Protocol
Site selection for reforestation purposes

Version rev version Feb 2007
Foundation CETEFOR

1. Introduction

These protocols have been developed in order to guide the forestry technician in his work of identifying sites for reforestation purposes, taking into account, like a requisite the optimum and sustainable use of the earth.

Objectives
Optimize the adequate use of forest species in reforestation activities, identifying the alternative potentials, with the goals to orient decision making by the development of activities and technologies compatible with the environment

Realize a tool of the evaluation of grounds versatile to the changes of information, which permits to take appropriate decisions, based on the knowledge of experts.

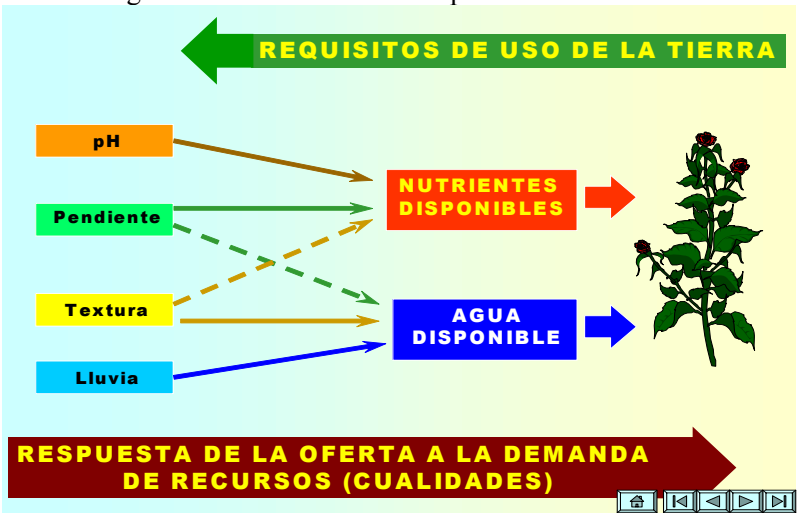
2. Demand and Offer

It is important to make a detailed description of the area, albeit the characteristics or the offer of the site, based on the offer one can start to define the types of reforesting activities and define the species to be planted.

On the one hand it is important to take into account the requisites of the projects, on the other hand we have to think about the offer, which are the specific characteristics of the area and wherefore it could serve.

The requisites of a project and the offer or the characteristics of an area need to correspond. The process to reach this is called **Harmonization.**

The next figure of a rose illustrates the process of Harmonization:



Source: CATIE 2000

The plant has certain requirements in order to be able to grow and develop, the terrain has certain offers, if these correspond the plant will grow and develop, if the offer of the site doesn't correspond with the requirements of the plant (pH, slope, texture, rain), the plant will not develop well.

3. Aspects to take into account in site evaluation

The objective of site evaluations is to generate information on which you can take decisions about the possibilities to develop forestry activities and to define the plantation design including the species to plant.

The process of evaluation exists out of two stages:

1. Exclusion stage
2. Pre-selection stage

For the site evaluation and the elaboration of project ideas one has to take into account: criteria, indicators, threshold values and verificators.

Criteria: *Minimum conditions of an area to be able to develop a specific project*
Indicator: *Variable who permits to evaluate a criteria*
Thresholds: *Value of indicator, passing this value means that you don't achieve the criteria*
Verificator: *Form in which one can measure or evaluate the indicator.*

In the exclusion stage the factors that prevent the development of reforestation activities in a specific zone are taken into account, in the stage of the selection one defines the threshold values for the indicators that prevent the development of a project. In the selection stage one defines the potential of the activities to develop, or in other words (o sea) the strong and weak aspects of an area for a certain activity.

