INCENTIVE MEASURES FOR CONSERVATION OF BIODIVERSITY AND SUSTAINABILITY:
A CASE STUDY OF COLOMBIA

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Economic Incentives for Micro-Watershed Management in Colombia.

Economic incentives for micro-watershed management in Colombia[1]

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1. Introduction

Diverse measures of economic incentives for the development of environmental policies and natural resource management have been tried in Colombia. Some foster forest use to substitute logging of tropical forests and others, protect and recover micro-watersheds that are strategic because of the environmental services they provide to human settlements. Among these are *the* ***Economic Incentives for Micro-watershed Projects*** that will be explained in this chapter based on three principle sources of information:

a The official documentation coming on the one hand, from the Environmental Ministry (the body that, along with the National Planning Department, manages the **Natural Resources Management Program** which includes the application of the incentives), and documents generated by the Inter-American Development Bank (IDB) and the International Bank for Reconstruction and Development (IBRD) (entities that contribute part of the resources through external credit).[3]

b Recently finished studies generated a proposal to develop a technical and institutional balance of the ***Economic Incentives for Micro-watershed Projects*** with the purpose of redesigning their performance. (Forero *et al,* 2000). Fieldwork was done in eight micro-watersheds and in four of them (76km2 and 189km2 in length) the following methodology was used:
   - Recording of vegetation cover with and without the project, i.e. simulating changes that can be promoted by the incentives and by other actions directed toward improving the environmental conditions of the micro-watersheds.
   - Establishment of hydrological externalities with and without the project: changes in the duration curves of water flow and in the production of sediments.

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[1] Sarah Hernández, Coordinator of the Incentives, Use and Valuation Group of the Alexander von Humboldt Institute, and Claudia Hernández from the National Planning Department, Environmental Policy Unit contributed to this essay.
Much of this chapter is extracted and adapted from the report (written by the author with the collaboration of L.E. Torres) "Revisión de Incentivos Económicos para Proyectos de Microcuencas". (Forero et al 2000). The study was entrusted to the Institute for Rural Studies of the Environmental and Rural Studies Faculty of the Pontifica Universidad Javeriana in Bogotá, Colombia. The following people participated: Biologist Mario Avellaneda, Hydrologists Rafael Ortiz, Xiomara Puente and Juan Andrés Galarza, Economists Juan Camilo Cárdenas, Elsa Hernández and Jaime Forero A, Forestry Engineer Hernando Cordero, Sociologist Elcy Corrales, System's Engineer Jorge Muñoz and Business Administrator Luz Elba Torres G.

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[3] Only the documents cited in this article are briefly summarized in the bibliography.

- Analysis of the production systems of the owners who are the potential users of the incentives and appraisal of the user cost derived from changes in vegetation cover.
- Economic appraisal of the benefits generated by the incentives.
- Analysis, with the participation of official, incentive users and rural communities, of the way in which the incentives are operating and their institutional and social viability.

c On the other hand, this essay has benefited from analyzing the Incentives for Conservation and Sustainable Use of Biodiversity in Colombia, coordinated by the Alexander von Humboldt Institute, cooperating with the National Planning Department (Environmental Policy Unit), the World Wildlife Fund (WWF), the Natural Reserves Network of the Civil Society and the Special Management Unit of the National Natural Parks of the Environmental Ministry (Ver. I. Von Humboldt, DNP, 1999). This study began in 1999, with participation of many experts from the public and private sectors, NGOs, universities, local and regional associations interested in biodiversity conservation and sustainable use. Consulting work was done through work groups and an international seminar on the subject, held in November 1999. As a result of this process a book has been published analyzing the subject of incentives for biodiversity conservation and sustainable use in the Colombian context and gives technical recommendations for their design and implementation.

Although this essay analyzes the subject of economic systems for micro-watershed management, the Micro-watershed Program in Colombia was not designed specifically for biodiversity conservation and sustainable use. However, actions carried out to improve the water supply have positive effects on biodiversity.

1.1 General Aspects of Economic Incentives for the Recovery and Conservation of Vegetation Cover in Colombia

To promote reforestation of degraded zones and ease the pressure on tropical forests caused by the demand for wood, two types of economic incentives have been implemented in the country: The Forest Incentive Certificate – CIF (Certificado de Incentivo Forestal) and tributary exemptions. Due to the strategic importance of the environmental and socio-economic benefits provided by micro-watersheds a broad spectrum of programs and prompt action have been generated, among the most important ones are: the ***economic incentives for micro-watershed projects***, financed with resources from IBRD and IDB and diverse national sources (see Table 1); the CIF-KFW incentive negotiated by the Coffee Producers Federation, with resources from KFW and national executors; and the initiatives of the Autonomous Regional Corporations- CARs, with resources from the energy sector and exemptions. Table 1 shows the balance of the amount of resources destined to those programs.

The CIF, created by Federal Law 139 in 1994, promotes investment in forest plantations with a protector/producer character to whomever commits to executing an Establishment and Forest Management Plan. The CIF gives the user 75% of

the installation costs for the forest plantations with native species, and 50% for introduced species, as long as the densities are greater than 1000 trees per hectare.[4] This program also gives 50% of the total net maintenance costs, from the second to the fifth year, for native and introduced species. To complement the activities, it gives 75% of the total costs that are incurred during the first five years corresponding to maintaining the natural forest areas that are found in an Establishment and Forest Management Plan.[5]

[4] When the density is lower, but more than 50 trees per hectare, the amount per tree is determined proportionally.
[5] Art. 4. Law 139, in I.V. Humboldt-DNP, 1999, p. 74.

