplies of forests, agricultural landscape, wetlands and air quality are estimated for the years 1991-2001 in Sweden. The authors find the net welfare contribution from these assets to be positive, but the net change in them indicates that they have not been sustainably used. The same results are held in Gren (2006a), and just like in Gren and Svensson's study, a comparison between adjusted and conventional NDP shows that growth can move in different directions depending on which measurement is used.

When it comes to regional comparisons of adjusted wealth measures, quite few studies have been made. Most of them have a cross-country approach and deal mainly with the relation between natural resource depletion and sustainability in developing countries (e.g. Pearce & Atkinson 1993, Hamilton & Clemens 1999). Hamilton and Clemens estimate the value of the change in an extended capital stock including natural capital (forests, oil and minerals and the atmosphere as a carbon sink), and the result indicate that many of the world's poorest countries, contrary to what conventional measures indicate, have become even poorer due to unsustainable use of their natural assets. One of the few studies that seems to have been made comparing regions within the same nation is made by Vincent (1997). In calculating the adjusted NDP for three subnational regions in Malaysia, he finds that only one of them had grown sustainably, something that the aggregate national figure, which was constantly growing during the period, were unable to grasp. Harris and Fraser (2002) pinpoint some of the questions raised with respect to interregional sustainability comparisons, such as the issue of substitutability across regions and at what level a sustainability criterion should be assessed. This issue will be returned to in the last section.

In reviewing the empirical literature on green accounting it is shown that there is by no means any single approach considered to be the correct way to adjust conventional economic measures for the values of natural capital. What is clear though is that the most common way to account for non-marketed values of natural capital is to subtract depreciation approximated by direct depletion or degradation through negative pollution impacts, and that this mostly has been made at the level of nations. In the beginning of the next chapter, some of the methodological questions concerning the application of adjustments at a regional level in Sweden are raised. Thereafter, we turn to the empirical study itself.

4. Data retrieval

The information required according to the theoretical chapter for making the adjustment of conventional GDP is *i)* quantitative estimates of the ecosystem stocks and their change during the period under study, *ii)* information about the relationship between stock levels and their respective outputs, and *iii)* monetary estimates of unit values of the ecosystem outputs. In the next, the connection between these three components is discussed generally in order to make way for the data compilation in sections 4.1– 4.3.

The difficulties in deciding which natural capital assets are relevant for an empirical green accounting application are in a way narrowed by the fact that choices are actually few; this depend heavily on the limited availability of both accounts on physical resources and value estimates. Since the approach here is to value natural capital by their non-marketed ecosystem outputs, the options also depend on information about known relations between asset stocks and their respective outputs. Estimating accounting prices of natural resources in practise imply a lot of difficulties of which the most challenging task seems to be to connect natural capital outputs to the ecological processes at work in associated ecosystems (Dasgupta 2003). To which ecosystem can a certain service be attributed, and what exactly does the relation between inputs and outputs look like? Although increased interdisciplinary work between economists and ecologists has improved matters, many of the input-output relations in natural resource accounting will most surely remain unsolved (Perman et al. 2003).

However, there are some connections that are fairly well established, and given those, accounting prices can be estimated by the use of different valuation methods readily applied within economics. Some examples are the contingent valuation method (CV) revealing people's willingness to pay (WTP) for a non-marketed item, the replacement cost method or the use of politically determined targets revealing social costs and worths[9]. In some cases even market prices can be used when these can be considered to be close to reflecting social worths (Dasgupta & Mäler 2001). The derived values depend on which method is used and aggregating different types of measures can result in various inconsistencies. For example, WTP is a social average value that in contrast to prices of marketed items includes consumer surplus. Replacement costs deducted from the cost savings made by avoiding alternative and more expensive technologies depend on information about available techniques and

[9] See e.g. Perman et al. (2003) for an overview of these methods.

politically determined targets[10]. Another caveat is that if outputs from ecosystems delivering other already marketed goods were traded among their "traditional" ecosystem outputs, this would change market allocations and hence the prices underlying the traditional accounts (Hultkrantz 1992). On the other hand, few markets are so perfect that they do not generate distorted prices, and many common property resources registered and added to GDP, e.g. those belonging to the public sector, are not market priced either (ibid, Perman et al. 2003).

Even if the results will suffer from the weaknesses mentioned (and those to be mentioned subsequently) they might be valuable to study since they do provide clues about more exact results. In accounting for environmental values, particularly those which are entirely outside the marketed economy, it can be argued that one should not claim too much if there is anything to be done at all about the matter (Solow 1992).

The values of non-marketed services that are to be considered in this paper are restricted to *recreational values* and *pollution sequestration values* from three types of asset stocks; recreational values are calculated for the ecosystems of *forests*, *agricultural landscape* and *wetlands*, while the values of two types of pollution sequestration are calculated for forests (carbon uptake) and wetlands (nitrogen uptake). Exept for the data availability, which is especially limited on a regional level, the motivation behind choosing these two services is that they represent two rather different types of welfare determinants; recreational services symbolize a value that nature provides directly to consumers, while pollution cleaning represents a type of service that has an influence on the production possibilities of the economy, indirectly acting on human well-being. Since the value of these outputs depends on regional characteristics, a study taking regional differences into account might contribute to the work of mapping welfare and welfare changes within a country. Sweden with its varying natural geography forms a good example for doing this.

Regional figures of natural asset stocks and changes in them are rather well documented in Sweden, but the time series do not report on the non-marketed shares of natural capital outputs. Non-market value estimates are usually held through case studies in a certain region during a certain year. In effect this makes them inapplicable to other regions and other years since scarcity differences, regional institutions and even preferences may vary along with area and time. In this study, site specific unit values are nonetheless applied nationwide, represented by WTP measures and replacement costs from selected studies in the data survey made by Sundberg and Söderqvist (2004)[11] and these are assumed to be constant over time. In all cases though, the value studies from which they are picked admit a great variance of their estimates, and therefore upper and lower bounds of the values are calculated.

To get the accounting prices, where the values are discounted with respect to future, a constant real discount rate of three per cent is assumed, following the practice of many other empirical wealth accounting attempts (Gren 2003)[12]. For consistency reasons, it is preferable to use a single constant discount rate. In reality, a uniform discount rate is extremely hard to determine and the choice can be controversial in many respects. For example, when considering the benefits of preserving an environmental asset, it can be argued that the rate should be kept as low as possible in order to make the project valuable enough. On the other

[10] Harris & Fraser (2002) run a thorough discussion on the tensions between economic theory and national accounting methodology and conclude that most results of empirical natural resource accounting are ambiguous in interpretation partly due to the use of dissimilar methods for the estimataion of values of natural capital parameters.

[11] Since the main task in this thesis is to provide an example of how income measures can be adjusted in practice, secondary data of known input-output relations and value estimates is used, and the reader is therefore reduced to the original studies for a methodological description of the valuation method underlying the respective monetary values (see references below for each ecosystem output).

[12] This three per cent rate is close to the historical interest rate on risk free Swedish governmental bonds (Gren 2006a), giving us a perception of time preference development.

hand, as a description of people's real time preference, a high rate could seem more realistic, since people tend to have difficulties with reciprocally valuing matters in a distant future (Barbier et al.1997).

The calculations in this study are made for two years, 1995 and 2000, in order to be able to make both interregional and intertemporal comparisons. The years are chosen mostly with respect to that only time series of five year sliding mean annual values of resource data is available at the regional level, and therefore the most reliable way to track changes in them is to pick years with intervals of at least five years[13].

In rest of this chapter, the practical step of valuing the non-marketed ecosystem services in Sweden's 21 counties is made. Sorted under three subheadings, the three types of natural capital – forests, wetlands and agricultural landscape – are presented along with descriptions of their respective outputs. For each asset, consumption and investment values corresponding to the terms $p^E E_t$ and $p^{NE} dN_t$ in chapter 2.2 and 2.3 are calculated, in accordance with what the theoretical chapter showed us was needed for making an accurate wealth adjustment of conventional GDPR. As a control parameter, values are also calculated for the four subregions of North and South Norrland, Svealand and Götaland, which include several counties each, but these are only presented in the Appendices[14]. Moreover, estimates of the entire country are provided, and just like for the four subregions those values are calculated using rounded figures from the orginal resource accounts which do not always correspond to an aggregate of the county figures presented here. Whenever average values of Sweden are referred to it is these national values that are the concern.

The complete presentation of all value estimates of each service for the years 1995 and 2000 is to be found in the Appendices, while in this chapter the main results are shown in column charts presenting the total consumption and investment values per ecosystem and county in year 2000. Since the main purpose of this chapter is to specify the input-output relations and how these can be valued monetarily, the results of the calculations are only briefly commented on here.

The values are mainly presented in per capita terms in order to be able to make accurate regional income comparisons, since both population size and resource quantities vary along with county area (for instance, the area of the smallest Swedish county is not more than three per cent of the area size of the largest county). All monetary values from the different studies have been transformed into Swedish 2000-year prices (units of SEK) using the official consumer price index (see Appendix 4). Original current prices from the years of each respective source are referred to in notes in order to facilitate check-ups and alternative applications.

4.1 Forests

A forest ecosystem supplies everything from timber and berries to biodiversity maintenance, carbon uptake and hunting possibilities[15]. In Sweden, which is largely covered by both boreal and deciduous forest, its associated values are closely related to human welfare, not the least since forestry is and has long been an important economic activity engaging people in a large

[13] The resource data used, that from the Swedish National Forest Inventory, is published in five year sliding mean annual values from 1993-1997 to 1999-2003 (see www, Swedish National Board of Forestry 2006a) while the regional economic SNA accounts are reported in a year-to-year series between 1993-2004 (www, Statistics Sweden, 2006). The most reliable years to pick is then the middle years of two non-overlapping five year sliding mean annual values of the resource data series.
[14] See map in Appendix 1 for the regional subdivisions.
[15] See for example Hultkrantz (1992) for an overview.

export sector. Among others, Jämttjärn (1996) shows that the typical Swede also has a more or less intimate relation to the forest, in part since everyone in Sweden has access to forest land through the national land ethic rule[16]. The forest ecosystem services selected in this thesis are the carbon sequestration and forest recreation. As mentioned above the choices are first of all motivated by the fact that valuation data of these services is relatively more available than for that of for example biodiversity maintenance[17].

In the 1980s, some of the non-marketed values provided by a forest ecosystem became a global welfare issue by reason of the severe depletion of rain forests and its foreseen consequences in the form of climate change and biodiversity loss. Since then, the carbon sink capacity of forests has become a question of elevated importance through the establishment of the Kyoto Treaty. Via the photosynthesis, forests absorb carbon dioxide (CO_2), which is the most important green house gas, and store carbon in tree biomass and in the ground (Energimyndigheten 2001). Current terrestrial carbon sinks bind about 25 per cent of the total antropogene CO_2 emissions, and maintaining or increasing this capacity will thus be a crucial matter when assessing future climate change (Boström 2003). Since year 2001, countries are allowed to include parts of the carbon sink of their national forests owing to deliberate management, in order to achieve their CO_2 reduction commitments under the Kyoto Treaty. This far, these distributed sink quotas amount to only a small part of the total forest carbon sink in each country since satisfactory scientific foundations for the proper way to count the sinks still lack, but the issue is rigorously debated. Having the second largest forest land area per capita in Europe, Sweden has a significant potential to use this option for achieving its emissions goal (LUSTRA 2002).

The forest's carbon sink capacity depends on a lot of different factors, such as type of soil, ground water level, tree species and climate (Morén 2003). Most important though, is the forest growth capacity, since *net* carbon uptake for a given area is determined primarily by the change in biomasse (Hultkrantz 1992)[18]. The main factor determining this change is forest cultivation and harvesting. Thus, depending on human management, the sink capacity will be increasing, decreasing or constant over time (Gren 2003).

The value of the forest carbon sequestration can be estimated by considering more expensive cleaning techniques for achieving a given CO_2 abatement target. In Sweden, the Kyoto emission target has been put up under the European Climate Change Programme, which since January 2005 engages a large part of the heavy industrial sectors in emissions trading in order to accomplish the common EU abatement target of an average of minus eight per cent of the 1990 year emissions level over the period 2008 to 2012 (European Commission 2000). Assuming this effort to be the alternative means to reach the national CO_2 abatement goal, the equilibrium trade price of emission permits on the EU market can be used for valuing the sink capacity of Swedish forests by estimating the costs that can be avoided thanks to the carbon sink. The value can thereby be seen as a politically determined marginal value of the carbon absorbtion performed by forests (Hultkrantz 1992).

[16] Called "Allemansrätten" in Swedish.

[17] See Sundberg and Söderqvist (2004) for an overview of the economic valuation studies made in Sweden. The value of the biodiversity maintainance performed by forests in Sweden is by the way in fact partly included in the recreation value as expressed by the questionnaires in the valuation studies used here, where the values of attributes like a rich flora and fauna have been asked about (see Jämttjärn 1996).

[18] The carbon storage in forests changes along the growth cycle of the tree biomasse. In some stages, normally in the beginning and in the end of their life cycles, forests emit more CO_2 than they absorb, through decompostition processes in the forest land soil. Subsequently though, when the soil is satiated, total forest carbon storage rises with the growth of the trees (Hultkrantz 1992, Morén 2003). Even though the forest soil contains almost twice as much carbon as the tree biomasse, the value of the carbon storage in the forest soils will be overlooked in this study, since it is much harder to estimate the exact amount stored in the ground each year (Morén 2003). In reality, the value of the sequestration provided by forest land is therefore a lot higher than what is presented in this study.

During its first two years, the EU equilibrium price has fluctuated between approximately SEK 0.06 and 0.30 per kilo CO_2 (Climate Corporation 2007). According to many studies though, the price is assumed to rise in order to achieve both the EU commitment and the overall global reduction target set up under the Kyoto Treaty[19]. Following Gren (2006a), lower and upper bounds will therefore be calculated for the prices of SEK 0.28 and 0.56 per kilo[20].