3. Excluded grounds for reforestation programs with CETEFOR

In the exclusion stage the following criteria are taken into account:

- *Exclusion Stage*
  - Biophysical aspects
    - Climate
    - Geomorphology
    - Soils
    - Hydrological aspects
    - Vegetation cover
    - Actual use
    - Projections of future use
  - Environmental aspects
    - Fragile ecosystems
  - Permissible conditions
    - Land owner ship
    - Grantings
    - Restrictions on mayor use of the ground, POP´s, PMOT´s, PLUS etc..
    - Other legal aspects that require the implementation of touristic activities

In the case of CDM A/R project activities, it is necessary to use additional criteria like the area needs to be deforested after 31st of December 1989, and the definition of forests has to be applied[1].

[1] In Bolivia the following definition of forest for CDM A/R projects is used: *A minimum surface of 0,5 hectare (ha) with a canopy cover (or an equivalent population density) which exceeds 30%, with trees that can reach up to 4 meters (m) of minimum height when maturing on site. A forest can consist of dense forest formations, where the trees have diverse heights and where the thicket cover a considerable part of the terrain, or a good woody mass. All forest masses that have reached a 10 to 30% canopy cover or a tree height between 2 and 5 m are considered forest, this way surfaces normally are part of the foresty zone but temporarily lack forest population as a consequence of human interference, for example exploitation, or natural courses, but that we hope will return to convert themselves into forest.*

Areas excluded for their biophysical characteristics

Considering the biophysical aspects one has been able to determine that the following criteria prevent the development of a woody cover in the pre Andean areas:

Category	Criteria	Indicator	Threshold	Verificator
Biophysical	Geomorphological characteristics and edafological extremes	Soils that prevent the development of roots	Rocky outcrops	Field evaluations
			Sandy mantles	Satellite image analysis and field excavations
	Hydrology	Excess or shortage of water	Stagnant waters for a large part of the year Water bodies Wetlands	"Map with inundation areas", map of the wetlands of Bolivia. Field evaluations

Areas excluded for their environmental characteristics

When considering environmental aspects the following criteria exclude reforestation. It is important to mention that in those areas it is possible that the trees will grow, with or without preparing the terrain, but the reforestation would have a negative environmental impact, for example on the soils, or the biodiversity, which endangers the ecological sustainability and or the environmental sustainability of the project.

Category	Criteria	Indicator	Threshold	Verificator
Environmental	High ecological values in the area	Existing conservation values related to not wooded areas (actual and future)	Areas without forest cover with high ecological values managed like protected areas, reserves, areas ramsar, and natural pastures. Wetlands Existence of endemic species	Maps, images Map of ecological systems (corridor Madidi-Amboró) Analysis of satellite images Field evaluations

Permissible conditions for excluding areas for CDM-A/R projects

Category	Criteria	Indicator	Threshold	Verificator
Permissible conditions; institutional politics and capacity for sustaining a development project	Legal	Ownership of the ground	There is no clear definition about landownership in the zone. Conflicts about landownership	Documents of the landownership

5. Stage of site selection

In the site selection stage the following criteria are taken into account:

- *Selection stage*
  - Biophysical principles
    - Quality of the sites
      - Geomorphology
      - Soils (texture, amount of stones, depth, freatic level, compaction and drainage)
      - Location of the water bodies
      - Vegetation cover
      - Actual use
      - Potential use
      - Planned use (PLUS, POP's, PMOT´s)
    - Analysis of the biophysical risks
  - Economic principles
    - Opportunity costs
    - Competence with other types of soils use.
    - Accessibility of the area,
  - Social principles
    - Projections for future use
    - Job availability
    - Perception of the landowner towards reforestation and the species to be planted
    - Conflicts
  - Environmental aspects
    - Conservation values
    - Erosion risks
  - Permissible aspects

For the site evaluation it is important to take into account the countries norms and regulations. Annex 1 shows part of the norm for the legislation predial (Agricultural Supervision NORMS AND TECHNICS ABOUT PLANS OF THE PREDIAL LEGISLATION, Ministerial resolution No *130/97, 9 of June1997) for mayor land use (or the most intensive land use that the ground can handle):*

6. Demarcation of the area and selection of species

The first step consists out of an approach to the persons interested by means of, group meetings, individual meetings, community meetings, etc.