Table 1
Colombia: Funds designated to forestry programs (One US dollar = $1.700 Colombian pesos, 1999 rates)

	1994	1995	1996	1997	1998	1994-1998
Micro-watersheds (m-w) – IBD contribution	1.281.639.000	4.249.201.000	3.575.189.000	3.016.883.000	1.018.294.000	13.141.206.000
(m-w) – IBD: Performing agency contribution	264.498.000	2.373.274.000	791.491.000	1.835.838.000	262.004.000	5.527.105.000
(m-w) – IDB: Community contribution	320.080.000	1.691.401.000	7.124.584.000	1.244.016.000	1.116.942.000	11.497.023.000
(m-w) – IDB: Hectares committed (1)	1.563.5	6.229.1	6969.5	4.300.6	0	19.062.7
(m-w) – IDB: Río Guadualajara	562	1076	449.6	373	0	2.460.6
IDB participation in entire program (%)	68.68	51.11	31.11	49.48	42.48	43.56 %
(m-w) –IBRD Contribution	850.194.000	3.318.384.000	2.849.995.000	6.006.238.000	1.150.662.000	14.175.473.000
(m-w) – IBRD: Performing Agency contribution	456.654.000	1.835.080.000	3.481.087.000	4.843.220.000	720.380.000	11.336.420.000
(m-w) – IBRD: Community contribution	275.004.000	1.411.915.000	1.340.425.000	2.621.029.000	467.759.000	6.116.132.000
(m-w) – IBRD: Hectares committed	785	4.897	5.354	9.003	0	20.039
IBRD participation in entire program (%)	53.75	50.54	37.15	44.59	49.20	44.62 %
CIF (Reforestation only) (2)	1.175.000.000	3.393.000.000	5.755.000.000	5.890.000.000	2.552.000.000	18.684.000.000
Tax discounts	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
National Royalties Fund - FNR (Forestry) (3)	S.I.	S.I.	671.668.000	1.715.727.000	963.297.000	3.350.692.000
Pacofor	1.423.768.522	1.161.406.739	972.213.912	799.320.819	5.333.135.151	9.689.845.143
Electricity Sector Transfers	N.A.	N.A.	N.A.	61.948.287.030	N.A.	N.A.
CIF – KfW (Incentive) (4)	N.A.	N.A.	N.A.	N.A.	N.A.	4.287.158.000

N.A. Information not available.

Notes: (1) The hectares committed refer to the establishment of new plantations. (2) Ministry of Agriculture and Rural Development. (3) For 1998: information supplied by John Bejarano, DNP-UPA. 84) Total contributions directly as incentives to users between 1993 and 1999: 4,287,158 marks. (Price of the marc in Feb/2000: $1000 Colombian).

Sources: a) IDB – IBRD: Coordinating Unit – MMA; b) CIF: CONPES Documents quoted in Forero, Jorge, 1998 Pg. 68; c)FNR: FNR, in Forero, Jorge, 1998, Pg. 98. Calculations by the author; d) PACOFOR: Forero, Jorge, 1998, Pg. 85; e) CIF-KFW: Fedecafé-Fund for the Protection and Recovery of the Environment.

Resources for the CIF come mainly from the national budget. This incentive destined to the installation of plantations has been well received by some reforestation sectors; nonetheless the impact on competitiveness of the wood sector still needs to be evaluated. Since this mechanism tends to exclude the large majority of campesinos[6], however, it has regressive effects and its capacity to counteract deforestation of natural forest is too limited. Furthermore it has been criticized for stimulating the introduction of production systems that possibly generate negative long-term externalities (monocultures with exotic species such as conifers and eucalyptus). There is not enough information and evaluation criteria that allow us to estimate the environmental and economic impact of forest activities stimulated by this incentive.

Additionally, CIF was created for the conservation of forests (Decree 900/97). Its objective is to compensate direct and indirect economic costs incurred by the owner to maintain, within his plot, natural forested ecosystems, disturbed or undisturbed, recognizing the environmental and social benefits derived from them. The value of the incentive is seven (7) monthly minimum wage salaries per hectare of conserved forest, which is adjusted by the environmental authority in charge, based on regional conditions, according to article 11 of Decree 900/97. This incentive has the advantage that it can help conserve strategic ecosystems. However, it has some perverse effects such as: a) stimulating pressure to intervene in primary forests in exchange for accepting the incentive; b) financial resources are insufficient to cover a growing demand, explained by the large expanse of land susceptible to be protected by this incentive, and; c) it tends to substitute compliance of the owners' obligations to preserve natural resources that are within their plots.

For more than 15 years, the national government has granted tributary exemptions for commercial forest activity with three schemes: on 80% of the sales value of wood, considered as costs and deductions inherent to production (Art. 83, Tributary Statute); on the value of investments made directly by companies or individuals in new reforestation plantations[7], deductible annually as long as it doesn't exceed 10% of the liquid rent of the taxpayer (Art. 157, Tributary Statute); and finally, a discount on the amount of rent tax up to 20% of the investment, certified by the corresponding environmental authority, for taxpayers that establish new crops of trees of the species and in the reforestation areas (Art. 253).

These exemptions are favorable in that they have been very well received in this activity at a national level and the international sector, attracting foreign investment. However, it has some disadvantages such as: its capacity to counteract the deforestation of natural forests is too limited, it has regressive effects since it concentrates on some middle income sectors and simultaneously- according to some sources- has propitiated exploitation procedures that generate negative environmental externalities. It must be

[6] Ambiental Consultores et al (1977).

noted that there is no information available about these fiscal discounts that seem to constitute the main source of incentives for reforestation.

With transfers from the National Exemption Fund, from the Electricity Sector and an environmental percentage of taxes to properties, the Autonomous Regional Corporations - CARs have provided incentives for reforestation and other tasks that tend to conserve and recover micro-watersheds. [8] There is no documentation explaining how they work, and much less, on the impact of these activities. Field work demonstrates that CARs have managed these resources with very limited participation from the actors involved, installing plantations in private or institutional plots, generally of exotic species, oftentimes in a way that is now considered anti-technical, such as planting pines at very close distances on hillsides. However, there is no systematic information, so this finding cannot be generalized.

1.2 Economic Incentives for Micro-watershed Projects

Through the use of ***economic incentives for micro-watershed projects***, conceived and implemented within the framework of a national strategy - the ***Environmental and Natural Resources Management Program*** - resources are directly transferred to private land owners to simulate them to carry out tasks agreed upon with the environmental authorities in charge of negotiating these types of projects. The program receives financial resources from three sources: a) credits from IDB and IBRD; b) contributions (in money and sometimes raw materials) from the regional or local body that is executing the plan, after receiving funds from the national budget and/or local rents, either in money or secondarily in raw materials; c) participation from users or communities, mainly in the form of labor.

