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GENETICALLY MODIFIED CROPS FOR BIODIVERSITY CONSERVATION? REFLECTIONS FROM THE GM DEBATE IN COSTA RICA

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ABSTRACT

A series of events in Costa Rica over the past months – from the departure of Monsanto to the issuing of a request by the national president's son that all transgenic crops be destroyed – has attracted attention to the debate about whether or not to continue permitting the cultivation of genetically modified seeds in the country. Proponents of GM cultivation have relied heavily on the argument that using GM food production can increase yields, thereby freeing more land for biodiversity conservation in national parks and protected areas. What do these proposals entail, who are their proponents, and why does biodiversity play an important role? This paper uses the current debate to understand the various interests in preserving Costa Rica's biodiversity, and the driving forces behind the promotion of GMOs as a catalyst for its conservation.

CONTENTS

ACRONYMS AND ABBREVIATIONS

ACPB	Central American Alliance for the Protection of Biodiversity
ACR	Agribiotechnology Costa Rica, S.A.
AESO	Association of Social Ecology
ANT	Actor Network Theory
CATIE	Center of Research and Teaching in Tropical Agronomy
CBD	Convention on Biological Diversity
CDC	U.S. Centers for Disease Control
CGIAR	Consultative Group on International Agricultural Research
CIBCM	Center of Investigation of Cellular and Molecular Biology
CIBCM	Center of Investigation of Cellular and Molecular Biology, Costa Rica
CNTB	National Technical Commission on Biosecurity
COPROALDE	Coordinator of Alternative Development Projects
CORBANA	National Banana Corporation
COVIRENA	Committee of National Resource Vigilance
FECON	Costa Rican Federation for the Conservation of the Environment
GM	Genetically Modified *or* Genetic modification
GMO	Genetically Modified Organism
HYV	Higher Yielding Variety
ICT	Costa Rican Institute of Tourism
IICA	Inter-American Institute for Cooperation on Agriculture
INBio	National Biodiversity Institute
INBio	National Institute of Biodiversity
ISAAA	International Service for the Acquisition of Agri-biotech Applications
ISNAR	International Service for National Agricultural Research
ITCR	Technological Institute of Costa Rica
MAG	Ministry of Agriculture and Livestock
MINAE	Ministry of Environment and Energy
RCB	Biodiversity Conservation Network
SINAC	Sistema Nacional de Areas de Conservación
STS	Science and Technology Studies
TNC	Transnational corporation
UCR	University of Costa Rica

1 INTRODUCTION

1.1 "No consensus on transgenics"

In May of this year, a daily national newspaper of Costa Rica, *La Nación*, published a front-page article entitled "No consensus on transgenics: a global discussion with repercussions in Costa Rica," (Barquero, 2004) reporting that, despite the small, experimental scale of their cultivation, genetically modified (GM) crops are generating an intense debate in the country. Four months later, on the 20th of September, Monsanto, the multinational corporation that holds over 90% of the world's transgenic seed market (Kimitch, 2004), retracted its plans to plant GM maize in the province of Guanacaste, and closed its Costa Rica office (Kimitch, 2004). A short eight days later, Abel Pacheco, president of Costa Rica, approved of a legal modification that grants civil society an official voice before the National Technical Commission on Biosecurity (CNTB) (Noticias centroamericanas de la sociedad civil 2004). With the ink on the amendment still drying in the press, the Ministry of Environment and Energy (MINAE) submitted a public letter to the CNTB and the Ministry of Agriculture and Livestock (MAG), requesting a moratorium on GM cultivation in Costa Rica (Ponchner, 2004). The letter has not yet received a response, and the true impetus behind Monsanto's decision to pull out may never be clear, but the events of this year witness to an issue that is very much alive and contested in Costa Rica, one that merits—and calls for—some detailed scrutiny.

1.2 Land-for-Nature: A proposal for the *Green Leader*

Over the past decades, Costa Rica has gained a reputation as an environmental leader for its conservationist policies, both internationally and nationally. Internationally, Costa Rica has been an active promoter and participator in the signing of international goal-oriented agreements aimed at "conservation" and "sustainable development." Great emphasis is placed on the model of safekeeping Costa Rica's wealth of biodiversity through parks and protected areas as the principle means of achieving sustainable development; an extensive system of national parks and protected areas places 25% of the country's territory under some form of environmental protection (PROCIG 2004).

The search for opportunities to increase the number of protected areas is continuously underway, and discussions on agricultural intensification through the cultivation of GM crops as a means of "freeing" more land for conservation of

biodiversity in nature (not agriculture) brought the GM debates to Costa Rica.[1] Although at present the actual cultivation of GM crops is not widespread, political developments like the formation of CAFTA (Central American Free Trade Agreement) have underscored the importance of the debate.[2] The implications of this free trade agreement and the intensified experimentation with GM seeds are making cultivation and trade of GM seeds an ever-likelier possibility, and have lent the GM debate in Costa Rica unprecedented importance. Most compelling, however, is the environmental argumentation for GM food production, due to the importance of Costa Rica's "green image" both nationally and internationally. The different perspectives taken in the debate, more than reflecting a variety of ideological approaches to GM crops, highlight some of the most important general principles underlying Costa Rica's environmental strategy, which emphasizes the conservation of biodiversity through protected areas.

> If Costa Rica is to conserve its biodiversity, it is imperative for the country to design and implement innovative strategies to link conservation and biotechnology, leading to increased agricultural production on less land [. . .] and to maximize the benefits of using in an intelligent manner biological/genetic resources from wildlands (Sittenfeld et al. 2003: 1).

This quote, from an article by Anna Sittenfeld and her colleagues at the Center of Investigation of Cellular and Molecular Biology (CIBCM) at the University of Costa Rica, sums up the essence of the land-for-nature arguments presented specifically for Costa Rica, setting biodiversity conservation at odds with agriculture and proposing biotechnology as a solution to the problem, as well as pointing out the potential economic benefits.[3] In the land-for-nature arguments, the natural biodiversity of the country is at the center of attention, with the cultivation of GM crops proposed as its salvation. The union between biodiversity and biotechnology that is the basis for the land-for-nature argument is based on the idea the GM crops can produce higher yields on less surface area; thus, as described by Dr. Norman

[1] The use of biotechnological processes is nothing new to humankind. From cross-breeding entire plants, to using microorganisms in food preservation methods, to the use of organisms' cells and molecules that begun in the 1960s and gave rise to the Green Revolution. However, the "new biotechnology" referred to here as GM is more specifically the altering of genes or the insertion of DNA—genetic information—from one species (be it of plant or animal) into the DNA of another.

[2] CAFTA will facilitate cross-border trade, which has implications for international trade in agricultural inputs and outputs. (Seed) companies have access to local markets, with little national institutional discretion.

[3] See chapter 3 for more detail on the proponents (and opponents) of GMO introduction into Costa Rican agriculture.

Borlaug, "Growing more crops and trees per acre leaves more land for nature," (High Yield Conservation Protects Biodiversity 2004).[4] The need to grow more crops on less land, beside the need to conserve more land as "nature," is said to arise from the need to provide food for an ever-increasing population. As Borlaug states, "We cannot choose between feeding malnourished children and saving endangered wild species. Without higher yields, peasant farmers will destroy the wild lands and species to keep their children from starving. Sustainably higher yields of crops and trees are the only visible way to save both," or, as Patrick Moore claims,

> [. . .] We need to use the science and technology we have developed in order to feed the world's population, a growing population. And the more yield we get per acre of land the less nature has to be destroyed to do that … It's simple arithmetic. The more people there are, the more forest has to be cleared to feed them, and the only way to offset that is to have more yield per acre (High Yield Conservation Protects Biodiversity 2004).

Is it as simple as that? The argument put forward assumes that food production and biodiversity conservation get in each other's way, and that the pressure both on reserves and on food production comes from an increasing population. However, this Malthusian argument for GM is problematic to apply to Costa Rica, as pressure on food production has less to do with the encroachment by population than with encroachment by *commercial* agriculture.[5] Costa Rica's commercial agriculture sector, particularly of non-traditional exports, is expanding at extraordinary rates. Over the first eight months of 2004, Costa Rica's agricultural exports increased by 10% as compared to the previous year. The fastest growing export crop is pineapple, making Costa Rica the world's largest pineapple exporter in the world ("Piña sigue creciendo" 2004). Banana has also been a number one export for many years, bringing in over 500 million dollars each year for the past five years (PROCOMER, 2003), and is an important source of foreign exchange; 700 million US dollars worth of bananas were exported in 1997 (Sequiera, 1997). For the first semester of 2004, Costa Rica fruit exports in general rose 12% compared to 2003, and pineapple exports rose 34% ("Piña sigue creciendo" 2004).

[4] Dr. Norman Borlaug, known as the "Father of the Green Revolution," won the Nobel Peace Prize in 1970 for his "[achievements] in wheat improvement, and the organization of the exploitation of the results of this improvement in agriculture, particularly in the developing countries" (Lionaes, 1970).
[5] See section 3.2 for a more detailed critical analysis of these assumptions.

1.3 A new green revolution to compensate for the old

The proposal that biotechnology in agriculture offers benefits for a conservation agenda comes at a time in which environmentalist groups and individuals vehemently oppose biotech, in part due to the disastrous legacy left by the pesticides and fertilizers of the agricultural intensification of the Green Revolution (Stonich 1999). GM cultivation was then proposed as an environmentally harmless alternative, and was enthusiastically embraced, even by many environmentalists (Stonich 1999). However, the possibilities of cross-pollination between GM and non-GM crops, as well as the potential adverse effects on local ecosystems, and the fact that many GM crops still required considerable inputs (especially water), soon revived concerns. Environmental voices have often been neglected or silenced, but this is becoming increasingly difficult in a global market where corporations and governments alike must maintain a façade of green responsibility. Thus GM seed manufacturers were once again faced with the challenge of how to convince a "green public" of the ecological benefits of their product. The land-for-nature proposals attempt to convert the sceptics of the second Green Revolution.

The land-for-nature argument presented for Costa Rica can be summarized as follows: The population of the country is increasing, so more food is needed to feed everyone. In order to provide all the necessary food using agricultural practices currently employed, more and more land will need to be brought under cultivation, which means the land cannot be used for other purposes. If we find a way to produce more food on less surface area of land (and the suggestion is to use hyper-efficient GM crops), more land can be set aside as protected areas for conservation. Consequently, the more land that is set aside as protected conservation areas, the greater the biodiversity wealth of the country.[6]

The argumentation offered echoes the reasoning used in the 1950's to usher in the Green Revolution, which also raised alarm about an apocalyptic over-population crisis, and promised that higher-yielding seed varieties (HYVs) would solve the problem. However, "The prospective yields of HYVs [. . .] depended on substantial use of pesticides, irrigation, and fertilizers" (Ross, 1998: 163).[7] Beside the fact that, more than fifty years down the line hunger is still a problem, the fertilizers and

[6] See section 3.1 for a summary of these assumptions.
[7] As is also pointed out, traditional seeds would also have responded to fertilizers (Ross 1998: 163).

pesticides have not been as harmless as they were once proclaimed to be, and high-input HYVs do not sell well with the health- and environment- conscious. In fact, "expansion of agricultural boundaries, improper use of water and land, abuse of toxic agrochemicals and low productivity" are considered important contributions to what has "[. . .] resulted in the last decades in poor natural resource management [. . .]" (Sittenfeld, 2004: 2). As a result, a new Green Revolution, without the pesticide stigma of the old, is promoted in the form of GM crop cultivation.

> [. . .] current agricultural practices observed in developing countries may be more dangerous than the introduction of GM crops, in terms of the effects on the already threatened fragile environments and human health (Sittenfeld, 2004: 2).