The consumption and investment values of the carbon uptake by forests in Sweden's counties are presented in *Table A1* in Appendix 2. As a stock variable the change in biomass has been used, which equals the growth in standing volume minus gross fellings for each respective year. Given the sink capacity of approximately 0.36 million tonnes of carbon per million m^3 biomass, the total CO_2 sequestration per county can be estimated[21]. In effect, these relations are not completely constant from year to year, since external factors like those mentioned above may alter the sequestration capacity. Ultimately, what is needed is knowledge about both the growth function of the stock of biomass and the growth function of the carbon sequestration (Gren 2006b). Since no such data is available, a constant relationship between biomass growth and carbon uptake is assumed in the calculations made here. As mentioned, the main factor determining the change in biomass, and hence CO_2 uptake, is a result of deliberate human actions the preceding year (mainly fellings), and historical trends of the Swedish forest growth do in fact show that the yearly change has been rather constant at around 20-30 million tonnes during the1990s (www, Swedish National Forest Inventory 2006). As explained in the theoretical chapter, the investment value is supposed to reflect the current and future social value rendered by a change in the stock. Thus, the same stock variable, annual change in biomass for each of the two years investigated, have been used for calculating both the consumption and investment values, since biomass change for a given year is assumed to generate the same sink capacity the years to follow. The value of the CO_2 uptake in each county is calculated by multiplying the amount of CO_2 sequestration with the unit values for consumption and the accounting price (the unit value divided by 0.03) for investment.

In all but one of the 21 counties both consumption and investment values are positive for both 1995 and 2000, since fellings were less than the annual increment in biomass[22]. The only exception is Skåne County whose CO_2 abatement capacity decreased in year 2000 due to a negative change in biomass that year. The highest values are found in the northern counties rich of forests, like Norrbotten and Västerbotten, as well as in Värmland and Västra Götaland in the south, and each of these represent around 12-15 per cent of the total value of CO_2 sequestration of 33.6 to 36.4 million tonnes in Sweden. In some counties there is a significant difference between the two years owing to large variations in biomasse growth. Östergötland, for example, has a value well above average in 1995 while in 2000 it has fallen to the second lowest in the country, and both Dalarna and Västra Götaland more than doubled their CO_2

[19] See e.g. Capros and Mantzos (2000) and Östblom (2003).

[20] In Gren's study these are reported in 2001 year prices, SEK 0.30 and 0.60, respectively.

[21] Using county data of biomass change in m^3 standing volume, the CO_2 absorbed has been estimated according to information from Olsson (2006). First, biomass dry weight is calculated to get the amount of carbon stored in the forest biomass measured in tonnes; the dry weight of one m^3 forest biomass equals 0.4 tonne, and of this 50 per cent is carbon. To include the carbon storage in branches and roots the carbon weight is multiplied by a factor 1.8, which results in a carbon conent of 0.36 tonne per m^3 biomass (0.4*0.5*1.8=0.36). With an oxygen/carbon relation of 44/12 in the CO_2 weight, the corresponding amount of CO_2 uptake in the forest biomass of each county can be estimated by multiplication.

[22] The estimates are highly uncertain though since there is relatively little knowledge about the development of forest carbon sinks and the way these should be valued. In the analyses in Chapter 5 the investment values will therefore be excluded.

abatement values between year 2000 and 1995. We will look further into these changes in Chapter 5 when we analyse the question of natural capital management and sustainability.

The other forest output, recreation, is an important source of Swedish social welfare, where some of the main examples are activities like sporting, walking, picking berries and mushrooms, bird watching and hunting. In a survey made by Jämttjärn (1996), it is found that Swedes visit the forest on average once a week for these types of activities, for which the corresponding total WTP is estimated to approximately SEK 19 billion, or SEK 810 per hectare forest. Jämttjärn's study is a summary of several questionnaire studies giving an average recreation value for the whole country based on the total area of forest land and population in Sweden. In order to calculate the recreational values per county, regional value estimates would be preferable given that values are likely to vary according to in what way and how often you make use of the forest for your recreation. For example, living close to the forest can make people value it both higher and lower than people who do not, since proximity might make you appreciate the forest more, or, just take it for granted (Bostedt 1995). Unfortunately, no regional valuation studies have been made in Sweden and therefore upper and lower bounds of the value in Jämttjärn's study are used for calculating the recreational values in all counties.

Using the same value bounds from Jämttjärn's study as in Gren and Svensson (2004), the recreational value is estimated to a range between 0.4 and two times the average total value of SEK 19 billion. This corresponds to a unit price of approximately SEK 324 or 1618[23] per hectare forest land, which are the unit values applied here.

The recreational values of forests are presented in *Table A2* in Appendix 2. Using area of forest as the stock variable, the consumption value is held by multiplying the unit values by the area of forest in each county. The value of the change in recreational service ouput, the investment value, is obtained by multiplying the change in forest area by its accounting price, again given the discount rate of three per cent.

Differences between total values in 1995 and 2000 can be rather big, depending on area changes. The highest total recreational values are again found in the north due to the large share of forest land there, but with the exception of Uppsala, the counties in central Sweden are not far behind. In more than half of the counties the area of forest land decreased for at least one of the two years, implying negative investment values. The trend do not correspond well with CO_2 sequestration figures; a negative change in forest land does not necessarily imply negative change in biomasse growth, since in all but one county biomasse grew for both of the years even though here it is shown that there has been an area decrease in that same year. It is also shown that in many cases high recreational consumption values are crowded out by disinvestments, affecting total production significantly. In Kalmar County for example, a large decrease in forest land in year 2000 causes total value to fall well below zero although that county is endowed with relatively high consumption values.

In *Figure 1* total consumption and investment values for the two services CO_2 sequestration and recreation provided by the forest are presented in terms of per capita. When adding the investment values the value of investment in CO_2 sequestration is predominant since it can be more than 20 times higher than recreational investment values in absolute terms. All negative recreational investment values are offset by the high investments in CO_2 sequestration creating positive total investment in forest outputs (except for in Skåne, where the negative effect of the decrease in biomasse growth crowds out both consumption and positive investment in recreation). For consumption it is the opposite; recreational consumption values are between four and five times higher than those for the CO_2 sequestration. The picture revealing high values in the northern counties compared to in the rest of the country is

[23] In 1996-year prices SEK 318 and 1590, respectively, which equals 0.4 and two times the value per hectare of SEK 795 reported in Jämttjärn.

reinforced, both for consumption and investment, although some counties in central Sweden and in the south get relatively high values too. Sorted by highest possible aggregated value (i.e. consumption plus investment for both services together, calculated for the higher prices; not shown in the figure) from the left to the right, it can be seen that the three highest values per capita are held in the sparsely populated forest-rich counties of Norrbotten, Västerbotten and Jämtland, being almost twice as high as that of the subsequent (Värmland), and between three and eight times higher than those for the rest of the counties. Västra Götaland, having the third highest total values in 2000, gets one of the lowest per capita values that year due to its large population.

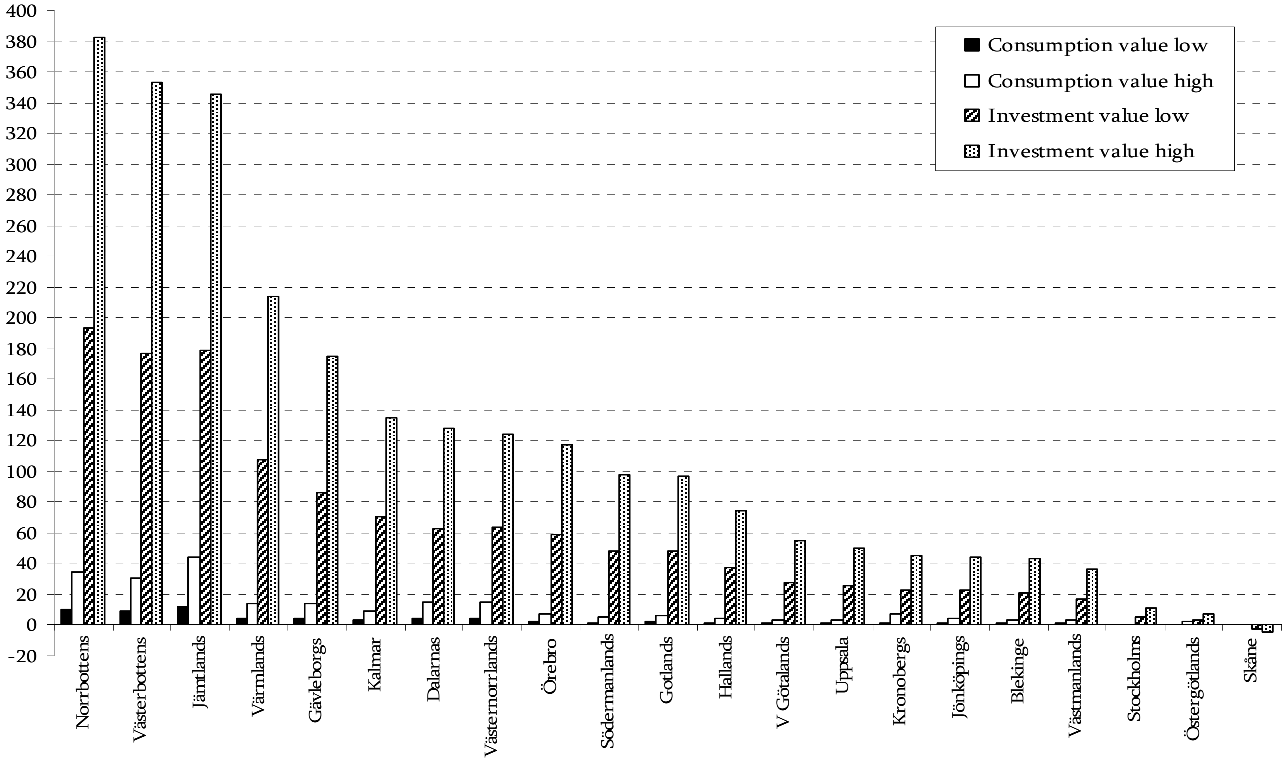


Figure1. *Non-marketed consumption and investment values of forests for different regions year 2000. In 2000-year prices and thousands of SEK per capita. Sources: Table A1 and A2 in Appendix 2 and Table A7 in Appendix 4.*

Strikingly, the county of Stockholm, which in conventional monetary accounts is ranked as the wealthiest in the country, is relatively poor when it comes to providing forest outputs like climate maintaining services and forest recreation.

4.2 Wetlands

Wetlands serve a usefull purpose for society in many different respects. Besides sustaining important hydrological functions like buffering of ground water and regulation of water cycles, wetlands can prevent flooding and reduce the effects of drought, as well as function as cleaning plants by absorbing chemicals and pollutives. Since wetlands host a diversified biological life and are vital environments for many rare species, they also attract people for recreational activities. Moreover, peat land and wetland sediments serve as historical archives by storing both cultural and biological information, making it possible to track everything from civilizational spread to climatological change (Swedish Environmental Protection Agency 2006).

Sweden is one of the most wetland-rich countries in the world with its 10 million hectares amounting to almost one quarter of the total country area (ibid). But the size of the wetlands varies a lot within the country and area estimates depend on what wetland definition is used. Given the definition by the Swedish Environmental Protection Agency (2003, pp. 12) which says that "a wetland is such land where water is, during a large portion of the year, just below, in line with, or just above the ground", wetland ecosystems can be divided into four main categories; mires, shores, miscellaneous and wetland forests. Of these, mires are the most common in Sweden and amount to approximately 50 per cent of the total wetland area (Svensson 2004). In the Swedish wetland inventory, performed county-wise by the Swedish Environmental Protection Agency between the 1980s and 2005, mires are also the best charted and both at the national and the county level mire is the only wetland type existing in time series data. This puts a limit to the subsequent calculations, which therefore concern values of open mire areas and mire areas with scattered trees, excluding for example the other big category, wetland forests, which in total might account for as much as 4 million hectares (Swedish Environmental Protection Agency 2006).

The far largest share of Sweden's wetland area is situated in the north – Norrbotten contains for example about one third of all the wetland area in the country (ibid). Until the end of the 1980s, the areas were steadily decreasing, especially in the south and in the counties of Stockholm and Uppsala, where almost 90 per cent of the original wetland area has vanished. This is mainly due to drainage in order to get hold of more arable land, for which governmental subsidies were paid out already 100 years ago. In the end of the 1980s, wetlands got legal protection and instead, wetland re-establishments at agricultural land in the southern part of Sweden became supported financially (Svensson 2004).

The wetland ecosystem services selected in this thesis are the nitrogen sequestration and recreational values. Again, the choice is made with respect to that valuation data of these services is relatively more available. Of the in total six valuation studies that have been made for wetlands in Sweden, four concentrate on wetlands' possibility to reduce waterborne anthropogenic emissions of nitrogen[24].

One of the national interim environmental targets concerns the question of reduced nitrogen emissions into the Baltic Sea, which is the main cause for eutrophication in lakes and coastal waters (Swedish Environmental Protection Agency 2004). For this purpose, services provided by wetlands have become of immediate economic interest thanks to their retention and denitrification capacity. In the valuation studies just mentioned, the value of a wetland with respect to nitrogen reduction is estimated by looking at alternative nitrogen abatement measures like cleaning plants or reduced use of fertilizers. The values are highly dependent on location, since both nitrogen emissions and eutrophication problems vary in areas where wetlands are placed (Gren 2006b). The nitrogen abatement capacity of a wetland has also been shown to correlate positively with nitrogen loads up to a certain level, why the surrounding areas are even more important to take into account when evaluating the cost savings made due to the presence of a wetland (Byström 1997). Compared to in the north, the abatement value per hectare can for example be expected to be a lot higher in the south of Sweden where eutrophication due to runoff from the more abundant agriculture is a much bigger problem (Gren and Svensson 2004).

[24] See Sundberg and Söderqvist (2004) or Svensson (2004) for an overview.

Following Gren and Svensson (2004), who uses values from the four surveys mentioned above, a lower and upper abatement value of SEK 488 and 73 212[25] per hectare and year is assumed, where the lower value corresponds to an abatement capacity of 100 kilo nitrogen per hectare, the higher to 500 kilo. Information about the exact abatement capacity of each specific wetland in Sweden does not exist and for that reason the values have to be applied with respect to how close to nitrogen leakage and coastal eutrophication problems the wetlands are located. The higher value does therefore most likely concern only the wetland areas in Götaland, since both nitrogen loads and eutrophication in the northern parts of the Baltic Sea are negligible[26]. It can even be argued that the wetlands in the north and central regions of the country have no nitrogen abatement value at all, like in for example Gren and Svensson (2004), since most of the wetland areas in the north are completely isolated from agricultural land and heavy nitrogen runoffs. On the other hand, the value of the nitrogen abatement provided by wetlands in the north can, presumably, be expected to increase along with increased fertilization of the northern forests[27]. In this thesis it is therefore assumed that at least the lower abatement value is applicable to the wetlands in Norrland and Svealand.