Incentives from IDB and IBRD resources are directed to small and medium farming or livestock producers who, generally, do not accept the CIF and much less, the tributary discounts. This mechanism tends to become a central element in rural sector environmental management policy, aimed at guaranteeing the water supply for urban centers or rural settlements with concentrated populations. The national government is considering increasing the resources destined to these types of incentives, with funds transferred from the energy sector.

The transferred resource, through economic incentives for micro-watershed projects, is justified as long as the action performed by the actor who receives it produces a positive externality (or neutralizes or lessens a negative one), resulting in a social benefit. In this way, strictly speaking, the incentive does not constitute a subsidy, but rather a payment

[7] Also for wells, irrigation and silos.

[8] In Spanish, Corporacions Autonómas Regionales CARs are “public corporations, integrated by territorial entities that because of their characteristics, geographically constitute the same ecosystem or form a geopolitical, biogeographic or hydrogeographic unit, with and administrative and financial autonomy, their own patrimony and judicial personnel, in charge of the law managing the environment and renewable natural resources, leaning towards sustainable development, in accordance with legal and political dispositions of the Ministry of the Environment.” (Art. 23 Law 99/93).

for an environmental service. Thus it corresponds to a transaction between the beneficiaries below the water and the users waters above, mediated by an entity that carries out the transaction.

There is outside financing totaling US$59.2 million for the execution of micro-watershed projects (US$21.2 million, as part of the loan contract with IBRD and a US$38 million credit with IDB).[9]

Projects co-financed with IBRD funds have as a main objective, the protection and rehabilitation of micro-watersheds located in the western and central mountain ranges. They support and/or generate micro-watershed organization and management processes with the participation of rural communities by co-financing environmental and forestry activities. Furthermore, criteria and methodological instruments will be developed for the recovery and conservation or areas suitable for forests, in watersheds in the process of rehabilitation.

Projects financed with IBD resources promote sustainable use of soil and water resources, benefiting the population living in the watershed. They also help solve externalities associated with the use of trail and municipal aqueducts, improving the quality and quantity of the water resource. Additionally, the projects seek to recover critically degraded areas, which are also part of the sub-watersheds. Phased intervention is planned, in long-term processes, to achieve the re-organization of land use and sustainable management of hydrological resources.

For the programs that should be applied using these funds, a wide range of integrated actions were designed (see IDB, 1993). In practice, however, the application of economic incentives for reforestation (directed mainly at the establishment of forest plantations) and to a lesser degree, to other systems such as silviculture (forestry agriculture and grazing) have had to be restrained.

It should be clear that ***economic incentives for micro-watershed projects*** are directed towards modifying environmental services of micro-watersheds, more specifically to improving water supply by promoting changes in vegetation cover that help regulate water flow and slow erosion. In an indirect way, they have an impact on biodiversity, since they contribute to improving the vegetation cover. One of the central recommendations of the study mentioned (Forero *et al*. 2000) is directed at strengthening alternatives that can be promoted through incentives to recover natural vegetation (incentives for natural regeneration and for establishing protective forests) that complement “traditional reforestation”.

[9] When developing the Environmental Policy of the country and the Forest Action Plan for Colombia (PAFC), the National Government was authorized by the National Council of Economic and Social Policy (CONPES Document 2660-DNP-UDA-DEAC-INDERENA of August 22, 1993) to contract credits with multilateral banks- IDB and IBRD. Based on this authorization contract IBRD 3692/Co with a value of US$39.0 million and with US$26.29 million of local money was drafted; and contracts IDB 774/OC-CO and IDB 910SF/CO with a value of US$81 million, which are complemented with a matching national amount of US$54 million. These funds were established to finance the Environmental and Natural Resources Management Program.

On the other hand, ***economic incentives for micro-watershed projects*** are conceived as a specific mechanism that do not encompass all programs and projects for micro-watersheds, and much less in the environmental policy of a region. Complete micro-watershed planning should define the areas in which, subject to environmental and socioeconomic considerations, it is necessary to intervene using diverse mechanisms, such as: a) restricted use areas; b) total conservation areas (zero intervention); c) areas that should become property of the nation, municipality or public or private companies in charge of the aqueduct or electrical energy; d) areas that can be acquired by non-profit institutions; e) areas that are being exploited by agriculture and cattle-ranching where changes should be motivated. This last one, is of course, the economic incentives arena. In this context, it is clear that the incentives contribute, in an integral way, along with other instruments to induce changes that have an impact on biodiversity.[10]

2. The ecosystem approach

The *economic incentives for micro-watershed projects* are applied in the Colombian Andean Region, which forms part of the North Andes Ecoregion (which includes all or part of Venezuela, Colombia, Ecuador and Peru). It is an ecoregion with a high diversity of ecosystems, numerous endemisms, a high number of species per unit of area, and between 30,000 and 40,000 plant species (Gentry 1993 in Etter, 1999). According to the classification accepted by WWF in Table 2 (Dinerstein et al. 1999), the current state of the Colombian Andean sub-ecoregions is listed in terms of loss of "original natural" cover.

Table 2
Colombia: Andean Region – Percentages of Ecogregion changes

Ecoregion	%	Ecoregion	%
Macarena Mountain Forest	16,6	Santa Marta Mountain Forest	64,5
Eastern Cordillera Real Mountain Forest (Real Range)	33,7	Magdalena Valley Mountain Forest	73,8
Northern Andes Páramo (high flatland) *	38,9	Cauca Valley Mountain Forest	77,6
Santa Marta Páramo*	49,5	Patía Valley Dry Forest	80,5
Northwest Andean Mountain Forest	51,0	Magdalena Valley Dry Forest	91,0
Cordillera Oriental Mountain Forest (Eastern Mountain Range)	60,2	Cauca Valley Dry Forest	93,3

(*) Provisional data, in revision. Source: CIIG Universidad Javeriana - Etter & Wan Wyngaarden, 2000. Tomado de Corrales *et al,* 2.000.