The fact that the cultivation of GMOs is currently being hailed as the protagonist of a New Green Revolution makes this debate an especially pressing one, both within local contexts as well as globally. Within the pro-GMO campaigns, the land-for-nature arguments are relatively new, and general arguments and counter-arguments are explored on a daily basis. In the Costa Rican context, the discussion is very current and takes on a particularly powerful and sensitive flavor due to Costa Rica's position in the world as a green leader. Costa Rican models of environmental management are often hailed globally as examples; if the introduction of GMOs is approved as a policy contribution to biodiversity conservation, implications may transcend national borders. It is therefore imperative that the land-for-nature proposal be thoroughly examined in this context. In addition to looking at the arguments against the background of the Costa Rican case, this paper will attempt to use the GM debate that is currently on the table in Costa Rica to understand and highlight the various interests in preserving Costa Rica's biodiversity and in promoting GMOs as a catalyst for biodiversity conservation. Through this discussion, the paper ultimately seeks to answer the following question: *Does the introduction of GMO cultivation facilitate biodiversity conservation in Costa Rica?*

1.4 Limitations and constraints

The current nature of the issues and events raised in this paper lends it relevance, but also imposes some constraints on the discussion. Events relating to the controversial issue unravelled even as the writing process progressed, constantly providing current information. However, this also means that many related issues and new questions arose that cannot be handled within the scope of this project. Time and

space were also limited. Elaborating more extensively on the analysis presented in the fourth chapter could potentially lead to more conclusive discoveries. In addition, a comparative study of the way land-for-nature arguments are employed in different countries could lend strength to the broader arguments put forward in this paper.

The debates around biotechnology and agriculture have a long history and can be approached from many different directions. The approach taken in this paper leads to an emphasis on the national-level policy processes, actors and influences. However, much could be gained from a methodology that focuses on detailed dialogue with a wider variety of actors who are affected by the decisions, or from a historical account of the changes that have taken place in both conservation policies and the agricultural landscape of Costa Rica since before the Green Revolution.

1.5 What to expect: Organization of the paper

The paper is organized into five chapters. This first chapter has given an introduction of the issue to be discussed, its particularities and its relevance to the reader and in the field. The following chapter will clarify the approach that is taken in this paper, the underlying theoretical groundwork and assumptions. Chapter three breaks down the land-for-nature arguments, leading the reader through the assumptions on which the arguments are based and the ideal scenario illustrated by proponents of the position. Using data on Costa Rican food exports and imports, national population, perspectives on the discursive limits on the debate, and information about GMO proponents and the GM seed, the problems with the argumentation are exposed. Chapter four gives an account of the most important actors involved in the GMO policy process in Costa Rica. Through a networking exercise in which the actors' relations to each other are explored, motivations behind the land-for-nature proposals are elucidated. The closing chapter will reflect on the concerns raised by the study, offering the author's perspectives on what it suggests about the relationship between Costa Rica's biodiversity conservation policies and the commercial interests, particularly of the transnational GMO market.

2 POLITICS, POWER AND SCIENCE

2.1 Introduction

The issue of genetic manipulation and agriculture can be approached from many different angles (a purely scientific elaboration, a historical account, a socio-political breakdown, for example). Before delving into the matter of the GMO debate in Costa Rica, it is helpful to explore the perspective – the lens, so to speak – through which the topic is approached in this paper, as well as the framework by which the material is collected and organized. This chapter seeks to show how a variety of theories grounded in political ecology were drawn upon to develop the particular angle that is employed and forms the basis for analysis.

2.2 Theoretical background

Should large-scale cultivation of GM crops be introduced to Costa Rica, the implications will go beyond the agricultural field and the protected area, as experiences from other countries who have taken up the cultivation of GMOs teaches. Adopting a policy, no matter how narrow its target, often has consequences on a broader plain. Agriculture, which involves farmers, traders, seed distributors and other suppliers, transporters, consumers, and a wide range of others, is no exception. A decision may be officially based on an environmental deliberation, but must take into account other considerations. Just as consequences of a decision do not exist in a vacuum, neither do the decision-makers. A policy that is based on a presentation of scientific facts is nevertheless ultimately drawn up and presented by the policy-makers, who are not the scientists alone, but politicians, who in turn deal with pressure from numerous sources. Moreover, scientific discoveries can be presented and interpreted in different ways, and scientists, like the decision-makers, do not work in isolation, either: research requires funding (and funders have their own priorities).

Dealing with the question at hand from this starting point implies an analysis that places the discussion in a political ecology context, bringing together power, politics, and science. This section will thus offer a brief note on what is understood by political ecology, and a critical exploration of various approaches to the interaction between politics, power, and science, from which the analytical basis for this paper is drawn.

2.2.1 Political ecology

Discussions and decisions about environmental matters are never simply that—the knowledge on which the debates are founded has been obtained and developed by human beings or groups of human beings, which inevitably means that its development has been guided by the perspectives and objectives of those involved. Moreover, the environment is not a "thing" on its own that can be manipulated from a distance. Every interaction with the environment is an interaction with consequences for the beings living in that environment. In that sense, environmental policy is no different from any other, in that potential effect – both positive and negative – are not limited to the object of the policy.

The idea that politics and ecology cannot be separated is often referred to, broadly, as political ecology. The term "political ecology" is a general term that covers a wide range of "marriages" of politics and ecology.[8] The sense of the term that is employed as a basis for this paper is the way in which political interests – fuelled by economic interests (political economy) – shape debates that may eventually give rise to ecological policy. The underlying objective is reflected in the following quote on ecologism (the purpose of the author was to differentiate ecologism from environmentalism). "Ecologism is not content with correcting the environmental impact of the system. It examines the *reasons* why certain technologies and forms of production and consumption were promoted in the first place [emphasis added]" (Gortz ,1989: 4 in Goodman and Redclift, 1991: 223).

This paper is based on the assumption that there are specific reasons for the promotion and/or adoption of particular technologies, and that, therefore, the argumentation used to promote the technologies should be examined, both by testing their validity, as well as by developing an understanding of who are promoting the technologies and their accompanying argumentation. In the following paragraphs a variety of relevant and related approaches are discussed.

[8] To name a few, political ecology can mean a) analyzing political phenomena using the same methodology as for analysis of ecosystems, b) research on biodiversity and/or environment that informs public policy, and c) understanding that ecological decisions are the result of political interests and struggles.

2.2.2 Approaches to the policy process

A debate – like the GMO debate – is the component of the policy formulation process in which information is exchanged, shaped and defined. In the introductory chapter of their book on environmental policy processes, Keeley and Scoones present three different approaches to understanding the policy process. These stem from three diverse approaches to how knowledge is established, and are listed by the authors as the following:

- "a reflection of structured political interests [political interests and policy change]
- a product of the agency of actors engaged in a policy area [actor-oriented and practice- based approaches];
- part of overarching power-knowledge relations that discursively frame practice in particular ways [policy as discourse]" (2003: 38).

The first approach presents political interests as having the most important role in policy change, more important than scientific knowledge. The second set of approaches – actor and practice-oriented – consider the weight of the actors as having the greatest influence. The third set approach knowledge formation by looking at how discourse is used to limit and shape the way information is perceived. A combination of the approaches is employed because, as is emphasized, "Analysis of policy processes from a variety of different conceptual lenses highlights the continuous interplay of discourse, political interests and the agency of multiple actors" (Keeley and Scoones, 2003: 39).

Due to the varied nature of the information available for the writing of this paper, this combination of approaches is very valuable and allows for the necessary flexibility.[9] Literature on the policy process proves to be very helpful because Costa Rican GMO policy is currently highly unstable and undergoing debate that could potentially result in changes in policy.[10] Therefore, the process(es) leading up to policy formulation are relevant. A significant part of any policy process is the underlying debate on the policy options and their implications. Different contributions to the debate are made by a variety of actors with particular motivations, and the

[9] News sources, (protest) letters from civil society, scientific and other essays and journal articles, government and other organizations' official websites, books, and government decrees/laws.
[10] At the moment, GMO cultivation for research, seed production and export is permitted. In addition, some foodstuffs derived from or containing GM crops are imported (Actualidad Fitosanitaria 2002).

contributions to debate are backed up by various presentations of knowledge, as well as the power of the actors presenting the arguments.

2.2.3 Actor-Network Theory

"Actor-network theory [ANT] is something of a misnomer since ANT is not one unified theory, but a range of concepts that a group of theorists have, in different ways, applied to the field of science and technology studies" (Brooks, 2003: 41). Nevertheless, actor-network theories are based on the assumption that there are links between local actors, between international actors, between local and international actors, and actors that are in both "worlds". These actors' links form a network, through which information is passed along. "As [truths] circulate through the network, [they] are transformed and re-inscribed into other knowledge-power constellations" (Escobar 1998: 56). Adding to this the consideration that the truths that are propelled by certain actors gain more momentum than those propelled by others, certain truths are produced and reproduced at a much higher rate than others. The influence of the actors thus determines to what extent their truths get through. Also affecting the discourse dominating a network at any given moment is the historical path its construction has taken. As certain definitions are accepted and others discarded, the range of options – the amount of "vocabulary" available – is narrowed in such a way that facilitates some constructions and makes impossible to even conceive others.

ANT makes a particularly useful contribution to the present discussion in that it emphasizes the importance of taking into consideration actors that are outside the local sphere, and to link local representatives to their international constituencies (in the case of this paper, primarily between national organizations and companies, and international companies, or TNCs). Creating complete and accurate accounts of networks, and identifying all the information flows, however, is in practice a different matter than in theory. Links between actors are not always explicit, some actors may hide behind others, and information exchanges are often undocumented or can only be insinuated. Maintaining an awareness of the networks when analyzing "truths," and mapping out what *is* known, however, is valuable.

2.2.4 The Biodiversity Production Network

The field of science and technology studies (STS) also offers an approach to examining, specifically, "biodiversity" through networks. STS scholars analyze

biodiversity as a discourse developed by networks of actors, in which all of the actors influence the network and in turn can be influenced by, the network. “Intervention in the network is done by models, theories, objects, actors, strategies, etc.” (Escobar, 1998: 55). Each actor in the network can be a starting point of a whole new network in itself. The network, and the way it develops due to the identity of the actors, determines how discourse will develop, creating “obligatory passage points for the construction of particular discourses” (1998:56). In reference to the discourse surrounding biodiversity, Escobar describes how the discourse “fosters a complex *network of actors*, from international organizations and northern NGOs to scientists, prospectors, and local communities and social movements. This network is composed of sites with diverging bicultural perspectives and political stakes [emphasis added]” (1998:53).

The interaction between discourses and networks, and the way in which they give rise to each other, is essential in understanding the shape of any debate. Equally important, however, are the “political stakes.” The networks and actors are not neutral nor are they homogeneous. The perspective offered here by STS scholars, as presented by Escobar, offers a structure in which it is possible to see how discourses and networks interact. What is also of utmost importance, however, is a mechanism through which to understand why particular discourses are given preference over others by the particular actors. In other words, to understand the development of the discourse throughout the network(s), it is imperative to understand the driving forces, the motivations, of the actors in favouring certain definitions and interpretations, the process which ultimately gives shape to the dominating discourse that in turn shapes future research and debates. Why do they prefer one approach (to biodiversity, for example) and neglect another? Is there an awareness of other definitions that are ignored because they inconvenience the agenda of the dominating actors in the network?

2.3 Conclusion

> An international regime is being created for biotechnology that is driven by market ideology and transnational corporate control over major segments of the world market (Peritore In: Peritore and Galve-Peritore 1995: 173).

Behind every decision or decision-making process, there is a variety of actors – corporations, individuals, organizations – from different spheres (political, private

sector, civil society) whose interaction determines the formation of knowledge, the way decisions are made, and in whose favour they will work. Which actors are "allowed" to dominate depends on the market priorities. In a neoliberal environment, where economic growth takes precedence, this means "the domination of agricultural research agendas by commercial interests" (Altieri, 2001: vii). Very often, it is possible for the commercial interests of the private sector to influence political decisions because, although on paper the political and private sectors are separate, in practice the members of these spheres overlap (i.e. political decision-makers and researchers informing them often have stakes in or depend on the support of large private corporations). This analysis will draw upon the essential components of the aforementioned political ecology theories to illustrate how commercial interests drive the actor networks. Decisions based on commercial interests do not take multiple interests into account (and therefore lead to unequal distributions of benefits); outcomes are likely to reflect the priorities of the dominant actors.