After that a visit to the entire parcels of every interested person is realized. During this visit site evaluation forms (see annex 2) are filled in. The soil evaluations are realized with a drill, the soil analysis is realized in a qualitative way apart from the pH measurement where a representative sample is taken.

The location and the exact surface of the section to be reforested is also defined, based on GPS points and property maps.

The criteria mentioned before make it possible to recommend if it is possible to proceed with the planning of reforestation, the type of reforestation (agroforestry system, forestry (silvopastoril), commercial plantation or a plantation with conservation goals), on what surface and the most adequate species for the selected site, the species that fulfill the expectations of the owners in terms of the type of production and the goals of the plantation.

As a result of the evaluations of the plantations that have been established before, the studies of the characteristics of the natural ecological niches of the species and literature, CETEFOR has selected species of the Cochabamban tropics; the next table shows these native species with their site specific requirements.

Table 1: Species requirements

Especies		**pH**	**Drenaje**					**Textura**					**Iluminación**	
Especies Preciosas		Tolerancia	libre	imperfecto	muy pobre	Tol. Inund	Profundidad	**arenosa**	**Franco**	**arcillosa**	Fertilidad	Compactación	luz	sombre
Mara	Swietenia macrophylla	N - C	f	t	nt	nt	f				f	nt	em	rj
Cedro	Cedrela fisillis	A - N	r	nt	nt	nt	f					nt	em	tj
Maderas duras														
Almendrillo	Dipteryx odorata	A - N	f		nt		f		f		ne		e	nt
Almendrillo amarillo	Dipteryx sp	A - N	f		nt	t			f		ne		e	nt
Tajibo	Tabebuia spp.		ne	t	t	t		f	f					rj
Verdolago negro de ala	Terminalia amazonica	N	f	nt	nt	t	ne	f	f				e	nt
Verdolago negro de pepa	Buchanavia sp.	N	f	t	t	t	ne		f	t				t
Especies semi duras														
Palo Roman	Tapirira guianensis	A - N	f	t	t	t			f				tj	tj
Gabún	Virola peruviana	A		t	t	t				A			ntj	rj
Paquio	Hymenaea courbanil	A	f	t	nt	t	f				f			rj
Palo Maria	Calophyllum brasiliense	A-N		t	t	t							ntj	rj
Trompillo de bajura	Guarea spp.		f	t	t	t	f	f	f	nt				e
Trompillo de altura	Guarea rusby		f	t	nt	t	f	f	f	nt			e	nt
Tejeyeque	Centrolobium tomentosum		f	t	nt	nt	f		f			nt	e	nt
Especies blandas														
Palo Yugo	Stryphnodendron purpureum	A - N		t	t	t		ne	ne	ne	ne		t	f
Serebo	Schlizobium amazonicum	A-N	ne	t	t	t		ne	ne	ne	ne	nt	e	nt

MA = Muy Acido — *f = favorable* — *r=require* — rj = require cuando joven
A=Acido — *t = tolera* — *ne = no exigente* — *ej = exigente en cuando es joven*
N=Neutro — *nt = no tolera* — *e = exigente* — *tj = tolera cuando joven*
C=Calizos — *em = exigente cuando es mayor* — *ntj = no tolera cuando joven*

Once the site selection is finished a table with potential species according to the specific site is elaborated. Together with the owner the objective of the plantations and the species to plant are defined based on this list.

Once these criteria are confirmed the final design of the plantation is made and the amount of planting material to be destined to the plantation is determined.

ANNEX 1

Norm for property legislation

Land Supervision TECHNICAL NORMS ABOUT MAPS OF PROPERTY LEGISLATION, Ministerial Resolution No 130/97, 9 of June 1997

For better ground use

Annex 1:

Grounds suitable for clean intensive crops, identified with the code "CIL": are those units which are flat or almost flat (up to a maximum of 15% of slope), agro ecologically little susceptible to erosion or other predominant degradation factors in the zone, below adequate management conditions.