[10] These changes are not necessarily within a conservation of species and ecosystems strategy (as in the design of protected areas) but in certain areas they "connect" to these types of strategies (buffer zones or biological corridors for example).

The Colombian Andean region is characterized for being the most densely populated in the country and one of the largest areas of transformed ecosystems (Table 3). In this sense, a very important part of the existing original natural ecosystem biodiversity has been lost in this region. According to other sources, "it is estimated that in the Andean region more than 74% of the forest cover has been lost and only 1.5% of the original tropical dry forests remain". Deforestation is attributed to (in order of importance) the expansion of the agriculture, cattle-ranching and colonization frontiers (73.3%), wood production (11.7%), firewood consumption (11%), forest fires (2%), and illegal crops (2%).[11] The panorama presented by the data in Tables 2 and 3 suggests that the vegetation cover in the Andean Region is altered by up to 62-64% for the medium to cold climate ecosystems, and 44% for those between 3000 and 3500 meters. The most severe alteration is in the lower region (less than 1000 meters above sea level) where 75% of the original cover has disappeared and where dry forests have been reduced to generally very small relict patches.

Table 3. Colombia – Andean Region percentage of ecosystem transformation according to altitude ranges – 1998

Range	Percentage	Range	Percentage
Less than 500 m.	74.5	2,000 - 2,500 m.	62.8
500 - 1,000 m,	64.3	2,500 - 3,000 m.	62.3
1,000 - 1500 m	69.3	3,000 - 3,500 m.	44.1
1,500 - 2000 m	73.6	Over 3,500 m.	No data

Source: Database reprocessed by CIIG - FEAR – U. Javeriana.
Tomado de Corrales et al, 2.000

Table 4 synthesizes some of the biophysical and productive characteristics of the 4 micro-watersheds studied (Forero *et al* 2000), that in certain way illustrate the situation of many Andean micro-watersheds integrated into commercial agricultural circuits based on small-scale family commercial production. It can be observed that Lenguazaque, the watershed with the most intervention is the one that presents a more balanced access to the land. This is typical of certain areas where improved distribution implies greater agricultural and cattle-ranching activity. However, generalizations cannot be made, other studies have shown that rural communities in Colombia with mini-plots reach better ecosystem balance than areas where large or medium-sized plots predominate (Cárdenas et al 1998).

[11] Fandiño M.C. and Paola Ferreira (Eds) 1998 Colombia, Biodiversidad Siglo XXI: Technical proposal for the formulation of a National Action Plan in Biodiversity. Alexander Von Humboldt Institute; Ministry of the Environment, National Planning Department PNUMA, UICN, Pg.27.

For the Rio de Oro micro-watershed, the main riverbed was found to be highly contaminated by fragments of trout production; the middle of the watershed is subject to intensive small-scale agriculture, it is assumed that the water and soils are contaminated from agricultural chemicals; in the entire watershed, there are erosion problems caused by extensive cattle-ranching (especially at the highest elevations) and by berry production; loss of forest diversity and the best timber resources from the extraction of wood and degradation of the forest's protective vegetation cover. There is also soil erosion caused, in part by the exploitation of "capote" or humus.

In the Río Tibita - Lenguazaque micro-watershed, the Checua Project identified erosion and sediment production caused by the tilling system to cultivate potatoes as the main problem for this watershed. [12] Potatoes also generate grave environmental problems, perhaps the most severe, the progressive advance of this crop on the scant vegetation of the remaining high flatlands or "páramos." Another problem is the intensive soil and water contamination process caused by the high use of pesticides and herbicides in agriculture. Soil also becomes compact from tractor use and cattle grazing, and this, along with the increase in erosion caused from cattle footprints digging into the soil, creating "divots" completes the picture of environmental problems generated by potato and cattle production that predominates in this watershed.

The Río Guadalajara micro-watershed has a high degree of pollution in the main riverbed due to the amount of agrochemicals and residue from barns, pig farms and some poultry establishments that it receives. There is also evidence of frequent massive soil removals that on occasion have caused avalanches on riverbed.[13] However, extensive livestock grazing and the destruction of great expansions of natural resources by the "neolatifundistas" or new large landowners with their large-scale cattle-ranching, is the greatest contributor to the increase in environmental deterioration in the lower part of the micro-watershed. Moreover, slash and burn practices used by some producers to clear land for cultivation, along with coffee monoculture practices have generated great biodiversity loss in the area.

[12] Project through officials of the Autonomous Regional Corporation together with the German GTZ that promotes minimum tilling for potato crops.

[13] In general, the origin of this phenomenon is in the special structural fragility of the soils in this watershed where sometimes areas with natural intact vegetation can slip away

Table 4
Micro-watershed characteristics of the Oro, Tibita - Lenguazaque, Guadalajara and Combeima Rivers

VARIABLES			WATERSHEDS			
			RÍO DE ORO	**LENGUAZAQUE**	**GUADALAJARA**	**COMBEIMA**
1. Location	1.1. Geography	Latitude	6º 58 '	5º 18'	3º 53 '	4º 27'
		Longitude	73º 02 '	73º 43'	78º 43'	75º 17'
	1.2 Political –Administrative	Department	Santander	Cundinamarca	Valle del Cauca	Tolima
		Municipality	Piedecuesta	Lenguazaque, Villapinzón	Buga	Ibague
2. Surface area	2.1. Tax area up to period studied.		76 Km ^{2} El Conquistador	166.5 Km ^{2} Tapias	125 Km ^{2} El Vergel	189 Km ^{2} Moctezuma
	2.2. Height (meters above seal level)		Max. : 3400	Max.:3400	Max: 2880	Max.: 5200
			Min.: 1450	Min.: 2572	Min.: 1150	Min.: 1600
3. Climate	3.1. Type		Temperate to Páramo	Cold to Páramo	Temperate to cold	Temperate to nival
	3.2. Annual average temperature, centigrade		16.7	11.4	23.7	20.4
	3.3. Relative humidity (average - %)		81.8	82.6	75.4	79
	3.4. Annual average rainfall (mm)		1791	820	2274	1157
4.Current soil use	4.1. Natural Forest (%)		64.51	29.97	62.51	42.51
	4.2. Planted Forest (%)		0.11	2.76	0	1.67
	4.3. Established pastures (%)		24.85	47.18	35.53	41.42
	4.4. Crops (%)		10.53	20.09	1.96	11.90
	4.5. Sustainability indicator of plant management. (Note 1)		32.3	15.0	31.3	21.3
5.Production unit characteristics	5.1. Predominant land tenure		Land owners and squatters	Land owner, sub-lessors and tenants	Land owners.	Land owners
	5.2. Number of inventoried units (%)		147	831	232	98 upper part
	5..3. Approximate percentage of units inventoried (%)		95	70	50	100 of the upper part
	5.4. Land distribution indicator (Note 2)		24.4	58.2	22.8	19.4