Particularly with respect to the biotechnology industry, understanding how private (biotech) corporations have extended their influence into other sectors is indispensable; biotech companies increasingly attempt to own or control all parts of the production chain, from the source of raw materials – genetic biodiversity – to the laboratory to the final product for the market. Whereas "the emerging post modern economy is based on contracting out production and remodelling the corporation as an information network rather than as a command hierarchy, the [. . .] biotechnology industry is a notable exception [. . .] Biotech corporations seek vertical integration for many reasons" (Peritore and Galve-Peritore, 1995: 2). However, access to the genetic resources for biotech research often lies with the public sector; government support is needed, and universities and existing research facilities are "incorporated."

As a result of the distribution of power behind the politics, scientific "knowledge" cannot be taken for granted and starting assumptions on which (potential) policy is based merits questioning and validation. To understand the knowledge that is produced, it is important to understand how and by whom it is produced. Uncovering the assumptions on which the argument is based, and sketching the networks of the most important actors can point the way back to some of the key actors and/or motivations behind the land-for-nature arguments in Costa Rica. This, in turn, can lead to a better understanding of why knowledge is being shaped as it is.

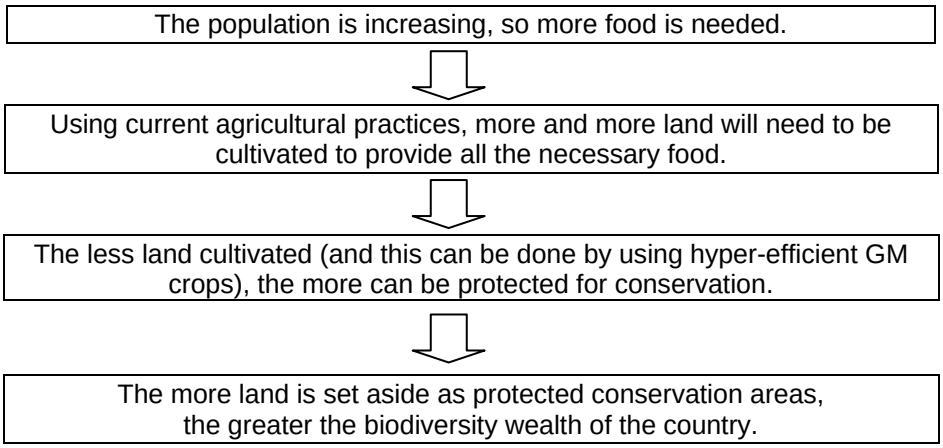
Any debate or event can only be understood if it is understood in its entirety, from the actors and their motivations to their relationships with each other and the issue at hand. Thus is the case with the question of GM crop cultivation in Costa Rica; the arguments endorsing the introduction of GM crops as a catalyst for conservation goals, and the recent departure of Monsanto, cannot be understood in a vacuum, but need to be set within their political and economic contexts.

3 LAND-FOR-NATURE: REAL PROBLEMS, REAL SOLUTIONS?

3.1 Framing the discussion: the Land-for-Nature arguments

The aim of this chapter is twofold. The first is exploratory; the land-for-nature arguments that uphold GMO crops as a solution to biodiversity conservation for Costa Rica will be further described and understood. The second is analytical; the arguments will be placed within the context of Costa Rica, and set against the available information about population, food, and other relevant factors, to discuss the application and validity of the land-for-nature proposals. A case-based, step-by-step examination of the land-for-nature arguments will highlight the shortcomings and gaps in the assumptions on which the arguments are based. It will also point out contradictions in the proposed scenario and in the distinctions between different forms of biodiversity. The contradictions, together with information about the driving forces behind the land-for-nature arguments begin to put large question marks behind the intentions of the GMO agenda.

The arguments are based on a specific set of assumptions that result from the way knowledge and "facts" have been defined in the debate. The chain of logic, from the *assumptions*, to the *proposals* put forward, can be summed up as follows:



This chain of logic implies a number of assumptions, namely:

- There is a real threat of food insecurity/insufficient food to feed the (future) population.
- Current agricultural practices are inadequate to provide the necessary food for the population, as they require too much land.
- The cultivation of higher-yielding crops will lead to more land being set aside for conservation.
- The biodiversity of Costa Rica is found in its protected areas.

In the following pages, the validity of these assumptions and the feasibility of the proposed scenarios will be examined.

3.2 The starting assumptions: Not enough land, not enough food.

3.2.1 Space-saving: Is there a shortage of land?

Arguments stressing the importance of agricultural intensification due to a lack of land claim that "having a quarter of its territory separated for wild land protection, and realizing that only 15 percent of the soils are *adequate* for agriculture, Costa Rica needs to find ways to take advantage of both the technology and its biodiversity [emphasis added]" (Sittenfeld, Espinoza, and Arrieta, 2003). However, the statement is meaningless for analysis unless it is clear what constitutes "adequate" land. Is this a reference to soils found at particular elevations, with adequate levels of naturally-occurring minerals in the top soil, and meeting other scientific qualifications? Or is this a reference to soils in rural areas that are available for agricultural use, because they are not being used for other purposes? It is possible that the parameters include a combination of both; the author offers no clarification. However, a brief historical account of the relationship between the two primary rural activities in Costa Rica – agricultural cultivation and livestock ranching – shows that more of the Costa Rican territory is adequate, in terms of quality, than is accounted for, based on considerations of availability.[11]

[11] There are two main types of livestock raising: cattle for dairy production, and cattle for beef production. Dairy farms are more intensively exploited than beef ranches. Beef ranches require proportionally large amounts of land for a relatively small output.

At the height of the first Green Revolution, which also emphasized the intensification of agricultural production through the use of high-yielding varieties (HYVs), Costa Rica was importing most of its basic foodstuffs, due to the fact that between 1950 and 1973 pasture area had more than doubled, with pasture constituting "76.1 percent of the total [. . .] hectares in agricultural and livestock uses" (Edelman 1987:21). At the time, "expansion of grassland [. . .] occurred at the cost of a dramatic destruction of Costa Rica's forests, [and] at the expense of subsistence crop production. [. . .]. In the traditional ranching province of Guanacaste, the area devoted to maize [. . .] declined" (Edelman, 1987: 21).

Essentially what was going on was not that there was a lack of land suitable for agriculture, and that therefore productivity needed to be intensified in order to feed the country (as are the assumptions of the New Green Revolution), but that land suitable for agriculture was being used for the livestock industry, for the export of beef to the United States. This not only raises the question of land availability, but of hunger. This clarifies why, though there was plenty of land for cultivation, Costa Rica was importing most of its basic food supply, exporting roughly half its beef supply, and Americans were eating four times as much beef as Costa Ricans.[12]

How is this relevant to our contemporary debate? The beef industry still contributes a very significant portion of the national exports, valued at 21.86 million US Dollars in 2002 (FAO, 2002). So while agriculture is blamed for taking land that could be protected forests and being asked to intensify and reduce (technical solutions), cattle ranchers that feed the North American population still take up large portions of fertile land and the real problem of availability of land is not being tackled. This, combined with the booming commercial export agriculture sector, raises questions about whether or not there is really a lack of agricultural land, in absolute terms.

3.2.2 Space-saving: Does more efficient use of surface area lead to less land use?

> The good news is that with modern science and specialization, a given income or quantity of food and fiber can be produced within a much smaller area [. . .] The bad news is the incentive to cultivate as much as possible of the high-productivity land (Mellor, 2002: 2).

[12] In 1979, Total red meat consumption for Costa Rica was 19.8 Kg per Capita per year; for the United States this was 82.7. Roughly the same proportion hold for the whole period from 1961 to 1979 (Edelman, 1987).

Why is it unlikely that the possibility to increase yield does not lead to a reduction in the amount of land cultivated? Despite the advertisement for "increased yields," genetic engineering is about profitability, not productivity.[13] If more crops can be grown on the land available, then all the land available will be cropped, rather than remaining satisfied with an equally-large harvest on a smaller plot of land. There are several reasons for this. First of all, it is not a natural reaction in a capitalist system where the accumulation of profit is a desired, and indeed necessary, goal. If a means of doubling what can be sold on the market is available, the reaction is to sell double, and, therefore, attempt to make double the profit. In addition, there is a further motivation: raising enough money to buy next season's seed and repay loans. GM crops can only come from GM seeds, which, just like the HYVs of the first Green Revolution, do not breed true. That is, they give the desired results for one or two seasons, after which a new batch of seeds needs to be purchased. This is particularly and explicitly true of, for example, Monsanto's GM seeds that have an inbuilt so-called "terminator gene" that renders the plants coming from the seed sterile, marketed as a solution to the fear that non-GM crops could be contaminated by natural pollination from GM crops (Marrero, 2004). This means that the cultivator is bound to a seed provider; for most the initial purchase of the first batch of seeds requires taking out a loan. In order to repay this loan, harvests need to bring in healthy profits, and one way of bringing them in is by maximizing sales. Higher yields are not equal to cost-effectiveness. It becomes a self-propagating cycle, one that is counter-productive to the aim of reducing land use by increasing yields. Furthermore, in a different situation, where the cultivator is a large company, or a transnational corporation (TNC) owning a large enterprise (usually for cultivation of export products), reduction of surface area cultivated does not decrease either, albeit for different reasons. Here the primary motivation is the already-mentioned aim of profit generation, inherent to the raison d'être of a large multinational. Yet, if intensification would lead the company to require less land and still increase profits, the scenario that plays itself out is that any extra land that may be made available will be dedicated to

[13] Despite the fact that GM proponents promise increased productivity, extensive studies have shown organic farms to produce higher average yields than high intensity farms. (Altieri, 2001:44) "Even by Monsanto's standards, few if any of the engineered crops have achieved significant yield increases (from Monsanto Roundup Ready pamphlet. Most yield data show a loss over conventional crops" (Lappé and Bailey, 1999: 89).

another profitable purpose – such as the growing of other commercial crops – or will be left un- or under- utilized, but will remain in the possession of the company as insurance, and therefore is not available to be set aside as a protected area. This land is then not only not used to produce food on, which in itself counters the proclaimed aims of intensification by GM crops, but it is also not used to create protected areas, as it is in the ownership of the corporation.[14] Intensification of agriculture does not lead to a reduction in the amount of land harvested; the very dependency-creating nature of the GM seed distribution system (and previously the HYV seeds), as well as the profit-maximizing drive of the capitalist system in which it operates, prevents it.

3.2.3 The need for more food

The staple diet in Costa Rica consists of rice, beans, and maize. A list of Costa Rica's food imports includes *rice*, *beans*, *maize*, wheat, breakfast cereals, and a few luxury products such as chocolate and pastry (and pet food). A list of Costa Rica's exports features products such as bananas (number one national export), pineapples (number one exporter in the world), coffee, beef and veal, alcohol, oil of palm, sugar, dried cassava, concentrated orange juice, buffalo meat, etc. (FAO, 2002). Costa Rica is importing its staple diet, and exporting luxury foods. It appears that there is a lot of food produced in the country, but it is: a) either not part of the staple diet, or low in caloric and nutritious value, and b) being exported for sale to consumers elsewhere. Cereal exports increased from 1,100 metric tons in 1990, to 18,255 in 1999, and over the same time period cereal imports have doubled from approximately 300,000 to 600,000 tons. "Scarce land" is being used to produce export food products, while at the same time proponents of GM seed crops are claiming to have the answer to the hunger problem.

