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METHODOLOGY FOR THE USE OF COST-BENEFIT ANALYSIS IN ENVIRONMENTAL INVESTMENT PROJECTS A REVIEW OF THE ISLAND OF RHODES ANALYSIS

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1. CHARACTERISTICS OF ENVIRONMENTAL PROJECTS

Environmental projects cover a wide range of investments with varying scope and technological features. There are some basic characteristics which are common to most environmental improvement projects :

- large capital cost
- long - term social benefits (community benefits)
- positive impacts on regional development
- "outputs" do not pass through markets (and cannot easily be priced)
- often commercially not viable
- undertaken by public sector agencies.

2. CHARACTERISTICS OF COST - BENEFIT ANALYSIS (CBA)

CBA is a powerful and versatile tool which enables economists and planners to construct an information and evaluation framework for the appraisal of *planned* or *on-going* public investments.

The main advantage of CBA is its capability to go beyond *financial analysis* and profitability concerns and take into account a wider definition of costs and benefits more appropriate for the analysis of environmental projects.

Since the results or outputs of environmental investments are not traded in markets for goods and services financial costs and revenues underestimate or fail to capture the social /community benefits associated with environmental improvements. On the basis of financial criteria environmental investments may fail to prove viable and fail to secure public funds.

The methodology of comparing costs and benefits is the same whether we are seeking the economic or the financial benefit of investments. Only what is defined as a "cost" and what is considered a "benefit" is different. The distinction between financial analysis and CBA must be kept in mind.

CBA	**Financial Analysis**
For any project we are interested in the first instance in the total return or productivity to the whole society of all the resources invested in the project regardless of who in the society contributes them or who receives the benefits. This is the social or economic benefit of the investment. Policy makers must be concerned about where scarce capital resources can best be directed to maximise social welfare. They are concerned to know which among alternative investments yields the highest social benefit.	In contrast, the individual financial authority or organisation which participates in the investment (farmers, hoteliers, businessmen, private companies, etc.) are concerned about the return to the private capital invested. This is the financial return or private benefit. In financial analysis, on the other hand, although the same discounted cash flow methodology is applied, the setting up of the analysis and the elements normally included in the cost and benefit streams mean t hat the results will be a measure of the return to the private investors in the project.

Financial analysis may show that the authority responsible for operating a project will not have revenues large enough to cover the capital cost. Even so, it will still be worthwhile to undertake the project if the economic analysis shows the total benefits to the society to be favourable.

There are three very important distinctions between CBA and financial analysis :

- In CBA certain prices may be changed to reflect true social values. In financial analysis market prices include taxes and subsidies.

- In CBA taxes and subsidies are treated as transfer payments. The wealth generated by an investment includes any taxes the project can bear during production or sales taxes buyers are willing to pay in consumption. Taxes are part of the total benefit transferred to the society to spend as it sees fit and are not treated as a cost. Conversely, a subsidy is a "cost" to the society since it is an expenditure of resources which the society incurs to operate the project. In financial analysis such adjustments are unnecessary; taxes are treated as a cost and subsidies as a benefit (return).

- In economic analysis interest is not deducted from benefits since it is part of the total return to resources available to society as a whole and it is that total return including interest which economic analysis is designed to estimate.

(Price-Grittinger, *Economic Analysis of Agricultural Projects*, p. 5-8).

CBA is a process for providing information and analytical tools necessary for identifying and estimating the value of all benefits associated with environmental improvements (over and above cash revenues) to serve as a framework for decision making for the allocation of funds for environmental programmes.

The serve this purpose CBA typically concentrates on the following key components :

- Identification and quantification of social benefits and resource costs in terms of a common monetary unit.

- The flow of benefits minus costs arising over time are brought under present values for comparison in order to arrival at a net present value.

- Unquantified effects are evaluated in qualitative terms so that they may be considered together with the quantified values for better decision making.

- Distributional effects are identified as guides for decisions regarding equity issues and strategies for the financing of investments.

- Conclusions are drawn for wider policy actions and long - term investment priorities.

3. THE INSTITUTIONAL CONTEXT OF CBA

Environmental investments and decisions leading to their implementation are made in various institutional contexts. Three such institutional contexts may be suggested :

- local/regional environmental control authorities with responsibilities focusing mainly on engineering/technological considerations.

- local/regional land-use-transportation planning authorities responsible mainly for formulating and implementing integrated resource planning and management policies.

- central economic planning ministries with responsibilities for defining national/regional investment priorities and approving budget allocations.

