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Use and management of edible non-crop plants in southern Ecuador

Veerle VAN DEN EYNDEN

…el shiring…esta sí tiene fruta bien rica…
…es frutita blanca, como mote…
…hay que laminar las frutitas hasta que quedan como manteca…
…es fresco…
…el nombre viene de los shiris, los antepasados…
Digna Pauco, Chalanga, Paltas
(describing *Allophylus mollis*)

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List of abbreviations

ANOVA – Analysis of variance
CATER – Centro Andino de Tecnología Rural, Universidad Nacional de Loja
CINFA – Centro de Investigación Forestal y Agropecuaria, Univeridad Nacional de Loja
LOJA – Herbarium Reinaldo Espinosa, Universidad Nacional de Loja
MY – Herbarium of Maracay University
NTSYS - Numerical Taxonomy and Multivariate Analysis System
QCA – Herbarium of the Pontífica Universidad Católica del Ecuador
QCNE – Herbarium of the Museo Nacional de Ciencias Naturales
UPGMA - unweighted pair-group method analysis

beT - bosque espinoso tropical - tropical thorn-forest
bePM - bosque espinoso premontano - premontane thorn-forest
bmsT - bosque muy seco tropical - very dry tropical forest
bsT - bosque seco tropical - dry tropical forest
bsPM - bosque seco premontano - dry premontane forest
bsMB - bosque seco montano bajo - dry lower montane forest
bhT - bosque húmedo tropical - humid tropical forest
bhPM - bosque húmedo premontano - humid premontane forest
bhMB - bosque húmedo montano bajo - humid, lower montane forest
bhM - bosque húmedo montano - humid montane forest
bmhT - bosque muy húmedo tropical - very humid tropical forest
bmhPM - bosque muy húmedo premontano - very humid premontane forest
bmhMB - bosque muy húmedo montano bajo - very humid, lower montane forest
bmhM - bosque muy húmedo montano - very humid montane forest
bpM - bosque pluvial montano - montane rain forest
pSA - páramo subalpino - subalpine paramo

Prologue

Wow, this has been a long process. Almost ten years have passed since I flew to Ecuador for the first time. Fortunately I did not spend all that time on this project. The study started as a very exciting job (a Latin American project!), making an inventory of edible non-crop plants for and with CATER. The focus of the project was on development and co-operation. Working with local researchers was essential for me, and Eduardo Cueva and Omar Cabrera proved to be the best colleagues I could have wished for. Jointly doing all fieldwork, plant identifications and research, and providing training opportunities was crucial. Together we produced a field guide of wild edible plants of southern Ecuador.

Only towards the end of the project did I decide to turn the "long list of plants" into a PhD project. The management aspect of plants had always intrigued me. So after three years, I stayed on another 6 months collecting more data on plant management. Then the plan was to analyse all data and write it all up. But, that got interrupted by a move to Scotland, and the birth of Joachim, and then Kaitlin and … priorities shifted. The PhD was abandoned and I got involved in Scottish ethnobotany and kids.

But the long plant list and six notebooks full of scribbles on plants kept haunting me. So eventually, I picked up all data again, sat down at my desk in the yellow room in Scotland and started the long process of analysing, more analysing, and writing. Interrupted by baby noises in the background, baby hands flicking though books, kids drawing on books and walls and floors behind my back, …. as I sat glued to my computer screen. The slow pace was set by trying to combine writing this with Scottish projects that seemed too good to miss and good times spent with Joachim and Kaitlin. It meant a delay for this to get written, but when I see Joachim climbing Scottish mountains and skiing down them, and Kaitlin running naked on beaches, I know it was worth it.

There are hundreds of people to thank. First of all the people of the villages and communities in southern Ecuador that we visited. For sharing their knowledge and friendship with us, for putting us up for the nights, for preparing nice food, and for the millions of plant tales told. Eduardo and Omar of course, for sharing the work, the joy, the laughter. And for climbing those trees even telescopic secateurs can't reach. Other people joined us on fieldtrips: thanks Pablo, Gumercindo, Ingrid, Imma, Kate, Xavier, Veerle, Ruth, Henrik, Rodrigo, the girls from the herbarium,… Thanks Montse (Ríos) for sharing ethnobotany with me, for lots of good advice and for help with the Spanish spelling.

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And finally, lots of love to Nick, Joachim and Kaitlin and thanks for the wonderful moments!

Abstract

Southern Ecuador's irregular topography and climate give rise to a wide range of very different ecological zones and vegetation types. This in turn results in high plant species diversity. More than 6,000 plant species occur in an area of 30,000 km^2. The region is inhabited by mestizo farmers and small communities of indigenous Shuar and Saraguros. Agriculture is the main economic activity, with a range of different production systems occurring throughout the ecological zones. One finds large-scale export-oriented agriculture in the coastal lowlands, subsistence farming in the Andes, Shuar subsistence horticulture in the Amazonian area and cattle farming and timber logging in newly colonised areas.

An ethnobotanical inventory of edible non-crop plants was carried out in 42 field sites, selected throughout the different ecological zones to include maximum geographical, altitudinal and ethnic diversity in the region. Semi-structured interviews with random and expert informants in each site, and botanical collections of all recorded species, resulted in the documentation of 354 edible non-crop species. Data were gathered on their local names, uses, preparations, parts used, ecology and management. All 846 collected plant specimens were botanicaly identified. At least three plant species new to science were recorded during this study and four were recorded for the first time in Ecuador. The plants belong to 65 plant families and 156 genera. Important families of edible plants in the area are Mimosaceae, Arecaceae, Solanaceae, Ericacaeae, Myrtaceae, Rosaceae and Passifloraceae. Well-represented genera are *Inga*, *Passiflora*, *Solanum* and *Rubus*.

The majority of plants (85%) have edible fruits. Very few roots and leaves are eaten. Regional food and drink preparations in which non-crop plants are used are described. Most plants (86%) are consumed raw. Thirty eight percent of plants have additional uses, the main ones being for fuelwood and timber. The fruits of 23 species are sold at local and regional markets. Overall, edible non-crop plants contribute little to the household economy. They do play a role in people's subsistence. Especially children often eat wild fruits. Mestizo people know many wild plant foods, but tend to use them only occasionally. For the Shuar people, wild foods form an essential part of their diet. Eighty-three edible plant species are known and used by Shuar people, which is significantly more than the number of plants mestizo people use. Mestizo and Shuar people show not only differences in the number of plants they use and the role plants play in their subsistence, but also in the type of edible plant parts they consume and where they collect them. Mestizo people show signs of loss of traditional knowledge on plant use.

A total of 411 common names were recorded for the 354 edible plants. The 328 mestizo plant names, predominantly Spanish, are often formed through transposition, borrowing from native languages (Shuar and Quichua) or neology.

These are mechanisms typically used by immigrants to name unknown plants. In southern Ecuador these were the Spanish immigrants arriving more than 500 years ago, and still today mestizo colonisers moving to new virgin areas in the coastal and Amazonian regions. Mestizo names show different levels of regional variability. Many plants have one unique name throughout the region. These tend to be opaque, undescriptive names. Other plants have names that vary from one area to another. The naming of plants is influenced by the plant composition of an area, which determines the need to name and distinguish between related or similar plants.

Indigenous Shuar people use only Shuar plant names. The 83 recorded Shuar names show little regional variation. A comparison of mestizo and Shuar naming practices suggests that mestizo people tend to use more generalised plant names. They often give the same name to different plant species and use more binomial names than Shuar people do. Plant names form an important part of the traditional knowledge of a society.

Plant use is highly variable throughout the region. Species use variation is due to ecological variations. Eight areas with similar edible plant species use profiles were identified by analysing the similarity of species between villages, using similarity coefficients and clustering analysis. These areas roughly follow existing ecological gradients. Some areas, however, show interesting differing edible plant compositions.

The number of edible plants used varies due to ethnic and agro-socio-economic factors. The highest number of edible plants was recorded in the Amazonian lowland area, an area with plenty of forest resources and inhabited by Shuar. *Colonos* inhabiting the same area use, however, far less plants. High numbers of edible plants were also recorded in the dry central part of Loja province, an intensely cultivated area with very few forest remnants. Presence of natural vegetation is therefore not necessary for wild plant use to occur. In this area many non-crop plants are managed within the agricultural system. Also in the higher parts of the western Andes range high numbers of edible species were recorded. Plant use is also influenced by length of colonisation of an area. Fewer plants are known in recently colonised villages in the humid coastal lowlands and Amazonian slopes.

Non-crop plant resources are integrated within agricultural systems, where they are often managed. This means that edible plants are more readily collected from agricultural habitats than from natural ones. Plant management was studied in detail in the Andean region above 1500 m. Half of all recorded edible species are managed. Economic species are always managed. Trees are more readily managed, compared to other life forms. Plants may be tolerated, sown, planted or transplanted. Many are managed purely for their fruits, whereas others are for multiple reasons, such as fuel, timber, soil fertility, shade, fodder and fencing.