The same pattern can be found on a global scale, with the added component that countries in the "North" are, in fact, producing excesses of food, at a subsidized rate. Not only that, but there is more food per person in the world today than ever before, with "at least 4.3 pounds of food per person a day worldwide: two and half

[14] The ownership of agricultural land by large holders and/or multinationals generally poses a problem for the pro-GM arguments, as most crops produced on such enterprises are not food crops for local consumption, but are cash crops or luxury foods or animal feed for export particularly in Costa Rica. Coffee is a cash crop for the export market; the crops that are currently grown from GM sees are soy and cotton, which are used as animal feed, not people-feed.

pounds of grain, beans and nuts, about a pound of fruits and vegetables, and nearly another pound of meat, milk and eggs-enough to make most people fat!" (Myths About World Hunger 2004). The following quote spells out the global problem succinctly.

> GMOs are the wrong answer to the wrong problem. The problem is not that there is not enough food, but that too many people have no access to adequate food. Four out of five hungry people live in countries that are exporting food, while Europe and North America are facing food surplus problems (Quote from Philippine rice farmer Rafael Mariano, in: Bessières, 2002).

In addition, growing populations are often blamed for hunger problems, despite the fact that there are also many sparsely populated countries with severe hunger problems. Costa Rica, where the population has more than doubled in the last 20 years from approximately 2 million in 1984 to approximately 4 million in 2004 (La Población de Costa Rica en el siglo XXI 2004), has a life expectancy – an important indicator of nutrition – that is 11 years longer than Honduras', whereas it only has half as many acres of cropped land (Myths About World Hunger 2004), yet more than half its population (Honduras has 6 million people). If hunger is related to amount of food available and population numbers, how is this possible?

Also intriguing is the fact that GM crops are presented as a solution to a hunger problem that is not a result of insufficient food: the GM crops are not being grown to feed the population. The crops are used for the production of GM seeds, not for human consumption. Moreover, they are not food crops: "72 % corresponds to diverse types of cotton, 27% to soy, and *less than 1% to maize and banana*" (Alerta Transgénica, 2003). Even if the crops produced were primarily food crops for human consumption, it would not feed the Costa Rican people. "In Costa Rica, Law 7764 of Phytosanitarian Protection [. . .] only allows investigation and reproduction of transgenic seeds for sale *outside of the country* [emphasis added]" (Pacheco, 2004).

The following table sums up the number of hectares of GM cotton and soy under cultivation by the three leading GM seed companies for the year 2002-2003. The table has been borrowed and translated from a paper by Isaac Rojas, for the organization COECOCEIBA (Rojas, 2004).

	Company			
	D & PL Seeds	Semillas Olson	Semillas del Trópico	Total
Crop				
Cotton	350.30	177.15	39.47	566.92
Soy	11.34	2.1	3.26	16.70
Total	361.64	179.25	42.73	583.62

Between 1997 and 2001, the amounts of transgenic maize planted decreased systematically, disappearing almost completely in 2002. The cultivation of cotton, on the other hand, increased steadily, and GM soy cultivation also rose in 2002. The proportions are noteworthy. In the period 1999-2000, for example, there was an average of three hectares of maize sown as compared to 100 hectares of cotton (Montero, 2002).

Another point to consider is the contamination of non-GM plants by GM-plants through cross-pollination. Maize, for example, cross-pollinates "very efficiently" (Alerta Transgénica, 2003). In various Mexican states up to a 33% rate of contamination of non-GM maize by GM-maize has been registered. The plants that were contaminated were produced for human consumption, but were contaminated by genetic material that is not authorized for human consumption (Alerta Transgénica, 2003). This means that not only were the GM crops not destined to be food for people, but they have contaminated crops that *were*, which means they further *reduced* the local food supply. That means a lost crop this year, but also a contamination of the genetic material of the maize, which means a loss of a strain of maize resulting from years of farming. Despite this example from Mexico, transgenic maize is also being grown in Upala (in the northern part of Costa Rica), a "center of agricultural diversity where a wide variety of types of 'criole' maize is cultivated" (Alerta Transgénica, 2003). The deliberate planting of transgenic maize in an area where non-GM maize cultivation is so diverse and abundant raises questions for some.

> According to Fabián Pacheco, member of the Costa Rican Association of Social Ecology, the genetic contamination is not a simple coincidence. It is an act of aggression planned by the biotechnological corporations (Alerta Transgénica, 2003).

Pacheco and others have reason to believe that the introduction of GMOs, not just in the region of Upala, but in the country as a whole, has little to do with a mission

to save the rainforests. This will become evident in chapter four, which elaborates in further detail on some of the driving forces behind the GMO proposals.

3.2.4 The value of Protected Areas

> A sustainable strategy to provide food security for a growing population must promote biodiversity conservation and avoid further habitat loss of natural ecosystems (Sittenfeld et al., 2002).

3.2.4a "Sustainability"

As the above quote (put forward by a leading writer in the cause *for* GMO introduction in Costa Rica) illustrates, a fundamental starting point of the land-for-nature debates is that an environmental policy based on protected areas is a means of achieving sustainable development, a means by which biodiversity can be conserved, while at the same time economic growth can be achieved.[15] "[. . .] Parks and natural reserves are seen as central instruments for the conservation of biological diversity" (Pimbert and Pretty, 1995: 1).

Incorporating – or indeed featuring – parks in the national sustainable development agenda requires an assumption of the sustainability of protected areas. This is an assumption that should not be taken for granted, particularly with the availability of information on the weaknesses of such a system. Whereas sustainability deals with human needs and the use of natural resources, preservation stresses the needs of nature itself; conservation may thus actually be at odds with sustainability (Lowry, 2002: 176). Beside the better-known problems with protected areas, such as exclusion of local and indigenous peoples, increased marginalization of the local poor, the reservation of access to an elite of national and foreign tourists, and the high costs of maintenance and management of protected areas (or the complex, often conflictive nature of co-management programs), there are problems of sustainability (often due to all the above-mentioned factors), which are problems of whether or not the system can be maintained and for how long. For example, the dependence of protected areas on

[15] The terms "sustainability" and "sustainable development" are much contested, and there is much debate with regard to definitions, employment, and absolute validity of the terms. The description of sustainable development used here is also open to contestation, from the value of economic growth as an indicator of development to the meaning of "conservation." As there are limits to the available space for discussion, I have employed the sense of "sustainable development" used in Rio and resulting policy/agreements since, as the term in that sense is the proclaimed goal of Costa Rican conservation policy, and the discussion at hand seeks to understand to what extent the system can indeed be maintained, by understanding why and by whom it is implemented.

tourism also puts their survival at risk. What happens to the protected areas if the tourism industry suffers a major blow, such as an economic depression, as a result of which people cannot afford luxuries such as travel to "exotic" places like Costa Rica?

The seventh Millennium Development Goal (MDG7), which deals with natural resource management, has two indicators that refer to conservation (Indicators 25 and 27), both of which refer to proportions of surface area covered by protected areas. This focus, beside the fact that it is "on the quantity of land area [and] ignores the quality the natural resources [. . .] and the land and resource rights of people living in and around them," also fail to deal with "a fundamental dimension of sustainability: how the costs and benefits of protected areas and forests are spread among society" (Dilys, 2003: 58). Most important in the present context, however, is the fact that recent experience lends serious doubt to the effectiveness of protected areas at protecting biodiversity.

> [. . .] there is contradictory evidence as to the efficacy of protected areas in conserving natural resources: the IUCN-UNEP list shows that protected area coverage has increased from 2.4 million square kilometers in 1962 to 18.8 million square kilometers today—*and yet, biodiversity and other natural resources are still being lost [emphasis added]* (Dilys, 2003*: 59*).

3.2.4b Bioprospecting

> In order for capitalist economy to continue to extract natural resources—genetic and chemical material, in particular—nature must be sustained as their reservoir, not destroyed and lost. The rhetoric of bioprospecting has been instrumental in opening up biodiversity to consumption, exploration, and conservation by framing nature and its resources selectively in terms of their market value and as commodities (Takeshita, 2001).

Also imperative when discussing the value and sustainability of protected areas is the question of to *whom* these areas are valuable. The protected areas, which are meant to protect a source of biodiversity, are "seen by rich nations as natural raw material that they may freely appropriate and transform into commodities, which are then strongly protected by intellectual property laws" (Peritore and Galve-Peritore, 1995: *xix*). This can take the form of bioprospecting, a model in which the host nation allows a biotechnology industry or corporation to make use of its protected areas for bio tech research (collecting and using biological samples and indigenous knowledge to discover genetic resources that can be used for pharmaceutical or other industries), in exchange for direct funding or technological donations to universities or research centers. Costa Rica's National Biodiversity Institute (INBio), a non-profit private organization that engages in biodiversity-related research, engaged in such an accord

with Merck, a transnational pharmaceutical company, in 1991. The INBio/ Merck agreement became the first model for bioprospecting, and was considered a "win-win model" (Rodriguez, 2001). However, ten years after its inception, the results are described by Rodriguez as follows:

> [T]here have been no pharmaceutical 'hits' and therefore no royalties. Appropriate and affordable medicines continue to be out of reach of those who need it. Bioprospecting techniques are not always non-invasive. There has been only limited and second rate technology transfer. The INBio-Merck contract and similar models have failed to accomplish their own objectives and those of the Convention on Biological Diversity (CBD). 'National sovereignty' has largely become meaningless. Nation states abdicate to third parties the real control of resources and knowledge through intellectual property rights transferred to companies. Pharmaceutical TNCs are pursuing other alternatives (such as combinatorial chemistry and gene therapy) and some are shifting to phytomedicines and nutraceuticals which are not regulated by the CBD or the Food and Agriculture Organisation (FAO). Last but not least, amongst some communities that have received small amounts of money (mainly for samples and labour), the income has been divisive (Rodríguez, 2001).

Despite the fact that in more than ten years' time the deal has failed to produce any of its foreseen potential, Sittenfeld, one of the most prominent writers promoting the land-for-nature arguments for the introduction of GMO crops, as well as former INBio bioprospecting president – head at the time of the closing of the deal in 1991 – writes in 2004 that "the biological diversity in protected areas represents a major renewable resource and a potentially powerful engine for intellectual and economic development" (Mateo, 1996; Sittenfeld, 1996, in: Sittenfeld, 2004: 3). What is further remarkable about the above quote is the reference to protected areas as a "renewable resource." Calling a protected area a renewable resource makes it just that—something that can be used, and endlessly. It is called a "*potentially* powerful engine for intellectual and economic development [emphasis added]" (Sittenfeld, 2004: 3). Also worth noting is the emphasis on intellect and economy, whereas, again, no mention is made of potential social benefits. In fact, later on in the paper, reference is again made to the "pioneering agreements" between INBio and Merck, which are "providing significant returns to Costa Rica" (2003: 4). All this by someone who is undoubtedly aware of the progression of events since 1991, as a president of INBio at the time, and someone who has worked and written extensively for the organization ("What is INBio?: Biodiversity Prospecting: Publications" 2004). The document also explains that "INBio in Costa Rica is negotiating since 1991 agreements with scientific research centres, universities, and private enterprises that are mutually beneficial to all parties" (Sittenfeld, 1996 in: Sittenfeld, 2004: 4). The "all parties"

mentioned do not include civil society, people living in and around protected areas, or those who have been displaced due to the creation of the protected areas.

The fact that the agreement has not had the desired outcomes for the parties involved raises questions about the continued relationship between Merck and INBio.[16] Why does the biotech company maintain its relationship with INBio? And why have other biotech corporations, such as Delta and Pine Land, moved into Costa Rica? In 1991, the protection and expansion of protected areas was beneficial to Costa Rica for reasons of tourism, but also to attract investment such as the Merck-INBio deal, as well as being beneficial to Merck for the same. More than ten years later, the biotechnology world has failed to find what it was looking for in the Costa Rican rainforests, but has found another way of making money off of the country (GMO's). It has been able to use the importance of the country's "green image" to sell its product, while at the same time taking advantage of the good relations between the biotech world and biodiversity as reflected by the Merck-INBio agreement.