In *Table A3* in Appendix 2 the consumption and investment values of wetlands in Swedish counties are presented. The consumption values are held by muliplying the wetland areas with the unit values of nitrogen abatement, while the investment values are held by looking at the change in wetland area and the respective accounting prices (unit values divided by 0.03). The spread in consumption and investment values is large and depend heavily on which marginal value is assumed. In case of the lower value, the counties in Norrland get significantly higher values than in the southern parts due their large wetland areas. But if instead the higher abatement value can be applied to the wetlands in Götaland, the values there exeed any high value in the north by up to a factor 10, whereas at the same time creating considerable losses in those same regions in case of even a small disinvestment (like in for example Östergötland and Västra Götaland in 2000). In the data used here, no clear pattern of area increases in the south and area decreases in the north is discernable, like in for example Gren and Svensson's study, and if so only in year 1995 when the largest net negative change in Sweden occurred in Norrland[28]. In 2000, most negative investments occurred in central Sweden.

The total value of nitrogen abatement per county thus varies between very high values in the south when investments are positive (Kronoberg year 1995 or Jönköping in 1995 and 2000, if the higher value is assumed), and very low values if disinvestments have occurred (also in the south).

The other two of the six valuation studies referred to above estimate the recreational values of wetlands using contingent valuation studies. Among the things investigated are people's willingness to pay for the maintained biodiversity upheld by wetlands, improved fishing possibilities and walking facilities. The studies are based on case study surveys examining people's valuation of construction of new wetlands. Both are made in the south of Sweden.

---

[25] In their study these are reported in 2001-year prices, SEK 500 and 75 000, respectively.

[26] See Swedish Environmental Objectives Council (www, Miljömålsrådet 2007). The nitrogen emitted into Bottenviken and Bottenhavet is mainly transported with sea-currents to the southern parts of the Baltic Sea, decreasing the negative effects in the north while increasing them in the south (Gren 2006b).

[27] According to Johansson (2003), intensive fertilization within forestry will play a key role in the work against climat change; increased nitrogen fertilizer use, as a means to increase the carbon sink capacity of the forest, could more than triple the volume of forest biomasse in the north part of Sweden (see also Olsson et al. 2005).

[28] These changes in wetland area are uncertain since the data is based on random samples (www, Swedish National Board of Forestry 2006b). Looking at different sources of wetland areas in Sweden reveals highly ambiguous results due to lack of year-to-year data and differences in wetland definition (see e.g. Swedish Environmetal Protection Agency 2006 for an overview). The large area changes reported in for example Dalarna in year 2000 is most likely unreliable, since area changes the years before and after are negligible in that county according to the same source, just like the wetland areas in Norrbotten and Västerbotten vary heavily from year to year without clear trend.

The appropriateness of using their estimates in other regions, where the access to wetlands and other forms of recreation areas might differ, can of course be discussed. Again, lack of suitable data leaves us with few options. The use of upper and lower bound values can at least partly attend to this problem.

In summing up the results of the two studies, Gren and Svensson (2004) conclude the marginal recreational values to range between SEK 2 440 and 15 688 per hectare and year[29]. When calculating the consumption and investment values of wetland recreation the same stock variables are used as for the nitrogen sequestration. *Table A4* in Appendix 2 show the results when the values are applied to the county data of 1995 and 2000. Values are highest in the north where wetlands are abundant, and although large area decreases occurred in almost the entire Norrland in 1995 this do not affect the total values so as to change their high ranks within Sweden. Like with the nitrogen abatement values there are significant differences between the two years in many regions depending on investments and disinvestments[30].

Figure 2 shows the total consumption and investment values per capita of wetlands in year 2000 sorted by highest possible aggregated value from the left to the right.

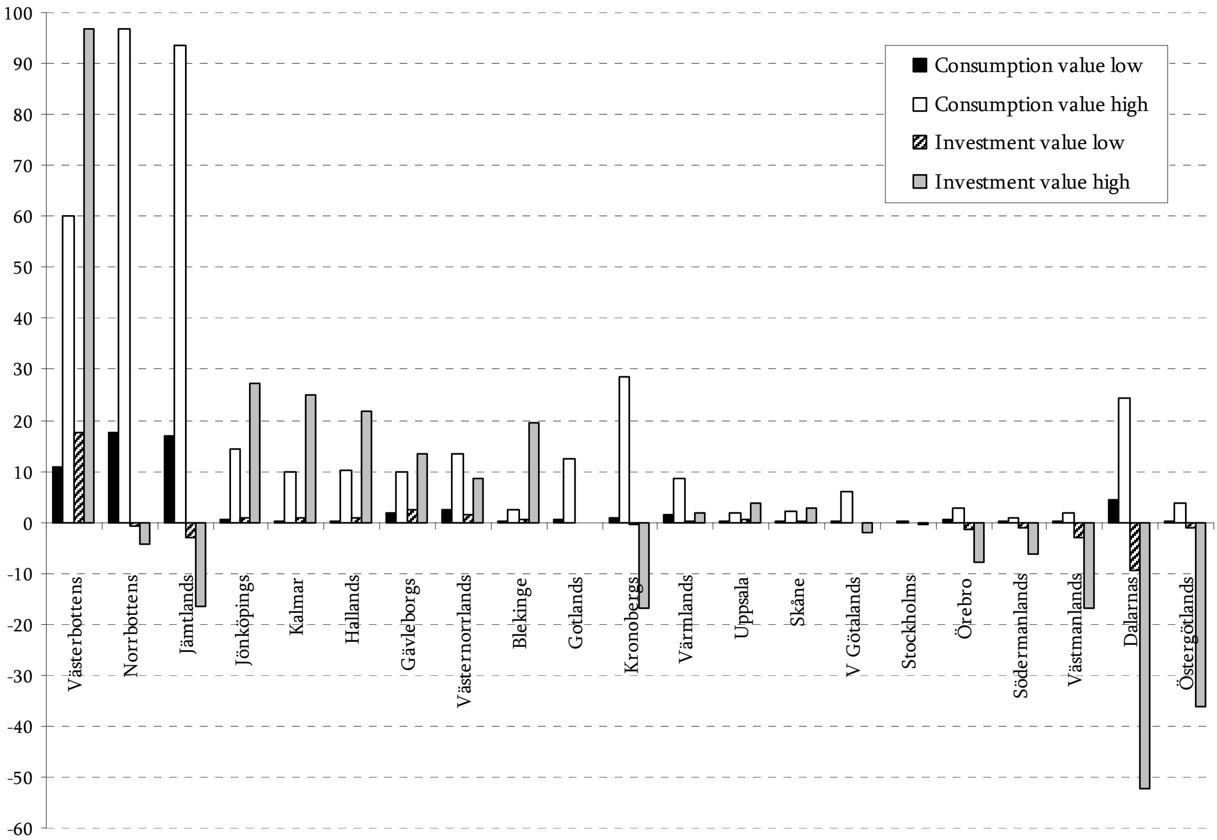


Figure2. *Non-marketed consumption and investment values of wetlands for different regions year 2000. In 2000-year prices and thousands of SEK per capita. Sources: Table A3 and A4 in Appendix 2 and Table A7 in Appendix 4.*

[29] In their study, SEK 2 500 and 16 051 in 2001 year prices, respectively.

[30] Like with the nitrogen abatement values what needs to be remembered is that the changes in wetland area are highly uncertain. The large decreases in e.g. Norrbotten and Dalarna, in year 1995 and 2000 respectively, and the even larger increase in Västerbotten in year 2000 are thus to be treated with caution.

Although nitrogen abatement values can be noticeably high in the south, the high recreational values dominate total values so as to make northern counties completely superior. This goes mainly for consumption, and for both high and low marginal values; the by far highest values per capita are again found in the wetland-rich counties in Norrland exceeding the maximum values in the south by a factor of almost 20 (comparing e.g. low investment values of Västerbotten, SEK 17 500 and Jönköpings län SEK 890). The lowest total investment values are all held in central Sweden, where the disinvestments in both nitrogen abatement and wetland recreation cause total values to fall significantly below zero.

4.3 Agricultural landscape

Apart from food production, the agricultural landscape provides society with a variety of valuable byproducts. In Sweden, agricultural land use like grazing and wooded pasture have a tradition running back to long before the Viking era and are among the richest in species in the country. The agricultural landscape thus creates a number of important services, such as maintenance of an open landscape, cultural heritage and biodiversity (Drake 1992). This study uses value estimates reflecting a merge of such different recreational services.

Three studies of the recreational values of agricultural landscape have been made in Sweden (Drake et al. 1991, Drake 1992 and Hasund 1997), but only Drake (1992) has made region specific estimations, dividing the country into a northern, central and southern part. According to that study, people in the northern regions with relatively less agricultural landscape has a higher WTP for its maintenance than people in the south, where agriculture is more abundant. Using his results, the different values per hectare of SEK 2 093 (Nourth and South Norrland), SEK 1 812 (Svealand) and SEK 1 143 (Götaland), are applied in the calculations with respect to its location within Sweden[31]. Although these estimates are considered reliable, Drake concludes they are likely to be over- and underestimated by up to 50 per cent, and values are therefore calculated for these upper and lower bounds of unit and accounting values.

In *Table A5* in Appendix 2 the recreational consumption and investment values of agricultural landscape in 1995 and 2000 are presented. The consumption values are estimated using area of agricultural landscape – the sum of arable land and grazing land – as the stock variable, which in turn is multiplied by the unit values. For the investment values the accounting prices are multiplied by the change in area of agricultural landscape. In all but two counties (Jämtland and Västmanland) the area decreased for at least one of the two years, implying negative investment values. North Norrland holds negative investment values both years, just like Västra Götaland. The site specific marginal values evens out some of the regional differences in total recreational values, but the highest total values are still found in the counties in central and southern Sweden rich in agricultural land.

Figure 3 shows the same values per capita for consumption and investment in all counties in year 2000, again sorted by highest possible aggregated value from the left to the right. Note how the northern counties have changed position, now having some of the lowest values in the country due to a combination of high marginal valuation and negative change in agricultural landscape.

[31] Reported in 1986-year prices in Drake's study, the original average values per hectare are SEK 1 287 (north), 1 114 (central) and 703 (south).

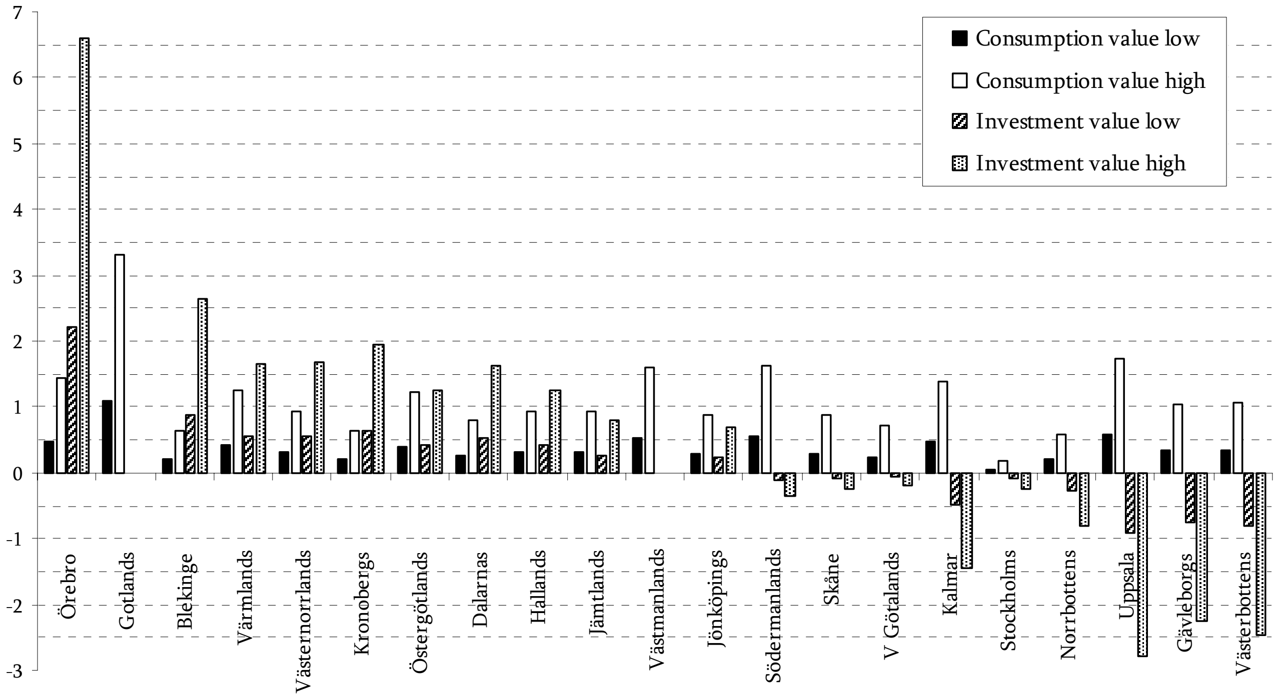


Figure 3. *Non-marketed consumption and investment values of agricultural landscape for different regions year 2000. In 2000 year prices and thousands of SEK per capita. Sources: Table A5 in Appendix 2 and table A7 in Appendix 4.*

Although their consumption values are not low in relative terms, the position of for example Västerbotten and Gävleborg in the north and Uppsala and Kalmar in central and south Sweden are inferred by their high negative investment values. Thanks to a large increase in agricultural land, Örebro län gets an investment value which is significantly higher than those in the rest of the country, both for the upper and lower marginal value. The population effect is particularly obvious when looking at the consumption values of Västra Götaland and Skåne; having the highest total consumption values in Sweden, they fall nonetheless behind due to their large populations. The highest consumption value for agricultural landscape recreation per capita is found at the island of Gotland, being no less than twice as high as anywhere else.