Sometimes edibility is only a side use. Some species are subjected to various management practices in various parts of the agricultural system.

Three main management patterns for edible species were found in Andean southern Ecuador. Certain species are primarily actively managed for their fruits in homegardens. *Annona cherimola*, *Capparis petiolaris*, *Inga* spp., *Juglans neotropica*, *Pouteria lucuma* and *Vasconcellea* spp. are native trees often found in homegardens. Some have marketable fruits. Another group of mainly non-economic edible species are tolerated in homegardens and hedges for a variety of uses, examples being *Acnistus arborescens*, *Clavija euerganea*, *Cyphomandra cajanumensis*, *Physalis peruviana* and *Solanum americanum*. A last group of species are primarily tolerated in pastures and hedges. Trees like Myrtaceae and *Inga* spp. are often tolerated for shade, fuel, timber and soil conditioning in pastures and hedges. Climbers like *Rubus* spp. and *Passiflora* spp. are tolerated in hedges for their edible fruits. Few trees and weeds are tolerated in fields. At least three separate types of homegardens exist in the area. In coffee growing areas, gardens are coffee groves where *Inga* trees often provide shade for coffee. At higher altitudes, native fruit trees or vegetables and medicinal plants dominate in gardens. Schematic representations of edible plants managed in various components of the agricultural area are given. Similar management practices are found throughout the tropics.

Plant management is strongly linked with agricultural practices. In areas with arable crops, coffee groves and homegardens, many non-crop plants are actively managed. In cattle farming and newly colonised areas, fewer edible species are managed. Those that are, are mainly tolerated in pastures. In certain agricultural production systems, plant management has led to a relatively high number of edible species, explaining species richness found in places like the central part of Loja province. Agricultural production systems and plant management within it thus have an influence on edible plant use.

The fact that non-crop plants are managed means that they are integrated and survive in an agricultural environment. This is an example of how traditional agricultural practices enhance biodiversity. The potential of traditional agriculture for conserving biodiversity is being recognised as an important strategy to complement conservation in protected areas. This study shows which regions in southern Ecuador and which elements of the agricultural environment contain many managed edible species. This information could be used in integrated development and conservation projects

Recommendations for future research would be to confront the findings of this research with the view of local people on plant management and biodiversity conservation. Farming systems in the coastal and Amazonian regions of southern Ecuador are very different. Plant management needs to be studied here too. Especially in the coastal region, biodiversity is possibly more threatened due to large-scale intensive farming. Comparisons between management practices in intensive and traditional agriculture could be made, as well as their effects on biodiversity. Traditional management practices may well offer opportunities for integration in intensive production systems to decrease biodiversity loss.

Samenvatting

Een onregelmatig reliëf en klimaat geven aanleiding tot verschillende ecologische zones en vegetatietypes in zuidelijk Ecuador. Dit leidt tot een hoge plantendiversiteit. Meer dan 6000 plantensoorten komen voor in een gebied van 30.000 km^2. De inwoners van zuidelijk Ecuador zijn grotendeel mestizo boeren, met kleine gemeenschappen van inheemse Shuar en Saraguros. De landbouw is de voornaamste economische activiteit in de regio. Deze varieert naargelang de ecologie van een zone. Men vindt grootschalige landbouw gericht op export in de laaglanden van de kuststreek, overlevingslandbouw in de Andes and in Shuar gemeenschappen in het Amazonegebied, en veeteelt en houtwinning in nieuw ontgonnen gebieden.

Een etnobotanische inventarisatie van niet-geteelde eetbare planten werd verricht in 42 dorpen die geselecteerd werden in de verschillende ecologische zones om een maximale geografische en etnische diversiteit te omvatten. Door middel van halfgestructureerde interviews met informanten en expertinformanten, en het inzamelen van alle plantensoorten, werden 354 niet-geteelde eetbare planten geïnventariseerd. Tevens werd informatie over hun namen, gebruiken, bereidingen, gebruikte delen, ecologie en beheer ingezameld. De 846 ingezamelde plantenexemplaren werden gedetermineerd om hun wetenschappelijke namen te bepalen. Ten minste drie nieuwe plantensoorten werden gevonden gedurende deze studie en vier soorten werden voor het eerst waargenomen in Ecuador. De eetbare planten behoren tot 65 families en 156 genera. De belangrijkste families van eetbare planten in de regio zijn Mimosaceae, Arecaceae, Solanaceae, Ericacaeae, Myrtaceae, Rosaceae en Passifloraceae. Genera die goed vertegenwoordigd zijn, zijn *Inga*, *Passiflora*, *Solanum* and *Rubus*.

De meeste planten hebben eetbare vruchten (85%). Slechts weinig wortels en bladeren worden gegeten. In de studie zijn regionale voedselbereidingen en dranken waarvoor wilde planten gebruikt worden beschreven. De meeste planten worden echter gewoon rauw gegeten (86%). Een derde van alle planten heeft bijkomende gebruiken zoals brand- en constructiehout en andere. De vruchten van 23 soorten worden verkocht op plaatselijke en regionale markten. In het algemeen dragen niet-geteelde eetbare planten echter weinig bij tot de huishoudeconomie. Ze zijn wel belangrijk als voedsel. Vooral kinderen eten dikwijls wilde vruchten. Mestizos kennen veel planten, maar eten ze redelijk weinig. Wilde planten vormen wel een belangrijk onderdeel van het dagelijks voedsel van de Shuar. Zij kennen en nuttigen 83 verschillende eetbare soorten, wat beduidend meer is dan de planten gebruikt door mestizos. De verschillen in plantengebruik tussen mestizos en Shuar betreffen niet enkel het aantal eetbare soorten die ze gebruiken en de rol die planten spelen in hun bestaan, maar ook de

soorten eetbare plantendelen die ze gebruiken en waar ze die inzamelen. Mestizos vertonen een verlies van traditionele kennis wat plantengebruiken betreft.

Voor de 354 plantensoorten werden 411 verschillende lokale namen opgetekend. De 328 mestizo plantennamen vertonen veel Spaanse invloed. Deze zijn dikwijls gevormd door transpositie, door lenen van inheemse talen (Shuar en Quichua) en door nieuwvorming. Dit zijn typische mechanismen gebruikt door immigranten om ongekende planten te benoemen. In zuidelijk Ecuador zijn dat de Spaanse immigranten die 500 jaar geleden naar Ecuador trokken, maar ook nu nog de mestizos die migreren naar nieuw te ontginnen gebieden in de kust- en Amazonestreek. Mestizo plantennamen variëren sterk van gebied tot gebied. Verschillende planten zijn gekend met één unieke naam in de ganse streek. Dit zijn dikwijls niet-transparante, onbeschrijvende namen. Andere planten krijgen verschillende namen in verschillende streken. Het benoemen van planten wordt beïnvloed door de plantensamenstelling in een gebied. Die bepaalt hoeveel gelijkaardige of verschillende planten moeten benoemd of onderscheiden worden.

Inheemse Shuar gebruiken enkel Shuar namen. De 83 Shuar namen vertonen zeer weinig regionale verschillen. Uit een vergelijking van de manier waarop mestizos en Shuar planten benoemen, blijkt dat mestizos meer algemene namen gebruiken. Ze geven dikwijls dezelfde naam aan verschillende plantensoorten en gebruiken meer samengestelde namen dan de Shuar. Plantennamen vormen een belangrijk onderdeel van de traditionele kennis van een gemeenschap.

De kennis en het gebruik van eetbare planten is zeer variabel in de regio. Variatie in plantensoorten is te wijten aan ecologische verschillen binnen de regio. Wanneer de plantensoorten voor alle dorpen vergeleken worden door middel van gelijkheidscoëfficiënten en groeperinganalyse, dan kunnen acht gebieden met gelijkaardige plantensoorten onderscheiden worden. Deze volgen grotendeels de bestaande ecologische gradiënten. Sommige gebieden vertonen echter een afwijkende samenstelling van plantensoorten.

Het aantal eetbare plantensoorten varieert door etnische en agro-socio-economische verschillen. De meeste eetbare plantensoorten werden genoteerd in het laaggelegen Amazonegebied, een gebied met rijke bosbestanden en bewoond door Shuar. Kolonisatoren die in hetzelfde gebied wonen gebruiken echter veel minder eetbare planten. Hoge aantallen werden ook aangetroffen in het droge centrale deel van de provincie Loja. Deze zone wordt intens beteeld en slechts weinig kleine bosrestanten worden hier aangetroffen. Hieruit blijkt dat de aanwezigheid van natuurlijke vegetatie niet noodzakelijk is voor een hoog gebruik van wilde plantensoorten. Vele niet-geteelde soorten worden hier beheerd binnen het landbouwsysteem. Ook in de hogere regio's van de Andes vindt men hoge aantallen eetbare planten. Plantengebruik wordt tevens beïnvloed door de duur van kolonisatie. Minder planten zijn gekend in gemeenschappen in recent ontgonnen gebieden in de tropische kuststreken en het Amazonegebied, vergeleken met gemeenschappen die reeds lange rijd bestaan.