Given the fact that the essential goal of the POPs is the conservation and sustainability of resources, and given the fact that the clean intensive crops per definition consist out of the use with mayor potential of environmental impact, the classification of the grounds for this use does not mean that the owner can not dedicate the grounds, permanently or temporarily, to whichever other use, with a smaller potential impact.

Grounds for clean extensive crops "CEL":
These are flat or almost flat grounds (up to 15% of slope), little susceptible to erosion, which can be used once a year for monoculture or associated crops with adequate fallow periods.

Grounds suitable for perennial or permanent crops, identified by the code "CP":
Are those grounds characterized by slopes between 15 and 45%, or flat grounds with clear pedological and climatic limitations, which only permit perennial or permanent crops which not imply continuous moving of the "capa arable" and protect the soil with their foliation cover or that of the tree vegetation or the bushes associated with the crops.

Grounds suitable for grazing, identified by the code "P":
Are those that for their agro ecological conditions only can be used in a sustainable way for pastures with complete cover or "silvipastoril" (basically because of the slope, rain, soil quality, fragility of the natural forest or the slow natural regeneration), besides those cases where the owner decides to dedicate himself to pasture grounds on grounds suitable for clean intensive crops.

Grounds suitable for permanent forestry production, identified by the code "F"
Are those grounds that the engineer or professional in charge determine in virtue of the natural forest richness which the grounds contain or the preferred soil use, this way those that the owner of free will dedicate to this use, apart from the case of protection grounds.

Protection grounds are identified by the code "UP" (unity of protection):
These are all ecological "servidumbres" established with the article 35° of the regulations of the forestry law (appendix), those that are established with their own POP and, in those cases, private reserves of natural heritage (RPPN), and this way any other servidumbre established or to be established according to the explained rules or article 5° of the forestry law and the articles 4° and 7° of the regulations.

Ecological Servidumbre
An imperative of the POP is the establishment and conservation of the ecological servidumbres.

1. Slopes superior to 45%
2. Wetlands, marshes, curichis, bofedales, and others
3. Grounds or eolic origin
4. Superficial grounds
5. Wind breaks
6. Water bodies (rivers, streams, lakes and pools)

Hillsides with slopes over 45%
The code is UP-L

Wetlands, marshes, curichis, bofedales, areas of water outcrops and water recharge
Minimally a retirement of 50 m counting from the maximum growing point identified
The code is UP-H

Eolic grounds
The identification and characterization is based on: A preliminary analysis of the information available in the area. Site verification with the approximate information of the land owners. Site Verification using easy methods like backside drills. Detecting sticking out external factors (plants, etc.)
The code is UP-TOE

Stony or superficial grounds
Superficial grounds are those grounds which are very stony, with a depth of less than 15 cm, those where the amount of stones prevent the possibility to grow crops or pasture. Soils with a hardpan of a natural origin determined based on external signs like long lasting inundations, revealing crusts and vegetation formations.
The code is UP-TP/S.

There is no restriction for the servidumbre, productive activities of ancestors subject to local protection or conservation techniques of superficial grounds.

Water bodies in flat grounds
For brooks and streams.
10 m at each side in not erosive and flooding zones.
20 m at each side in erosive and flooding zones.

For rivers
50 m at each side in not erosive and flooding zones.
100 m at each side in erosive and flooding zones

For lakes and canals
50 m around the lakes and pools
10 m at each side of the public canals including férreas
The code is UP-FPR (riverside protection strip)

In case of brooks and gullies
The maximum protection retirement is depending on the permanent or temporal water flow and the grade of the gully, to be determined by the engineer.
The code is UP-QC

Source; Land Supervision TECHNICAL NORMS ABOUT MAPS OF PROPERTY LEGISLATION, Ministerial Resolution No 130/97, 9 of June 1997

ANNEX 2

Field forms

PLANILLAS DE CAMPO **Fundación CETEFOR** **FORMULARIO** 1 2

Date:……/……/……. Name observant:…… Nº Form:……....