Source: This study, except for #1: IGAC

Note 1: The sustainable management indicator of the vegetation shows the proportion plant cover, whether natural or artificial, managed in a sustainable way.

Note 2: The Gini Coefficient was used to calculate the land distribution indicator, for this case it measures the degree of land concentration in each of the watersheds studied. The formula used was (1-Gini) x100. The indicators were defined between 0 and 100. Zero indicates the extremely precarious and undesirable situation and 100 the optimum and desirable situation.

Finally in the Río Combeima micro-watershed extensive and semi-extensive cattle ranching maintains free grazing practices along the hillsides with slopes over 60 degrees. This system of production has been generating growing sheet erosion and solifluction, with sediments that are carried to the watershed's central channel. With the coffee crisis in the country, there have been changes in land use, from agricultural forest to prairies, with negative consequences for the soil and water conservation. In other cases, clean crops have taken the place of coffee, along hillsides with steep slopes, accelerating the dynamics of the erosion process and the amount of sediment that reached some ravines and the Combeima riverbed. In general, the fragile stability conditions of the hillsides and the local and regional seismic dynamic have historically precipitated the flow of mud and debris to the lower part of the watershed.

3. Characteristics of the incentives

Regional Autonomous Corporations CARs and especially NGOs were assigned the task of carrying out the micro-watershed management and recovery projects. CARs are public corporations in charge of managing environment and renewable natural resources, with a focus on sustainable development. The country has been divided up in a set of regions, using biogeographic, ecoregional, hydrographic and political-administrative criteria (sometimes with client-elitist interests) in which the local CAR is the primary environmental authority in each region. Because of their nature and assigned functions, the CARs are considered adequate to execute and advance eligible projects, and for this reason, can request the Environment Ministry to finance projects with external credit resources. NGOs and other organizations also participate in developing incentives that benefit communities.

With resources from IBRD, there are approximately 5,000 users (landowners or beneficiaries), 131,000 direct beneficiaries (inhabitants of the intervention or micro-watershed area) and more than 2,000,000 indirect beneficiaries (inhabitants of places that receive benefits from the aqueduct that gets its water from the micro-watershed) participate in the incentives. This population is settled in the influence area of just over 360 small canals and municipal aqueducts. More than 40,000 users, 450,000 direct beneficiaries and close to 1,600,000 inhabitants in the area or using the aqueducts provided by the different micro-watersheds, have benefited from IDB funds. Also, through a micro-watershed sub-program activities have been performed in 341 micro-watersheds, 176 of which have been supported by IBRD resources and the other 165 by funds from IDB. Additionally, 23 departments and 254 municipalities from the geographic regions of the country have been involved in the incentive projects, including the island area of San Andrés and Providencia.[14]

4. Requirements for incentive implementation

The process to select the agencies to carry out this program is based on six elements: agreement of the participating organizations, project identification and preparation (a task realized with the community); complete analysis by the Coordinating Unit of the Environment

[14] This information, provided by the National Planning Department is preliminary and the definitive data will be obtained once the database for the program is completed.

Ministry; selection and establishment of priorities by the interested agencies; selected projects are then included in the Annual Investment Operation Plan of the Coordinating Unit and the necessary Agreements and Contracts are established.

The following process must be followed to adequately transfer the incentives to the agencies selected to carry them out:

1. The selected agency (normally an Autonomous Regional Corporation) must identify the micro-watershed that will be subject to financing, elaborate a basic analysis and deliver a performance plan to the Coordinating Unit of Environment Ministry.
2. The Coordination Unit must revise the plan and make recommendations for any changes.
3. A Framework Inter-administrative Agreement and an Annual Inter-administrative Performance Contract is then signed between the performing agency and the Coordinating Unit.
4. The performing agency commits to carry out all necessary activities to promote the program and to identify its potential users.
5. The performing agency then may establish contracts with users at an individual level or through an intermediary institution.

The Autonomous Regional Corporations (CARs) has adopted diverse measures to make the corresponding contributions, according to available resources, logistic possibilities and follow-up strategies for the investments. It is a matter of optimizing their performance and control possibilities, according to the users' characteristics. In general, in-kind contributions are preferred, which often implies active participation of officials in the technical supervision of the tasks performed, as well as serving as a mechanism to allow the organization contact with the community.

Users are selected among those who manifest their desire to participate in the program. To have access to the incentive they must have technical approval after a professional from the performing organization visits their land. The type of "project" to be carried out is planned during the site visit. The user must meet some legal requirements that accredit him as the landowner. He must sign a public contract, committing to carry out the incentive "project" and to contribute to the project as well. In some cases, local organizations intervene during the selection process (mainly leaders of the community action council or an association of the villages or rural communities).

The strategy of the performing agencies (CARs or NGOs in exceptional cases) to interact with the communities or with other users has been vital in the application of incentives.

5. The process of implementing the incentive

The existence of two co-financing possibilities within the same program has been problematic for the promotion of the organization offering a lower incentive. The co-financing "matrix" that involves a 20% user contribution is more attractive than some as high as 62%. Different co-financing requirements have complicated establishment of the incentives. Potential users do not obviously, take options that cost them more. Although both alternatives have not been offered at the same time, the fact is, users postpone making a decision on the incentive, since

economic return on investments is not a factor. On the other hand, the 80/20-government/community-contribution plan offers an incentive barely equivalent to that offered by the CIF for reforestation. Under these circumstances, it does not make sense to offer lower incentives to small producers, many of whom live in poverty, to carry out reforestation activities with relatively similar costs, but with financial yields radically lower than those of commercial reforestation.