Niet-geteelde plantensoorten zijn geïntegreerd binnen het landbouwsysteem, waar ze dikwijls beheerd worden door lokale boeren. Dit heeft tot gevolg dat eetbare planten meer ingezameld worden in landbouwhabitats dan in natuurlijke. Plantenbeheer werd in detail bestudeerd in het Andijns gebied boven de 1500 m. De helft van alle eetbare planten die hier aangetroffen worden, zijn beheerd. Economische soorten worden altijd beheerd. Boeren geven een voorkeur aan het beheren van boomsoorten, in vergelijking met andere levensvormen. Planten worden getolereerd, gezaaid, geplant of verplant. Verschillende planten worden beheerd voor hun eetbare vruchten, terwijl andere beheerd worden om andere redenen, zoals voor brand- of constructiehout, bodemvruchtbaarheid, schaduw, veevoeder of als omheining. Soms is de eetbaarheid slechts een bijkomend gebruik. Sommige plantensoorten worden of verschillende plaatsen binnen het landbouwsysteem op verschillende manieren beheerd.

Drie voorname beheerspatronen werden aangetroffen in Andijns zuidelijk Ecuador. Bepaalde plantensoorten worden voornamelijk actief beheerd vanwege hun vruchten in tuinen. *Annona cherimola*, *Capparis petiolaris*, *Inga*-soorten, *Juglans neotropica*, *Pouteria lucuma* en *Vasconcellea*-soorten zijn voorbeelden van inheemse bomen die dikwijls in tuinen groeien. Sommige ervan hebben vermarktbare vruchten. Een tweede groep zijn niet-economische eetbare planten die voornamelijk getolereerd worden in tuinen en hagen om verschillende redenen. Voorbeelden zijn *Acnistus arborescens*, *Clavija euerganea*, *Cyphomandra cajanumensis*, *Physalis peruviana* en *Solanum americanum*. Een laatste groep plantensoorten worden voornamelijk getolereerd in graaslanden en hagen. Myrtaceae en *Inga*-soorten zijn bomen die dikwijls aldus getolereerd worden voor schaduw, brand- en constructiehout en bodem-verbetering. Klimplanten zoals *Passiflora*- en *Rubus*-soorten worden getolereerd in hagen wegens hun eetbare vruchten. Slechts weinig bomen en kruiden worden getolereerd in velden. Er bestaan minstens drie verschillende soorten tuinen in de regio. In koffieteeltgebieden vindt men koffietuinen, waar *Inga* soorten dikwijls beheerd worden als schaduwbomen. Op grotere hoogtes zijn inheemse fruitbomen of groenten en medicinale planten dominant in tuinen. Schematische voorstellingen van het beheer van niet-geteelde eetbare planten in verschillende delen van het landbouwsysteem zijn weergegeven in deze studie. Gelijkaardige beheerspraktijken treft men aan in de meeste tropische streken.

Het beheer van eetbare planten is sterk afhankelijk van de bestaande landbouwsystemen. In gebieden waar landbouwgewassen, koffieteelt en tuinen domineren worden veel niet-geteelde planten actief beheerd. In veeteeltgebieden of pas ontgonnen gebieden worden relatief minder eetbare planten beheerd. Degene die toch beheerd worden, vindt men voornamelijk als getolereerde planten in weilanden. In bepaalde landbouwsystemen heeft plantenbeheer geleid tot een relatief hoog aantal eetbare soorten. Dit verklaart de rijkdom aan eetbare planten die men aantreft in bijvoorbeeld het centrale deel van de provincie Loja. Landbouproductiesystemen en plantenbeheer hebben dus een invloed op het gebruik van eetbare planten.

Het feit dat niet-geteelde planten beheerd worden betekent dat ze integreren en overleven in een landbouwomgeving. Dit illustreert hoe traditionele landbouwpraktijken biodiversiteit kunnen verrijken. De mogelijkheden die landbouw bieden om biodiversiteit te beschermen worden tegenwoordig erkend als een belangrijke strategie om beheer in beschermde gebieden aan te vullen. Deze studie toont welke streken en welke onderdelen van de landbouwomgeving in zuidelijk Ecuador hoge aantallen eetbare planten bevatten. Deze informatie kan gebruikt worden in geïntegreerde ontwikkelings-en natuurbeheerprojecten.

In de toekomst kunnen de resultaten van dit onderzoek getoetst worden aan de opinie van de lokale bevolking over plantenbeheer en behoud van biodiversiteit. Landbouwsystemen in het kust- en Amazonegebied van zuidelijk Ecuador zijn zeer verschillend van het Andijns gebied. Ook hier zou plantenbeheer moeten bestudeerd worden. Vooral in de kuststreek, waar biodiversiteit mogelijk meer bedreigd is door grootschalige intensieve landbouw. Beheerspraktijken binnen intensieve en traditionele landbouw zouden kunnen vergeleken worden, alsook hun respectievelijke invloed op de biodiversiteit. Het is mogelijk dat traditionele beheerspraktijken kunnen geïntegreerd worden in intensieve productiesystemen om aldus een mogelijk verlies aan biodiversiteit tegen te gaan.

Resumen

El relieve y el clima en el sur del Ecuador han generado una gran variedad de zonas ecológicas y tipos de vegetación que albergan una alta diversidad de especies de plantas. Es así que allí crecen más de 6.000 especies de plantas en una zona de 30.000 km². La población humana está conformada por campesinos mestizos y pequeñas comunidades de indígenas Shuar y Saraguros. La agricultura es la principal actividad económica y tiene diferentes sistemas de producción que están relacionados con las zonas ecológicas. En las zonas costeras existe agricultura de gran escala con fines de exportación, en los Andes agricultura de subsistencia y en la Amazonía las comunidades Shuar practican horticultura de subsistencia y los colonos mestizos ganadería y tala de madera en las zonas recién colonizadas.

El inventario etnobotánico de plantas comestibles no domesticadas se realizó en 42 sitios seleccionados dentro de las diferentes zonas ecológicas. Se aplicaron entrevistas semiestructuradas a informantes y expertos/as en cada sitio. Se registraron 354 especies comestibles con nombres comunes, usos, preparaciones, partes utilizadas, ecología y manejo. Se identificaron un total de 846 especímenes de plantas que pertenecen a 65 familias y 156 géneros, destacándose las familias Mimosaceae, Arecaceae, Solanaceae, Ericaceae, Myrtaceae, Rosaceae y Passifloraceae y los géneros *Inga*, *Passiflora*, *Solanum* y *Rubus*. Se descubrieron por lo menos tres nuevas especies de plantas durante este estudio y cuatro especies fueron registradas por primera vez en el Ecuador.

El 85% de las especies registradas presentan frutos comestibles. La gente consume pocas raíces y hojas. Se describen preparaciones regionales de comidas y bebidas en las cuales se usan plantas silvestres. El 86% de las especies comestibles son consumidas de forma cruda. El 38% de las especies presentan usos adicionales, siendo los principales para leña y madera. Los frutos de 23 especies son vendidos en los mercados locales y regionales. Las plantas comestibles no domesticadas contribuyen poco a la economía familiar, pero son importantes para la subsistencia diaria, siendo los niños y las niñas quienes más consumen frutos silvestres. La gente mestiza conoce bastantes frutos silvestres comestibles, pero los consume ocasionalmente y parece que está perdiendo sus conocimientos tradicionales sobre el uso de plantas. Para la población Shuar los frutos silvestres forman una parte esencial de su dieta: conocen y consumen 83 especies comestibles y tienen un amplio conocimiento del mundo vegetal. No solo hay diferencias entre las poblaciones mestiza y Shuar en el número de plantas comestibles que utilizan y su contribución a la subsistencia diaria, pero también en las partes comestibles que consuman y los lugares donde se recolecta las plantas.

La gente denomina con 411 nombres comunes a las 354 especies de plantas comestibles. La mayoría de los 328 nombres mestizos son de origen español. La

asignación de los nombres mestizos se da por transposición o por neologismo; algunos provienen de lenguas indígenas (Shuar y Quichua). Los/as inmigrantes típicamente utilizan estos mecanismos para crear nombres de plantas no conocidas. En el sur del Ecuador fueron inmigrantes españoles/as que llegaron hace más de 500 años, pero igual hoy en día hay colonización mestiza en nuevas áreas en la Costa y en la Amazonía. Los nombres mestizos tienen diferentes niveles de variabilidad regional. La mayoría de las plantas tienen un nombre único en toda la región, siendo más frecuentes los nombres no descriptivos. La minoría de las plantas tienen un nombre que varía de una localidad a otra. La composición florística de una zona determina la necesidad de nombrar y distinguir entre especies relacionadas o similares, lo que se refleja en la denominación de las especies.