Highly relevant to the present debate is the fact that many of the world's largest pharmaceuticals also have agricultural innovation and biotechnology departments.[17] The fact that the largest pharmaceuticals are also involved in GMO research and sales should come as no surprise, as both branches of research require expertise in biotechnology. However, the fact should lead to a more critical analysis of the land-for-nature arguments. If the same companies who benefit from ample sources of "wild" biodiversity are those who also benefit from selling GM seeds and related products, arguments that both promote the use of GM seeds and the expansion of protected areas should at least inspire a thorough examination of the value of the arguments.

[16] See chapter 4 for more on the relations between actors.

[17] On July 26, 2000 pharmaceuticals Novartis and Astra Zeneca "their respective Agribusiness and Agrochemicals activities to create Syngenta, the world's first global dedicated agribusiness company" (*Syngenta merger gets green light from European Commission*, 2000).
Monsanto, the world's leading producer of genetically-modified seeds, has a pharmaceutical subsidiary, G.D. Searle & Co., and has mergers with other pharmaceuticals, such as Pharmacia & Upjohn of Peapack, N.J., as well as medicinal research alliances with biotechnology companies, such as Cambridge Antibody Technology. (Monsanto Teams Up With Biotech Firm in Drug Development Deal, 1999). See also sections 4.4 and 4.5.

3.2.4c Tourism

> [Protected areas are] the main attraction for tourism, which generated US $1,249 million in 2000 (9% of GDP) indicating that protected areas are contributing substantially to the economy (Proyecto Estado de la Nación, 2000, in: Sittenfeld, 2004: 3).

Protected areas are a major tourist attraction – likely the most important tourist attraction – for Costa Rica, where tourism and protected areas have always gone hand in hand. The first protected area was created in 1945, and ten years later the same law that created the Costa Rican Institute of Tourism (ICT) also proclaimed as national parks all areas within a 2-kilometer radius of the country's volcanic craters. In addition, tourism comprises an important part of the GDP, with commerce and tourism together comprising almost a quarter of the total GDP. Tourism, thus, is undeniably important and has become increasingly so. That means that conservation of the protected areas, as central to tourism, is considered high priority, which means investing money in them, and those funds need to come from somewhere. Although the National Tourism Institute (ICT) invests an annual $10.9 million in promoting the country's natural wealth, MINAE lacks funds to preserve them as it should (Varela and Corella, 2003). Interestingly enough, plenty of resources seem to be available for the *promotion* of the nation's "natural wealth," while the actual maintenance of the protected areas, which relies heavily on the availability of funds, suffers (Varela and Corella, 2003). This raises questions about what the parks are there for in the first place. Is the government really interested at all in the parks as places that contribute to a better interaction between nature and humans, or is there a very clear awareness that in reality protected areas mean a separation of nature from humans for the sake of preserving biodiversity (under one very specific definition), an arrangement suitable for attracting tourists and multinationals?[18]

Also important to take into account when considering the value of protected areas to the country, is the fact that Costa Rica's government also benefits from large tracts of protected areas, because they equate "clean air" that can be sold, as according to the Commitments outlined in Article 4 of the 1997 Kyoto Protocol Agreement (Kyoto Protocol to the United Nations Convention on Climate Change, 1997). With reference to tracts of land that had been set aside as national parks by the national

[18] See section 3.3.

park foundation, but not yet handed over to the central government, an article in a daily newspaper, La Nación, writes “In 1998, when it was announced that the country was going to sell oxygen to the world, it was also said that the farms acquired by the foundation were ideal for the project” (Varela and Corella, 2003).

3.3 The proposed scenario: More protected areas, more biodiversity

> Although biodiversity has concrete biophysical constructs, it should also be ‘seen as a discursive invention of recent origin’ (Takeshita, 2001).

3.3.1 The preservation of one biodiversity at the expense of another

There is no single, generally agreed-upon definition of biodiversity, a fact which is both an advantage and a weakness in debates concerning the value of biodiversity. The advantage is that the definition can be adjusted according to the purposes of the debate, or in favour of one’s position in the debate. On the other hand, without an agreed-upon definition of the concept, discussion on the topic is likely to be unfruitful.

Regardless of the definition employed, there are two basic aspects of biodiversity to take into account: quantity and variability of (between and within) species. These aspects are directly related to the measurement of biodiversity, and at what stage and level this measurement takes place. One can begin to talk of a threat to biodiversity when a decline in numbers of a particular species is detected. A decline in numbers that goes so far as to lead to an extinction of a species means a reduction in the variety of species present. Moreover, biodiversity within a species also exists. For example, the variability of the gene pool of a species, which gives rise to different traits within a species, is also an essential component of biodiversity. In fact, a significant and accelerated reduction in the variability of the gene pool puts a species at risk of extinction (which means an overall reduction of species in the environment), as it makes the species more vulnerable to external events to which it has weak resistance. Moreover, “the lower the diversity in an ecosystem, the higher its vulnerability to pests and diseases” (Shiva, 1991: 58).

Cultivation of one single crop (monoculture) is a salient example. If a monoculture of maize is grown on a single plot, and a pest that is particularly damaging to that strain attacks, the harvest will be lost in its entirety. However, if a variety of strains are cultivated on a single plot, then it is likely that portions of the

harvest – those crops that are more resilient to the pest – will be salvaged. This leads to higher degrees of economic and food security.

In the land-for-nature debate at hand, the importance of biodiversity on cultivated land is submitted to the value of biodiversity on non-cultivated land, particularly the land set aside in national parks or reserves. The emphasis tends to be on quantities of species, that is, variability *between* species; variability *within* species takes a second place. Moreover, the suggestion that land under agricultural cultivation be reduced and converted in as much as possible to protected land suggests a hierarchy of biodiversities: the biodiversity found in national parks is considered more important than the biodiversity found on the farm. Advocating GM, the following quote appears to suggest that agricultural diversity should even be sacrificed for the sake of natural diversity: "Costa Rica needs to develop agricultural practices that are friendlier to *native* biodiversity [*emphasis added*]" (Sittenfeld, 2004: 5).

The term "biodiversity" deserves particular attention, as it is the different possible interpretations and means of employment of the term that underlie the differences of opinion in the debate. The differences in definition are inseparable from the actors and the way their preferred "knowledge" is brought into the debate. In fact, Escobar goes so far as to point out that the discourse surrounding the definition of biodiversity gives rise to the network in which these actors are placed, and that in fact biodiversity "from a discursive perspective, then, [. . .] does not exist in an absolute sense. Rather, it anchors a discourse that articulates a new relation between nature and society in global contexts of science, cultures, and economies" (1998: 55). Biodiversity as a discourse is a relatively new construct. In fact, biodiversity did not appear in the 1989 *Oxford English Dictionary* (Mc Pherson, 1995). "The *textual* origins of the emergence [of biodiversity as an exclusive term for "natural diversity] can be identified with precision: the publication of Global Biodiversity Strategy (WRI/IUCN/UNEP 1992); and the Convention on Biological Diversity (CBD), signed at the Earth Summit in Rio de Janeiro in 1992. Subsequent texts and elaborations, from the plethora of UN and NGO meeting reports to Global Environmental Facility (GEF) project descriptions, exist within the confines of this discourse" (Escobar 1998:54). Costa Rica has been a cosignatory of a large number of international agreements on biodiversity, sustainable development, and conservation, all of which are limited to the confines of this discourse. National law and documentation on issues of biodiversity conservation reflect the discourse employed at the global level.

The definition of biodiversity tends to be mono-faceted and refers to biodiversity as the variety of species found in "nature," to whose conservation national parks and protected areas are dedicated (Sancho, 2001). The one-dimensional usage of the term has a) excluded other faces, or occurrences, of biodiversity from the documented agreements and law, and b) has made it very difficult, if not absurd, to draw attention to biodiversity within a context other than that of the rainforests, marine parks, or protected areas.

> Just six years after its adoption at the 1992 Rio Earth Summit, the Convention of Biological Diversity (CBD) is starting to transform the international community's approach to biodiversity. This progress has been driven by the Convention's inherent strengths and near-universal membership (over 170 parties), a comprehensive scientific-driven mandate, international financial support for national projects, world-class scientific and technological advice, and political involvement of government ministers (Downloaded from the CBD web page, text from the fourth meeting of the Conference of the Parties (COP 4), Bratislava May 4-15, 1998, in: Escobar, 1998: 57).

As has become evident, "the discourse of biodiversity as resource management is linked to three other discourses: conservation science (and related fields), sustainable development, and benefits sharing [. . .]" (Escobar, 1998: 58). The discursive boundaries in which biodiversity can exist limit discussion of biodiversity in a way that excludes other forms of biodiversity, not only making it impossible to defend them, but erasing them from common "vocabulary," making them impossible to discuss. Ultimately, one biodiversity is given so much precedence over another that it becomes the only acceptable one.

This subordination of one biodiversity before another, the fact that the loss of one biodiversity (cultivated) at the expense of another ("wild") is recommended, raises questions. Each has its merits. "Agricultural biodiversity [. . .] contributes to productive and environmental sustainability, as well as supporting rural development" (Dilys, 2003). Biodiversity of "naturally occurring" tropical plants and animals contributes to the maintenance of the ecosystem at large, and holds tremendous potential for medical and technological advances. "[. . .] The environmental/biological interest in maintaining biodiversity is increasingly shared by industry, albeit from a more utilitarian perspective. [. . .] Biodiversity has [. . .] become a potential industrial, genetic resource" (Pistorius and van Wijk, 1999: 1).

Why is one considered more important than another, and who decides which is more important? Biodiversity on the farm is important to the cultivator. Biodiversity

in the protected area in Costa Rica is important for the ecotourism industry (specifically, the attraction of tourists to the national parks), and for research bioprospecting. Clearly, both have significant value; agriculture is the food source for all people, whereas ecotourism strengthens the national economy, and medicinal research can lead to the valuable discoveries. But for whom, exactly, are these most valuable? Who profits the most from each benefit? Essentially, the value of the source of biodiversity is determined by the use that can be extracted from it, and therefore by who profits from it. The rural population, being those who are most directly affected by the biodiversity of their surroundings, and specifically the agriculturalists, who depend most directly on a safe and resilient crop – and therefore on agricultural biodiversity – are the poorest segment of the population.[19] Those who profit from tourism, on the other hand, are investors in the hotel industry, the food and catering business, and other tourism-related industries, such as chartered transport or tour booking. These investors, particularly in the luxury hotel industry, are often foreign investors, or already belong to the wealthiest groups of society. Needless to say, tourism also provides jobs to local middle-to-low income earners, but these are not the main beneficiaries. Finally, those deriving benefits from bio prospecting are, by far, primarily the large pharmaceuticals and biotech corporations (often seed producers themselves).[20]

Although rhetorically it is possible to make distinctions between various "types" of biodiversity, the reality of the matter is more complex. First of all, diversity within and between species cannot be isolated from each other (as diversity within species is often what leads to diversity between species). Moreover, it is impossible to separate diversity "in the field" from diversity in the protected tropical forest. In reality there are no gene-proof walls around national parks or enclosing cropped fields, and one "gene pool" cannot be separated from the other. That is, genetic material can be shared between the maize field and the rainforest by cross-pollination, or feeding animals. The gravity of the consequences of this possibility is much-debated. For the case of Costa Rica, however, the results of one set of studies are enough to put a question mark behind the arguments that GMOs can help preserve the

[19] Figures from the national census of the years 2000-2001 show that the average rural income is more than 1.7 times less than the average urban income (Madrigal, 2001).
[20] See sections 4.5 and 4.6.

highly-valued biodiversity of the tourist-attracting kind. The studies divulged that GM maize pollen has been shown to have detrimental effects on the health of the monarch butterfly, particularly its larvae (Smith 2003:6). Results revealed that pollen from GM maize can cause the monarch caterpillar to die or not undergo full development, leading to underdeveloped, malformed larvae or butterflies. This simple detail raises interesting concerns for the case of GMOs in Costa Rica. The monarch butterfly is one of the prized species – specimens of "natural" biodiversity – in Costa Rica's national parks. It seems ironic that growing GM crops is proposed as a solution for the preservation of more species in these national parks, when there are real possibilities that the GM crops may not only lead to a reduction of biodiversity through monoculture and contamination of plants both on and off the agricultural field, but may actually harm existing valuable species of plants and animals in the protected areas.

