

IIED

International
Institute for
Environment and
Development

FOREST RESOURCE ACCOUNTING

Monitoring Forest Condition
and Management

A joint IIED/WCMC project
funded by ODA in support
of ITTO's Target 2000 policy



World
Conservation
Monitoring
Centre

FEASIBILITY STUDY FOR NATIONAL FOREST RESOURCE ACCOUNTING IN ECUADOR

30 March 1993

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FEASIBILITY STUDY FOR NATIONAL FOREST RESOURCE ACCOUNTING IN ECUADOR

1. SUMMARY

International FRA Reporting is feasible in Ecuador, but only basic information on the presence/absence of the conditions for sustainability can be reported, as only a small part of the potential PFE has been defined and demarcated and formal management is not taking place, even within the currently demarcated areas.

A National FRA System would therefore not be effective in improving the management of natural forests and its main purpose would be to keep track of the changing forest area. This would provide the essential information required to contribute to improved forest, national park and colonisation policy, and especially to reduce inter-institutional conflicts.

The authorities in charge of forestry, parks and colonisation, and the (strong) NGOs concerned about the environmental and social impacts of the conflicts of these activities, have an incentive to support National FRA. No group, however, declared themselves willing to contribute to establishment costs.

The options for beginning National FRA demand good information on the forest. For plantation development, the records are good. For natural forests, one of the relative strengths of the forestry sector in Ecuador is the land capability mapping already available, and the satellite coverage and interpretation capability in CLIRSEN. However, in contrast, the field presence of foresters is poor and they suffer from major resource constraints which hinder effectiveness. The best way of adding value to these, and at the same time helping to improve forest policy through setting up a National FRA, may be to bring these capabilities together in a GIS. GIS could help with some of the coarse-scale FRA functions and it may reveal priority forest zones for land use planning, improved field management and monitoring.

Where policy needs considerable revision, experience shows that this should be done through dialogue with all the major interest groups: government, NGO, private sector and community. Any information/monitoring system - like a National FRA System - that is developed to further this policy dialogue, must be open to all. Hence, while INEFAN, or another government body, could coordinate a National FRA System, a partnership is recommended. NGOs and the private sector would contribute information and use FRA outputs for policy dialogue and forest management purposes.

2. FORESTRY INFORMATION IN ECUADOR

The forestry sector in Ecuador is at present undergoing a period of considerable institutional change and uncertainty following the change of Government in August 1992. This is consistent with the pattern of frequent policy, directional and institutional changes which have characterised the sector since the creation of a forest service in 1952, and is clearly not conducive to the development and implementation of the long-term, cohesive policies which the sector requires. The newly created government body with sectoral responsibility is INEFAN, which depends, as did its predecessor, SUFOREN, on the Ministry of Agriculture. At the time of the visit the new organisation was undergoing a period of consultation and discussion to define its policies and directions. As a result, there are many uncertainties concerning its role and direction. The indications are that it will be less conservation minded than the previous administration and focused more on serving the interests of the private industrial sector.

2.1 Protected Areas

Ecuador has been recognised as one of the World's most important areas for biodiversity, on account of its equatorial location and extreme geographical and climatic variation. The importance of the Ecuadorian forest resource in the context of global biodiversity was described by Dodson and Gentry (1991), who also depicted the threats to the future of the resource, particularly as a result of deforestation and other human activities. Southgate (1992) attributed much of the problem to inadequate and frequently conflicting policies adopted and promoted by different Government organisations, in particular the conflict between the forest service and the land colonisation agency, IERAC. A further major contributing factor is inadequate implementation of policy.

In 1976 the Government initiated a network of conservation areas, the management of which is the responsibility of the National Directorate of Natural Areas within INEFAN. These areas comprise six National Parks, eight biological, ecological or wildlife reserves, and two designated recreational areas. These reserved areas cover a total of 2,865,477 hectares (including the Galápagos Islands with 693,700 hectares), and include a representative sample of many of the biologically most important areas in the country.