5. Regional growth and sustainable development

In this section the total non-marketed values of natural capital of each county are added to figures from conventional regional monetary accounts. The results allow for interregional comparisons of growth in GDPR and EDPR. The last sub-section analyses whether or not the natural resources have been sustainably used between the years 1995 and 2000. In order to facilitate the analysis, the values of investment in CO_2 sequestration are excluded in the calculations to follow since they were shown to exceed most other values by several hundred per cent[32].

5.1 Interregional comparisons

In *Table 1* the total consumption and investment values of natural capital outputs for each county in year 2000 are presented together with the conventional and adjusted GDPRs for the same year (see Table A7 in Appendix 3 for year 1995). Here, the counties are sorted by their location in Sweden from north to south. The adjusted GDPRs, that is, the EDPRs, are held by adding the total value per county of all three services calculated in the previous chapter to the conventional GDPRs of 1995 and 2000. The correct way to do this requires information on

Table 1. GDPR and EDPR of different regions in year 2000, in 2000-year prices.

County/Region	GDPR *Million SEK* (1)	GDPR per capita *1 000 SEK* (1)	Total value of natural capital *Million SEK*		EDPR *Million SEK*		EDPR per capita *1 000 SEK*		Natural capital share of/ increase in GDPR *Million SEK*	
			Low	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Norrbotten	57 139	222	56 586	130 777	113 725	187 916	443	731	0.99	2.29
Västerbotten	51 690	202	54 901	138 262	106 591	189 952	416	742	1.06	2.67
Jämtland	26 042	200	26 700	60 856	52 742	86 898	406	668	1.03	2.34
Västernorrland	58 856	237	18 015	40 549	76 871	99 405	310	401	0.31	0.69
Gävleborg	60 553	216	26 453	58 952	87 006	119 505	311	427	0.44	0.97
Dalarna	59 553	213	17 553	32 891	77 106	92 444	276	331	0.29	0.55
Värmland	55 785	202	31 764	66 679	87 549	122 464	317	444	0.57	1.20
Örebro	58 090	212	17 186	35 007	75 276	93 097	275	340	0.30	0.60
Västmanland	58 607	228	4 167	6 712	62 774	65 319	244	254	0.07	0.11
Uppsala	62 700	214	8 054	17 043	70 754	79 743	241	272	0.13	0.27
Stockholm	634 052	350	10 417	21 401	644 469	655 453	355	362	0.02	0.03
Södermanland	50 156	196	12 626	25 332	62 782	75 488	245	295	0.25	0.51
Östergötland	87 874	214	1 535	-8 101	89 409	79 773	218	194	0.02	-0.09
V Götaland	367 003	246	43 841	94 100	410 844	461 103	275	309	0.12	0.26
Jönköping	77 089	235	8 470	30 398	85 559	107 487	261	328	0.11	0.39
Kronoberg	41 629	235	4 650	11 845	46 279	53 474	261	302	0.11	0.28
Kalmar	51 241	217	17 647	42 315	68 888	93 556	292	396	0.34	0.83
Gotland	11 195	195	2 953	6 793	14 148	17 988	248	316	0.26	0.61
Halland	53 816	196	11 127	30 855	64 943	84 671	237	309	0.21	0.57
Blekinge	34 937	232	3 649	10 852	38 586	45 789	256	303	0.10	0.31
Skåne	258 866	230	-2 109	1 411	256 757	260 277	228	231	-0.01	0.01
N Norrland	108 829	212	111 487	269 039	220 316	377 868	429	737	1.02	2.47
S Norrland	145 451	221	71 350	161 179	216 801	306 630	329	466	0.49	1.11
Svealand	978 943	284	101 946	206 121	1 080 889	1 185 064	313	344	0.10	0.21
Götaland	983 650	231	91 924	226 461	1 075 574	1 210 111	253	285	0.09	0.23
Sweden TOTAL	*2 217 290*	*250*	*376 506*	*861 728*	*2 593 796*	*3 079 018*	*292*	*347*	*0.17*	*0.39*

(1) www, Statistics Sweden, 2006a.
Sources: Table A1-A5 in Appendix 2, excluding investment values of $C0_2$ sequestration, and Table A7 in Appendix 4.

[32] As mentioned earlier, estimating investment values of CO_2 sequestration is ambiguous due to lack of information about the development of forest carbon sinks.

the depreciation of man-made capital, which is to be withdrawn from the gross products. Unfortunately, the regional economic accounts at hand do not report on capital depreciation and net regional products as is done in the accounts for the entire Swedish economy. Therefore, the adjustments here will have to dismiss from this component and apply the adjustments to regional gross measures[33].

The pattern is clear; the net contribution of natural capital to regional welfare is positive. For the most part, adjustments for natural capital values increase conventional GDPRs of all Swedish counties considerably both year in year 1995 and 2000. In year 2000 the increases are consequently at between 10 and 230 per cent, depending on the marginal valuation of natural capital. Stockholm, the wealthiest county measured in conventional terms, is the only county whose EDPR do not exceed its conventional GDRP by more than 2 or 6 per cent. The only cases in which the EDPR is lower than GDPR are Östergötland – minus nine per cent if the higher value is assumed – and Skåne – minus one per cent if the lower value is assumed. The decrease in Östergötland is due to the decline in wetland area that year, which for the high marginal valuation implies a significant loss. The wealth decrease in Skåne is a cause of the negative change in forest biomass and CO_2 sequestration. Perhaps most remarkable is that the EDPRs of the three northernmost counties are more than two or three times higher than their GDPR values, just like Gävleborg and Värmland are twice as wealthy as according to conventional measures. Also, in contrast to conventional estimates, these counties are wealthier than the Swedish average with EDPRs per capita up to two times higher the average EDPR per capita value of Sweden. In the south Kalmar County is between 34 or 83 per cent above its traditional GDPR figure.

There are some differences between the two years 1995 and 2000 to be remarked. Firstly, in some cases the counties get very high values one year but lower the other. Östergörland is one example, since in 2000 its adjusted GDPR decreased while being as much as 50 per cent higher than conventionally in 1995[34]. Secondly, although total values of natural capital seem to have increased on average during the period, there is no clear pattern revealing increases in natural capital shares of the aggregate production values. What can be distinguished is that adding the values of natural capital increases total wealth more in the north in year 2000 than in 1995, just like the opposite is true for most counties in central and south Sweden. This means that compared to other forms of welfare determinants, like conventional consumption and investment, non-marketed outputs from natural capital increased their share of total regional wealth in the north during the period while in the south their relative importance decreased. This has partly to do with the change in other wealth components, which grew more or less relative to the natural capital stocks considered here. In the next section, gowth in the two ways of measuring regional wealth is analysed.

5.2 Conventional and adjusted growth

Table 2 below shows growth in EDPR and GDPR between the years 1995 and 2000. Growth is here measured as the change in the two measurements respectively, where EDPR growth equals growth in conventional GDPR corrected for the consumption and investment values presented in chapter 4.

[33] The rate of depreciation of physical capital at the national level was for the years 1995 and 2000 around 14 per cent of total GDP (www, Statistics Sweden 2006b), but since industrial sectors are very unevenly distributed in the different regions and depreciation rates can vary heavily among industries, applying the national rate to each county would be incorrect.

[34] Again, what needs to be remembered here though is that data of the changes in natural capital is not very reliable, why the results need to be treated with caution.

Table 2. Growth in GDRP and EDPR 1995-2000, in 2000-year prices.

County/Region	Growth in GDPR *Million SEK*	Growth in GDPR *Per cent*	Growth in EDPR *Million SEK*		Growth in EDPR *Per cent*	
			Low	*High*	*Low*	*High*
Norrbotten	2 150	4	6 316	15 668	6	9
Västerbotten	2 150	4	19 993	59 358	23	45
Jämtland	-132	-1	3 826	9 017	8	12
Västernorrland	3 813	7	7 446	10 275	11	12
Gävleborg	2 876	5	3 016	9 096	*4*	8
Dalarna	3 384	6	10 810	-27 969	16	*-23*
Värmland	3 694	7	4 000	6 712	*5*	*6*
Örebro	5 964	11	14 766	16 573	24	22
Västmanland	7 668	15	6 739	-8 634	*12*	*-12*
Uppsala	12 691	25	15 328	-3 179	28	*-4*
Stockholm	171 095	37	170 384	163 041	*36*	*33*
Södermanland	5 840	13	9 874	12 364	19	20
Östergötland	10 362	13	-7 655	-38 948	*-8*	*-33*
V Götaland	74 197	25	95 288	134 878	30	41
Jönköping	13 590	21	7 941	1 822	*10*	*2*
Kronoberg	5 670	16	3 010	-13 167	*7*	*-20*
Kalmar	5 986	13	8 260	16 615	14	22
Gotland	780	7	1 993	3 523	16	24
Halland	323	1	1 324	10 936	2	15
Blekinge	7 034	25	7 378	10 844	*24*	31
Skåne	48 742	23	30 055	14 757	*13*	*6*
N Norrland	4 299	4	26 405	75 562	14	25
S Norrland	6 557	5	14 525	29 377	7	11
Svealand	210 336	27	232 244	165 885	27	16
Götaland	166 684	20	147 881	150 249	*16*	*14*
Sweden	388 002	21	420 900	419 652	*19*	*16*

Sources: Table 1 and Table A6 in Appendix 4.

For most counties, growth is higher than growth in conventional GDPR when adjusting for the consumption and investment values of natural capital. The largest net increase, comparing growth in EDPR and GDPR, is as high as 41 per cent (Västerbotten, which if the higher values of the ecosystem services are applied get an EDPR growth of 45 per cent instead of only 4 in GDPR). In seven of the 21 counties though, growth in EDPR is consequently lower than growth in GDPR, and in some cases there is even a net decrease in total production once the environmental adjustment is made, especially for higher values of natural capital. Östergötland for example gets an EDPR growth value that is as much as 46 per cent lower than its 13 per cent GDPR growth in such a case, which implies negative growth and a decumulation of the capital base between 1995 and 2000, and the county of Stockholm, which has the far highest conventional growth figure at 37 per cent, gets its growth figure adjusted downwards by between one and four per cent depending on how high the marginal valuation of natural capital is. Skåne, another high growth region according to its growth in GDPR gets a significantly lower EDPR growth that places it as one of the least successive counties in Sweden. This is either due to large disinvestments in natural capital, or disinvestments large enough, crowding out growth in other forms of capital.

The growth figure for Sweden in total does in fact show that growth in EDPR on average is between two and five per cent lower than conventional growth. According to the average figures of each subregion, it seems that adjusted growth is higher in Norrland than in Svealand and Götaland, but this pattern is less distinct when studying the values of the respective counties; on the whole both large increases and decreases occur all over Sweden when growth is corrected for the change in non-marketed natural capital values. Jämtland, the only county that according to growth in conventional GDPR decreased their income per capita between 1995 and 2000, is actually shown to have grown with between eight and 12 per cent in EDPR.

Thus, when comparing growth in EDPRs and conventional GDPRs it is shown that the two measurements of provide significantly different pictures of regional growth and productivity; regions that are traditionally considered as relatively less growth promoting, like the counties in Norrland and Halland and Gotland in the south, are shown to hold important sources of wealth, while on the other hand counties that are rich in conventional terms fall behind when adjusting for values of natural capital. Moreover, it is shown that growth in EDPR and GDPR can change in different directions.

The changes in growth figures are not unambiguously to be explained by the natural capital investment values of the two years in question. As shown in the next section, total net investment in natural capital can decrease during a period without affecting the development of total production negatively. The reason is to be found in the development of the asset stocks in the intermediate years, when the total capital stocks might have increased enough to form a base for higher consumption values. Sooner or later though, disinvestment in the natural capital base causes total wealth to fall, indicating that a region is on an unsustainable path. This is why it is relevant to look at the development of investment in natural capital between 1995 and 2000.

5.3 Regional sustainable use of natural capital?

As was seen in section 5.1, relative natural capital abundance adds significantly to regional wealth. Whether these assets are being sustainably used is another question. By studying the net change in natural capital between 1995 and 2000 we can get an indication of whether the counties have been on a sustainable development path or not during the period. Since no data of total net investment in man-made capital is available at the regional level, other forms of capital are excluded from the analysis, which instead focuses entirely on the management of natural capital.

In *Table 3* below the regional changes in total investment in each asset are presented together with the figures for total investment in natural capital between the years 1995 and 2000. To be able to elucidate interregional differences the table also shows a mean investment value. The sustainability criterion derived in equation (4) in Chapter 2 showed that non-negative change in the total natural capital stock is needed in order not to adventure the production possibilities of the capital base. A reduction in the stock of one of the natural capital assets is thus allowed for as long as this is compensated by an increase in one or several of the other natural capital assets[35]. Since only a fraction of the values provided by the natural capital base is included in this study, the results presented below are only partial estimates of sustainable change.

[35] In the literature this is often referred to as strong sustainability, as opposed to weak. A weak sustainability allow for substitution among different forms of reproducible capital (human-made and natural) as long as the total capital stock is non-declining, while strong sustainability requires change in the total natural capital stock not to be negative, unenabling natural capital to be substituted for any other form of capital (Perman et al. 2003).

Table 3. Investment in natural capital in different regions 1995-2000, million SEK in 2000-year prices.