3.3.2 Space-saving: Can "rescued" land be set aside for biodiversity protection?

Knowing with precision whether or not agricultural land that is currently being farmed could potentially be converted into protected territory, would require precise accounts of the geographical location of the land, what is grown on it, how much land could be "saved" by the intensification brought on by GM, and a number of other indicators that can only be determined by research that extends far beyond the scope of this brief study.

Also affecting the possibilities of converting land into protected areas is the preferred approach. If there is a preference for the enlargement of existing parks, then potential areas need to be situated near the parks. If, however, the creation of entirely new areas is also possible, then proximity to existing parks is not important. However, there is still a setback to consider: if pieces of land from several farms actually becomes superfluous and is allotted for conservation, then one visualizes a fragmented scattering of small plots of protected areas. Of course, this would be ineffective at providing suitable habitats for many prized "wild" species.

Therefore, regardless of the approach taken to the conversion of farms into parks, the process would entail the planning of a tremendous overhaul of an entire region or province, with the reallocation of territory to different purposes. Put simply, we would have to take what each cultivator is "freeing up," (assuming, of course, that GM crops lead to reduced land use), add it up, and find a spot somewhere where that

amount of land can be turned into a park. Then each farmer would be allotted a new plot, smaller by the amount that has been given to the park by that farm. This process would have to be repeated every time agriculture is made more efficient and new land is set aside, provided of course, that the land would, indeed be left uncultivated. Clearly, the idea of handing over agricultural land to conservation is a straightforward plan in theory, but in practice very difficult to carry out.

3.4 Conclusion

The starting points from which the land-for-nature arguments are launched are incorrect assumptions, and the solutions proposed unrealistic. This poses a problem: if the proposals don't seem to have a feasible future, why are they kept in circulation? And who are the actors who are promoting them? The following chapter will seek to get a little closer to an answer to these questions.

4 TWO SIDES OF THE SAME COIN

> As a keystone science in the transition to a 'postmodern' world economy, biotechnology is considered a strategic good by national governments and transnational corporations. It is being developed with a triangular relationship between government, corporate business, and university laboratories, and the venture capital firms that spin off from them after making commercially valuable discoveries (Peritore and Galve-Peritore, 1995: xviii).

4.1 Introduction

An online article titled "High-yield Conservation Protects Biodiveristy," published by the Center for Global Issues (http://www.highyieldconservation.org), reports that on April 30, 2002, "a broad coalition of food, environmental, farming and forestry experts – including two Nobel Prize laureates – invited their colleagues worldwide to co-sign a declaration in favour of high-yield conservation." A photograph taken during the presentation of the declaration features some of the co-signatories, including Dennis Avery, Rudy Boschwitz, Patrick Moore, Norman Borlaug and Eugene Lapointe. Other co-signatories include Oscar Arias, who is a former president of Costa Rica, Per Pinstrup-Andersen, James Lovelock, and George McGovern. Some of these names may ring bells to those who are familiar with Green Revolution history or conservation movements, and should come as no surprise. Norman Borlaug, for example, is considered the "Father of the Green Revolution,"

due to his work with genetics and plant breeding of wheat in Mexico, a project that was initiated in 1944 and was funded by the *Rockefeller Foundation* (Nobel E-Museum 2004).[21] Some background on several of the other cosignatories, however, may offer further insight into the GMO agenda in Costa Rica.

Dennis Avery is a Senior fellow of the Hudson Institute, an institute which "is funded by many firms whose products are excluded from organic agriculture: e.g., AgrEvo, Dow AgroSciences, *Monsanto*, Novartis Crop Protection, Zeneca, Du Pont, DowElanco, ConAgra, and Cargill." (Dennis T. Avery: Profiles: GM Watch, 2004) Given his sponsorship profile, it is perhaps not surprising that Avery is one of the prominent signers of the declaration. It is perhaps also an explanation for why Avery would publish a book titled "The Hidden Dangers in Organic Food," in which he claims that studies by the CDC (U.S. Centers for Disease Control) showed that eating organically-grown foods increases the chance of being attacked by the E.Coli bacteria eightfold, despite the fact that the CDC never conducted any research comparing E.Coli risks in organic foods as compared to non-organic foods. He published the book even as a UN FAO report concluded that organic foods actually *reduce* the risk of E.Coli (Creamer, 1999).

Patrick Moore is cited in the article as "co-founder of Greenpeace." However, he "quit [Greenpeace] almost two decades ago and was never more than a founding member" (Patrick Moore: Profiles: GM Watch, 2004).

Later, Moore:

> set up his own environmental consultancy, Greenspirit. [. . .] Around the same time, he became a full-time paid director and consultant for the British Columbia Forest Alliance. The Alliance, although presented as a 'citizens group', was the brainchild of PR firm Burson-Marsteller. The Alliance has a budget of around $2m derived mostly from the forest industry and its 170 or so corporate members, and it campaigns for clear-cutting [emphasis added] (Patrick Moore: Profiles: GM Watch, 2004).

A quick read of the website of Burson-Marsteller reveals that the founding chairman of the company, Harold Burson, is, among his many other endeavours, board member of the World Wildlife Fund in Geneva (Burson-Marsteller, 2004).

[21] As Eric Ross (1998) elaborates on, the Rockefeller foundation promoted "the global agricultural transformation [. . .] In that role, it was less about enhancing food security of the poor in developing countries than about securing the economic security of the United States, through the enhancement of the Western corporate interests with which they were associated." (1998: 140).

These, and other similar facts, make evident that a closer look at the actors proposing GMOs in Costa Rica would be a valuable exercise.

4.2 The key actors

As is the case for any controversial issue, there are certain key figures and/or organizations that have a clear position regarding the matter, evident through statement (publications, press, speeches), or through action (sponsorship, research, policy). Regarding the GM controversy in Costa Rica, there are some key actors who either support or oppose the cultivation of GM crops. The most important actors are represented in the table below. There are also a few actors that play an important role, but that do not hold a clear position. The most important two are the Promoter of Exterior Commerce (PROCOMER), and the National Commission on Biodiversity Management (CONAGEBIO), the latter of which is a body that includes the public and private sectors, and defines national policy on biodiversity.[22] Both CONAGEBIO and PROCOMER hold ambiguous positions as they are potentially able to hinder biotechnological experimentation and import/export of GMOs, but do not clearly fall into a "for" or "against" category. For example, all entities carrying out any form of genetic manipulation are required to be registered with CONAGEBIO, which has some limited power to reject a permit for GM cultivation granted by the Ministry of Agriculture. CONAGEBIO also advises government policy. PROCOMER could facilitate the export of non-GM crops, and could also levy heavy export taxes on GM products. PROCOMER's second quarterly review of this year (Enlace Mundial, 2004) features articles emphasizing the benefits of transgenic biotech; it appears to lean in favor of GMOs. However, both ultimately operate within the boundaries of existing legislation, and have neither favored nor opposed the presence of GMOs in the country. It must also be remembered that CONAGEBIO is composed of representatives from both organizations that oppose GM cultivation as well as from organizations that actively participate in it.

[22] The Biodiversity Act (#7788, 30/04/1998), which aims to ensure "the conservation and sustainable use of biodiversity, as well as the equitable distribution of derived benefits and costs"(Environmental Legislation, 2002) created CONAGEBIO and the National System of Conservation Areas (SINAC).

TABLE: PRIMARY ACTORS[23]

Public Sector	Promoting GMO cultivation	Opposing GMO cultivation
PROCOMER: Promoter of Exterior Commerce	MAG: Ministry of Agriculture and Livestock	MINAE: Ministerio de Recursos Naturales y Energía
	State Fitosanitary Service (Servicio Fitosanitario del Estado)	SINAC: Sistema Nacional de Areas de Conservacion
	CNTB: National Technical Commission on Biosecurity	COVIRENA: Committee of National Resource Vigilance (Comité de Vigilancia de Recursos Naturales)
	National Seed Office	
	UCR: University of Costa Rica	
	CIBCM: Center of Investigation of Cellular and Molecular Biology, Costa Rica	
	School of Biology	
	ITCR: Technological Institute of Costa Rica	
	CORBANA: National Banana Corporation	
	CATIE: Center of Research and Teaching in Tropical Agronomy (Centro Agronómico Tropical de Investigación y Enseñanza)	
	**********	
	IBS: Intermediary Biotechnology Services	
	CIDA: Canadian International Development Agency	
	IICA: Inter.-American Institute for Cooperation on Agriculture	
	USAID: United Status Agency for International Development	
	IFPRI: International Food Policy Research Institute	
	CIP: International Potato Center	
	ISNAR: International Service for National Agricultural Research	
	CGIAR: Consultative Group on International Agricultural Research	
	IARC: International Agriculture Research Center	
CONAGEBIO: National Biodiversity Commission	ISAAA: International Service for the Acquisition of Agri-biotech Applications	
Private Sector	Delta & Pine Land	
	Semillas del Trópico	
	Semillas Olson	
	ACR: Agribiotechnology Costa Rica, S.A.	
	Monsanto	
	Pioneer Hi-Bred International	
	Asgrow Seeds (now ELM/Seminis)	
	Novartis (previously, Ciba Seeds and Sandoz Seeds, and Northrup King	
	CIB (now BIOTECanada)	
	Rockefeller Foundation	
	ICI Seed Company	
	Diversa	

[23] It is important to note that the classification of actors presented in this table was the reality at the time of writing of this paper. It is possible that positions may have shifted from what they were in the past, or may change in the future, such that the actors may find they are misrepresented at a later time. Please also consider that the table is not comprehensive; it cannot list all the actors. The most relevant and prominent ones have been selected.

Civil Society	INBio: National Institute of Biodiversity	RCB: Biodiversity Conservation Network (Red de Coordinación de Bioseguridad) and members Mesa Nacional Campesina Mesa Nacional Indígena FECON: Costa Rican Federation for the Conservation of the Environment COPROALDE: Coordinator of Alternative Development Projects COECOCEIBA-Friends of the Earth AESO: Association of Social Ecology (Asociación de Ecología Social) ACPB: Central American Alliance for the Protection of Biodiversity (Alianza Centroamericana de Protección a la Biodiversidad)

Rather than re-list all the above actors, particular organizations and their roles in the debate will be highlighted. Those that will be discussed in detail in the following paragraphs are those on which more information is available, and those that recur most often in essays, newspaper articles, and other publications regarding the GMO debate. More important than describing the place that these actors hold in the debate, the discussion will underscore the ways that some of these actors – across the different sectors (public, private, civil society) – are connected, related to each other or work together, be it structurally, through individual(s), or through other common links. By "networking" the actors in this way and seeing how particularly the public and private sectors cooperate, more can be known about the actors' positions, and light can be shed on how the GMO discussion has taken shape, and how the land-for-nature arguments gained enough momentum as to instigate a significant counter-movement, a movement that appears to be making political gains.

4.3 Opposing GMO cultivation

4.3.1 MINAE, SINAC, COVIRENA

The majority of actors actively opposing the cultivation of GMOs are NGOs from the civil society sector. However, Minister of Environment and Energy, Carlos Manuel Rodríguez, acting on behalf of his ministry (MINAE), officially requested a moratorium on GMOs in Costa Rica, demanding that permission for their cultivation

will not be extended into the coming year.[24] Endorsed and promoted by MINAE, the document was originally drafted by the Biodiversity Conservation Network (RCB). Apparently this support is recent. Eduardo Aguilar Espinoza, from the RCB was quoted as saying "It is opportune that MINAE supports us; too bad they didn't do it sooner" (Ponchner, 2004). SINAC, which falls under MINAE, is specifically concerned with the national parks system. The risk of cross-pollination is an important factor in the position it holds regarding GMOs. COVIRENA, the "vigilance" committee of the ministry, is closely linked to SINAC, as it submits quarterly reports on the "health" of protected areas.