El pueblo Shuar utiliza únicamente los nombres en su idioma. Los 83 nombres Shuar tienen poca variabilidad regional. Una comparación de las prácticas de denominación entre gente mestiza y Shuar sugiere que la primera tiende a utilizar nombres más generalizados porque se emplea el mismo nombre común para especies diferentes y existen más nombres binomiales que los Shuar. Los nombres comunes forman una parte importante de los conocimientos tradicionales de una sociedad.

El uso de plantas comestibles en el sur del Ecuador es muy variable. Las especies comestibles varían por la diversidad ecológica. Al analizar la similitud de especies comestibles entre comunidades por medio de coeficientes de similitud y análisis de conglomerados, se identificaron ocho áreas con especies similares de plantas comestibles, las cuales corresponden a gradientes ecológicos existentes; sin embargo, algunas aún presentan excepciones interesantes.

El número de plantas comestibles conocidas y utilizadas varía por razones étnicas y agro-socio-económicas. El número más alto de plantas comestibles fue registrado en la zona baja amazónica, siendo ésta una zona con amplios recursos forestales y habitada por comunidades Shuar. Los colonos que habitan la misma región utilizan aún menos plantas. Se registraron altos números de plantas comestibles en la parte central seca de la provincia de Loja en una zona intensamente cultivada con pocos remanentes de bosque. Por lo tanto, no se necesita una presencia de vegetación natural para mantener un uso amplio de las plantas silvestres. En esta zona se manejan muchas plantas silvestres dentro del sistema agrícola; también en la parte alta de la cordillera andina occidental se registran muchas especies comestibles. La duración de la colonización de una zona influye sobre el uso de las plantas, por lo tanto, menos plantas son conocidas en zonas recién colonizadas en la zona húmeda costera y en las pendientes amazónicas.

Las plantas no domesticadas son integradas y manejadas dentro de los sistemas agrícolas, lo que implica que muchas plantas comestibles sean recolectadas en hábitats agrícolas en vez de naturales. El manejo de plantas fue estudiado en detalle en la región andina sobre los 1.500 msnm, donde la mitad de las especies comestibles registradas son manejadas. Las especies comerciales siempre son manejadas. Los agricultores manejan más árboles en comparación con otras formas de vida. Las plantas pueden ser toleradas, sembradas, plantadas o trasplantadas. Muchas especies son manejadas específicamente por sus frutos comestibles mientras que otras son manejadas por una variedad de razones que incluyen leña, madera, aumento de la fertilidad del suelo, sombra, forraje y cercas. A veces, el uso comestible es sólo un uso secundario. Algunas especies son manejadas de varias maneras en varias partes del sistema agrícola.

Existen tres patrones principales de manejo de plantas comestibles en la región andina. Algunas especies son principalmente manejadas de forma activa por sus frutos en huertas caseras, como *Annona cherimola*, *Capparis petiolaris*, *Inga* spp., *Juglans neotropica*, *Pouteria lucuma* y *Vasconcellea* spp., que son árboles nativos. Algunos tienen frutos comerciales. Otro grupo de especies comestibles es tolerado en huertas y en cercas por varios usos, como *Acnistus arborescens*, *Clavija euerganea*, *Cyphomandra cajanumensis*, *Physalis peruviana* y *Solanum americanum*. Un tercer grupo de especies comestibles son toleradas en potreros y cercas. Árboles de Myrtaceae e *Inga* spp. son tolerados para sombra, leña, madera y mejoramiento de los suelos. Las enredaderas como *Passiflora* spp. y *Rubus* spp. pueden ser toleradas en cercas por sus frutos comestibles. Pocos árboles y hierbas son tolerados en chacras y terrenos. Existen por lo menos tres tipos de huertas caseras en la región. En zonas cafeteras, muchas huertas son cafetales con árboles de *Inga* para sombra. En zonas más altas, frutales nativos, verduras y plantas medicinales predominan en las huertas. Se presentan dibujos esquemáticos del manejo de las plantas comestibles en varias partes del área agrícola. Existen prácticas semejantes de manejo en los trópicos.

Existe un estrecho vínculo entre el manejo de las plantas y las prácticas agrícolas. En áreas de cultivos, áreas cafeteras y áreas con huertas caseras, muchas plantas no domesticadas son manejadas de forma activa. En áreas ganaderas y áreas recién colonizadas se manejan menos plantas comestibles. Las plantas que son toleradas están presentes sobre todo en los potreros. En ciertos sistemas agrícolas el manejo de las plantas resulta en un número alto de especies comestibles, lo cual explica la riqueza de especies que se encuentra en la parte central de la provincia de Loja. Los sistemas agrícolas y el manejo de plantas influyen entonces sobre el uso de plantas comestibles.

El hecho de que muchas plantas no domesticadas sean manejadas, implica que están integradas y que sobreviven en un medio agrícola, siendo éste un ejemplo de prácticas tradicionales de agricultura que pueden enriquecer la biodiversidad. Se reconoce el potencial de la agricultura tradicional para conservar la biodiversidad como una estrategia importante para complementar la conservación en áreas protegidas. Este estudio indica cuáles zonas agrícolas en el sur del Ecuador y cuáles partes del sistema agrícola contienen muchas plantas comestibles manejadas. Se puede utilizar esta información en proyectos integrados de desarrollo y conservación.

Las recomendaciones para la investigación futura serían enfrentar los resultados de esta investigación con la opinión de la gente local sobre el manejo de plantas y la conservación de la biodiversidad. Los sistemas agrícolas en las regiones costeras y amazónicas del Ecuador del sur son muy diferentes. El manejo de plantas debe también ser estudiado aquí. Especialmente en la región costera, la biodiversidad es posiblemente más amenazada debido a la agricultura intensiva en grande. Se podrían comparar entre las prácticas de manejo en agricultura intensiva y tradicional, así como sus efectos sobre la biodiversidad. Las prácticas tradicionales de manejo podrían ser integradas en sistemas de producción intensivo para disminuir la pérdida de la biodiversidad.

1 Introduction

…sharimat tiene frutos amarillos en el tronco …se chupa el fruto…
… el árbol no sirve ni para leña, ni para madera…
Adam Ubigin, Centro Shuar Shayme
(on *Mouriri grandiflora)*

An estimated 12,000 of the world's plants are edible (Lewington 1990). About 150 are important crops. More than ninety percent of the world's food comes from only fifteen plant species: rice, wheat, maize, sorghum, barley, sugar cane, sugar beet, potato, sweet potato, manioc, beans, soy bean, peanut, banana and coconut. Most societies today rely on agriculture for their food provision. But that does not mean that agriculture alone provides all food. Wild foods remain important in all agricultural systems (Scoones et al. 1992).

They can form an important addition to people's diets, providing essential vitamins and minerals. Especially children, who often snack on wild foods, are major "wild" eaters (Alvarez-Buylla 1989; Cotton 1996; Scoones et al. 1992; Styger et al. 1999). Wild foods also play a role as famine and seasonal foods (Scoones et al. 1992). Equally, they can form important sources of income (High & Shackleton 2000; Melnyk 1995; Scoones et al. 1992).

Wild foods may be collected anywhere in the environment. Some might come from forests or areas of natural vegetation, many are gathered in fields, pastures roadsides, etc. and are not necessarily strictly wild, but rather managed. Wild food plants have therefore been named the "hidden harvest" of agriculture (Scoones et al. 1992).

This study aims to research the wild, or better still, non-crop food plants in southern Ecuador; and the role they play in people's life.

1.1 Southern Ecuador

Southern Ecuador, as defined in this study, comprises the provinces of El Oro, Loja and Zamora-Chinchipe (Map 1-1). This area of about 30,000 km², is situated between 3º30' and 5º00' latitude south and 78º20' and 80º30' longitude west. Ecuador lays on the Equator, along the western coast of the South American continent. Its neighbouring countries are Colombia in the north and Peru in the east and south.

Southern Ecuador is quite different from the rest of the country in a socio-economic, ethnic and geographical sense (Pietry-Levy 1993). Because of its borderline position near Peru, and because it has for a long time been relatively isolated from the rest of Ecuador through lack of roads, it has more economic and social relations with northern Peru than with the rest of Ecuador. In the past, southern Ecuador and northern Peru formed a unity. Since 1831, an international border divides the two regions. Although socio-economic links between the two regions remain strong, the border often forms a true barrier. Many historical conflicts (since 1941) over the exact position of the border, have inhibited relations between the two regions, and brought armed conflicts to the area. Only in 1998 did the governments of the two countries finally sign a peace agreement. Since then, cross-border trade and co-operation have improved enormously.