Name of property:……..……..Coord: X:……Y:……...height:…above sea level

Description of the plot

Name of interviewed:……..…… ☐ Owner ☐ persons in Charge ☐ Worker
Name of the owner:……..…… CI:……NºPlot……
Syndicate:……Central:……..……Others:……

Access to Plot: ☐ Passable road (with truck)
☐ With problems in rainy season ☐ Only in the dry season
☐ Without access over land ……
General location:
Dpto.:…… Prov.:…….....
Mcpio.:……Cantón:……...
Colindancias (Neigbhors):
North:…….……
West:…….…….....
South:……...……..…
East:……..…

Property rights:
☐ Title saneado ☐ Title in execution
☐ Title applied for ☐ Document Buy-Sell
☐ Without title
Other: ……..

Name of nearby population:
……
Distance:…….……Km

Surface of plot:……Has.
Nº of plots:……
Total surface……Has.

Was the first to occupy this plot?:
☐ NO ☐ YES ☐ Family
Time to have occupied the plot: ….years……..months

Dry months:…….……

Climatical risks:……....……..

Frequency of frost : ☐ There is no information
☐ Never ☐ Rarely ☐ Common ☐ Periodically
Months……..

Flooding: ☐ There is no information ☐ Never
☐Seldom (<1/year) ☐Occasionally (1-3/year)
☐Frequently(>3/year)

Fire risk:
☐ There is no information
☐ Never ☐ Seldom ☐ Yearly ☐ Frequently

Coordinates of the Plot (UTM-WGS 84):

X_1	Y_1
X_2	Y_2
X_3	Y_3
X_4	Y_4
X_5	Y_5
X_6	Y_6

Frequency of wind: ☐ There is no information
☐ Little (does not affect growth) ☐ Moderate (affects)
☐ Very windy (Limit growth)

Problems with insects:
□ don't know □ Never □ Seldom □ Common
Names:……..
……
……
Severity: ☐ Light ☐ Medium ☐ Severe

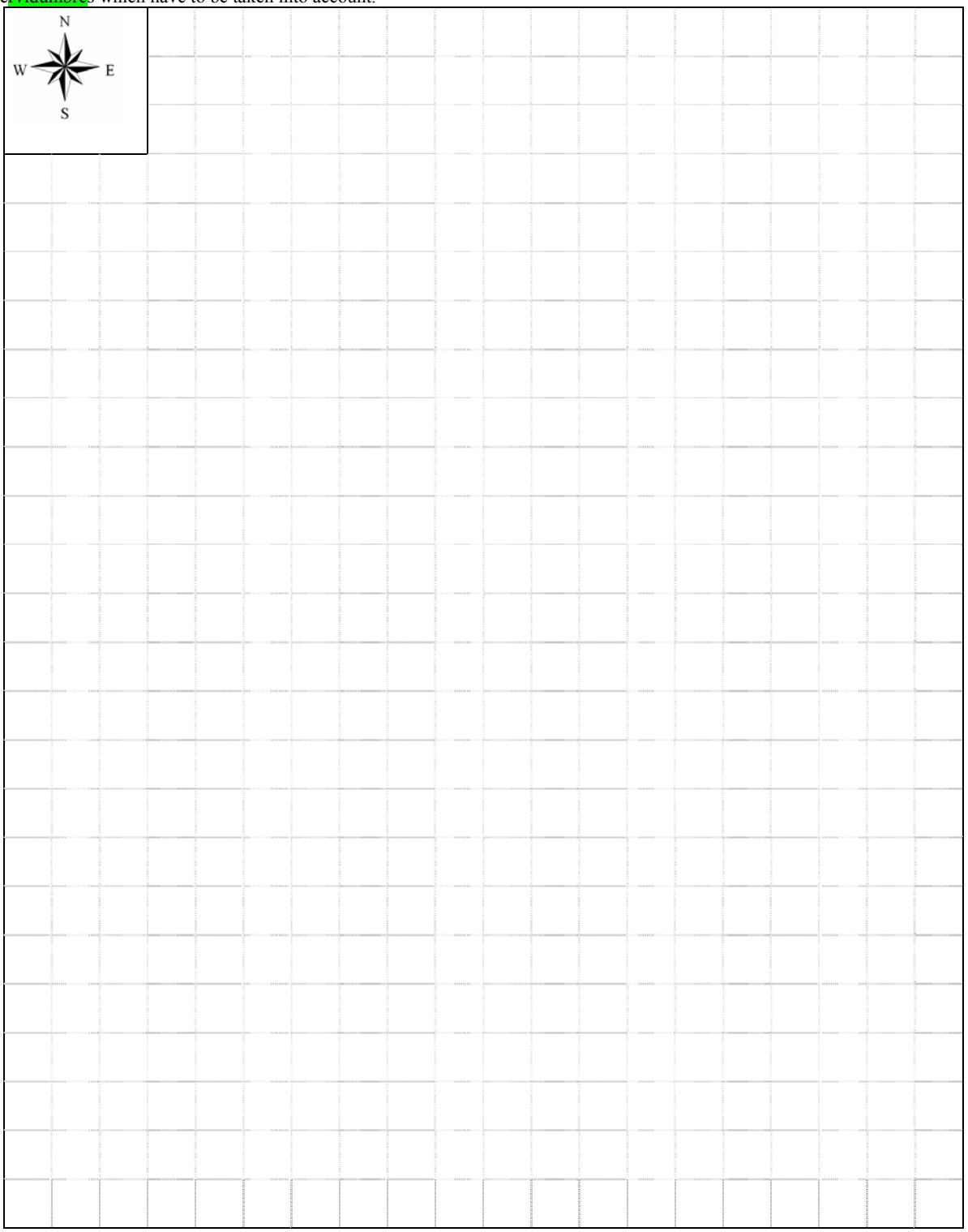
Family data:
Nr of family members:
……..
Nr of sons: ……..
Nr of sons that work on the plot: ...……...
Nr de peones disponibles plantación ……..