4.3.2 Biodiversity Conservation Network, AESO, ACPB

The Biodiversity Conservation Network (RCB) consists of an agglomeration of environmental organizations seeking improvement of biodiversity conservation strategies. The RCB's members, such as FECON, COPROALDE and COECOCEIBA have openly objected to GM testing and the presence of Monsanto in the country. AESO, who is not listed as a member of the network, but does work together with members on a regular basis, is a social ecology organization, and therefore not in favor of GMO presence in the country due to the problems it can cause small farmers and food producers. AESO's chair, Fabian Pacheco, is the son of the national president, Abel Pacheco, and has been a leading – if not the most important – in the fight against GM cultivation and the domination of the seed market by GM seed-producing transnationals. His personal relationship with the presidency has provided him with a public profile, drawing extra attention to his ideas and cause. These organizations draw increased legitimacy from their association with the Central American Alliance for the Protection of Biodiversity (ACPB), which establishes a network of related organizations.

4.4 Promoting GMO cultivation

4.4.1 The Ministry of Agriculture and Livestock

A particularly notable feature of the table above is the fact that two national ministries find themselves on opposite "sides" of the discussion. Whereas the MINAE

[24] The request was sent to the CNTB, who will review the proposition, but who does not have binding power; the moratorium can only be instituted by executive decree. Opposition to the idea comes from geneticists, whose research would be affected.

is currently actively seeking a moratorium on GMOs in Costa Rica, the Ministry of Agriculture and Livestock (MAG) and some of its subsidiaries openly support GM cultivation. The MAG's Fitosanitary Service grants the necessary permits to companies interested in carrying out agricultural biotech research and cultivation. It is empowered to "regulate [. . .] the import, export, investigation, experimentation, mobilization, multiplication, industrial production, commercialization, and the use of transgenic materials and other genetically modified organisms for agricultural use or its products" (Decreto Poder Ejecutivo: No. 30111-MAG 2002). At a seminar organized for the press in late 2002, the then- director of the Fitosanitary service, although he warned of the care with which GMOs must be handled, "emphasized that GM will generate many advantages, like intensifying agriculture, which benefits forests" (Actualidad Fitosanitaria, 2002). The National Seed Office was also represented at the seminar, and highlighted the importance of GM-induced characteristics of crops for export. Dominating the seminar was the message that potential risks posed by GMOs can be kept in check through proper management, and that the abundant benefits should not be sacrificed for fear of risks. This has been maintained by the MAG, whose position is in line with that of the GM growers. "Ministry officials and transgenic crop growers have said that Costa Rica's GM crops pose no immediate danger to the environment, as they are planted a scientifically tested safe distance from non-GMO crops" (Kimitch, 2004). In short, the MAG and its branch organizations have favored GM cultivation through policies that facilitate and enable GM seed production and export. The National Technical Commission on Biosecurity (CNTB), for example, which was created in May of 1996 to advise official institutions that deal with the promotion, trade, and use of GMOs (Montero 2002), is in charge of supervising GMO projects, together with the Fitosanitary Service and the National Seed Office.

4.4.2 The University of Costa Rica

The University of Costa Rica, one of the country's oldest and largest universities, hosts the Center of Investigation of Cellular and Molecular Biology (CIBCM), as well as the School of Biology. The CIBCM initiated transgenic crop research in the country with its rice trials in 1990; the CIBCM and the School of Biology have worked together on various projects for GM maize (Valdez Merala, 2003). As an institute, the university has worked together on several occasions with

private biotech corporations like Monsanto, Pioneer Hi-Bred International, Novartis Seeds, and Asgrow Seeds to organize workshops and projects dealing with the development of transgenic crops. At the moment, the university registers 76 biotechnology research projects (Biotecnología en Cifras, 2004).

For example, in February 1992, the Ministry of Agriculture, the Inter-American Institute for Cooperation on Agriculture (IICA), and the University of Costa Rica worked together with the Rockefeller Foundation, Asgrow Seeds, Novartis, Monsanto, Pioneer Hi-Bred International, and Northrup King on the ISAAA Biosafety Workshop in Costa Rica, which "focused on development of capacity for regulating field trials of transgenic crops [. . .]" (A Global Roadmap for Modern Biotechnology 2004) and was funded by Novartis and the Rockefeller Foundation.[25] Later that year, the university and the IICA participated in a workshop by the same title in Argentina, with the same private enterprises participating (Global Roadmap 2004). Also in 1997, the CIBCM and the ISAAA worked together with Asgrow Seeds on a project entitled "Development of Virus Resistance Melons" (Global Roadmap, 2004). The university does not limit its participation to GM development at home; in 1997 it participated, together with other organizations and Novartis, in an "ISB Course on Managing Biotechnology in a time of transition" (Global Roadmap, 2004) that took place entirely in Asia. As was said of a similar Latin American project that aimed to teach the technology surrounding "economically important maize diseases," funded by Pioneer Hi-Bred in which Costa Rica also participated, "this is 'tecnhology transfer' to the end" (Casela, Renfro and Kattinger, 1998).

Professor at the university, and director of the CIBCM in 1999, is Anna Sittenfeld, who was also a co-founder of INBio and was Director of the INBio Bioprospecting Department at the time of the signing of the well-known Merck-INBio bioprospecting agreement.[26, 27] Sittenfeld, who has written (and presented at the CGIAR) a significant number of essays on the benefits of GM cultivation for Costa

[25] "The ISAAA receives—apart from 60% received by philanthropic entities, and 30% by bilateral agencies—10% of its financing from biotechnological companies: Novartis, Agrevo, Pionner, and Monsanto" (Iáñez Pareja, 2001).

[26] INBio "works under the premise that the best way to conserve biodiversity is to take advantage of the opportunities it offers to improve the quality of life of human beings." (Que es INBio? 2004) It also carries out biotech research (Biotecnología en Cifras 2004). Its strategy is based on three steps, the third of which is "Using biodiversity to fuel society's intellectual and economic development." (INBio 2004) No mention is made here of the social dimension(s) that come into play.

[27] See also section 3.2.4b.

Rica's conservation, is also on the Board of Trustees of International Plant Genetic Resources Institute (IPGRI), an international institute dedicated to researching biotechnology, that recently announced a new scholarship program co-funded by the Australian Grains Research Development Coroporation (GRDC) and Pioneer Hi-Bred International (IPGRI 2004). Pionner Hi-Bred also supports "research and training initiatives in [. . .] Costa Rica" ("Pioneer Hi-Bred funds UI rural safety and health professorship" 2001). Sittenfeld has collaborated on several works with Joel Cohen – head of the population labs at *Rockefeller University* (The Rockefeller University 2004) – including works published for ISNAR, which is part of the CG system, a driving force behind the Green Revolution (Bell, 1998).[28]

The department of Biotechnological Engineering and the School of Agricultural Engineering at the Technological Institute of Costa Rica (ITCR) are also involved in GM projects. Articles written by investigators and students at these institutes praise the potential of transgenic cultivation, and reassert that scientific testing ensures the safety of the crops for the environment (Enlace Mundial, 2004).

4.4.3 Center of research and teaching in tropical agronomy

CATIE, classified as an intergovernmental organization, is a regional scientific center for research and teaching in tropical agronomy, with its headquarters in Costa Rica. Its creation in the 1940s was a result of the ideas of Henry A. Wallace (CATIE's main building is named after him), secretary of Agriculture of the United States at the time, who supported Rockefeller Foundation-funded research toward high-yielding varieties of wheat in Mexico at the start of the Green Revolution (Shepard, 2003; "Four Iowans" 2002). CATIE works within the framework of the IICA, to which it is associated, although it is independent. (As mentioned, the IICA has cooperated on Rockefeller Foundation-funded projects involving transgenic crops.) The very mission of this organization appears to embody the ideas behind the land-for-nature arguments that technology in agriculture is needed in order to conserve biodiversity. Its mission

[28] For example:* Sittenfeld, A., Lovejoy, A., (1999) *Managing bioprospecting and biotechnology for Conservation and Sustainable use of Biological Diversity*. IN: Cohen, Joel I. [ed] *Managing Agricultural Biotechnology: Addressing Research Program Needs and Policy Implications for Developing Countries. ISNARCAB International* Biotechnology in Agriculture Series No. 23 UK pp.92-101. * Sittenfeld, A., Lovejoy, A., Cohen, J. (1997). *Managing Genetic Resources and Biodiversity. An Institute Perspective from INBio and Costa Rica.* In: New Technologies for Agricultural Research: Managing Biotechnology in a Time of Transition. Project Planning Meeting. JIRCAS Headquarters, Tsukuba, Japan, March 24-27.

as stated on the official website is to "Contribute to the reduction of rural poverty by promoting competitive and sustainable forms of agriculture and natural resource management, through education, research, and *technical* cooperation [emphasis added]" (CATIE 2004). In addition, the leadership is supposed to be composed of people from either the MAG or the MINAE. Through its research department, CATIE developed a GM strain of bananas and plantains resistant to particular virus [illegible]gues.

4.4.4 The National Banana Corporation

As has been mentioned, there is also some small scale banana GM research underway in Costa Rica. CORBANA, the National Banana Corporation, is a non-state public entity. The genetic research CORBANA carries out is primarily directed at controlling the Sigatoka Negra virus, a historical problem for the banana industry, research in which the CATIE also invests its time and resources (Valdez Melara, [illegible]3). Its board of directors consists of one representative from the president, two from the national banks, and two from actual banana farmers. The current executive appointee, Romano Orlich Carranza, is a friend of President Abel Pacheco, and chairman of CORBANA. He is also owner of Santa Maria Del Monte, which supplies for Chiquita Banana Corporation, which dominates the northern sector of the atlantic coastal banana zones (Urgent Action Banana Link, 2004). Public sector decisions thus overlap with private sector commercial interests.

The list below, from the Scientific Technological Register, gives an overview of the number of biotechnology projects the aforementioned public organizations were involved in 2003. (Proyectos de biotecnología en el RCT, 2003) The list highlights the weight the University and the MAG give to the field.

University of Costa Rica (UCR)	69
Ministry of Agriculture and Livestock (MAG)	12
Technological Institute (ITCR)	8
Center of Research and Teaching in Tropical Agronomy (CATIE)	5
CORBANA	4

4.4.5 Agribiotecnología Costa Rica

Between 1990 and 1995, this private sector company collaborated with USAID in a project "to develop a more efficient, cost-effective way to propagate pineapple plants, using the bioreactor micro propagation method [. . .]" (Global Roadmap, 2004). In 1993, Agribiotecnolgía (ACR) and Asgrow Seeds held Latin American regional workshop to examine "the [. . .] biosafety guidelines and regulations in the region [. . .] and assist [with] recommendations to begin building the necessary biosafety policies [for participating countries]" (Global Roadmap, 2004). It was co-funded by USAID and The Agricultural Biotechnology Support Project (ABSP), which is funded by Monsanto and the Rockefeller Foundation.[29] ACR has also worked together with institutions such as the IICA and ISNAR on other biotechnology-promoting projects throughout the years.

4.4.6 Delta & Pine Land, Semillas del Trópico, Semillas Olson

These are the leading GM research companies operating in Costa Rica. They breed GM seeds for research purposes as well as for sale to their customers in the areas of "Cañas, Liberia, La Rita de Guápiles [and] Upala" ("Alerta transgénica en Costa Rica" 2004). Delta & Pine Land is a subsidiary of Monsanto, and has patented the so-called "terminator" technology, which guarantees that seeds cannot be replanted with the same results more than a predetermined number of times. Semillas del Trópico, also known as Costa Rica Seed, works with soybeans, cotton, and maize, and is active in the Upala region.[30, 31] It also has a farm in Cañas, a tract of land that is now used for growing rice and sugar cane (important Costa Rican food sources), but has already been earmarked to be turned into plots for the cultivation GM soy and cotton ("What is Costa Rica Seeds?" 2004). Semillas Olson also specializes in soy, cotton, and maize, and has sites in four different provinces of the country, in the locations Liberia, Upala, La Guácima, and Cartago.