Ethnically, southern Ecuador is the region with the lowest percentage of indigenous people in the country (CATER 1996). Less than 5% of the population is indigenous (compared to 35% nationally) and consists of small communities of Saraguros and Shuar. More than 95% is mestizo. The term mestizo is generally used in Latin America to indicate people of mixed Spanish-indigenous descent. The term is somehow dubious in that it is used by social scientists as an indication of ethnicity, but not by the people themselves. The people of southern Ecuador refer to themselves as Ecuadorian, not as mestizo. The term is only used here to be able to distinguish non-indigenous people from indigenous Saraguros and Shuar.

The Andes, which form two parallel mountain ranges, an eastern and western, dominate Ecuador's relief (Map 1-2). The two *cordilleras* transverse the country roughly from north to south (NNE-SSW to be more precise). The Andes divide the country into three natural areas: the western coastal area of plains and low mountains (*costa*), the central area of Andean mountain ridges and valleys (*sierra*) and the eastern Amazonian lowland area (*oriente*). In southern Ecuador the *cordilleras* of the Andes reach their lowest point. The altitude is never higher than 3800 m, which is much less than in the areas further north, where high peaks up to 6000 m and above dominate the landscape. At the same time, the western mountain range loses its strict north-south orientation and splits into numerous fragmented mountain systems, extending in various directions. This results in a very complex and irregular topography in southern Ecuador (Fig. 1-1) (Best & Kessler 1995; Kessler 1992). From the coast eastward the altitude varies from 0 to almost 3800 m and decreases to 800 m again on the Amazonian side. Southern Ecuador is therefore geographically quite different from the remainder of the country, with a much lower and more irregular relief.

The most variable climate factor is the precipitation. In southern Ecuador, mean annual precipitation varies from less than 250 mm in the south-west to more than 2000 mm in the Amazonian region. Both the Pacific and Amazonian climate system

Map 1-1 . Ecuador (US - CIA 1991)

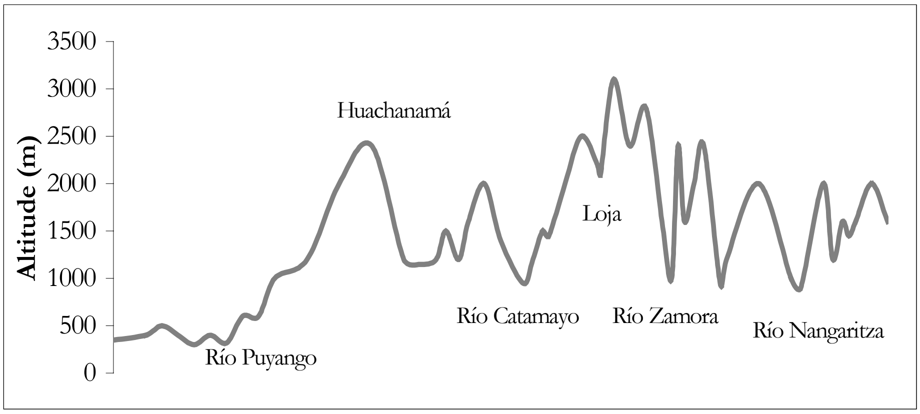
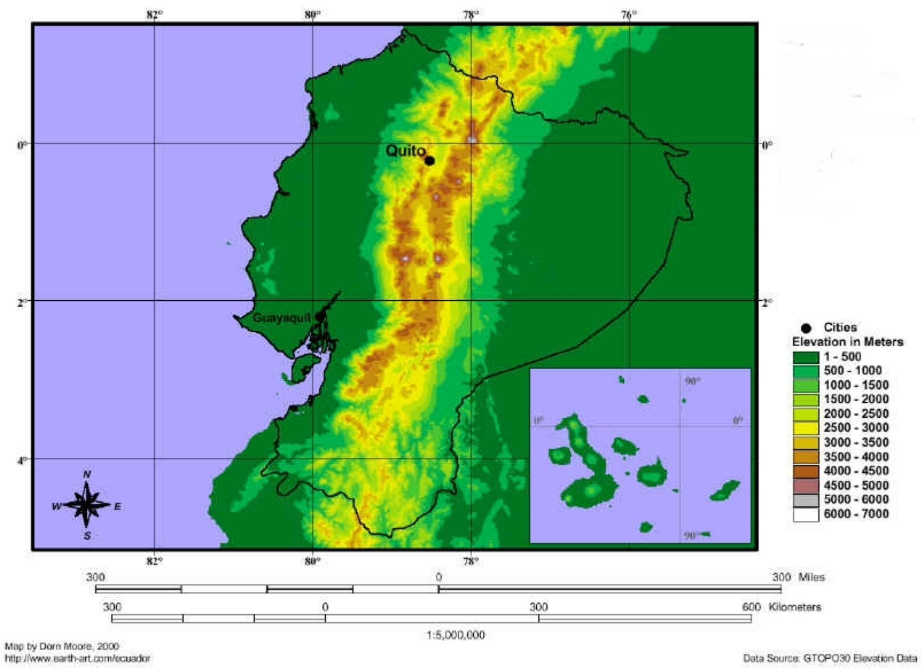


Figure 1-1 . West-east elevation profile along 4° S line



Map 1-2. Relief of Ecuador (Moore 2000)

exert an influence. The coastal area generally has a maximum precipitation at the beginning of the year, whereas for the Amazonian region the precipitation maximum occurs halfway the year. The Andean area is characterised by two distinct rain periods, in January-April and October-November. Mean temperatures vary relatively little. The mean annual temperature is 22-25ºC at sea level, decreases by 0.7ºC with every 100 m of altitude, and varies by only 1-3ºC throughout the year (Best & Kessler 1995; Cañadas Cruz 1983). The overall climatic patterns in the area are that (1) precipitation increases from west to east and from south to north, (2) precipitation decreases from the coast inland due to the presence of mountains and (3) with increasing altitude, temperature and evapotranspiration decrease so that humidity increases (Best & Kessler 1995; Kessler 1992).

The region's irregular topography causes, however, localised exceptions to this general pattern, resulting in a vast range of microclimates (Cañadas Cruz 1983). At the coast, both dry and humid hot areas are found. In the Andes humid and cold areas are interspersed by dry inter-Andean valleys. On the eastern side of the Andes the climate is very humid and hot. Within one hour's drive by car from the town of Loja, one can be in a hot semi-desert valley (Catamayo), in a dry temperate valley (Vilcabamba), in cold wet mountains (San Lucas) or in a humid tropical environment (Zamora).

1.2 Vegetation

Ecuador is one of the 17 most megadiverse countries in the world (Mittermeier et al 1997), based on its high species richness and high concentrations of endemic and endangered species. In Ecuador we also find two of the world's 25 biodiversity hotspots, priority areas for biodiversity conservation, the Chocó-Darién-Western Ecuador hotspot and the Tropical Andes hotspot (Myers et al. 2000).

In southern Ecuador the irregular topography and climate result in high species diversity and a large range of very different vegetation types in a relatively small area. Southern Ecuador has the highest latitudinal ecological gradient of the tropics: the vegetation changes from desert in northern Peru to humid tropical forest near Guayaquil in less than 300 km (Deler 1991).

Several vegetation and phytogeographical classifications have been proposed for Ecuador, some specifically for the south. Harling (1978) distinguishes 16 vegetation types for Ecuador, ten of which are found in southern Ecuador (Table 1-1). Best and Kessler (1995) describe 10 vegetation types for the coastal and west-Andean area of southern Ecuador below 2000 m (the so-called Tumbesian area) (Table 1-2). This system does not cover the entire southern Ecuadorian area. Sierra et al. (1999) recently developed a new vegetation classification for Ecuador (Map 1-3). They classify the vegetation on either side of the Andean cordillera as different types, and separate northern from southern vegetation types, resulting in 46 different types for the entire country. For southern Ecuador, they distinguish eight coastal, nine Andean and four Amazonian vegetation types (Table 1-3). This vegetation classification is the most accurate.

Since southern Ecuador has very much an agricultural landscape, the vegetation is strongly influenced by human activities. Vegetation classifications base themselves on the presumed "original" vegetation. Areas are described in terms of "forest type". The majority of the landscape, however, has no forest today, but is under cultivation, or is a mixture of fields, shrubland, forest, etc. There is no longer an original forest vegetation present and an important question is what this original vegetation was like. The original forest vegetation is usually presumed "destroyed" by human impact. Forest patches in valleys and watersheds are seen as remains of that original vegetation. Vegetation presumptions are then based on these remains. One needs to be critical, however, about such presumptions. Fairhead and Leach (1995) have shown how in Guinea, deforestation and environmental degradation, usually attributed to population pressure and a breakdown of traditional societies and authority, are in reality more based on western imagination than on the real forest history. Only a detailed historical analysis can reveal what is truly happening to the vegetation. Another important fact to remind is that vegetation is in continuous transition. There is no original static climax vegetation in the beginning of time, from where the actual vegetation is a poor remainder. Vegetation at any time is always a result of both human and ecological conditions, and of changes (natural or unnatural) that take place.