County/Region	Forest (1)		Agricultural landscape		Wetland		Total	
	Low	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Norrbotten	334	1 672	-105	-314	14 250	78 723	14 479	80 081
Västerbotten	1 230	6 148	419	1 256	4 490	24 803	6 138	32 207
Jämtland	1 424	7 119	-384	-1 151	-4 782	-26 421	*-3 742*	*-20 453*
Västernorrland	-108	-539	349	1 047	1 659	9 166	1 900	9 674
Gävleborg	-431	-2 157	-244	-733	2 538	14 019	1 862	11 129
Dalarna	-140	-701	0	0	195	1 078	55	377
Värmland	162	809	-211	-634	-2 050	-11 323	*-2 099*	*-11 148*
Örebro	-270	-1 348	845	2 536	-293	-1 618	283	*-430*
Västmanland	-97	-485	755	2 265	-2 147	-11 862	*-1 489*	*-10 083*
Uppsala	-129	-647	-634	-1 902	781	4 314	17	1 764
Stockholm	-453	-2 265	332	996	195	1 078	74	*-190*
Södermanland	86	431	-181	-544	-488	-2 696	*-583*	*-2 808*
Östergötland	-227	-1 133	553	1 658	-293	-8 890	33	*-8 365*
V Götaland	76	378	324	972	1 074	32 597	1 473	33 946
Jönköping	-65	-324	476	1 429	-293	-8 890	119	*-7 784*
Kronoberg	140	701	-419	-1 258	390	11 853	111	11 297
Kalmar	345	1 726	-572	-1 715	98	2 963	*-129*	2 974
Gotland	-54	-270	76	229	98	2 963	120	2 922
Halland	108	539	133	400	195	5 927	436	6 866
Blekinge	-76	-378	114	343	98	2 963	136	2 929
Skåne	-453	-2 265	191	572	781	23 707	518	22 013
Mean	*67*	*334*	*87*	*260*	*785*	*6 879*	*939*	*7 472*
N Norrland	1 564	7 820	314	942	18 739	103 526	20 617	112 289
S Norrland	874	4 369	-244	-733	-586	-3 235	44	401
Svealand	-852	-4 261	876	2 627	-3 611	-19 950	*-3 588*	*-21 584*
Götaland	-194	-971	877	2 630	2 342	71 120	3 025	72 779
Sweden	1 381	6 903	1 822	5 466	16 803	150 938	20 006	163 307

(1) Excluding investment in CO_2 sequestration.

Sources: Table A1-A5 in Appendix 2.

For most of the counties, the use of natural capital assets was sustainable during the period, although when studying net changes in the assets separately it is shown that only three counties, Halland, Västra Götaland and Västerbotten, experienced net increases in all three assets. In Götaland the counties of Östergötland, Jönköping and Kalmar show a net decline for either the high or the low marginal value. The declines in Östergötland and Jönköping are mainly attributable to negative changes in wetland area, which for the higher marginal value implies a significant loss in nitrogen abatement, while in Kalmar the higher marginal value makes its increase in wetland area offset a relatively important loss in agricultural land. In Svealand, which in total appears to be the least sustainably managed region, five out of seven counties show negative investment values for the higher marginal value. Again these declines are mainly due to disinvestment in wetland services, except for in Örebro and Stockholm County where disinvestment in forest recreation are shown to be the causes of net declines too. In the north all counties except for Jämtland were on a sustainable path during the studied years. There, a decline in one of the three assets is always compensated by an increase in one or two of the other assets. Jämtland appears to have the largest net decline in entire Sweden due to a significant loss in wetland area.

The largest accumulation of natural capital occurred in Norrbotten, whose investment in wetland services and forest recreation result in a total net investment value being 10 to15 times as high as the mean value for Swedish counties. Investment in north Norrland, that is, the sum of investment in Norrbotten and Västerbotten, are in fact as high as the total net value of natural capital investment in the whole country if the lower value is assumed, and approximately 70 per cent of total investment if the higher value is assumed. The highest investment values in the south are held for the higher marginal values in Västra Götaland and Skåne, when their investments are between 3 and 4.5 times higher than the average value, and almost all of this is attributable to investment in wetland services.

Thus, for the most part, regional development seems to have been on a sustainable path between the years 1995 and 2000, although we do not know anything about the year in between these two years. What needs to be remembered is that the analysis is partial and concerns only some of the non-marketed values traditionally excluded from monetary accounts. Inclusion of other forms of natural capital outputs (e.g. the investment in carbon sequestration) might therefore change the net figures so as to either compensate for or crowd out the declines or increases in the assets investigated here.

The results in sections 5.1-5.3 does not correspond entirely with those held in similar studies made in Sweden, like Gren and Svensson (2004) and Gren (2006a). Unlike what is shown by the aggregated Swedish investment figure in table 3, they find that the Swedish economy decumulated its natural capital base between the years 1995 and 2000. Just like in this study though, they demonstrate that the net welfare contribution from natural capital is positive and that adjusted and non-adjusted growth can move in different directions.

6. Summary and conclusions

The purpose of this thesis was to measure environmentally adjusted regional growth and present EDPR figures in order to compare this with the conventional growth measurement. Specifically, the aim was to introduce non-marketed values of natural capital into Swedish regional monetary accounts following modern theoretical guidelines for green accounting, where natural capital is valued by its current and future streams of ecosystem outputs, here in the form of recreational values and pollution sequestration. For each of the three assets forests, agricultural landscape and wetlands consumption and investment values were calculated using secondary natural resource and valuation data. Assets and outputs were chosen mainly with respect to that non-marketed values of natural capital are of limited availability, especially at the regional level, and in order to overcome some of the uncertainties regarding this upper and lower bounds of the marginal values were always applied. The derived estimates were used to calculate regional gross products partially adjusted for the non-marketed ecosystem services in each of Sweden's 21 counties for the years 1995 and 2000. In doing this it was possible to compare growth in EDPR with conventional GDPR growth figures. In addition, estimates of net investment in natural capital allowed for an assessment of sustainability in the different regions.

The empirical demonstration shows that in most counties the net welfare contribution from the assets in question is positive. The highest per capita values provided by forest land and wetlands were consequently found in the counties in Norrland, especially in Norrbotten and Västerbotten. This was thanks to a combination of large holdings in these assets and a small population, since the relatively high total values in some of the counties in Svealand and

Götaland were shown to be less important when dividing the values among the inhabitants of each county. In the same way, wetland values were lowest in densely populated Svealand as a consequence of decreases in already sparse wetland areas. The fact that nitrogen abatement can be higher valued in the south had some influence on the total wetland values there, although they never got close to the values per capita found in northern Norrland. For the recreational values of agricultural landscapes though, the highest values were found in Götaland and Svealand. Even a small decrease in agricultural land in the north caused total values to fall below zero due to a higher marginal valuation of agricultural landscape there compared to in the south.

When comparing the EDPRs and conventional GDPRs it was shown that the two measurements of growth provide significantly different pictures of regional wealth and productivity. Regions that are traditionally considered as relatively less growth promoting, like for example the counties in the north, were shown to hold important sources of wealth with EDPRs per capita that were more than twice as high as their GDPR figures and up to two times higher than the average EDPR per capita, while on the other hand counties that are rich in conventional terms, like Stockholm, Västra Götaland and Skåne, fall behind when adjusting per capita values for the value of natural capital. Moreover, it was shown that growth in EDPR and GDPR can change in different directions. For most counties, EDPR growth was higher than growth in conventional GDPR, sometimes with as much as 20-40 per cent, but in seven of the 21 counties growth in EDPR showed a net decrease in total production, especially for higher values of natural capital. The declines in growth could in part be explained by disinvestments in natural capital between 1995 and 2000. Although the net welfare contribution from natural capital was shown to be positive in most regions, in several counties the use of the assets was unsustainable; especially Svealand seemed to have decumulated many of its resources. These results are in accordance with what similar green accounting studies made by Gren and Svensson (2004) and Gren (2006a) have found.

Chapter 5 showed that negative changes in one asset often imply increase in another. Although the sustainability criterion allowed for such substitution it is possible to talk of conflicting values at stake. Furthermore, in section 4.1 it was shown that a negative change in forest land does not necessarily imply negative change in biomasse growth, since in all but one county biomasse grew for both of the years although the forest area decreased in most of the counties during at least one of the two years investigated. In this respect, one might ask oneself whether decreases in existing forest land that at the same time provide an increase in biomass and CO_2 sequestration can be assumed to provide the same characteristics so as to really uphold its marginal valuation of forest recreation. As abridged by Granlund (2005), recent research stresses for instance that as much as 95 per cent of the Swedish forest land is today used for forestry, steadily converting it into homogeneous forest plantations. How far subtitution between different types of assets and ecosystem services can be taken without affecting total production is mainly dependant on the marginal values of the respective assets. This highlights the need for correct value estimates, especially such that take non-linearities into account.

Thus, some remarks on the robustness of the results must be made. One of the main features of this thesis is that it in contrast to other green accounting studies take regional heterogeneities into account, but for most assets this was only possible with respect to physical resource quantities. Regional specific values of non-marketed natural capital outputs still lack, just like the time development of these prices. In those cases where regional values were available, the study showed that the way counties have managed their natural capital holdings can be more or less important compared to in other regions. A deficiently managed asset that in one county is relatively more valuable might make GDPR decrease more than in counties where the same asset is less valued. An example of this was Östergötland, whose disinvestment in nitrogen abatement caused its total wealth to decline, while on the other hand an even larger decline in the same asset is undetectable in total adjusted GDPRs in Norrland and Svealand where the marginal valuation of wetland nitrogen abatement is assumed to be lower. In other words, studies of regional monetary accounting do of course demand accurate regional monetary values in order to give correct answers about spatial differences in wealth and economic development. Further empirical green accounting research could attend to this.

Some concluding comments can be made. The consumption and investment terms help tracking prospects and potential. For example although the investment term might indicate that an asset has been unsustainably used, studying the consumption term of a county shows how large part of the productive base the county is in hold of. In this context, it is interesting to look at interregional differences in the supply of the two different services, since they represent two different kinds of determinants of human well-being. The range of recreational consumption values reveal the relative availability to direct consumption of nature experiences in each county, perhaps enabling somewhat speculative interpretations as why people choose to live on the countryside despite its relative disadvantage in terms of conventional sources of wealth. The pollution sequestration values expose information on the relative contribution to national wealth and welfare (or, for that matter, global welfare, when it comes to carbon dioxide abatement) with respect to means for productivity driving resources, not the least since this output is valued in terms of replacement costs.

An overall aim of this study was to try to contribute to the depiction of human welfare by highlightening the impact of environmental values on it. In a sense its aim was to show how conventional measures based on traditional theory can mislead our comprehension of what is really valuable to us, and that the practice of using them for welfare descriptions or comparisons might convey important properties of our preferences. Viewing the natural environment as a form of capital asset that ought to be considered when evaluating welfare is in fact completely in line with what happens in other areas of economic research today, where alternative forms of capital like human capital, intellectual capital and social capital are recognised as important components of societal economic performance. If national financial records were to take account of the non-marketed part of the natural resource base and its contribution to national prosperity, this could, besides improving economic efficiency, provide a more comprehensive picture of social welfare and raise our consciousness of nature's importance to us. The study has shown that this is by no means a simple task. Even though the suitability of GDP as a measure of welfare and social well-being is questioned, GDP accounts and annual changes in them are still the most common measures for evaluating the welfare of nations or regions. This means that common welfare measurements are already distorted. This study does not pretend to demonstrate what *true value* is either, or to say that the adjustments made here will form a complete, or even better, picture of welfare. Given the difficulties in quantifying both social well-being and non-marketed environmental output values, the aim can only be to create alternatives that help us shade off our interpretation of reality.

Bibliography

Literature and publications

Ahlroth, S. (2000). Correcting Net Domestic Product for Sulphur Dioxide and Nitrogen Oxide Emissions: Implementation of a Theoretical Model in Practice. Working Paper No. 73. National Institute of Economic Research. Stockholm.

Arrow, K., Dasgupta, P. & Mäler, K-G. (2004). Evaluating Projets and Assessing Sustainable Development in Imperfect Economies. In Dasgupta, P. and Mäler, K-G. (eds). *The Economics of Non-Convex Ecosystems*, pp.149-187. Kluwer Academic Publishers. Netherlands.

Barbier, E. B., Acreman, M. & Knowler D. (1997). Economic Valuation of Wetlands; A guide for policymakers and planners. Ramsar Convention Bureau. Gland, Switzerland.

Bostedt, G., & L. Mattsson. (1995). The Value of Forests for Tourism in Sweden. *Annals of Tourism Research*. No 22, pp 671-680.

Boström, B. (2003). Kyotoprotokollet styr kampen mot klimatförändringar. *Miljötrender*. Nr 3, pp 3-5.

Byström, O. (1998). The nitrogen abatement cost in wetlands. *Ecological Economics*. No 26, pp 321-331.

Capros, P. & Mantzos, L., 2000. The Economic Effects of EU-Wide Industry-Level Emission Trading to Reduce Greenhouse Gases – Results from PRIMES Energy Systems Model. Institute of Communication and Computer Systems. National Technical University of Athens. Athens.

Costanza, R. & Folke, C. (1997). Valuing ecosystem services with efficiency, fairness and sustainability as goals. (pp 49-68). In Daily, G. (ed). *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press. Washington DC.

Daily, G. (1997). (ed). *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press. Washington DC.

Dasgupta, P. (2003). *The Economics of the World's Poorest Regions.* Beijer Discussion Papers Series No. 171. Beijer International Institute of Ecological Economics, The Royal Swedish Academy of Sciences. Stockholm.

Dasgupta, P. & Mäler, K-G. (2000). Net National Product, Wealth and Social Well-Being. *Environment and Development Economics*. No 5, pp 69-93.

Dasgupta, P. & Mäler, K-G. (2001). Wealth as a Criterion for Sustainable Development. *World Economics*. Vol. 2. No. 3, pp 19-44.

Decand, G. (2000a). Regional Policy and statistics – A long story. *Sigma*. 1/2000, pp 6-8. Eurostat. Office for Official Publications of the European Communities. Luxemburg.

Decand, G. (2000b). Revealing Europe's Wealth. *Sigma*. 1/2000, pp 2-3. Eurostat. Office for Official Publications of the European Communities. Luxemburg.

Drake, L.. (1992). The non-market value of the Swedish agricultural landscape. *European Review of Agricultural Economics*. No. 19, pp 351-364.

Drake, L., Kumm, K-I. & Andersson, M. (1991). Har jordbruket i Rottnadalen någon framtid? En analys av landskapsvärden och företagsekonomiska kostnader. Småskriftserien no 48, Department of Economics and Statistics, Swedish University of Agricultural Sciences, Uppsala.

Energimyndigheten. (2001). *Klimatpolitik i EU*. Eskilstuna.

European Comission. (2000). Grönbok om handel med utsläppsrätter för växthusgaser inom Europeiska unionen, Bryssel.

Granlund, T. (2005). "Är det något vi har gott om i det här landet så är det skog". *EcoSensus*. Nr 2, pp 5. Albaeco, Stockholm.

Gren, I-M. (2003). Monetary Green Accounting and Ecosystem Services. Working Paper No. 86, July 2003.The National Institute of Economic Research. Stockholm.

Gren, I-M. (2006a). Natural capital and ecosystem services: A practical step towards measuring sustainaibility in Sweden. *Review of income and wealth* (in review).