Organization:
Is there an association nearby: Yes☐ No☐
Are you a member? Yes☐ No☐
……..

	Is it possible to apply el Ayni for the plantation?: Yes☐ No☐

DRAWING OF THE PLOT

Indicate the different types of land use, localize the points of the GPS and if possible indicate the historical dates of soil use, indicating the space and number of photos, note down names of the present water bodies in the plot and identify the ecological servidumbres which have to be taken into account.



Specific Point: History of soil management and tendency towards future use.

	Actual type of use	Area (Has)	Actual age *	Percentage of commercial/personal use	Capacity (per Has.)	Rotation period (years)	Cattle? N°/Ha	Previous use	Time of previous use	Reason of change	Future Use
1				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
2				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
3				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
4				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
5				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
6				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
7				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
8				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
9				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
10				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
11				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
12				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	
13				/						□ Economic □ Harvest □ Little fertility □ Project □ Other……..	

* If the actual vegetation is fallow or chume mention the amount of years

PLANILLAS DE CAMPO **Fundación CETEFOR** **FORMULARIO** 1

SITE CHARACTERISATION

Nº File:……...

Coord: X:……..……Y:……..…...Alt.:……...…above sea level Name Waypoint:……..

Vegetation: Cultivated (According to its Fenología)

Type of Stratum	Number dominated live form	Medium height (m)	Cover %	Surface (ha)	Type of leaf	Fenology of the leaf	Category	Development stage	Name of crop	Age (years)
Trees		<1 1-2 2-3 3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		<0,5 >0,5	Wide Narrow	Perennial Deciduous	Garden Plantation Neither	Ploughed Initial Ripe Harvest		
Trees		<1 1-2 2-3 3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		<0,5 >0,5	Wide Narrow	Perennial Deciduous	Garden Plantation Neither	Ploughed Initial Ripe Harvest		
Bushes		<1 1-2 2-3 3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		<0,5 >0,5	Wide Narrow	Perennial Deciduous	Garden Plantation Neither	Ploughed Initial Ripe Harvest		
Bushes		<1 1-2 2-3 3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		<0,5 >0,5	Wide Narrow	Perennial Deciduous	Garden Plantation Neither	Ploughed Initial Ripe Harvest		
Grasses		<1 1-2 2-3 3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		<0,5 >0,5		→		Ploughed Initial Ripe Harvest		
Grasses		<1 1-2 2-3 3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		<0,5 >0,5		→		Ploughed Initial Ripe Harvest		