Many users are very poor and their expectations of future income are very low. It has been established that many users are motivated to accept the incentives because of their desire to preserve the soil and water sources and to apply incentives to their small forest plantations to receive economic benefits.

Although CARs do recognize that watersheds are the basic planning and performance unit, in practice they act in an isolated fashion, channeling their effort to recruiting users or groups of users (through organizations like the Community Action Councils), without having clear environmental management or land use planning criteria. As a result, the plantations with incentives are not technically guided by environmental criteria.

Producers, as well as officials in charge of carrying out the program unanimously agree that the producer will not be willing to carry it out if he is forced to accept the high costs of the transactions derived from the procedures that small reforestation activities entail. Therefore, the successful application of economic incentives depends on the performing organization absorbing these costs.

Considering the circumstances in which the incentives are applied, the following conclusions need to be emphasized:

- When the performing organizations are centered exclusively on recruiting users for the incentives they lose credibility, presence and leadership.
- The promotion and placement of the incentives should be accompanied by effective promotion, increased awareness and training. Also, they should be within the framework of a complete environmental and productive planning strategy with inter-institutional participation.
- To maximize the capacity of the CARS and to implement the incentives more efficiently, existing community organizations should be involved and NGOs and government organizations should support the effort.
- Forestry alternatives are not readily welcomed among producers with limited access to land, or who are poor. It is necessary to offer them incentives compatible with short-term income gains.
- In most cases, producers are not very willing to plant exotic tree species. They prefer native species valued for their eventual benefits in regulating water resources.
- Municipal organizations have serious limitations to offer continuity to medium and long-term programs because of unstable conditions for government officials.

6. The impacts of the incentives

Because the program is fairly new a thorough evaluation of its impact is still possible. However, the results of the study are presented below; the changes in the externalities derived from change in vegetation cover promoted by the economic incentives for micro-watershed projects and other complementary actions as simulated in four micro-watersheds.

In the Río de Oro, Lenguazaque, Guadalajara and Combeima micro-watersheds, curves showing water flow over time, with and without changes in vegetation cover, where established using SCS and DEEB hydrological models. With only one exception (in the Guadalajara watershed), all cases produced greater water supply during the seasons in which there normally would be a deficit. To illustrate, Table 5 shows the changes in the most relevant flow levels. The differences between the flow duration curves for deficit periods are taken to evaluate these externalities (see point 1.8 below).

Twenty-year projections were made to appraise social benefits, including the following:

a) the demand of potable water from the municipal aqueducts that depend on the micro-watershed defined for each case (with its intake coinciding with the micro-watershed closing point);
b) the demand for irrigation water for agriculture and in some cases, livestock;
c) water deficits according to population projections;
d) changes in water supply according to the duration curves of water flow estimated from the hydrological models;
e) decrease in the water deficits checked against the previous data;
f) appraisal of benefits from the decrease in potable water deficits using the medium fee without a subsidy - assuming the consumer is willing to pay;
g) the value of the benefits represented by surplus in the largest area available for agriculture with irrigation;
h) the value of the benefits derived from the costs avoided by water storage;
i) benefits represented by the costs avoided in treating potable water resulting from the reduction of sediment production.

For this last point a model developed by Juan Andrés Galarza, was applied, using regressions and savings in treatment costs with changes in vegetation cover. This model can be applied in situations where it is difficult to get direct information, as in the case of most of the small aqueducts. For this reason it is included in the “Methodological Design” (Metodología para calcular externalidades hídricas y beneficios sociales).

Table 5. Water flow changes in watersheds, affected by the projects

WATERSHED	MODEL	Water flow volume changes, with and without the project (%)					Disminution deficit year 20 (1000 m3)
		Qmed	Q99	Q95	Q5	Q1	
RÍO DE ORO	SCS	0.55	8.89	9.72	2.25		460
	DEEB	(1.34)	4.83	2.70	(1.09)	(2.54)	105
LENGUAZAQUE	SCS	24.08	7.69	12.10	(9.76)	(9.59)	2,282
	DEEB	9.49	9.44	9.46	9.49	6.66	819
GUADALAJARA	SCS	0.56	14.72	10.68	(2.42)	(0.87)	1,911
	DEEB	(2.24)	7.51	4.11	(4.22)	(2.15)	(528)
	SWAT			2.23			
COMBEIMA	SCS	2.91	12.86	25.78	(3.62)	(9.20)	3,942
	DEEB	0.40	0.40	0.40	0.67	0.38	287

Source: Forero *et al.,* 2.000

Following the procedure described above, the estimation results from the economic value of the benefits are presented in Table No. 6. Four alternatives were derived from the use of two different hydrological models (SCS and DEEB) were used as well as two different ways of calculating the benefits, the first one by a greater availability of water for human use and irrigation (appraisal method I) and the second, from costs avoided in storing water (appraisal method II). From these four methods the most appropriate was selected, one that combines the results from the SCS model and appraisal method II.