[29] The ABSP has also funded biotechnology internship programs in Costa Rica organized by Asgrow Seeds. (Global Roadmap, 2004).
[30] Interestingly enough, the official Delta and Pine Land website does not indicate any research locations outside of the United States; research or production sites in Costa Rica and elsewhere are not mentioned. (http://www.xxx.com)
[31] Recall the importance of maize cultivation in the Upala region (end of section 3.2.3).

4.5 Where the "Pros" and the "Cons" overlap

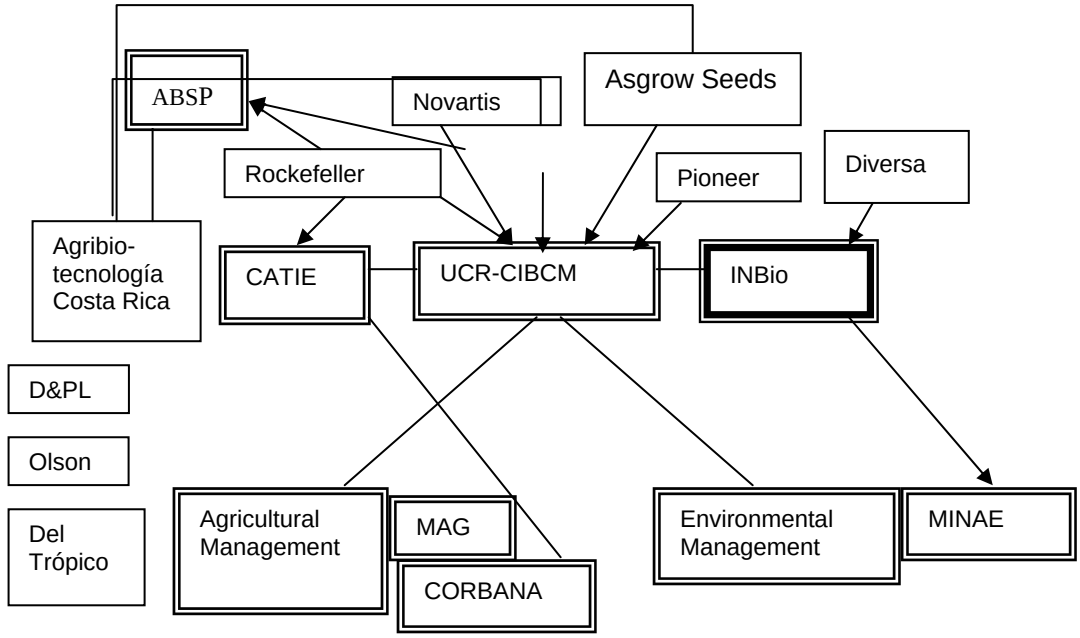
In order to see how the land-for-nature arguments came to be, and continue to be, an important prop for those who support biotechnology in agriculture, it is useful to see where there is common ground between (particularly commercial) agricultural interests and environmental interests, as the land-for-nature arguments are all about how to make the two meet.

INBio and MINAE, who appear to be on "opposite sides" on the table above, must in fact work together often, as MINAE, through the SINAC, is in charge of the country's conservation areas, and INBio works in conservation areas to carry out biodiversity documentation. However, the story is more complex than it seems. Take the following example. Diversa, which is a biotech firm based in the United States, has bioprospecting contracts with INBio and MINAE. INBio carries out research for Diversa, looking for enzymes and DNA in protected areas, and receives, in turn, research equipment and the occasional scholarship or training for its scientists. Diversa "has looked in Costa Rica for enzymes for biomass conversion (making ethanol), *improving animal feed*, and loosening up residual petroleum in old well fields; and *genes for transgenic crop protection and pharmaceuticals*.[*emphasis added*]" (Partnerships with All Species, 2000). Diversa, thus, *uses the biological resources in Costa Rica's protected areas to produce GM crops*, and INBio is its facilitator[32]. INBio, in turn, by standing behind the land-for-nature arguments is standing behing the dual interests of one of its main "benefactors." MINAE, who is today officially opposed to GM cultivation in Costa Rica due to the damage it can cause to the country's biodiversity, "receives 10 percent of the bioprospecting budget from INBio and 50 percent of any royalties. (These revenues can only be used for conservation)" (Partnerships with All Species, 2000). The fact that it has been contractually specified that revenues can only be used for conservation is significant. MINAE is also concerned with a wide range of other matters, such as pollution, the institutional structure of environmental management, involvement of civil society groups in decision-making, and, as we have seen, lobbying for a moratorium on GM cultivation in the country. Yet the contracts with INBio and Diversa aimed to ensure

[32] This is not unique to the Diversa arrangement. INBio also "uses the capabilities and recognition it received from its agreement with Merck to implement bioprospecting projects with several other foreign corporations, including [. . .] Akkadix (agricultural biotechnology)." (Artuso 2002). Akkadix produces GM seeds.

that MINAE spent the money exclusively on conservation; environmental welfare outside of the conservation realm (i.e. pollution, recycling, and other activities important to the ministry) is not of interest.

The University of Costa Rica's CIBCM and School of Biology are clearly involved in GM research, and work together with private, transnational biotech enterprises. At the same time, however, these schools at the university also play a significant role in environmental policy, working closely with MINAE and in conservation areas on research. Thus what you get is a scheme in which what seems



like two separate sectors actually overlap not only in the obvious and necessary cooperation between ministries, but in the sense that, underlying the management of both is one body, such that the decisions concerning agriculture and the decisions concerning environment may appear contradictory, but the decision makers are in fact the same. And their revenues come from sources whose interest it is to sell transgenic seeds.

The chart above illustrates this, and includes the other principal actors previously referred to. The purpose of the chart is to give an overview of the actors and to point to the complexity of the relations between them. Some of the lesser actors have been left out for the sake of simplicity of the diagram. (Such as the Fitosanitary service, as it is a part of the MAG.)

4.6 Conclusion

This section shows that there are links of cooperation, sponsorship, and membership that run within sectors, but also between the public and the private sectors, and civil society. Private enterprises fund civil society organizations, thereby influencing their agenda. Individual members of the public sector have stakes in the private companies, which also plays a role in determining priorities. These links affect the way a problem is defined and propagated. If it is in the interest of, for example, Diversa, to both make sure the rainforests are protected (so that its genetic reserves remain intact), and the GM market is opened (so it can sell its products there), it will pass on the message that GMOs and biodiversity are complementary, by funding research in organizations that have an interest in preserving the environment as well, or in universities that have the crucial role of distributing information to the decision-makers. This, in addition to the overlapping functions of individuals in different sectors or organizations, means that ultimately those who are in charge of environmental issues and agricultural issues are the same, and the land-for-nature arguments cover both sides of the coin.

5 NEW SALES PITCH, LAST SEASON'S MERCHANDISE

> Profiting from biodiversity and conserving it are two sides of the same coin for this new form of ecological capital that relies on sustainably managing resources (Takeshita, 2001).

The question with which this research was launched was whether or not genetically modified organisms are indeed a solution to biodiversity conservation in Costa Rica. It appears, however, that the true question is in fact the opposite. The question that appears to have emerged is not *does the introduction of GMO cultivation facilitate biodiversity conservation?* but *do biodiversity conservation policies facilitate the introduction of GMO cultivation?* Whereas the land-for-nature proposals

take as a starting point hunger and a scarcity of land to justify GMO introduction, the more realistic underlying starting point is in fact the proponents' need to have access to the protected areas of Costa Rica, which are the "bioreserves" of genetic diversity. To achieve this, biodiversity is narrowly defined as existing in nature, food production is portrayed as the primary threat to this nature (commodity crops for export are not mentioned), and technical solutions from which the same proponents can profit, namely GMOs, are introduced.

Alarming and disturbing messages of hunger and booming populations are presented as the motivations for promoting GMO introduction, but "[. . .] the current call to revive the Green Revolution may be a response less to a real Malthusian crisis than it is to a crisis in the nature of Western capitalism" (Ross, 1998:138). What looks like three separate areas of interest – agriculture for food production, biodiversity (and bioprospecting), and commercial agriculture – is in fact a triangle whose corners are held together by common interests. The decision-making in each sector ultimately comes from the same origin and serves the same interests. Promoting GMO cultivation as a method of food production not only draws attention away from whether or not there are shortages of food, and what the causes may be, it also justifies further encroaching on food-producing land for the commercial activities that are lucrative to large multinationals, be it for the purpose of commercial agriculture or bioprospecting.

From the inception of the Green Revolution until the present, the reasons given for the need for new seeds have been changing. When the "high output" seeds did not produce the promised high yields nor prevent starvation, the focus was shifted to the commercial profitability of the seeds. When, due to the high inputs required, the seeds turned out to make for a highly inefficient, environmentally destructive, agriculture, GM seeds designed to lower fertilizer and pesticide inputs were introduced. When these faced criticism for their homogenizing effects on the gene pool, the land-for-nature arguments presented them as a positive contribution to – rather than a problem for – biodiversity. Throughout, the arguments for the benefits of the old and the new green revolutions have been adjusted to the public concerns of the times, but the message has been the same: buy the seeds. "Despite all the talk of ushering in a new era of environmentally-friendly agriculture, the biotech revolution is simply a continuation of the Green Revolution [. . .], not an escape from it. Freedom

from the chemical treadmill is simply being replaced with dependence on a faster-moving and more expensive technology treadmill" (Bell, 1998).

The land-for-nature arguments in favour of GM crop cultivation, which initially were applauded by some environmentalists and supporters of national parks, have recently also been critically reviewed by the same. What this paper has sought to address is how the two meet: how the land-for-nature arguments become, not a dream promoted by deep green environmentalists and lovers of national parks, but another justification for opening new markets for GM seeds. It is particularly striking that it happens in Costa Rica, a country that for years has worked on its green image, devoted to the conservation of "natural" biodiversity in protected areas. The land-for-nature arguments, particularly as employed to promote GMO cultivation in Costa Rica, propose that GM cultivation will advance biodiversity conservation in the country.

Biotech corporations involved in GM seed production will stop at nothing to open markets to their product. Monsanto makes no secret of the fact that its one and only goal is to make a profit. "This was made clear at a biotech industry conference in January 1999 [. . .] Monsanto [was] asked what their ideal future would look like in fifteen to twenty years. Monsanto executives described a world with 100 percent of all commercial seeds genetically modified and patented" (Smith 2003:1). As Smith elaborates on in his book, Monsanto has been selling lies to purchasers and consumers around the world at different times in history in order to push its products onto the market.[33]

Where there were fears of a resistant market, information has been withheld; where there was haste to create a market, research was not adequately conducted and products were presumed innocent until proven guilty, as was the case with Agent Orange in Vietnam; where the market has been resistant, it has been necessary to

[33] Despite the fact that the FDA's own scientists have carried out research that consistently shows GE crops to be full of potential health hazards, "[. . .] FDA administrators, who admit they are following a directive to foster the biotechnology industry, disregarded their experts' input and claimed there is an overwhelming consensus among experts that GE foods are so safe they don't need to be tested." (Druker 2003: 4). In the United States and western Europe, where primary concerns have been with the potential health risks of consuming GM foods, public resistance has been overcome either by withholding information from the public (Smith 2003: 5-46), or by ensuring that their lawyer, Attorney Michael Taylor, work for the FDA and create a new position in that organization for himself, as Deputy Commissioner for Policy. "He instantly became the FDA official with the greatest influence on GM food regulation, overseeing the development of government policy." (Smith, 2003: 130-131).

assure the public of not only the safety of products, but its “overwhelming benefits,” and where the hunger argument is not effective (as in Costa Rica), other arguments need to be presented in order to squeeze GMOs in. In Costa Rica, which argument could be closer to the hearts of the conservationists, the wallets of all who depend on tourism, and the politicians who depend on the national green image, than the land-for-nature excuse?

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