The only vegetation classification for southern Ecuador that takes human influences into account is that by Espinosa (1997) for Loja province (originally made in 1948), whereby the agricultural landscape is seen as an integral part of the vegetation (Table 1-4). Crops and secondary vegetation form the dominant vegetation in Loja province.

Table 1-1 . Vegetation types for southern Ecuador according to Harling (1978)

Vegetation type	**Physical characteristics and area**	**Plants**
Mangrove	tidal zones of river estuaries and bays along coast	*Rhizophora mangle, Avicennia germinans, Laguncularia racemosa, Conocarpus erecta*
Desert and semi-desert shrub vegetation	coastal S Ecuador, annual precipitation 100-300 mm, dry season 9 months	*Armatocereus catwrightianus* cacti, scattered shrubs and small trees
Savannah	lowland SW Ecuador, annual precipitation +/- 1000 mm, dry season 7 months	*Ceiba trichistandra, Ceiba pentandra, Eriotheca ruizii*
Semi-deciduous forest	coastal W Ecuador, annual precipitation < 2500 mm	tall trees, few lianas and epiphytes
Lower montane rain forest	700-2500 m altitude, W and E Andean slopes	dense tall forest, numerous epiphytes
Cloud forest	2500-3400 m altitude, both sides of the Andes	dense low forest, numerous epiphytes
South Ecuadorian shrub vegetation	inter-Andean valleys, 2000-3000 m altitude	Asteraceae, Ericaceae, Melastomataceae, Proteaceae, Bromeliaceae
Dry shrub vegetation of southernmost Ecuador	intermontane valleys of the Catamayo and Calvas rivers	low, thorny shrubs (*Acacia macracantha, Prosopis juliflora, Erythrina* spp.) and cacti
Inter-Andean desert and semi-desert	inter-Andean valleys, annual precipitation < 300 mm	sparse vegetation, small trees and cacti
Grass *páramo*	>3400 m altitude	dwarf shrubs, grasses, sedges, herbs.

Table 1-2. Vegetation types for southern Ecuador according to Best & Kessler (1995)

Vegetation type	Altitude (m)	Climate
Deciduous tropical thorn-forest and *Acacia* thorn-forest	0-50 to 50-400	<500 mm annual precipitation, high temperatures
Deciduous *Ceiba trichistandra* forest	0-400 to 150-1400	200-1000 mm annual precipitation, 7 months dry season
Semi-evergreen *Ceiba pentandra* forest	0-1000 to 100-1200	500-1300 mm annual precipitation
Semi-evergreen lowland and premontane tall forest	0-1000 to 400-1400	900-1700 mm annual precipitation
Moist lowland forest	150-300 to 500-600	1100-2300 mm annual precipitation
Humid to very humid premontane cloud forest	500-600 to 1100-1500	> 1400 mm annual precipitation
Deciduous to semi-evergreen intermontane shrub and thorn-forest	500-1000 to >2000	150-800 mm annual precipitation, pronounced dry season
Humid to very humid lower montane cloud forest	1400-1500 to 1700-1800	> 1300 mm annual precipitation
Deciduous to semi-evergreen lower montane cloud forest	1300-1400 to 1800-2000	400-1300 mm annual precipitation, 4-5 months dry season
Humid to very humid montane cloud forest	> 1700	> 1000 mm annual precipitation.

Table 1-3. Vegetation types for southern Ecuador according to Sierra et al. (1999)

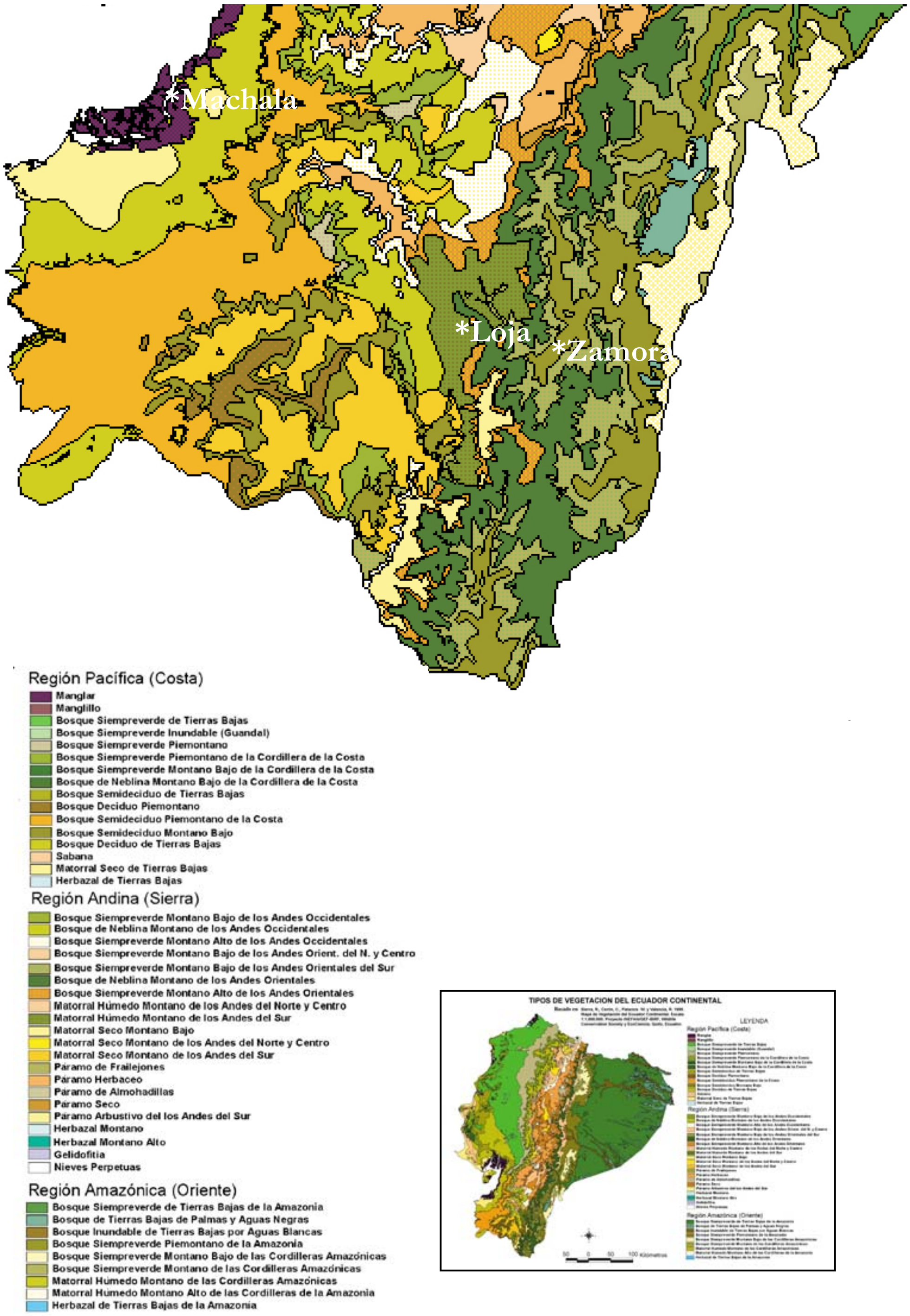
Coastal vegetation	Andean vegetation	Amazonian vegetation
Mangrove	Evergreen lower montane forest of the western Andes	Lowland forest of palms and black water rivers
Evergreen premontane forest	Montane cloud forest of the western Andes	Evergreen premontane Amazonian forest
Semi-deciduous lowland forest	Evergreen montane forest of the western Andes	Evergreen lower montane Amazonian forest
Deciduous premontane forest	Evergreen lower montane forest of the eastern southern Andes	Evergreen montane Amazonian forest
Semi-deciduous premontane coastal forest	Montane cloud forest of the eastern Andes	
Semi-deciduous lower montane forest	Evergreen montane forest of the eastern Andes	
Deciduous lowland forest	Montane humid shrubland of the southern Andes	
Dry lowland shrub vegetation	Montane dry shrubland of the southern Andes	
	Shrub *paramo* of the S Andes	

Table 1-4. Vegetation of Loja province according to Espinosa (1997)