Their management, however, is a source of major concern in the country. Although they exist on paper, and have been legally designated, the situation on the ground is generally unsatisfactory. This is aggravated by scant and declining resource allocations by Government, rendering management of large, remote areas with poor or non-existent infrastructure and communication difficult if not impossible. Unauthorized activities continue unabated in many areas, with illegal logging, colonisation for agriculture (on occasion promoted by the Government) and gold mining being common problems. In the Amazon area, there is a major conflict of interest with the petroleum industry, which is actively prospecting for oil and gas within the Yasuni National Park and the Cuyabeno Ecological Reserve. The main problems created by the oil industry are the increased ease of access following the opening of new roads, with consequent escalation of illegal activities, and pollution associated with the exploitation of the petroleum resource. Such is the importance of the oil industry to the

national economy that the Directorate of Natural Areas has very little possibility of influencing the Government position *vis a vis* the regulation of petroleum industry activities within protected areas.

The Directorate of Natural Areas has prepared management plans for most of the areas under its control, and the most recent of these have taken a much more multi-disciplinary approach to planning than the earlier ones. However, the implementation of these plans is little advanced. There is expanding collaboration with environmental NGOs, in particular Fundación Natura and international organisations such as UNDP/FAO, WWF International and UNESCO in the management and conservation of these areas. It is likely that these partnerships will become increasingly important given the deteriorating resource availability in the public sector. It is probable that the NGO sector, given its presence on the ground, will be best equipped to play a role in monitoring the trends and situation in these areas as part of any nationally appropriate FRA exercise.

2.2 Land capability and use

Within the Ministry of Agriculture, the PRONAREG project, with technical and financial assistance from ORSTOM in France, developed an impressive series of land use capability maps for the country at scales of 1:50,000 in more important agricultural areas such as the Andean Region to 1:200,000, based on the existing topographical maps. The main characteristics used in the preparation of these maps were soil, relief and climate. These maps potentially provide a very useful baseline for any FRA system which may be developed. A summary of the actual and potential land use is presented in Annex 4.

Ecuador has a very large proportion of its land area under forest cover, though much of this area has been colonised to a degree, either spontaneously or as a result of government policy, executed by the land reform agency, IERAC. A forest map at 1:1,000,000 was completed in 1990 as a result of a collaboration between the Ministry of Agriculture and CLIRSEN. The forest area is broadly classified into:

- Protection forest on steep slopes.
- Protection forest in mangroves.
- Protection forest in dry areas.
- Production forests.

The protection forest areas declared by Government decree, which includes forest areas in both private and public ownership, comprises 88 forest areas varying in size from 25 to 540,000 hectares, and totalling approximately 1.5 million hectares, mainly on steep slopes. The total area which it is considered should be legally declared as protection forest totals approximately 3.4 million hectares, with most of the additional area being in dry forest. The declared function of these protection forests is to conserve and protect the resources of water, soil, flora and fauna. Most protection forests in the provinces of Guayas, Azuay and Pichincha.

The "production forests", covering an area of approximately 8,000,000 hectares, are the

main forest areas of importance in relation to the design and implementation of an FRA system. The actual control of their use and availability of reliable information on their status is a major cause for concern. During the 1980's, with the assistance of USAID, a programme of delimitation of the "Patrimonio Forestal del Estado" (State Forestry Resource) was begun. This programme delimited on the map approximately 2,000,000 hectares in the provinces of Napo, Sucumbios and Esmeraldas; the work has been paralysed in recent years due to lack of funds. The level of control by INEFAN over these areas is minimal, and land colonisation, both spontaneous and directed, is continuing within these areas. The colonisation process leads generally to conversion of forest to subsistence and extensive agriculture; the low prices paid to colonists for standing timber encourage forest clearance for conversion of land use from forest cover to other uses, frequently unsustainable. Furthermore, to obtain title to land from IERAC, the colonist has to demonstrate that land is being converted from forest to another use, hastening the process of deforestation.

2.3 Forest management

There is little forest management within the normally accepted definitions at present in Ecuador, apart from plantation management in the temperate Andean Region. Although the State has a normative or regulatory remit, it is neither actively involved in management, nor has the institutional capacity to enforce sustainable forest management by the private timber sector.

During the 1970s and continuing up to 1982, a system of forest concessions was implemented to provide management areas for the private sector companies. These companies rely mainly on the lowland humid tropical forest of North-Western Ecuador as a source of raw material for the domestic and the export timber market, though the export market is relatively small. The exploitation for industrial raw material on the Amazon side of the Andes is much less on account of greater transport costs and difficulties, and the poorer species composition of the forest. The concession system was abandoned on account of its unworkability, with the timber industry blaming the pressures of spontaneous agricultural colonisation in the concession areas, rendering long term management impossible.