The institutional context and the policy framework in which specific environmental problems are defined, and the need for investment is perceived, are important for the methodological scope of the CBA and influence the practical purposes which CBA should serve.

There are at least three broad approaches which CBA may be expected to follow roughly corresponding to the institutional / policy context in which it operates :

(a) On-going projects : (Benefit-side studies). Environmental protection authorities often implement projects and undertake expenditure which although necessary for the improvement of the environment are launched without prior full consideration of all the benefits that are likely to accrue to the community. Decisions are taken mainly on the basis of financial cost estimates while project preparation concentrates on technical design and engineering studies. CBA may be introduced within on-going projects to serve the purpose of identifying the non-market long-term social benefits (direct and indirect) at a time when the project is already under construction to present the "benefit side" of the expenditure for follow-up budget allocations.

(b) On-going land-use / transportation strategies with environmental objectives included : (Cost-side studies). Regional or national planning authorities responsible for the implementation of regional development policies often assign high priority to the implementation of specific environmental improvement projects to achieve clearly defined objectives relating, for example, to the reduction of marine pollution, protection of lakes or forests for recreation, etc. CBA may be introduced to evaluate the financial costs necessary to achieve specific environmental benefits (such as reduction of sea pollution, saving a lake or a forest, increasing recreational opportunities, etc).

(c) Evaluation of alternative environmental investments : (CBA part of the process of environmental management). National / regional economic planning authorities responsible for the formulation of medium and long term investment programmes often use CBA in order to make choices between alternative investments and competing project designs on social grounds and ensure that scarce public resources are used to achieve the highest benefit to society.

It is therefore essential to view CBA as part of the institutional framework in which it operates. The institutional setting will inevitably influence the approach of CBA and the definition of costs and benefits relevant to the project setting. In cases where project proposals are already defined and costed (case a) CBA accepts financial costs as a basis and focuses on the identification and social valuation of benefits. In cases where new investment programmes are formulated (case c) costs are estimated in social terms as a better reflection of the (resource) cost of undertaking investment and generating desired benefits.

4. IDENTIFICATION OF COSTS AND BENEFITS

CBA is concerned with all costs and benefits associated with environmental investments. On the cost side, three broad categories of costs should be considered : (i) *Capital costs* (ii) *Operating costs*, (iii) costs associated with *environmental damage, resource degradation* and *human / social impacts* (dislocation, loss of amenity, noise etc). The first two categories are often given in market prices and adjustments may have to be made to arrive at "shadow prices" expressing the value of resources excluding taxes, subsidies and other transfer payments. Human and environmental costs require valuation based on social pricing (explained later). The disruption of village communities, forests, coastal landscapes, health hazards etc. are examples of human costs requiring social valuation approaches.

On the benefit side, two major categories are identified as important : (i) *Direct benefits*, which often correspond to monetary benefits as indicated by cash/income benefits and (ii) *Indirect benefits* or non-market benefits which are estimated through social valuation principles (explained later).

The above cost/benefit categories provide only the framework within which practical choices and decisions must be made in the light of what is feasible to obtain at low cost in the specific institutional and country context. Maintaining a broad perspective on costs and benefits is still the best starting point in looking for relevant information for further use. Whatever the specific project at hand, the cost items and benefit categories outlined above are almost certain to be relevant to practical data collection work.

5. VALUATION APPROACHES

Valuation is perhaps the heart of CBA. It is also one of the most difficult steps in CBA. The most important principle of valuation central to CBA is that costs should reflect "opportunity costs" as opposed to financial costs and benefits should reflect willingness to pay as opposed to actual cash payments.

Valuation from a social point of view can be grouped in three main categories referring to market or market-related settings in which indications of values may be obtained to give monetary measures to costs and benefits :

- Conventional markets
- Implicit markets
- Artificial markets

Conventional markets : Existing markets can provide indicators of social values relevant to CBA. There are four such indicators which can be used effectively : (i) changes in production, (ii) replacement cost, (iii) preventive expenditure and (iv) human capital changes. The choice of indicator depends on the problem under investigation. Sometimes several approaches may be combined: Air pollution from industrial sources may affect agricultural output and/or tourist income (approach 1) necessitate earlier replacement of building materials on houses and/or hotels (approach 2) cause additional construction costs to prevent exposure to polluted sites, three - glass windows etc (approach 3) and cause damage to human health entailing money costs, loss of wages and time (approach 4). Many environmental impacts have direct effects on production levels: Pollution can damage fisheries and potable water; Soil erosion reduces the value of crops.