Gren, I-M. & Svensson, L. (2004). Ecosystems, Sustainability and Growth for Sweden during 1991-2001. Occasional Studies No. 4, May 2004. The National Institute of Economic Research. Stockholm.

Hamilton, K. & Clemens, M. (1999). Genuine Savings Rates in Developing Countries. *The World Bank Economic Review.* Vol. 13, No 2, pp 333-356.

Harris, M. & Fraser, I. (2002). Natural Resource Accounting in Theory and Practice: A critical Assessement. *The Australian Journal of Agricultural and Resource Economics*. 46:2, pp 139-192.

Hartwick, J. (2001). National Accounting with Natural and Other Types of Capital. *Environmental and Resource Economics*. Vol.19. No. 4, pp 329-341.

Hasund, K. (1997). Documentation of Three Contingent Valuation Surveys on Preservation of Landscape Elements of Agricultural Land. Småskriftserien no107. Department of Economics. Swedish University of Agricultural Sciences, Uppsala.

Heal, G. & Barbier, E. (2006). Valuing Ecosystem Services. *Economists' Voice*. The Berkeley Electronic Press. January 2006, pp 1-6.

Heal, G. & Kriström, B. (2001). National Income and the Environment. Manuscript. Pinted in Mäler, K-G. & Vincent, J.R. (Eds). *Handbook of Environmental Economics,* Volume 3. (2005). Elsevier B.V, New York.

Hicks, J.R. (1939). *Value and Capital*. 2nd Edition New York. Oxford University Press, New York.

Hultkrantz, L. (1992). National account of timber and forest resources in Sweden. *Environmental and Resource Economics.* Vol. 2. No. 3, pp 284-305. Springer Netherlands.

Jämttjärn, J. (1996). Den svenska skogens rekreationsvärde. Småskriftsserien nr 109. SLU, Institutionen för naturresurs och miljöekonomi. Uppsala.

Johansson, M-J. (2003). Så kan skogsbruket motverka klimatförändringar. *Miljötrender*. No 3, pp12-15.

LUSTRA. (2002). Land use strategies for reducing net greenhouse gas emissions. Progress Report 1999-2002. December 2002. Swedish University of Agricultural Sciences. Uppsala.

Millenium Ecosystem Assesment. (2005). *Ecosystems and Human Well-Being: General Synthesis.* Island Press. Washington DC.

Morén, A-S. (2003). Kolsänkor – en av lösningarna. *Miljötrender*. No 3, pp 6-7.

OECD. (1994). *Environmental Indicators: OECD Core Set*. OECD. Paris.

Olsson, P., S. Linder, R. Giesler, & Högberg,P. (2005). Fertilization of boreal forest reduces both autotrophic and heterotrophic soil respiration. *Global Change Biology* . Vol. 11, pp 1745-1753.

Perman, R., Ma, Y., McGilvary, J. & Common, M. (2003). Natural Resources and Environmental Economics. Pearson Education Limited, Harlow.

SCB, (2006). Regionala räkenskaper 1993-2003. In *Statistiska meddelanden NR 13 SM 0601.* Sveriges officiella statistik. Statistics Sweden, Stockholm.

Skånberg, K. (2001). Constructing a Partially Environmentally Adjusted Net Domestic Product for Sweden 1993 and 1997: A presentation of the methodological steps and empirical data. Working Paper no. 76. National Institute of Economic Research.

Solow, R.M. (1992). An almost practical step toward sustainability. Resources for the Future 40th Anniversary Lecture, Washington DC.

Sundberg, S. & Södetqvist, T. (2004). The economic value of environmental change in Sweden:
A survey of studies. Beijer International Institute of Ecological Economics. Stockholm.

Svensson, L. (2004). Monetary Environmental Accounts - Data Compilation of Wetlands in Sweden. (PM). National Institute of Economic Research, Stockholm.

Swedish Environmental Protection Agency. (2003). Myllrande våtmarker - Underlagsrapport till fördjupad utvärdering
av miljömålsarbetet. Report 5328.

Swedish Environmental Protection Agency. (2004). Rikare mångfald och mindre kväve - Utvärdering av våtmarker skapade med stöd av lokala investeringsprogram och landsbygdsutvecklingsstöd. Report 5362.

Swedish Environmental Protection Agency. (2006). Nationell strategi för Myllrande våtmarker – Underlagsrapport. (In press 2006).

Söderqvist, T. (2001). Naturens Nytta och Helighet. Beijer Reprint Series No.157. Beijer International Institute of Ecological Economics. Stockholm.

Vincent, J. (1997). Resource Depletion and Economic Sustainability in Malaysia. *Environment and Development Economics* 2. pp 19-37.

Wastenson, L. & Helmfrid, S. (eds). (1996). *Sveriges Geografi*. Sveriges Nationalatlas (SNA). 1st Edition. Bokförlaget Bra Böcker. Höganäs. (In English *The Geography of Sweden*).

Weitzman, M. (1976). On the Welfare Significance of National Product in a Dynamic Economy. Quarterly Journal of Economics. *Quarterly Journal of Economics*. Vol. 90. No 1, 156-162.

World Commission. (1987). Our Common Future. World Commission on Environment and Development (Bruntland Report). Oxford University Press. New York.

Östblom, G. (2003). Samhällsekonomiska konsekvenser för Sverige av begränsad handel med utsläppsrätter enligt EU:s direktiv (in Swedish). National Institute of Economic Research and SCB. Report 2003:1.

Personal contacts

Gren, Ing-Marie. (2006b). Professor at Department of Economics, Swedish University of Agricultural Sciences (telephone +46 (0)18 - 67 17 53).

Olsson, Mats. (2006). Professor at Department of Forest Soils, Swedish University of Agricultural Sciences (telephone +46 (0)18 - 67 22 13).

Internet

Climate Corporation. (www.climatecorp.com).
Carbon Pool Europe. (2007-01-17).
www.carbonpool.eu

Statistics Sweden. (www.scb.se).
a. Regionalräkenskaper (2006-10-17).
http://w41.scb.se/templates/Product____11078.asp

b. Nationalräkenskaper (2006-10-17).
http://www.scb.se/templates/Product____11030.asp

c. Konsumentprisindex (1980=100), fastställda tal
http://www.scb.se/templates/tableOrChart____33847.asp

Swedish Environmental Objectives Council. (www.miljömål.nu).
Kväve i havet (2007-01-18).
http://miljomal.nu/Pub/Indikator.php?MmID=7&InkID=Kva-46%3A2-NV&LocType=CC&LocID=SE

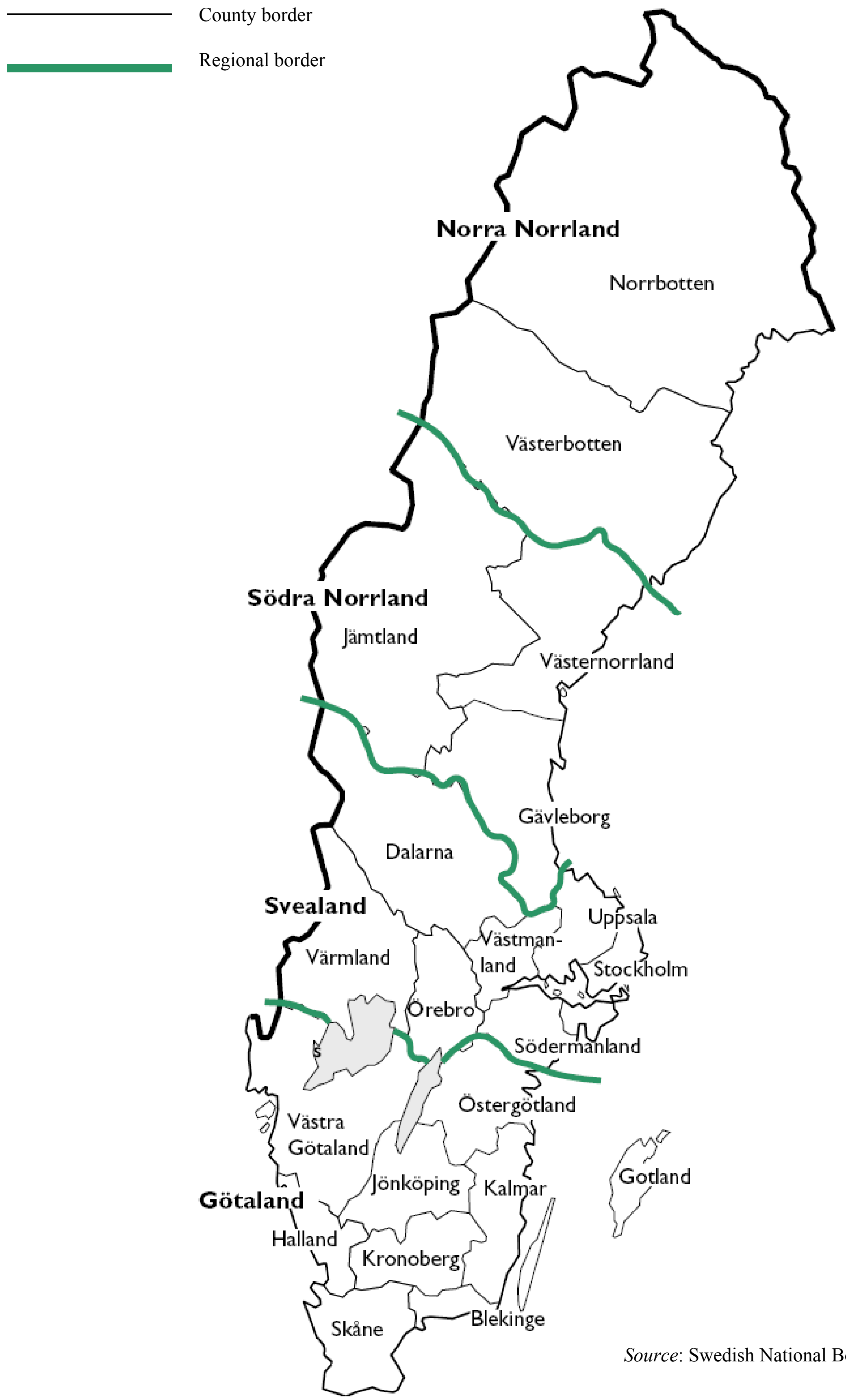
Swedish National Board of Forestry (www.skogstyrelsen.se)
a. Skog och skogsmark – Arealer (2006-10-01).
http://www.svo.se/minskog/Templates/EPFileListing.asp?id=15322

b. Skog och skogsmark – Beskrivning av respektive statistikavsnitt (2006-10-28).
http://www.svo.se/episerver4/templates/SNormalPage.aspx?id=16585

c. Produktion – Avverkning (2006-10-15).
http://www.svo.se/episerver4/templates/SFileListing.aspx?id=15376

Swedish National Forest Inventory (www-riksskogstaxeringen.slu.se)
Årlig tillväxt avgång och avverkning (2006-12-10).
http://www-riksskogstaxeringen.slu.se/Resultat/Figurer/TvA.pdf

Appendix 1. *Map of Swedish counties and provinces*



Source: Swedish National Board of Forestry

Appendix 2. *Regional values of ecosystem services*

***Table A1.* CO_2 sequestration values of forests in different regions in year 1995 and 2000, million SEK in 2000-year prices.**

County/Region		Change in forest biomass (1)	CO_2 seq (2)	Consumption value, *Million SEK* (3)		Investment value, *Million SEK* (4)		Total value	
	Year	*Mill m^3*	*Mill ton*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Norrbotten	2000	4.03	5.32	1 501	3 008	50 044	100 265	51 545	103 273
	1995	3.81	5.03	1 417	2 840	47 245	94 657	48 662	97 497
Västerbotten	2000	3.66	4.84	1 364	2 732	45 459	91 078	46 822	93 811
	1995	2.74	3.62	1 021	2 046	34 044	68 208	35 065	70 254
Jämtland	2000	1.92	2.53	714	1 430	23 796	47 676	24 510	49 106
	1995	1.62	2.14	603	1 209	20 115	40 300	20 718	41 509
Västernorrland	2000	1.30	1.71	482	966	16 074	32 206	16 557	33 172
	1995	1.00	1.33	374	749	12 469	24 981	12 843	25 731
Gävleborg	2000	1.94	2.56	721	1 444	24 028	48 141	24 749	49 585
	1995	2.04	2.69	758	1 519	25 272	50 633	26 030	52 152
Dalarna	2000	1.40	1.85	522	1 045	17 394	34 849	17 915	35 894
	1995	0.64	0.85	240	481	8 000	16 028	8 240	16 509
Värmland	2000	2.40	3.17	893	1 789	29 771	59 648	30 664	61 438
	1995	2.44	3.22	908	1 819	30 263	60 632	31 170	62 451
Örebro	2000	1.29	1.70	479	961	15 981	32 018	16 460	32 979
	1995	0.62	0.82	230	461	7 678	15 383	7 908	15 844
Västmanland	2000	0.35	0.46	131	263	4 369	8 753	4 500	9 016
	1995	0.35	0.46	129	259	4 311	8 637	4 440	8 896
Uppsala	2000	0.62	0.81	229	459	7 641	15 309	7 870	15 769
	1995	0.33	0.43	121	243	4 045	8 104	4 166	8 347
Stockholm	2000	0.80	1.06	299	599	9 959	19 954	10 258	20 553
	1995	0.83	1.09	307	616	10 242	20 520	10 549	21 135
Södermanland	2000	0.98	1.29	364	729	12 131	24 305	12 495	25 034
	1995	0.65	0.86	242	485	8 077	16 182	8 319	16 667
Östergötland	2000	0.11	0.14	39	79	1 314	2 632	1 353	2 711
	1995	1.51	2.00	564	1 129	18 791	37 649	19 355	38 778
Västra Götaland	2000	3.39	4.47	1 261	2 525	42 017	84 183	43 277	86 708
	1995	1.74	2.30	648	1 299	21 612	43 301	22 261	44 601
Jönköping	2000	0.60	0.79	223	447	7 441	14 908	7 664	15 355
	1995	1.04	1.38	388	777	12 935	25 916	13 323	26 693
Kronoberg	2000	0.34	0.44	125	250	4 166	8 346	4 290	8 596
	1995	0.52	0.69	195	390	6 488	12 998	6 682	13 388
Kalmar	2000	1.38	1.82	513	1 028	17 111	34 282	17 624	35 311
	1995	1.15	1.51	427	855	14 220	28 490	14 647	29 345