Water management (irrigation practices)	Amount of space	Evidence of past type of use
☐ Rain	□ Flooding	□ < 2 Has	☐ Stumps ☐ Rests of crops ☐ Soil disturbance
☐ Irrigation	□ Sprinkling	□ 2 a 5 Has	
	□ Drip	□ > 5 Has	☐ Others/description:……

Vegetation: Natural / Semi-Natural (According to the height of the Stratum)

Type of stratum	Number of stratum	Medium height (m)	Cover (%)	Type of leaf	Fenology of the leaf	Category	Development stage	Name and description of the vegetation	Age (years)
Woody (Indefinable mixture between tree and bush)		2-3 3-4 4-5 5-7 6-7		Wide Narrow Cactus	Perennial Deciduous	Fallow Forest	Dry Green Flower Fruit		
Tree		3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		Wide Narrow Cactus	Perennial Deciduous	Fallow Forest	Dry Green Flower Fruit		
Tree		3-4 4-7 7-10 10-15 15-20 20-25 25-30 >30		Wide Narrow Cactus	Perennial Deciduous	Fallow Forest	Dry Green Flower Fruit		
Bushes		<1 1-2 2-3 3-4 4-5		Wide Narrow Cactus	Perennial Deciduous	Fallow Forest	Dry Green Flower Fruit		
Grasses Wide leaf grass Lichen Moss		<0,3 0,3-0,8 0,8-3,0			→		Dry Green Flower Fruit		

SOIL CHARACTERISATION

Variable	Depth - cm.	- cm.	- cm.	- cm.
Horizons				
Texture class (Classification FAO)				
Color				
Compaction	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No
pH				
Indicator of the prevention of drainage and the evidence of its intensity	□ Not obvious □ Oxidation + ++ □ Gleyzation + ++	□ Not obvious □ Oxidation + ++ □ Gleyzation + ++	□ Not obvious □ Oxidation + ++ □ Gleyzation + ++	□ Not obvious □ Oxidation + ++ □ Gleyzation + ++
Presence of stones (Need to take samples)	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No
Organic matter	□ Yes □ No	□ Yes □ No	□ Yes □ No	□ Yes □ No
Observations				
Slope (%)	□ 0 – 5 □ 5 – 10 □ 10 – 15 □ 15 – 30 □ 30 – 45 □ > 45			
Landscape - Micro-relief	□ Flat □ Little undulating □ Undulating □ Micro Relief			
Superficial stoniness	□ Free (15%) □ Moderate (15-50% 10-30 m distance) □ Stony (50-90% 2-10 m distance) □ Very Stony (>90% 1-2 m distance)			
Presence of indicator plants	□ Not obvious □ Deficiency of nutrients (evident in the vegetation) □ Indicator Plant: Species:…….. Indicator of:……			

BIOMASS ESTIMATION

Trees 0,5 a 1,3 m of height Plot 2 x 2 m		Trees 1,3 m of Height y 5 cm. DAP Plot 5 x 5 m		Trees 5 to 10 cm. DAP Plot 10 x 10 m	
Species	Quantity	Species	Quantity	Species	Quantity

Trees > 10 cm. DAP Plot 10 x 10 m

Species	DAP (cm.)	Total Height (m)	Commercial Height (m)	Age (years)

General Description:

Forestry plantation:

□ Commercial Forestry: Surface: ……Has.
Species:……
…..……

□ Agroforestry system: Surface: ……Has.
Species:……
…..……

□ Silvopastoril System: Surface: ……Has.
Species:……
…..……