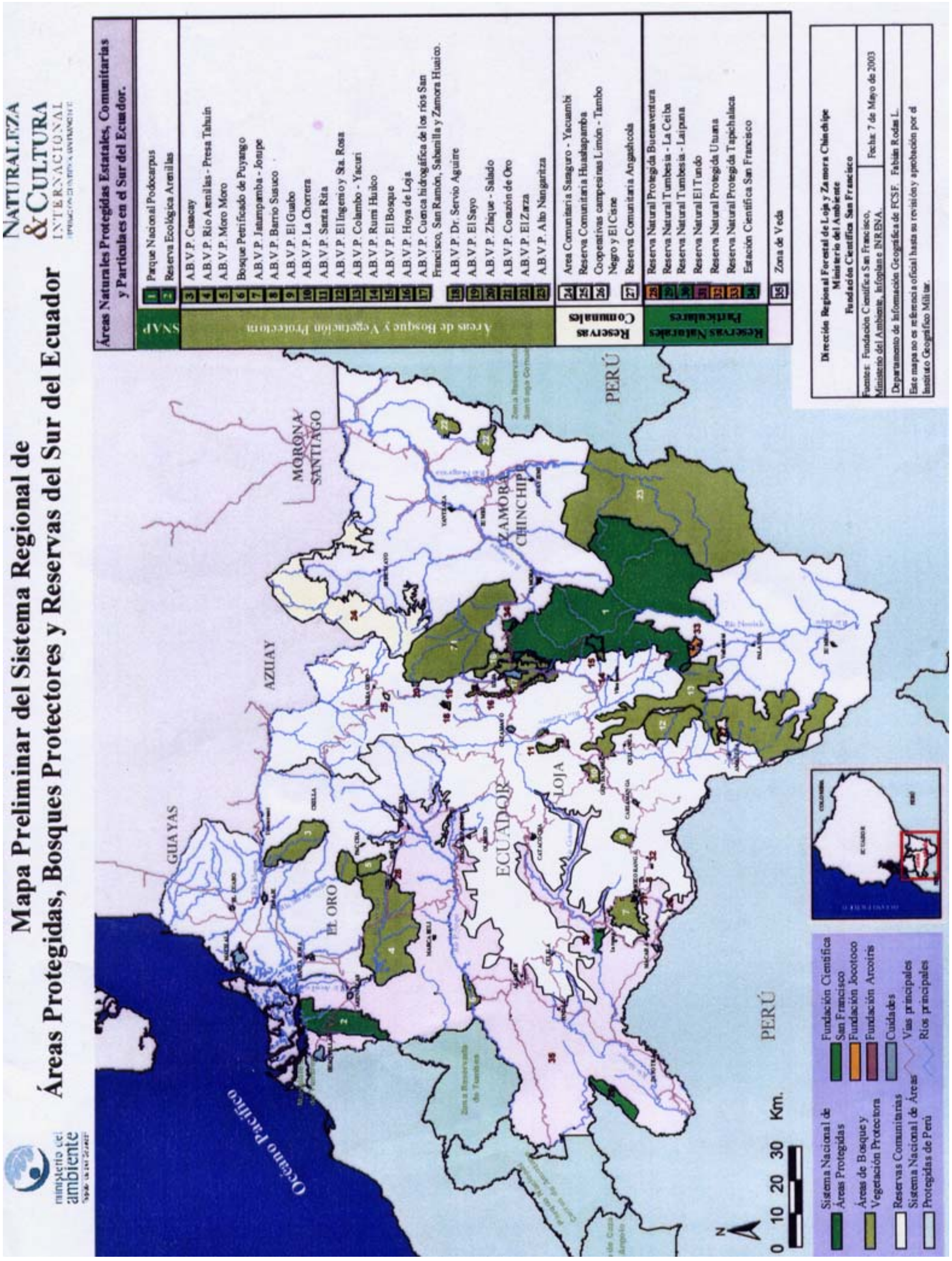
	Vegetation	Characteristics
Anthropogenic vegetation	*Lugares de cultivo* (fields, gardens)	introduced and native crops
	Potreros, prados, praderas (pastures)	native and introduced grasses and herbs, native trees
	Lomas (hillsides)	native vegetation of herbs and small shrubs for grazing
	Matorral bajo (lower shrubland)	secondary vegetation: herbs, shrubs and small trees to 3 m high
	Taludes (roadsides)	secondary shrub and herb vegetation
Natural vegetation	*Matorral de altura* (montane shrubland)	primary shrub and small tree vegetation, abundant in epiphytes
	Breñas (steep rocky slopes)	lichens, mosses and *Tillandsia* spp.
	Pantanos (marshes)	inundated areas: Cyperaceae, Juncaceae
	Bosque de altura (montane forest)	trees and shrubs, many epiphytes
	Páramo	grasses, herbs and small shrubs; above 2800 m

Dodson and Gentry (1991) describe the history of forest destruction for the coastal Ecuadorian lowlands (0-900 m). Forest cover reduced dramatically from 63% in 1958 to less than 5% today, caused by population pressure, land reforms, road constructions (that open new areas to colonisation), an increase in plantations for export crops, and government policies that encourage migrations to previously unexploited areas. Near the coast, a large proportion of the mangroves has been destroyed and replaced by shrimp farms. The humid lowland areas of southern Ecuador are entirely covered today with banana plantations. In the Andes, a long history of agriculture has resulted in a largely agricultural landscape with small forest patches on steep slopes and in deep valleys. The Amazonian forests seem threatened by timber logging and cattle farming. The present forest cover for Ecuador is estimated at 37% of the total land area, with a 12% loss of forest over the last ten years, due to land clearance for colonisation and fuelwood and charcoal production (WRI 2003). About 21% of the forest area of Ecuador and 26% of the total land area are protected (WRI 2003). In southern Ecuador, forest area and protected area percentages are lower than the country averages. Two national protected areas exist in southern Ecuador. The Parque Nacional Podocarpus in the eastern *cordillera* east of Loja (1000 – 3500 m altitude) has lowland rain forest, montane cloud forest and *paramo* vegetation. Reserva Ecológica Arenillas in the dry coastal part of El Oro (<400 m) has dry deciduous lowland forest. In recent years, many protected forests and nature reserves have been established in southern Ecuador by local and international non-governmental organisations, by community groups and by individual landowners (Map 1-4; pers. comm. Naturaleza & Cultura Internacional[1]). Protected areas are mainly situated in the Amazonian region and in coastal dry forest areas.

[1] Comment made in Loja, Ecuador in August 2003.



Map 1-3. Vegetation of southern Ecuador, detail from vegetation map of Ecuador (Sierra et al. 1999)



Map 1-4. Protected areas, protected forests and nature reserves in southern Ecuador (Ministerio del Ambiente 2003)

A phytogeographical classification system used in Latin America is Holdridge´s life zone system (Cañadas Cruz 1983). This classification assumes that there is a relationship between climate and vegetation of a given area. The system attempts to describe the vegetation, in a simplified way, as a function of climatic data (precipitation) and altitude. Since observations of actual vegetation are hardly taken into account, this system can only be used as an indication of which vegetation type could theoretically occur in a certain area. The boundaries between different life zones in southern Ecuador are not very clear due to a lack of detailed climatic data. Sixteen different life zones occur in southern Ecuador (Table 1-5), compared to 25 for Ecuador and 30 for the whole world. This lifezone system was used as a basis for the selection of field sites for the present study, because it was the only classification system for which maps for southern Ecuador existed at the time.

1.3 Plant diversity

A total of about 16,087 species of vascular plants have been described for Ecuador to date, with new species being described at a rate of one every two days (Jørgensen & Léon-Yánez 1999). One quarter of all species is endemic to Ecuador (Borchsenius 1997). For southern Ecuador, 1294 species are known for El Oro province, 3039 species for Loja province and 2715 species for Zamora-Chinchipe. Taking into account the overlapping of species between the provinces, this brings the total for southern Ecuador to 6186 species. In general in the neotropics, plant diversity decreases with elevation from 1500 m altitude upwards (Gentry 1995; Jørgensen et al. 1995). The highest number of species and the highest level of endemism in Ecuador are found in the Andes. The southern Andes is particularly rich in endemic species (Borchsenius 1997). The Andes between 1000 and 1500 m is the most species-rich (Jørgensen & Léon-Yánez 1999). More species are found here than in the Amazonian lowland region (0-500 m). At the same time, especially in the western Andean foothills, Andean forests have largely disappeared as a result of human impact. In most areas, only small forest patches remain today.