Implicit markets : The main concepts behind this approach to valuation is the link between the consumption of market goods with strong environmental characteristics (like *houses* in different residential areas) and people's willingness to pay a premium on houses with such environmental characteristics. Thus changes is environmental quality will reflect on *house prices* and differences in the price of houses of similar architectural type and size are very likely to offer clues to the value of residential amenity and environmental quality. The same basic idea leads to the use of *travel costs* as indication of people's valuation on recreational areas, parks, coastal environments etc.

Artificial markets : It is not always possible to draw inferences from actual behaviour as in the approaches outlined above. Sometimes valuation may have to be measured through further manipulations and hypothetical situations in order to estimate the *willingness to pay* for an environmental improvement or for preventing environmental damage. Alternatively, to estimate *the willingness to accept compensation* for environmental damage or a project with negative effects.

6. DISCOUNTING

It is impossible to make any economic sense of any project or programme unless you are able to compare costs with the flow of benefits. The need for comparison is the reason for identifying costs and measuring the benefits. As costs and benefits occur over time it is necessary to bring all costs and benefits with different time - profiles under a common present value. The importance of bringing all costs and benefits on a common basis is particularly crucial in environmental projects which typically have long-term benefits and large initial costs. The process of expressing the stream of benefits arising over time in terms of present values is done through discounting by using or appropriate discount factor.

The choice of the discount factor is controversial because the higher the discount factor the lower is the present value of benefits arising later in time relative to benefit (and costs) arising earlier. For example : an increase in tourist income of $100 million arising in 20 years time is worth $14.8 today at a 10% discount factor but $37.7 at a 5% discount factor. Another controversial issue concerning discounting is that it expresses society's preferences between present consumption relative to conservation of resources for future use. Higher discount factors imply stronger preference for earlier use of resource (development) allowing fewer choices to future generation (non-sustainability).

Generally, the choice of the appropriate discount factor should be established by the national planning agencies in the context of national priorities and environmental concerns. It should be clear however, that the higher the discount factor the lower the Net Present Value which implies that environmentally desirable programmes with long-term benefits may appear financially and even socially unfeasible.

The proper way to approach the issue of discounting in environmental projects is to select the factor in close consultation with national authorities so that it best reflects the investment opportunities and the environmental concerns within the national economy.

To avoid underestimation of long-term benefits CBA should concentrate on adequate valuation of benefits and risk rather than on manipulation of the discount factor.

> "Instead of adjusting discount rates we recommend therefore that environmental efforts be concentrated on :
>
> (i) improving valuation techniques, including valuing costs and benefits more carefully;
>
> (ii) integrating environmental considerations into all economic decisions; and
>
> (iii) incorporating a sustainability constraint into the appraisal of environmental programmes."
>
> (David Pearce, Aril Markardya, Edward B. Barbier
> *"Blue print for a Green Economy"*, p. 151, 152)

7. DISTRIBUTION EFFECTS

The analysis of distributional effects is an important part of the CBA. It raises important questions about who pays the costs and who incurs the benefits of environmental improvements. There are two aspects which require attention : the first aspect is a matter of *equity* and focuses on the distribution of costs and benefits between the rich and the poor. If the benefits of environmental improvement accrue to rich property owners or high-income neighbourhoods or

prosperous regions, CBA should highlight the fact that the investment will improve the living standards of the rich at the expense of the poor. The second aspect is a matter of *financial strategy* and concerns the issue of how to design a system of beneficiary charges or taxes through which to recover all or part of the cost of projects to ensure replicability and fairness. There are two approaches to the cost recovery problem : (i) Cost recovery through the *general tax system* using the existing tax bases (income, property value or water consumption) and (ii) cost recovery through *direct beneficiary charges* or levies assigned to the identified user/beneficiary group (hoteliers, visitors to a park, residents of the area improved etc).