Following the collapse of the concession system, the raw material supplies for the timber industry, estimated to be some 3 million m³ per year, at present come almost exclusively from purchases by the timber companies or their agents from agricultural colonisers in the organised and spontaneous sectors. The prices paid to colonists for standing timber are extremely low at approximately US\$ 4 per tree. Exploitation is highly selective in terms of species, and environmentally damaging due to the use of heavy machinery and the general disregard for environmental safeguards to minimise costs of exploitation. INEFAN authorises cutting based on exploitation plans, which must make provision for regeneration, and a reforestation bond is charged on the extracted volumes which are reported. However, INEFAN does not have the resources to check the authenticity or appropriateness of the plans, or on the effectiveness or otherwise of the regeneration. Furthermore, the low value of timber to the colonist farmer provides little or no incentive under present exploitation practice to consider forest management as a long term form of land use.

There are some innovative attempts to introduce forest management activities at the community level, with either indigenous groups or groups with legal title to land. ODA is involved in such a project in North-Western Ecuador and an NGO consortium, headed by CARE International is working in the same area and also in the Amazon. These initiatives will provide an opportunity for local communities to harvest timber on the basis of defined management plans, using portable sawmills. The export market for sawn lumber is the main target, given the price distortions of the domestic market. If technical and organisational problems can be resolved, these programmes provide an exciting alternative to the *status quo*, and may provide major benefits to the local economy, as well as being a significant force in forest conservation. Given the pressure from the international community for timber from certified sources, timber from such projects should have ready acceptability. The extensive regeneration of *Cordia alliodora*, particularly in the Amazon area, may provide an important opportunity for management at the colonist farmer level for small diameter quality hardwood.

2.4 Forest inventory

During the period 1965 to 1984, the state forest service, in collaboration with various national and international organisations carried out forest inventories, generally with an extremely low sampling intensity, over some 10 million hectares of forest. These inventories gave an estimated standing volume of 1,223 million m³ of timber, though much of this timber is in small diameter classes and with a great diversity of species, the majority of which are not of interest to the forest industry on account of lack of information on their characteristics. The forests of the North West had a higher exploitable volume, both in terms of diameter and species composition. This, in conjunction with the greater transport costs associated with the Amazon side, have resulted in a greater concentration of forest exploitation on the Pacific side of the Andes. There has not been much inventory done at a scale upon which forest management plans for long term management could be developed.

The last major inventory to be completed, which was conducted within the framework of an agreement between the Ministry of Agriculture and CLIRSEN was an inventory of the coastal mangrove resource. There is no detailed inventory work in progress at the present time.

2.5 Satellite data and GIS

Ecuador has a well-equipped satellite receiving station which gathers information for a large area of south and central America. They receive data from Landsat, Geosat, SPOT 1 and 2 and ERS. A Canadian software system called Meridian is used to produce vector data from the satellite image.

INEFAN uses a GIS (IDRISI) and AutoCAD and are expecting a Belgium donation of ArcInfo, 386 PC with VGA screen, A4 plotter and a 140 x 120 cm digitising table.

3. FEASIBILITY OF FOREST RESOURCE ACCOUNTING IN ECUADOR

3.1 Existing systems

The availability of forest information has been described in section 1 above. An excellent series of paper maps exists covering land use capability, land use conflicts, colonisation, forest cover, soils, geology and climate. However, the only current potential for development towards a FRA system lies with CLIRSEN. The facilities of a GIS would maximise use of currently available data and would enable satellite information to be integrated with thematic data currently available on paper maps. They would also enable field work to be concentrated in areas where limited resources can be used to maximum effect.

3.2 Potential national uses

The commercial timber companies would welcome the idea of a FRA system but would not be prepared to fund it. However, they anticipate becoming customers of the data once the system is operational. The companies anticipate that a FRA system might help them to calculate the exact amount of land required to sustainably fulfil the industry's demand for timber. However, their expectations of the amount of information obtainable from satellite images are probably unrealistic, including such things as deforestation rates, afforestation rates, condition of the forest, species, density and spread of the colonos.