Gotland	2000	0.22	0.29	82	164	2 735	5 480	2 817	5 645
	1995	0.13	0.18	50	100	1 661	3 328	1 711	3 428
Halland	2000	0.83	1.09	307	616	10 248	20 533	10 556	21 149
	1995	0.78	1.04	292	585	9 738	19 511	10 030	20 096
Blekinge	2000	0.26	0.34	96	192	3 186	6 384	3 282	6 575
	1995	0.26	0.34	95	191	3 175	6 362	3 271	6 553
Skåne	2000	-0.21	-0.28	-79	-158	-2 624	-5 257	-2 702	-5 414
	1995	1.25	1.65	464	930	15 474	31 003	15 938	31 933
N Norrland	*2000*	*7.70*	*10.16*	*2 865*	*5 740*	*95 502*	*191 343*	*98 367*	*197 084*
	1995	*6.55*	*8.65*	*2 439*	*4 886*	*81 290*	*162 868*	*83 729*	*167 754*
S Norrland	*2000*	*5.15*	*6.80*	*1 917*	*3 841*	*63 898*	*128 023*	*65 815*	*131 863*
	1995	*4.66*	*6.15*	*1 735*	*3 477*	*57 842*	*115 889*	*59 577*	*119 366*
Svealand	*2000*	*7.84*	*10.35*	*2 917*	*5 845*	*97 246*	*194 837*	*100 163*	*200 682*
	1995	*5.85*	*7.72*	*2 178*	*4 364*	*72 597*	*145 452*	*74 775*	*149 815*
Götaland	*2000*	*6.90*	*9.11*	*2 568*	*5 145*	*85 595*	*171 493*	*88 163*	*176 638*
	1995	*8.39*	*11.07*	*3 122*	*6 254*	*104 051*	*208 471*	*107 173*	*214 726*
Sweden	*2000*	*27.58*	*36.41*	*10 267*	*20 571*	*342 240*	*685 693*	*352 507*	*706 264*
	1995	*25.45*	*33.60*	*9 474*	*18 981*	*315 796*	*632 712*	*325 270*	*651 693*

(1) Mean annual increment 1993-1997 for 1995 and 1998-2002 for 2000 (www, Swedish National Board of Forestry 2006a) minus mean annual gross fellings 1995-1997 and 1999-2001 respectively (www, Swedish National Board of Forestry 2006c).
(2) Change in biomass times 0.4 for dry weight, times 0.5 to get the amount of C in tonnes, times 1.8 to include the amount of C in branches and root system, times (44/12) for the corresponding weight of CO_2.
(3) CO_2 uptake times lower and upper value of million SEK 282 and 565 per million tonne CO_2.
(4) Accounting prices of million SEK 9 400 and 18 833 per million tonne CO_2.

Table A2. **Recreational values of forests in different regions in year 1995 and 2000, million SEK in 2000-year prices.**

County/Region		Area of forest land (1)	Consumption value, *Million SEK* (2)		Change in area of forest land (3)	Investment value (4), *Million SEK*		Total value	
	Year	*1 000 ha*	*Low*	*High*	*1000 ha*	*Low*	*High*	*Low*	*High*
Norrbottens	2000	3 592	1 162	5 812	-38	-410	-2 049	752	3 762
	1995	3 561	1 152	5 762	61	658	3 290	1 810	9 052
Västerbottens	2000	3 180	1 029	5 145	-10	-108	-539	921	4 606
	1995	3 066	992	4 961	-42	-453	-2 265	539	2 696
Jämtlands	2000	2 648	857	4 284	-51	-550	-2 751	307	1 534
	1995	2 516	814	4 071	13	140	701	954	4 772
Västernorrlands	2000	1 685	545	2 726	-27	-291	-1 456	254	1 270
	1995	1 695	549	2 743	24	259	1 294	807	4 037
Gävleborgs	2000	1 478	478	2 391	14	151	755	629	3 146
	1995	1 518	491	2 456	-28	-302	-1 510	189	946
Dalarnas	2000	1 935	626	3 131	18	194	971	820	4 102
	1995	1 948	630	3 152	-28	-302	-1 510	328	1 642
Värmlands	2000	1 330	430	2 152	-11	-119	-593	312	1 559

	1995	1 315	426	2 128	-21	-227	-1 133	199	995
Örebro	2000	575	186	930	5	54	270	240	1 200
	1995	600	194	971	-1	-11	-54	183	917
Västmanlands	2000	387	125	626	10	108	539	233	1 165
	1995	396	128	641	-2	-22	-108	107	533
Uppsala	2000	389	126	629	-12	-129	-647	-4	-18
	1995	401	130	649	-3	-32	-162	97	487
Stockholms	2000	261	84	422	17	183	917	268	1 339
	1995	303	98	490	15	162	809	260	1 299
Södermanlands	2000	338	109	547	16	173	863	282	1 410
	1995	330	107	534	-8	-86	-431	20	102
Östergötlands	2000	590	191	955	8	86	431	277	1 386
	1995	611	198	989	-11	-119	-593	79	395
Västra Götalands	2000	1 310	424	2 120	-30	-324	-1 618	100	502
	1995	1 303	422	2 108	27	291	1 456	713	3 564
Jönköpings	2000	703	227	1 137	-4	-43	-216	184	922
	1995	709	229	1 147	6	65	324	294	1 471
Kronobergs	2000	658	213	1 065	-7	-76	-378	137	687
	1995	645	209	1 044	3	32	162	241	1 205
Kalmar	2000	747	242	1 209	-45	-485	-2 427	-244	-1 218
	1995	715	231	1 157	17	183	917	415	2 074
Gotlands	2000	120	39	194	1	11	54	50	248
	1995	125	40	202	-5	-54	-270	-13	-67
Hallands	2000	295	95	477	-1	-11	-54	85	423
	1995	285	92	461	1	11	54	103	515
Blekinge	2000	186	60	301	3	32	162	93	463
	1995	193	62	312	1	11	54	73	366
Skåne	2000	343	111	555	7	76	378	187	933
	1995	385	125	623	-3	-32	-162	92	461
N Norrland	*2000*	*6 772*	*2 191*	*10 957*	*-48*	*-518*	*-2 589*	*1 674*	*8 368*
	1995	*6 627*	*2 144*	*10 722*	*19*	*205*	*1 025*	*2 349*	*11 747*
S Norrland	*2000*	*5 811*	*1 880*	*9 402*	*-63*	*-680*	*-3 398*	*1 201*	*6 004*
	1995	*5 730*	*1 854*	*9 271*	*8*	*86*	*431*	*1 941*	*9 703*
Svealand	*2000*	*5 214*	*1 687*	*8 436*	*44*	*475*	*2 373*	*2 162*	*10 809*
	1995	*5 293*	*1 713*	*8 564*	*-49*	*-529*	*-2 643*	*1 184*	*5 921*
Götaland	*2000*	*4 953*	*1 603*	*8 014*	*-68*	*-733*	*-3 667*	*869*	*4 346*
	1995	*4 971*	*1 609*	*8 043*	*36*	*388*	*1 942*	*1 997*	*9 985*
Sweden	*2000*	*22 749*	*7 362*	*36 808*	*-135*	*-1 456*	*-7 281*	*5 905*	*29 527*
	1995	*22 621*	*7 320*	*36 601*	*15*	*162*	*809*	*7 482*	*37 410*

(1) Sliding mean annaul value 1993-1997 for year 1995 and 1998-2002 for year 2000 (www, Swedish National Board of Forestry 2006a).

(2) SEK/ha 324 and 1618; 0.4 and 2 times average value of SEK 795/ha forest from Jämttjärn (1996).

(3) Sliding mean annual values of 1993-1997 and 1998-2002 minus sliding mean annual values of 1992-1996 and 1997-2001 respectively (www, Swedish National Board of Forestry 2006a).

(4) SEK/ha 10 787 and 53 933; accounting price, which are the unit values above divided by 0.03.

Table A3. **Nitrogen abatement values of wetlands in different regions in year 1995 and 2000, million SEK in 2000-year prices.**

County/Region		Area of wetland (1)	Consumption value, *Million SEK* (2)		Change in area of wetland (3)	Investment value, *Million SEK* (4)		Total value	
	Year	*1 000 ha*	*Low*	*High*	*1000 ha*	*Low*	*High*	*Low*	*High*
Norrbotten	2000	*1 538*	751	-	*-2*	-33	-	718	718
	1995	*1 392*	679	-	*-22*	-358	-	321	321
Västerbotten	2000	*952*	465	-	*46*	748	-	1 213	1 213
	1995	*906*	442	-	*-12*	-195	-	247	247
Jämtland	2000	*751*	366	-	*-4*	-65	-	301	301
	1995	*800*	390	-	*-15*	-244	-	146	146
Västernorrland	2000	*204*	100	-	*4*	65	-	165	165
	1995	*187*	91	-	*3*	49	-	140	140
Gävleborg	2000	*172*	84	-	*7*	114	-	198	198
	1995	*146*	71	-	*-7*	-114	-	-43	-43
Dalarna	2000	*419*	204	-	*-27*	-439	-	-235	-235
	1995	*417*	203	-	*3*	49	-	252	252
Värmland	2000	*145*	71	-	*1*	16	-	87	87
	1995	*166*	81	-	*-5*	-81	-	0	0
Örebro	2000	*48*	23	-	*-4*	-65	-	-42	-42
	1995	*51*	25	-	*1*	16	-	41	41
Västmanland	2000	*27*	13	-	*-8*	-130	-	-117	-117
	1995	*49*	24	-	*3*	49	-	73	73
Uppsala	2000	*32*	16		*2*	33	-	48	48
	1995	*24*	12	-	*7*	114	-	126	126
Stockholm	2000	*11*	5	-	*-1*	-16	-	-11	-11
	1995	*9*	4	-	*2*	33	-	37	37
Södermanland	2000	*11*	5	-	*-3*	-49	-	-43	-43
	1995	*16*	8		*0*	0	-	8	8
Östergötland	2000	*18*	9	1 318	*-5*	-81	-12 202	-73	-10 884
	1995	*21*	10	1 537	*0*	0	0	10	1 537
Västra Götaland	2000	*102*	50	7 468	*-1*	-16	-2 440	34	5 027
	1995	*91*	44	6 662	*-8*	-130	-19 523	-86	-12 861
Jönköping	2000	*53*	26	3 880	*3*	49	7 321	75	11 201
	1995	*56*	27	4 100	*3*	49	7 321	76	11 421
Kronoberg	2000	*57*	28	4 173	*-1*	-16	-2 440	12	1 733
	1995	*53*	26	3 880	*4*	65	9 762	91	13 642
Kalmar	2000	*26*	13	1 904	*2*	33	4 881	45	6 784
	1995	*25*	12	1 830	*-1*	-16	-2 440	-4	-610
Gotland	2000	*8*	4	586	*0*	0	0	4	586
	1995	*7*	3	512	*0*	0	0	3	512

Halland	2000	*31*	15	2 270	*2*	33	4 881	48	7 150
	1995	*29*	14	2 123	*-1*	-16	-2 440	-2	-317
Blekinge	2000	*4*	2	293	*1*	16	2 440	18	2 733
	1995	*3*	1	220	*0*	0	0	1	220
Skåne	2000	*25*	12	1 830	*1*	16	2 440	28	4 271
	1995	*17*	8	1 245	*0*	0	0	8	1 245
N Norrland	*2000*	2 490	*1 215*	-	44	*716*	-	*1 931*	*1 931*
	1995	2 298	*1 121*	-	-35	*-569*	-	*552*	*552*
S Norrland	*2000*	1 128	*550*	-	8	*130*	-	*681*	*681*
	1995	1 134	*553*	-	-19	*-309*	-	*244*	*244*
Svealand	*2000*	694	*339*	-	-38	*-618*	-	*-279*	*-279*
	1995	731	*357*	-	9	*146*	-	*503*	*503*
Götaland	*2000*	326	*159*	*23 867*	4	*65*	*9 762*	*224*	*33 629*
	1995	302	147	22 110	-4	-65	-9 762	82	12 348
Sweden	*2000*	4 637	*2 263*	*25 971 (5)*	16	*260*	*9 989 (5)*	*2 523*	*35 961*
	1995	4 465	*2 179*	*24 142 (5)*	-48	*-781*	*-10 494 (5)*	*1 398*	*13 648*

(1) Sliding mean annual value 1994-1998 for 1995 and 1998-2002 for 2000 (www, Swedish National Board of Forestry 2006a).

(2) From Gren & Svensson (2004); Unit values of SEK 0.49 million (low) and 73 million (high) per 1000 hectare.

(3) Sliding mean annual value 1994-1998 minus 1993-1997 for 1995 and sliding mean annual value 1998-2002 minus 1997-2001 for 2000 (www, Swedish National Board of Forestry 2006a).

(4) Accounting prices of SEK 16 million (low) and 2 440 million (high), which are the unit values above divided by the 3 per cent discount rate.

(5) Since different regional prices are used the value of the total change at the national level are calculated as sums of the figures from N and S Norrland, Svealand and Götaland since those figures are assumed to be more precise.