Table 6. Río de Oro, Lenguazaque, Guadalajara y Combeima watersheds project benefit values, external from the production units.
(Present value in millions of pesos, 1999. Discount rate 12%)

	RÍO DE ORO Estimation according to model		**LENGUAZAQUE** Estimation according to model	
Water flow volume changes valuation method	**SCS**	**DEEB**	**SCS**	**DEEB**
Valuation method I				
Availability to pay for potable water.	374.93	125.92		–
Increase in productive agricultural areas.			663.71	239.78
Costs avoided from decreased sediment.	249.82	249.82	3.10	3.10
Total according to Valuation Method I	624.75	375.74	666.81	242.89
Valuation Method II				
Costs avoided in water storage.	305.74	69.89	1,518.03	544.58
Benefits from decreased sediment.	249.82	249.82	3.10	3.10
Total according to Valuation Method II	555.56	319.71	1,521.14	547.68

	GUADALAJARA Estimation according to model		**COMBEIMA** Estimation according to model	
Water flow volume changes valuation method	**SCS**	**DEEB**	**SCS**	**DEEB**
Valuation Method I				
Benefits for water flow volumes according to availability to pay and productive area increase..	–	–	5,035.78	365.75
Benefits for water flow volumes according to productive area increase.	951.81	(265.74)		
Benefits from decreased sediment.	15.38	15.38	599.81	599.81
Total according to Valuation Method I	967.19	(250.36)	5,635.59	965.56
Valuation Method II				
Benefit for increase in water flow volumes according to avoided costs and water storage.	1,271.45	(351.28)	2,607.50	190.68
Benefits from decreased sediment.	15.38	15.38	599.81	599.81
Total according to Valuation Method II	1,286.83	(335.90)	3,207.31	790.21

Source: This study.

Table 7 compares incentives with the derived benefits. For the first seven rows the minimum incentive is calculated as the sum (in current value 12% discount rate) of the yearly compensations for producer deficits resulting from substituting current production systems for the proposed alternatives. These alternatives were locally designed for each one of the four micro-watersheds studied and for several types of producers (the average is taken in each micro-watershed). The incentive currently in use (row 8) corresponds to the resources that are being given to the user to establish and sustain various forestry options for the two first years of the project.

The Integral Sustainable Systems (SIS in Spanish, sistemas integrales sostenibles) in rows 1-4, refer to projection of changes in crop practices that mitigate environmental effects, as well as some small reforestation activities (live fences, spring protection, small plantations). The incentive for a sustainable agricultural option refers to the changes programmed for only one crop with the same logic explained before.

The incentive for changing cattle ranching shown in row 6, tries to improve an activity that yields very low income (around $80,000 per ha/year). Consequently, the small areas set aside for adaptation tasks, especially live fences, have a relatively small opportunity cost. Furthermore, adjustments that promote improved uses are not very costly.[15] Under these conditions the incentive reaches a relatively reduced value. Effectively, the amount of the incentive for conversion of cattle-ranching is only $630,000 per hectare (the value over a 20 year period), which is equal to less than half of what is currently being applied for forest activities (IDB – IBRD).

To compare incentives and the social benefits they generated, four scenarios were quantified, as presented in Table 7:

Scenario I. With hydrological benefits: this only considers social benefits generated by the decrease in sediments and the increase in minimum water flow. Only the benefits considered as central in the design of the recovery and micro-watershed management program are taken into account.

Scenario II. Cultural, recreational and carbon storage are added to hydrological benefits: to calculate these new benefits results reported in two studies were considered (Constanza- Nature 1997 and the electronic data base, and Dixon 1995)[16]. These values were adjusted introducing a conversion factor for each watershed, but it must be noted that this exercise merely pretends to address the possible impact of non-quantified benefits.

Scenario III. "Internal" (private) benefits derived from the projects are added to hydrological benefits: This includes the assumption, sustained by economic theory, that social benefits are an addition to private benefits. In this case, hydrological benefits

[15] This proposal is not that novel, considering that a group of experts lead by IBD officials highlight the "improvement of grasses" among the "direct actions of rational use" in micro-watersheds. This alternative, along with agricultural forestry are among the measures that "have been considered within the forest management and vegetation component" and also imply recovery, protection and conservation, on the one hand and use and production on the other (Basterrechea et al., 1996:xix).

[16] CONSTANZA et al (1997), The value of the world's ecosystem services and natural capital, NATURE, Vol. 387, 15 May, 1997. DIXON, Robert K. Agricultural forestry systems and greenhouse gasses, Agroforestería en las Américas, Año 2. No 7. Pgs. 22-26, July-September 1995.

generated outside the user's plots were added to those gained as a result of applying the incentives, and that would not have been obtained through other sources.

Scenario IV. With the set of external and internal benefits: Sum of all the social benefits considered in the previous scenarios.

Table 7. Minimum Incentive and subsidy in different scenarios

	WATERSHED	ESCENARIO				
		VARIABLE	I: Water benefits	II: Water, cultural, recreational and carbon storage benefits	III: Water and private benefits	IV: Water, cultural, recreational and carbon storage benefits
INTEGRAL SYSTEMS	1. LENGUAZAQUE. Integral sustainable systems (SIS)	Subsidy	233	(564)	(4,074)	(4,871)
		Subsidy / Incentive	79%	0	0	0
	2. RIO DE ORO SIS	Subsidy	575	(358)	(9,052)	(9,985)
		Subsidy / Incentive	65%	0	0	0
	3. GUADALAJARA SIS	Subsidy	298	(635)	(2,031)	(2,964)
		Subsidy / Incentive	36%	2%	16%	0
	4. COMBEIMA SIS	Subsidy	1,786	542	3,121	1,878
		Subsidy / Incentive	77%	23%	135%	135%
5. SUSTAINABLE AGRICULTURE		Subsidy	1,809	1,215	(2,089)	(2,899)
		Subsidy / Incentive	87%	58%	0	0
6. LIVESTOCK RAISING CONVERSION		Subsidy	360	(235)	(3,539)	(4,349)
		Subsidy / Incentive	57%	0	0	0
		Subsidy / Incentive	57%	0	0	0
7. FOREST PROTECTOR, PRODUCER BOSQUE PROTECTOR PRODUCTOR		Subsidy	2,505	2,148	166	(320)
		Subsidy / Incentive	101%	86%	11%	6%
7. CURRENTLY APPLIED 80-20 MATRIX		Subsidy	1,089	495	(2,809)	(3,619)
		Subsidy / Incentive	80%	36%	0	0

Source: I y III, Forero *et al* 2000, II y IV: adapted from Constanza 1997 y Dixon 1995

A subsidy is equal to the difference between the social benefit and the incentive. When only the benefits derived from hydrological externalities are considered these subsidies are 50% greater than the incentives, with the exception of only one case (Table No. 7).

When we consider the benefits of scenario II, the situation would change radically; in the majority of cases the benefits would surpass the incentives and as a consequence, there would be no subsidies.