It might be possible to computerise the system of recording colonisation. This is currently carried out manually by IERAC and its provincial offices but there may be cost benefits from computerising the process and using GIS to produce the maps of colonisation areas. Such a system would provide a useful input to any FRA system developed in the future. However, detailed study would be required to determine whether such a system would be feasible and cost effective.

3.3 Associated national plans

Ecuador has developed a National Forestry Action Plan following the guidelines set down for TFAP. The TFAP Round Table was held in Quito in 1990 and defined possible projects for funding under five major areas: Forestry and land use; Forest-based industrial development; Fuelwood and energy; Conservation of tropical ecosystems; Institutions. Some of the project profiles presented in the TFAP have attracted international funding.

3.4 Constraints

Any successful FRA system will have to operate within the constraints outlined below, unless those constraints can be overcome.

3.4.1 Political

A major political issue which mitigates against rational forest management and hence the ability to monitor management is the inability of successive governments to rationalise land

use to balance agricultural colonisation with the need to develop sustainable forest management, or indeed maintain areas of the country under permanent forest cover. The pressure to colonise the remaining forest areas of lowland Ecuador is high, and this happens both spontaneously, followed by attempts to obtain legal title, and on a directed basis through IERAC. Since 1964, nearly five million hectares of land have been colonised with the assistance of IERAC, in many cases on land only suitable for forest use. The insistence by IERAC on the colonists to clear a proportion of land each year to convert from forest to agriculture in order to obtain legal title has been, and continues to be, a major force in deforestation. Speaking to staff of INEFAN, the conflict is clear, it has been present for years, but successive governments have failed to resolve it. The problem of corruption and vested interest is also very real. Even where legislation exists to protect the forest, the political will to enforce it is absent because of the economic advantage of developments such as oil exploration.

The situation for protected areas is no better. No coherent legal framework exists by which national conservation objectives may be implemented. There is no management programme for protected areas and, although there is a written workplan, it is not implemented.

There is, therefore, an urgent need for strategic land use planning at national and provincial level - both levels are essential - and for enforcement of such a strategy. In so doing, it is essential that short-term needs are balanced against longer-term problems. Without such balance new, short-term problems will be continually created. Control of colonisation within the framework of such a land use policy is essential as is zonation and enforcement of areas for productive forest management. Control of the forest industry and provision of incentives for forest regeneration and plantation development are also necessary, to help create a vertically integrated industry.

There would appear to be little political will at the moment to address these issues, even against a background of a rapidly reducing forest resource base.

3.4.2 Financial

The present prices being paid for standing timber in Ecuador are so low in relation to likely costs of production, either by plantation development or by management of natural regeneration that there is little incentive in the foreseeable future to regard forestry as a long-term, sustainable land use system.

INEFAN, in common with forest services in many parts of the world, is seriously underfunded in relation to the scale of its responsibilities. A major source of its income is from stumpage charges, which at less than US\$ 0.50 per m³, with a reforestation bond of US\$ 0.35 per m³, amount to less than US\$ 500,000 per year. However, the funds generated from these stumpage charges are apparently not available for field activities related to forest management. A radical revision of stumpage charges, and investment of income generated in forest management, are needed.

INEFAN is not in a position to fund an FRA exercise, given the resource constraints and the

alternative ways to spend money. It was made quite clear at the final seminar that the international community would be expected to finance such a programme. This is justifiable in the initial stages, given the required infrastructure and start up costs, but it is both inconceivable and incorrect that the international community would fund FRA in perpetuity. There would be a very high likelihood of FRA being discontinued following the cessation of international funding and the long term aims of FRA as an aid to monitoring the progress in forest management would not be realised. If resources are committed to a FRA system, it must be carefully designed in such a way as to maximise its impact on the real sustainability problems, including the political, management and socioeconomic problems.

3.4.3 Technical

In relation to the scale of the problem, INEFAN has inadequate trained and resourced staff to carry out the enforcement and supervision of management in the field. The areas are huge, means of transport and communication are poor, and consequently it is extremely difficult for staff to carry out enforcement or monitoring activities.