***Table A4.* Recreational values of Swedish wetlands in different regions in year 1995 and 2000, million SEK in 2000-year prices.**

County/Region		Area of wetland (1)	Consumption value, *Million SEK* (2)		Change in area of wetland (3)	Investment value, *Million SEK* (4)		Total value	
	Year	*1 000 ha*	*Low*	*High*	*1000 ha*	*Low*	*High*	*Low*	*High*
Norrbotten	2000	1 538	3 753	24 128	-2	-163	-1 046	3 590	23 082
	1995	1 392	3 396	21 838	-22	-1 789	-11 505	1 607	10 333
Västerbotten	2000	952	2 323	14 935	46	3 741	24 055	6 064	38 990
	1995	906	2 211	14 213	-12	-976	-6 275	1 235	7 938
Jämtland	2000	751	1 832	11 782	-4	-325	-2 092	1 507	9 690
	1995	800	1 952	12 550	-15	-1 220	-7 844	732	4 706
Västernorrland	2000	204	498	3 200	4	325	2 092	823	5 292
	1995	187	456	2 934	3	244	1 569	700	4 502
Gävleborg	2000	172	420	2 698	7	569	3 661	989	6 359
	1995	146	356	2 290	-7	-569	-3 661	-213	-1 370
Dalarna	2000	419	1 022	6 573	-27	-2 196	-14 119	-1 174	-7 546
	1995	417	1 017	6 542	3	244	1 569	1 261	8 111
Värmland	2000	145	354	2 275	1	81	523	435	2 798

	1995	166	405	2 604	-5	-407	-2 615	-2	-10
Örebro	2000	48	117	753	-4	-325	-2 092	-208	-1 339
	1995	51	124	800	1	81	523	206	1 323
Västmanland	2000	27	66	424	-8	-651	-4 183	-585	-3 760
	1995	49	120	769	3	244	1 569	364	2 338
Uppsala	2000	32	78	502	2	163	1 046	241	1 548
	1995	24	59	377	7	569	3 661	628	4 037
Stockholm	2000	11	27	173	-1	-81	-523	-54	-350
	1995	9	22	141	2	163	1 046	185	1 187
Södermanland	2000	11	27	173	-3	-244	-1 569	-217	-1 396
	1995	16	39	251	0	0	0	39	251
Östergötland	2000	18	44	282	-5	-407	-2 615	-363	-2 332
	1995	21	51	329	0	0	0	51	329
Västra Götaland	2000	102	249	1 600	-1	-81	-523	168	1 077
	1995	91	222	1 428	-8	-651	-4 183	-429	-2 756
Jönköping	2000	53	129	831	3	244	1 569	373	2 400
	1995	56	137	879	3	244	1 569	381	2 447
Kronoberg	2000	57	139	894	-1	-81	-523	58	371
	1995	53	129	831	4	325	2 092	455	2 923
Kalmar	2000	26	63	408	2	163	1 046	226	1 454
	1995	25	61	392	-1	-81	-523	-20	-131
Gotland	2000	8	20	126	0	0	0	20	126
	1995	7	17	110	0	0	0	17	110
Halland	2000	31	76	486	2	163	1 046	238	1 532
	1995	29	71	455	-1	-81	-523	-11	-68
Blekinge	2000	4	10	63	1	81	523	91	586
	1995	3	7	47	0	0	0	7	47
Skåne	2000	25	61	392	1	81	523	142	915
	1995	17	41	267	0	0	0	41	267
N Norrland	*2000*	*2 490*	*6 076*	*39 063*	*44*	*3 579*	*23 009*	*9 654*	*62 072*
	1995	*2 298*	*5 607*	*36 051*	*-35*	*-2 847*	*-18 303*	*2 760*	*17 748*
S Norrland	*2000*	*1 128*	*2 752*	*17 696*	*8*	*651*	*4 183*	*3 403*	*21 880*
	1995	*1 134*	*2 767*	*17 790*	*-19*	*-1 545*	*-9 936*	*1 222*	*7 854*
Svealand	*2000*	*694*	*1 693*	*10 887*	*-38*	*-3 091*	*-19 871*	*-1 397*	*-8 984*
	1995	*731*	*1 784*	*11 468*	*9*	*732*	*4 706*	*2 516*	*16 174*
Götaland	*2000*	*326*	*795*	*5 114*	*4*	*325*	*2 092*	*1 121*	*7 206*
	1995	*302*	*737*	*4 738*	*-4*	*-325*	*-2 092*	*412*	*2 646*
Sweden	*2000*	*4 637*	*11 314*	*72 745*	*16*	*1 301*	*8 367*	*12 616*	*81 112*
	1995	*4 465*	*10 895*	*70 047*	*-48*	*-3 904*	*-25 101*	*6 991*	*44 946*

(1) Sliding mean value 1994-1998 for 1995 and 1998-2002 for 2000 (www, Swedish National Board of Forestry 2006a).

(2) Gren & Svensson (2004); Unit values of SEK 2.44 million and 15.7 million per 1000 hectare.

(3) Sliding mean annual value 1994-1998 minus 1993-1997 for 1995 and sliding mean annual value 1998-2002 minus 1997-2001 for 2000 (www, Swedish National Board of Forestry 2006a).

(4) Accounting prices of SEK 81.3 and 522 million per 1000 hectare, which are unit values above divided by the 3 per cent discount rate.

Table A5. **Recreational values of agricultural landscape in different regions in year 1995 and 2000, million SEK in 2000-year prices.**

County/Region		Area of agricultural landscape (1)	Consumption value, *Million SEK* (2)		Change in area of agricultural landscape (3)	Investment value, *Million SEK* (4)		Total value	
	Year	*1 000 ha*	*Low*	*High*	*1000 ha*	*Low*	*High*	*Low*	*High*
Norrbotten	2000	48	50	151	*-2*	-70	-209	-20	-59
	1995	51	53	160	*-1*	-35	-105	18	55
Västerbotten	2000	86	90	270	*-6*	-209	-628	-119	-358
	1995	74	77	232	*-3*	-105	-314	-27	-82
Jämtland	2000	38	40	119	*1*	35	105	75	224
	1995	49	51	154	*4*	140	419	191	572
Västernorrland	2000	74	77	232	*4*	140	419	217	651
	1995	64	67	201	*-5*	-174	-523	-107	-322
Gävleborg	2000	93	97	292	*-6*	-209	-628	-112	-336
	1995	100	105	314	*7*	244	733	349	1 047
Dalarna	2000	82	74	223	*5*	151	453	225	676
	1995	82	74	223	*-1*	-30	-91	44	132
Värmland	2000	127	115	345	*5*	151	453	266	798
	1995	134	121	364	*-1*	-30	-91	91	274
Örebro	2000	146	132	397	*20*	604	1 812	736	2 208
	1995	118	107	321	*-2*	-60	-181	47	140
Västmanland	2000	150	136	408	*0*	0	0	136	408
	1995	125	113	340	*0*	0	0	113	340
Uppsala	2000	188	170	511	*-9*	-272	-815	-101	-304
	1995	209	189	568	*7*	211	634	401	1 202
Stockholm	2000	119	108	323	*-5*	-151	-453	-43	-130
	1995	108	98	293	*0*	0	0	98	293
Södermanland	2000	154	140	419	*-1*	-30	-91	109	328
	1995	160	145	435	*2*	60	181	205	616
Östergötland	2000	294	168	504	*9*	171	514	340	1 019
	1995	265	151	454	*-5*	-95	-286	56	169
Västra Götaland	2000	625	357	1 072	*-5*	-95	-286	262	786
	1995	608	348	1 043	*-3*	-57	-171	290	871
Jönköping	2000	170	97	292	*4*	76	229	173	520
	1995	145	83	249	*-2*	-38	-114	45	134
Kronoberg	2000	67	38	115	*6*	114	343	153	458
	1995	89	51	153	*-11*	-210	-629	-159	-476
Kalmar	2000	191	109	328	*-6*	-114	-343	-5	-15
	1995	221	126	379	*11*	210	629	336	1 008
Gotland	2000	110	63	189	*0*	0	0	63	189
	1995	106	61	182	*-2*	-38	-114	22	67

Halland	2000	150	86	257	6	114	343	200	600
	1995	143	82	245	-4	-76	-229	6	17
Blekinge	2000	55	31	94	7	133	400	165	494
	1995	49	28	84	-4	-76	-229	-48	-145
Skåne	2000	579	331	993	-5	-95	-286	236	707
	1995	569	325	976	9	171	514	497	1 490
N Norrland	2000	134	140	421	-8	-279	-837	-139	-417
	1995	125	131	392	-4	-140	-419	-9	-26
S Norrland	2000	206	216	647	1	35	105	250	751
	1995	213	223	669	5	174	523	397	1 192
Svealand	2000	966	875	2 625	14	423	1 268	1 298	3 893
	1995	937	849	2 546	7	211	634	1 060	3 180
Götaland	2000	2 240	1 281	3 842	14	267	800	1 547	4 642
	1995	2 194	1 254	3 763	-10	-191	-572	1 064	3 191
Sweden	2000	3 546	2 511	7 533	21	445 (5)	1 336 (5)	2 956	8 869
	1995	3 467	2 456	7 369	-2 (5)	56 (5)	167 (5)	2 512	7 536

(1) Sliding mean annual value 1993-1997 for year 1995 and 1998-2002 for year 2000 (www, Swedish National Board of Forestry 2006a).
(2) From Drake (1992), the average values in 1986 of 1287 SEK/ha (North), 1114 SEK/ha (Central), 703 SEK/ha (South), estimated for a lower and upper bound of 50%; that is in 2000 year prices SEK 1046 and 3140 (north), SEK 906 and 2717 (central) and SEK 572 and 1715 (south).
(3) Sliding mean annual values of 1993-1997 and 1998-2002 minus sliding mean annual values of 1992-1996 and 1997-2001 respectively (www, Swedish National Board of Forestry 2006a).
(4) Accounting prices SEK/ha; 34 885 and 104 666 (Norrland), 30 200 and 90 567 (Svealand) and 19 067 and 57 167 (Götaland), which are the unit values above divided by 0.03, times change in area of agricultural landscape.
(5) Since different regional prices are used, the values of the total changes at the national level are calculated as sums of the figures from N and S Norrland, Svealand and Götaland since those figures are assumed to be more precise.

Appendix 3. *GDPR and EDPR 1995*

Table A6. **Conventional GDPR and EDPR of different regions in year 1995, 2000-year prices.**

County/ Region	Total natural capital		Conv GDPR (1)	Conv GDPR per capita (1)	EDPR *Million SEK*		EDPR per capita *1000 SEK*		Natural capital share of/ increase in GDPR *Million SEK*	
	Low	*High*	*Mill SEK*	*1000 SEK*	*Low*	*High*	*Low*	*High*	*Low*	*High*
Norrbottens	52 420	117 259	54 989	206	107 409	172 248	402	645	0.95	2.13
Västerbottens	37 058	81 053	49 540	190	86 599	130 594	333	502	0.75	1.64
Jämtlands	22 742	51 707	26 174	192	48 916	77 881	360	573	0.87	1.98
Västernorrlands	14 383	34 088	55 043	212	69 426	89 131	268	344	0.26	0.62
Gävleborgs	26 312	52 732	57 677	200	83 989	110 409	291	382	0.46	0.91
Dalarnas	10 126	64 244	56 169	193	66 295	120 414	228	414	0.18	1.14
Värmlands	31 459	63 661	52 091	183	83 550	115 752	293	406	0.60	1.22
Örebro	8 385	24 398	52 126	188	60 510	76 523	218	276	0.16	0.47
Västmanlands	5 096	23 014	50 939	194	56 035	73 953	215	283	0.10	0.45
Uppsala	5 418	32 913	50 009	174	55 427	82 922	192	288	0.11	0.66
Stockholms	11 128	29 455	462 957	270	474 086	492 412	276	287	0.02	0.06
Södermanlands	8 592	18 808	44 316	171	52 907	63 124	204	244	0.19	0.42
Östergötlands	19 551	41 209	77 512	186	97 064	118 721	233	285	0.25	0.53
V Götalands	22 750	33 419	292 806	197	315 555	326 225	213	220	0.08	0.11
Jönköpings	14 119	42 167	63 499	192	77 618	105 666	235	320	0.22	0.66
Kronobergs	7 310	30 682	35 959	200	43 269	66 641	239	368	0.20	0.85
Kalmar	15 373	31 686	45 255	185	60 628	76 941	248	315	0.34	0.70
Gotlands	1 740	4 050	10 415	179	12 155	14 465	210	249	0.17	0.39
Hallands	10 126	20 242	53 493	200	63 619	73 735	237	274	0.19	0.38
Blekinge	3 304	7 041	27 903	182	31 208	34 944	204	228	0.12	0.25
Skåne	16 577	35 396	210 124	189	226 701	245 520	204	221	0.08	0.17
N Norrland	89 382	197 776	104 530	198	193 912	302 305	368	574	0.86	1.89
S Norrland	63 381	138 359	138 894	203	202 275	277 254	296	405	0.46	1.00
Svealand	80 038	250 573	768 607	228	848 645	1 019 180	251	302	0.10	0.33
Götaland	110 727	242 896	816 966	193	927 693	1 059 862	219	250	0.14	0.30
Sweden	*343 608*	*830 079*	*1 829 288*	*208*	*2 172 896*	*2 659 367*	*246*	*301*	*0.19*	*0.45*

(1) www, Statistics Sweden, 2006a.
Sources: Table A1-A5 in Appendix 2, excluding investment values of $C0_2$ sequestration, and Table A7 in Appendix 4.

Appendix 4. *Population and consumer price index*

Table A7. **Population in Swedish regions year 1995 and 2000**

County/Region	***1995***	***2000***
Norrbotten	267	257
Västerbotten	260	256
Jämtland	136	130
Västernorrland	259	248
Gävleborg	289	280
Dalarna	291	279
Värmland	285	276
Örebro	277	274
Västmanland	261	257
Uppsala	288	293
Stockholm	1 717	1 813
Södermanland	259	256
Östergötland	416	411
V. Götaland	1 480	1 492
Jönköping	330	328
Kronoberg	181	177
Kalmar	244	236
Gotland	58	57
Halland	269	274
Blekinge	153	151
Skåne	1 109	1 127
N Norrland	527	513
S Norrland	684	658
Svealand	3 378	3 448
Götaland	4 240	4 253
Sweden	8 827	8 872

Source: www, Statistics Swedish 2006a.

Swedish consumer price index

Year	***KPI***	***Inverted***
2000	260.7	1
1999	258.1	1.0100736
1998	257	1.0143969
1997	257.3	1.0132141
1996	256	1.0183594
1995	254.8	1.0231554
1994	248.5	1.0490946
1993	243.2	1.0719572
1992	232.4	1.1217728
1991	227.2	1.1474472
1990	207.8	1.2545717
1986	160.3	1.6263256

Source: www, Statistics Sweden 2006c.

Pris: 100:- (exkl moms)

Tryck: SLU, Institutionen för ekonomi, Uppsala 2007.

Distribution:

Sveriges lantbruksuniversitet
Institutionen för ekonomi
Box 7013
750 07 Uppsala

Tel 018-67 2165

Swedish University of Agricultural Sciences
Department of Economics
P.O. Box 7013
SE-750 07 Uppsala, Sweden

Fax + 46 18 673502