Considering scenario III, private benefits appropriated by users, the same logic proposed in the design of micro-watershed programs is applied. Only those benefits that have to do with the project are considered. This case is interesting in that all the benefits of the other sectors involved, the producers up-river, were taken into account. In this scenario subsidies practically disappear and projects would be justified on their own benefits. Evidently, scenario IV that includes all types of benefits offers the most favorable result in terms of the technical viability of the incentives, understanding viability as the relationship between the incentive and the benefits it generates.

The first result, that takes into account only hydrological benefits and implies relatively high subsidies, should not imply that incentives are not justified because the benefits only partially and in a very low proportion, represent the social benefits derived from these projects. On the other hand, it is clear that these types of incentives represent one of the few possibilities of channeling efforts and funds to certain strategic micro-watersheds and toward rural social sectors that are almost completely excluded from access to other types of incentives.

8. Balancing the course of this experience

Mechanisms that work efficiently in placing incentives are, generally: a) the individual selection and placement of incentives for medium and large land owners who have clear expectations of environmental advantages of reforestation only or of the environmental and economic advantages as well; b) liberating the user from some of the procedures and placing them in the hands of the performing organizations, the Autonomous Regional Corporations or CARs; c) relationships between CARs and the Community Action Councils; d) promotion workshops and meetings and training; and e) control and follow-up systems established between the Environment Ministry and the CARs.

On the other hand, the following aspects are problematic: a) the individual selection and placement of incentives for small producers; b) in some cases, the lack of forestry alternatives adapted to the users; c) the lack of alternatives that use incentives different than forestry; d) excessive procedures that the user has to deal with alone; f) the lack of estimates for externalities and social benefits of projects that will use incentives; g) the lack of technical-environmental criteria to promote the tasks; h) the lack of inter-institutional coordination in micro-watershed planning

and integrating incentives into land use planning strategies; and i) the lack of coordination when establishing incentives and planning projects that use them. This situation becomes critical in periods when funds have to be provided for watershed maintenance.

According to the balance between mechanisms and problems, it is clear that the program should not be totally revamped. Instead, the mechanisms that are working correctly should be strengthened and those that are problematic should be corrected. To complement this, on the one hand, new elements should be added to try to reach those users or social sectors that have not found the incentives attractive, and on the other, obtain more coherence among the expected effects of the incentive and the environmental problems of the micro-watersheds where they will be applied.

Faced with heterogeneous productive, environmental, social, economic and institutional conditions of the different micro-watersheds, it is clear one of the central elements of the methodology is the flexibility with which this mechanism is applied. Flexibility in at least two aspects, the institutional mechanisms and the alternatives offered to producers. The first includes the promotion, agreement, hiring, user selection, funding, verification and follow-up systems. The second refers to the gamut of productive-environmental possibilities that can be promoted through the use of incentives.

From the institutional and technical analysis done by the study mentioned above (Forero *et al* 2000), it is suggested that other alternatives should be promoted, with which similar results can be obtained in generating tree cover. Using economic incentives could advance these.

Among the new alternatives that can use incentives, the “integral sustainable systems”, “sustainable crops” and “cattle-ranching conversion” offer the possibility of inducing changes in agricultural and cattle-ranching practices. This does not necessarily imply substituting agricultural and cattle-ranching policies. The alternatives that can be promoted through the use of incentives should center exclusively on areas of high environmental priority, if the goal is to promote tree plantations or agricultural systems.

Incentives for natural regeneration and cattle-ranching conversion are especially important because they can help solve many environmental problems in Andean hillsides (of hydrological origin: severe erosion, massive sediment removal, de-regulating water flows, and non-hydrological origin: biodiversity loss), due to the severity of such problems and because of their low cost (Table No. 6). The fact that the cost of these incentives is much lower than current alternatives is explained by the reduced opportunity cost of the activity that must be substituted: extensive hillside cattle-ranching.

It is necessary to take performance and control measures to guarantee access to small owners and producers, the target population (without risking a proportion of

the attended areas, in certain large plots, that may not be carried out under strictly environmental criteria). To deal with this some adjustments to the "information system for follow-up" model were proposed to allow for permanent quantification of incentive distribution according to the types of users and the size of the attended areas.

Community participation has been prominent in the general formulation of the Natural Resources Management Program, as well as the Conservation and Recovery of Micro-watersheds Subprogram, as one of the essential aspects for project eligibility and for all of operational aspects. [17] This is an aspect, which should be supported and which in some cases problems were found. The methodological redesign of the program proposes to strengthen these mechanisms of inter-relationships between the performing organizations with the communities and their organizations based on the positive experiences in some micro-watershed management. Participation should be included in the selection of alternatives, in the selection of users and in the evaluation, follow-up and control of incentives application. The performing organization and the communities should have a direct relationship with potential users and simultaneously with the organizations that represent them. Furthermore, strengthening community or civil society institutions is a requisite to guarantee adequate program implementation.

On the other hand, the evaluation of the performing organizations operation (The Autonomous Regional Corporations), highlights the need to work with NGOs and governmental organizations that have effective presence and credibility in the micro-watersheds. This is considered in the initial formulation of the micro-watersheds program. The collaboration of institutions in applying the incentives, led by the performing organization, enables other organizations to participate, resulting in the project having higher success potential, although there may be limited human resources. This also qualifies social participation and generates control and vigilance mechanisms that guarantee the transparency in funding expenditures.

The institutional convergence scheme must be adapted to the possibilities of each case without being a rigid guideline. The recommendation is to effectively build a team that includes at least two local organizations, to guarantee an inter-institutional balance, which is key to reach greater efficiency and transparency in resource management.

[17] "The community, campesinos and Afro-Colombians, will participate and directly benefit from the different activities of the projects. Their active participation should be in deciding on investments, their performance, follow-up and evaluation, as well as control and vigilance of the protected areas" (MMA-IRDB). Regarding the eligibility criteria of projects it is explicitly mentioned as a requisite that "all projects, especially field ones should contemplate the active and real community participation (Ibid.).

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