3.4.4 Data

There are not, at the moment, sufficient accurate data available from inventory of standing volumes, or on management activity, to monitor management activities towards sustainability. There is no established pattern of forest management to monitor and, as a result, there are no management data on which to build a FRA system. The land tenure in the lowland tropical areas of the country is too fragmented and too ill-defined to monitor progress towards sustainability and there is no annual statistical presentation by INEFAN detailing forest ownership, forest use, volumes cut etc.

An additional problem is accessibility of data. NGOs report that oil companies and government departments have information which they refuse to release. Greater co-ordination is necessary, both between and within sectors, to maximise use of the available resources.

3.4.5 Social

The social and economic pressures on the forest appear at the present time to be without solution. Ecuador's socio-economic problems focus attention on short-term problems and away from medium and long term issues. In addition, taking the short term view is very much part of Ecuadorian culture. The hunger for land and new opportunity is leading, with tacit government approval but with inadequate planning and provision of technical assistance, towards a situation of major forest loss. The land clearance activities of the colonist farmers are resulting in a supply of cheap raw material to the timber industry, generally on an unsustainable basis, which with few exceptions, is not taking a longer term view of raw material supply.

4. RECOMMENDATIONS

- 4.1 The first step towards establishment of a FRA system should be taken by development of a geographic information system. The GIS should be used to integrate satellite data, aerial photography, information on land characteristics and colonisation data from IERAC.
- 4.2 Although detailed monitoring of the forest resource is not currently feasible in Ecuador, information from a FRA GIS would enable field work to be concentrated in areas where limited resources can be used to maximum effect.
- 4.3 Establishment of FRA should be agreed between the government, commercial, NGO and community sectors. FRA will only operate effectively with full participation by, and co-operation between, these sectors. A pooling of knowledge and expertise will ensure FRA gives maximum benefit with minimum resources.
- 4.4 It is recommended that FRA be the responsibility of a partnership of the above sectors, or of an independent organisation agreed by these sectors. This should enable the system to present factual, unbiased information providing a common basis for interpretation by others, and would facilitate maximise dissemination and use of data.
- 4.5 A careful analysis should be undertaken of data availability, data movements, existing availability of equipment and expertise, and individual organisations' requirements. Due to the high cost of digitisation and of obtaining satellite data, careful consideration should be given to the funding of FRA. While donations may be suitable for initial investment in equipment and training, running costs cannot be met this way. Installation of FRA is of little value without long term security of funding.
- 4.6 Since CLIRSEN data cover much of south and central America, the possibility of funding FRA through provision of a service to other Latin American countries should be investigated.
- 4.7 To provide an environment appropriate to the operation of FRA, existing information on land characteristics should be combined to develop a strategic land use policy. In particular, existing conflicting land use policies should be resolved. An appropriate land use strategy should balance short-term needs against longer-term problems. Without such balance new, short-term problems will be continually created.
- 4.8 A more detailed FRA system should be developed slowly and incrementally, to keep pace with developments in forest policy, forest management and data collection.

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- MAG/CLIRSEN (1988). Inventario de manglares, Quito.
- Southgate, D. (1992). Policies contributing to agricultural colonisation of Latin America's tropical forests. In: *Managing the World's Forests*. Ed. N. P. Sharma. Kendall Hunt Publishing Company, Iowa, USA.

ANNEX 1: LIST OF INDIVIDUALS AND ORGANISATIONS CONTACTED

Government departments

Marco Almeida, Planning Department, INEFAN
Victor Alomoto, INEFAN
Mario Cardenas, ITTO/INEFAN
Esteban Tobar Carriñ, SETRAFOR
Julio Comejo, Forest Management, INEFAN
Sergio Figueroa, Director of National Parks and Wildlife
Carlos Gonzales, ITTO office, INEFAN
Eberhard Klinge, PROFORS
Gerardo Lozano, ITTO
Juan Salinas, Management Division, INEFAN
Roberto Sanchez, CLIRSEN
Gonzalo Sevilla, Director of Programming, IERAC
Patricio Toledo, CLIRSEN
Mario Torres, ITTO office, INEFAN
Franklin Troncoso, Reforestation Division, INEFAN
Hernan Velasquez, PRONAREG, MAG
Oswaldo Vivanco, Forest Management Division, INEFAN