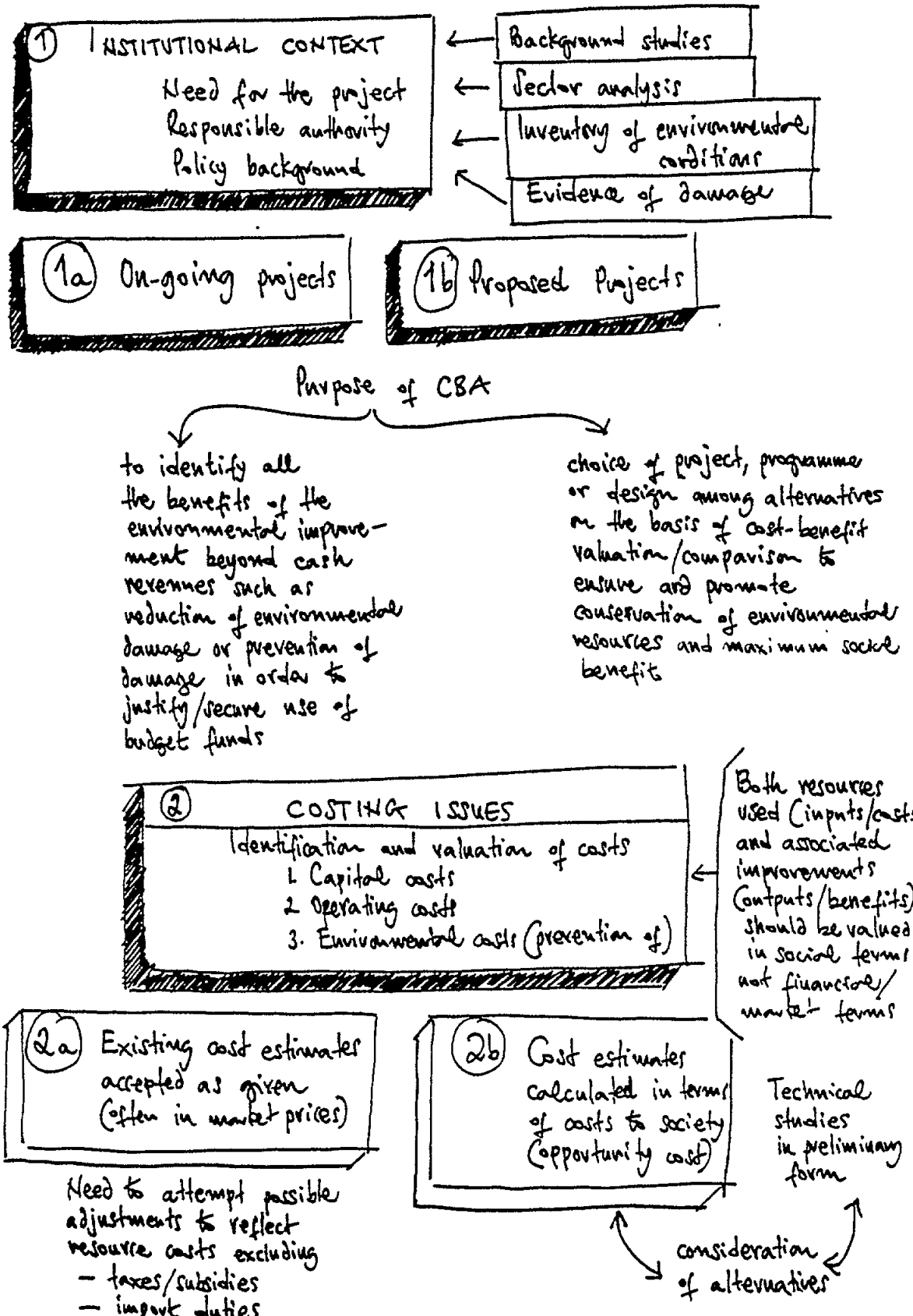
8. FINANCING CONSIDERATIONS

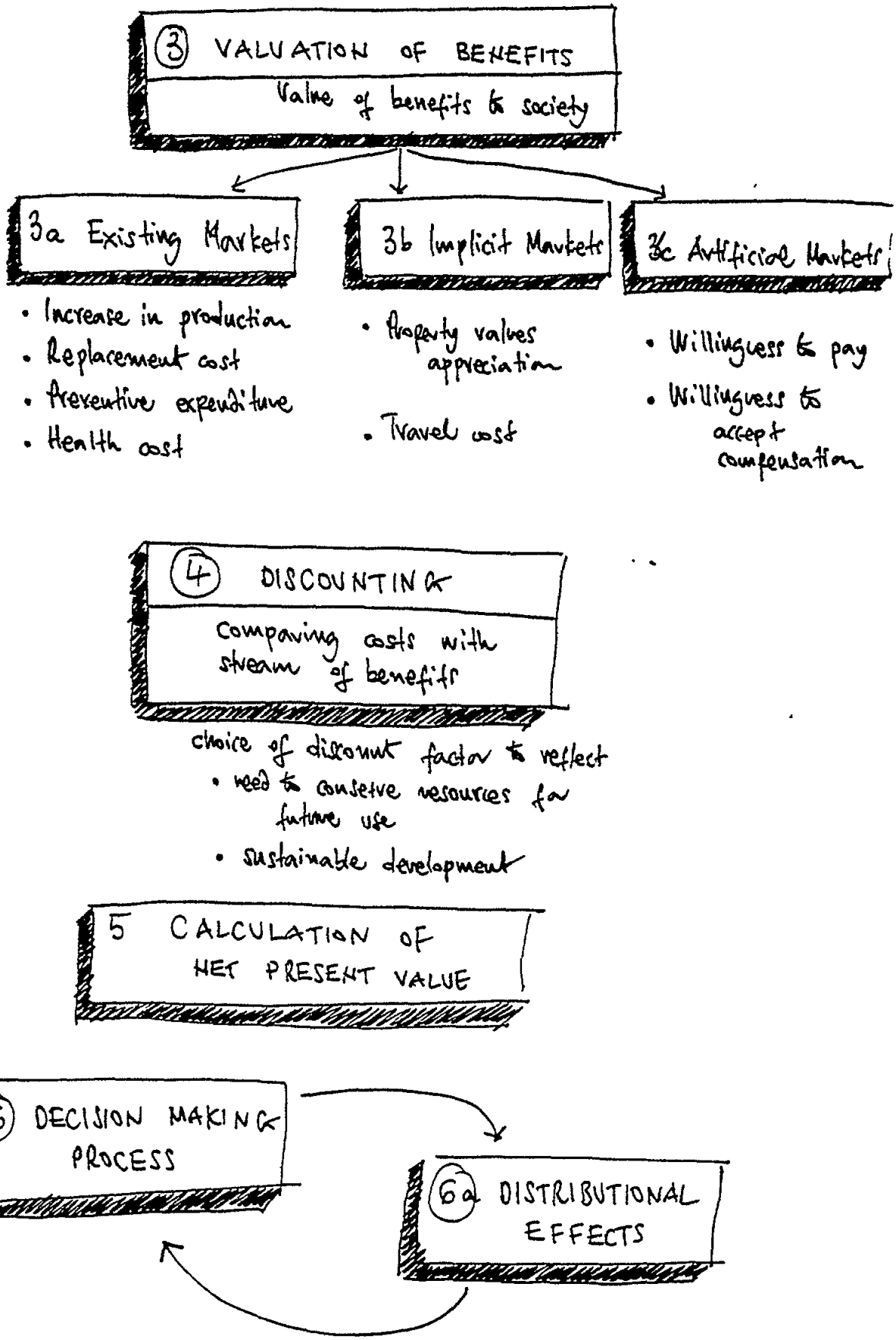
Even though the focus of CBA is on the welfare of the society as a whole attention should still be directed to the public authority operating environmental improvement investments and the management of financial resources at its disposal. Financial management and the mechanism of converting social benefits into cash income remain significant aspects in CBA. For example, the public authority operating a sewerage system has to remain financially viable in order to continue as an active agent of environmental policy. When the benefits generated by a sewerage system are large enough to make the system socially viable, financial strategies have to be designed to cover the costs undertaken by the authority. Often public authorities are politically unwilling to impose on the beneficiaries full - recovery sewerage charges (or water charges) in which case subsidies are necessary. It is a matter of financial analysis to show how much this transfer payment will amount to, who will receive it, who will ultimately finance it, and how if will affect the finances of the authority. Financial analysis is important when we turn to tackle the distributional effects of environmental projects and decide on the incentive system for the use of the services by different income groups with different ability to pay. It is of little actual benefit to society to construct a project which is potentially valuable to society when individual households are unable to afford its services. Financial considerations, although different from social considerations, must always the incorporated within the CBA process.

9. POLICY ACTIONS AND INVESTMENTS PRIORITIES

Financial analysis cannot take into account the social costs of environmental damage and the social benefits of investments necessary to protect the environmental and natural resources. Without the use of CBA city administrations and national governments will have little information and analytical concepts to justify investments in environmental programmes on the basis of long-term social benefits leading to scarcity of funds, fragmented policy actions and degradation of the environment.

BASIC METHODOLOGICAL STEPS IN CBA




3 VALUATION OF BENEFITS
Value of benefits to society
3a Existing Markets
• Increase in production
• Replacement cost
• Preventive expenditure
• Health cost
3b Implicit Markets
• Property values appreciation
• Travel cost
3c Artificial Markets
• Willingness to pay
• Willingness to accept compensation
4 DISCOUNTING
Comparing costs with stream of benefits
choice of discount factor to reflect
• need to conserve resources for future use
• sustainable development
5 CALCULATION OF NET PRESENT VALUE
6 DECISION MAKING PROCESS
6a DISTRIBUTIONAL EFFECTS