Non-government organisations

Lilyana Benites, Director of the Resource Management, Fundación Natura
Antonio Brack, UNDP, Coordinator of assistance programme to the Secretaria Pro Tempore
of the Amazonian Cooperation Treaty
Douglas Ferguson, Director, CIBT
Rebecca Justicia, Executive Director, Fundación Maquipucuna
Elías Mamallacta, Secretary of the *Fundación Izu Mangallapa Urcu*
Rodrigo Ontaneda, Presidente, Fundación Maquipucuna
Luiz Ortiz, Director of UTEPA
Rodrigo Sierra, EcoCiencia
Danilo Silva, Executive Director, EcoCiencia
Roberto Troya, National Executive Director, Fundación Natura
Jorge Uquillas, Sociologist, FUNDAGRO
Ana Maria Varea, Coordinator of the Andean forests Programme of IUCN

Commercial sector

Manuel Durini, General Manger, ENDESA
José Franco, Executive Director, AIMA
Manuel Luna, Forester, Lago Agrio
Fernando Montenegro, Fundación Forestal Juan Manuel Durini
Vladislav Quirola, Administrative Director, Forestry Department, Plywood Ecuatoriana S.

A

Mauricio Terán, General Manager, BOTROSA
Lino Veloz, Fundación Forestal Juan Manuel Durini
Marco Vinuesa, Forestry Consultant

Other

Michael Dunn, British Embassy
Frank Wheeler, British Ambassador to Ecuador

ANNEX 2: ITINERARY

- 13/01/93 Travel from UK to Quito, arriving 2330, night Hotel Alameda Real
- 14/01/93 Travel to Rio Silanche Farm of ENDESA, Pichincha province. Night in Fundación Durini house.
- 15/01/93 Visit to logging operations and veneer factory of BOTROSA. Night in Fundación Durini house.
- 16/01/93 Visit to plantations of ENDESA and natural forest reserve. Return to Quito.
- 17/01/93 Preparation in Quito for meetings.
- 18/01/93 Meetings with staff of INEFAN and Ecociencia.
- 19/01/93 Morning meeting at CLIRSEN, afternoon meeting with HMA at British Embassy.
- 20/01/93 Meetings with FUNDAGRO, Fundación Natura and Fundación Maquipucuna.
- 21/01/93 Meetings with Fundación Natura, IERAC, AIMA and other representatives of the private forestry sector.
- 22/01/93 Meetings with Tratado de Cooperación Amazónica and IUCN.
- 23/01/93 Travel via Baeza and Loreto to Coca, holding discussions with the Fundación *Izu Mangapalla Urcu*.
- 24/01/93 Visit to on-farm agroforestry demonstration plantings in the Coca area, then travel to Lago Agrio visiting species trial established in 1978.
- 25/01/93 Travel from Lago Agrio to Quito, visiting agroforestry demonstration plantings at Lumbaqui.
- 26/01/93 Meetings with INEFAN and Ecociencia, followed by preparation for FRA seminar.
- 27/01/93 Seminar on FRA in INEFAN.
- 28/01/93 Claire Appleby returns to UK, George Gibson has final visits to INEFAN offices.
- 29/01/93 George Gibson travels Quito - UK.
- 30/01/93 George Gibson arrives UK.

ANNEX 3: ACRONYMS

AIMA	Asociación Ecuatoriana de Industriales Madereros
BOTROSA	Bosques Tropicales S. A.
CIBT	Centro de Investigación del Bosque Tropical
CLIRSEN	Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos
ENDESA	Enchapes Decorativos S. A.
FRA	Forest Resource Accounting
FUNDAGRO	Fundación para el Desarrollo Agropecuario
IERAC	Instituto Ecuatoriano de la Reforma Agraria y Colonización
INEFAN	Instituto Ecuatoriano Forestal y de Areas Naturales y de Vida Silvestre
IUCN	International Union for the Conservation of Nature
MAG	Ministerio de Agricultura
PROFORS	
PRONAREG	Programa Nacional de Regionalización Agraria
SETRAFOR	
SUBIR	Uso Sostenible de los Recursos Biologicos
SUFOREN	Subsecretaría Forestal y de Recursos Naturales Renovables
TCA	Tratado de Cooperación Amazónica
UTEPA	Unidad Técnica Ecuatoriana del Plan Awá

ANNEX 4: ACTUAL AND POTENTIAL LAND USE

Actual land use (from Mangrove inventory, MAG/CLIRSEN, Quito, 1988)

Use	Area	Percentage
Agriculture	7,720,500	28.52
Saline areas	18,800	00. 07
Shrimp farms	92,500	00. 34
Natural forest	11,473,000	42. 39
Forestry plantations	66,100	00. 24
Deforested land of forestry potential	12,600,000	09. 61
Land with no agricultural use, urban areas etc.	5,095,800	18. 83
TOTAL	27,066,700	100. 00

Potential land use (from PRONAREG, Potential land use

Category of use	Hectares	Percentage
Agriculture	6,951,200	25. 68
Cattle	5,495,600	20. 31
Forestry	12,093,300	44. 68
Unproductive	1,725,600	06. 38
Galapagos	801,000	02. 95
TOTAL	27,066,700	100. 00

Data extracted from tropical Forestry Action Plan

ANNEX 5: INFORMATION AVAILABLE

- published base maps at 1:250,000
- climate at 1:1m - a whole series of maps showing various factors (listed below)
- maximum temperature
- precipitation
- hydrology
- information quality for precipitation and hydrology
- underground water reserves
- water stress
- water deficit
- geology
- soils at 1:500,000, with potential land use
- soils drawn by hand onto 1:20,000 1988 aerial photograph mosaics
- detailed soil profiles with detailed mapping using the American soil classification system, for the central mountainous area only
- slope
- contours
- forest cover from air photography hand-drawn onto 1:250,000 base maps
- land use
- land use conflicts for the Esmeraldas region
- actual land use, 1:200,000, 1972-84 - covers all Ecuador except the Amazon
- colonisation - 1:50,000, 1:100,000 and 1:200,000 (see below)
- agricultural potential
- vegetation formation (natural vegetation, pasture etc, from satellite)
- actual vegetation, including actual crops
- forest cover - 1991, 1:1m, compiled from various sources
- forest type - 1:500,000, from 1983 forest inventory and satellite
- forest potential - 1:50,000, central Ecuador only
- mangrove inventory at 1:100,000 covering all Ecuadorian mangroves, 1988 and 1991, from satellite and air photography

Agricultural potential is derived from the other information (soils, geology, vegetation, slope, altitude, precipitation and water stress) including where temperature is limiting. Water stress is derived from soil data.

Colonisation - IERAC get statistics about the areas for colonisation and agrarian reform from each of their provincial offices. However, this is obtained via a manual system and is not computerised. They use PRONAREG's base maps and produce maps of colonisation areas at 1:50,000, 1:100,000 or 1:200,000, depending on the area. They have given these maps to CLIRSEN who will incorporate them into their satellite data. IAREC also have dates of when each colonised plot was given legal title (although this date may not be the same as the date of actual colonisation). IAREC will combine these maps with those of agricultural potential to help determine the best use of land according to its capability. They will also use the information to prioritise areas of deforestation. All such legally designated areas are marked on maps and these detailed maps are held at the provincial offices. They precise map

numbers are reference on smaller scale maps held at IERAC's national office. These maps do not record illegally occupied land, however.

Belgium is to finance a project doing an ecological classification of the country using CLIRSEN data.

CLIRSEN have complete data from Landsat for 1991 but they had no access to Landsat during 1992 due to lack of funds. They also have ERS data for the whole of the country for 1992. It is possible to buy Landsat data up to 20 years old. CLIRSEN have the equipment to enable them to interpret this old data. Satellite imagery has precise co-ordinates and can be overlaid on to topographical maps. This can be done at scales up to 1:50,000, but 1:100,000 or 1:250,000 are better. CLIRSEN provide tapes for users to analyse with their own software. They can provide tapes for the whole area or for just one particular "window". CLIRSEN also supply microfiche and transparencies at different scales and with different information. 120 x 120cm is the biggest that can be supplied. CLIRSEN's photographic section can combine two images to eliminate cloud cover from the resulting scene, but this can only be done for flat areas.

CLIRSEN are working with a Brazilian organisation on the monitoring of land use change (ie deforestation) in the whole of the Amazon area. CLIRSEN can use their satellite data to monitor forest fires and shrimp farming.

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