Table 1-5. Life zones and their characteristics in southern Ecuador, according to Cañadas Cruz (1983)

Life zone	Code	Altitude (m)	Mean annual precipitation (mm)	Mean annual temperature (ºC)
Bosque espinoso tropical Tropical thorn-forest	beT	0-300	250-500	>24
Bosque espinoso premontano Premontane thorn-forest	bePM	>300	250-500	18-24
Bosque muy seco tropical Very dry tropical forest	bmsT	0-300	500-1000	>24
Bosque seco tropical Dry tropical forest	bsT	0-600	1000-2000	>24
Bosque seco premontano Dry premontane forest	bsPM	coast >300 Andes 1800-2000	500-1000	18-24
Bosque seco montano bajo Dry, lower montane forest	bsMB	2000-3000	500-1000	12-18
Bosque húmedo tropical Humid tropical forest	bhT	0-1000	2000-4000	>24
Bosque húmedo premontano Humid premontane forest	bhPM	coast 300-2000 Andes 600-2000	1000-2000	18-24
Bosque húmedo montano bajo Humid, lower montane forest	bhMB	2000-3000	1000-2000	12-18
Bosque húmedo montano Humid montane forest	bhM	3000-3900	500-1000	6-12
Bosque muy húmedo tropical Very humid tropical forest	bmhT	0-1000	4000-8000	>24
Bosque muy húmedo premontano Very humid premontane forest	bmhPM	600-2000	2000-4000	18-24
Bosque muy húmedo montano bajo Very humid, lower montane forest	bmhMB	2000-3000	2000-4000	12-18
Bosque muy húmedo montano Very humid montane forest	bmhM	3000-3900	1000-2000	6-12
Bosque pluvial montano Montane rain forest	bpM	3000-3900	2000-4000	6-12
Páramo subalpino Subalpine páramo	pSA	>3900	1000-2000	3-6

1.4 The people and their history

Southern Ecuador has a population of about 1 million; 44% live in Loja province, 48% in El Oro and 8% in Zamora-Chinchipe (CATER 1996). More than 95% of the population is mestizo. Indigenous Saraguros (about 22,000 according to Chalán et al. (1994)) live in the Saraguro area in Loja province and in the higher parts of Zamora-Chinchipe province in the Yacuambi area. Indigenous Shuar communities (probably totalling about 20,000 people) inhabit the easternmost part of Zamora-Chinchipe province along the Río Zamora, Río Nangaritza, Río Numpatakaime and their tributaries.

The oldest proof of human presence in southern Ecuador dates back to 8300 BC and consists of a pre-ceramic site found in Cubilán (near Saraguro) in the Andes (CATER 1996). Various agricultural cultures developed in southern Ecuador after 1500 BC. Before the Inca conquest, the Andean area was inhabited by Palta and Cañari and the Amazonian area by Jívaro, then known as Pacamoras (or Bracamoras) and now known as Shuar (CATER 1996). Not much is known about the ancient inhabitants of the coastal area (Taylor 1991).

From 1463 AD, the Incas exerted their influence, mainly in the Andean area. The Palta were apparently easily conquered, whereas the Jívaro (Shuar, Pacamoras) in the Amazonian area successfully resisted the Inca rule and were only marginally influenced (Jaramillo 1991; Steel 1999). During the Inca reign, the indigenous population seemed to decrease. The Incas used a tactic of displacing people throughout their empire, for efficient work organisation and to avoid opposition (Taylor 1991). These displaced groups are called *mitimae*. *Mitimae* were brought to Loja, Macará and Saraguro (CATER 1996). Most probably the present-day Saraguros were *mitimae* brought in from near Lake Titicaca in Bolivia. It is not known whether people from southern Ecuador were moved to other areas.

When the Spanish arrived in 1531, they found southern Ecuador populated by Cañari (in the north), Palta, *mitimae* (Saraguros) and Jívaro (Shuar) (based on the account of *conquistador* Cieza de León, in Jaramillo 1991). The languages spoken at the time were Cañar, Palta and Malacatos in the Andean area (the two latter apparently being similar) (Jaramillo 1991), Jívaro in the Amazonian area and Quichua by the Saraguros. The Spanish founded the towns of Loja, Zamora and many others. The indigenous peoples were divided amongst the *conquistadores* and subjected to forced labour in the gold mines of Zaruma and Nambija, and on farms (CATER 1996; Jaramillo 1991). Gold mining was the most important economic activity at the time in southern Ecuador.

During the first century of Spanish occupation, the Andean part of southern Ecuador, which was inhabited by Palta, became largely void of inhabitants (Deler 1991). It is not clearly known why the Palta and their culture disappeared so rapidly. One possible explanation is that they were eradicated by the introduction of new diseases and their subjection to harsh forced labour. Some researchers believe the Palta may have been of Jívaro origin and that therefore so few cultural aspects remain today (Taylor 1991; Harner 1984). The empty area left by the Palta was later occupied by gold diggers that flocked to the area and by Spanish *campesinos* (small-scale famers) (Pietri-Levy 1993).

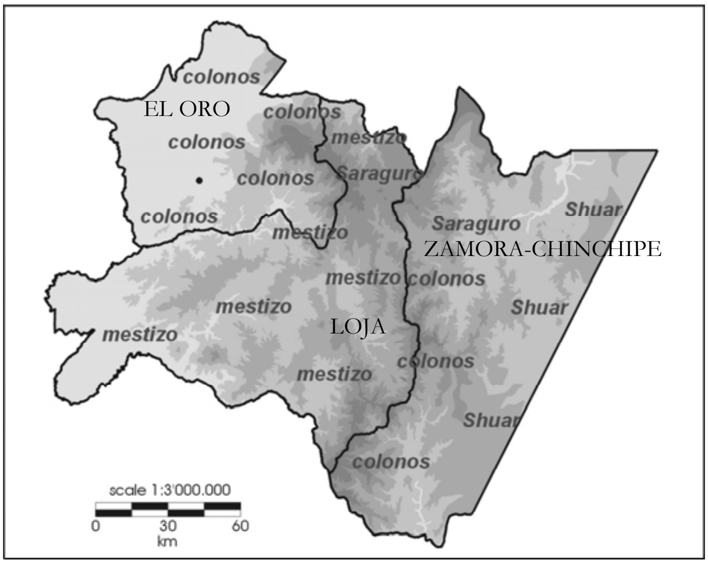
The *conquistadores* abandoned the Amazonian area after various attempts to establish settlements and to defeat the Shuar (Jívaro) failed. A major Shuar uprise in 1599 with the destruction of Logroño, Sevilla del Oro and Zamora signalled the end of the Spanish attempts to subdue the Shuar (Harner 1984; Jaramillo 1991; Steel 1999). They were the only indigenous people ever to resist the Spanish *conquista*. At the same time, the Shuar moved ever more south-east to avoid contact with the Spanish colonisers. The eastern Andes slopes were only slowly recolonised by mestizos in the second half of the 18th century (1750-1780), because of the *cascarilla* exploitation. *Cascarilla* or the bark of the *quina* tree (*Chinchona* spp.), was exported from Malacatos and Cajanuma to Europe for the extraction of quinine (malaria cure). As more and more *cascarilla* was needed, more and more colonisers (*colonos*) entered the eastern Andes slopes (CATER 1996). As a result, the Shuar slowly abandoned this region, which once formed part of their territory.

In the course of the seventeenth century, gold mining decreased in favour of cattle farming and Spanish *campesinos* populated the Andean part of southern Ecuador. The few indigenous people that escaped the Spanish influence populated the marginal, higher Andes regions (CATER 1996).

During the 19th century, *haciendas* in the Andean area acquired always more terrain and colonisation of the coastal and Amazonian region increased. The coastal colonisers were mestizo and Spanish. In the Amazonian area, Saraguros and mestizos settled, the first in the Yacuambi area (east of Saraguro), the latter further south near Valladolid, Zumba and Bombuscara (CATER 1996).

The creation of large banana plantations in the humid coastal areas, and of cacao and cattle farms in the higher coastal areas from the 1940s onwards, opened the north-western coastal region to colonisation. The colonisation of coastal and Amazonian regions was accelerated by the agricultural land reforms (introduced from the 1960s onwards), by severe droughts in southern Ecuador (1968) and by major new road constructions (CATER 1996). A similar eastward migration of highland *campesinos* in search for new land is happening all over the Andes in South America (Schjellerup 2000).

The result of all these population migrations is that today we find three distinct ethnic groups living in southern Ecuador: the Quichua-speaking Saraguros, the Shuar and the Spanish-speaking mestizo majority, descending from Spanish colonisers and indigenous peoples whose origins are sometimes vague (Palta, Malacatos, Cañaris) (Map 1-5). The province of Zamora-Chinchipe is inhabited by Shuar in its easternmost part, by *colonos* (colonisers of mestizo ethnicity) and by Saraguros (in the Yacuambi area). Saraguros (in the Saraguro area) and mestizos inhabit the province of Loja. El Oro province is inhabited



Map 1-5. Ethnic groups and recent colonisations of southern Ecuador (*colonos* are mestizo, the distinction indicates recent colonisations) (base map by CINFA)

entirely by mestizos. In some areas colonisation is recent (indicated as *colonos* in map 1-5).

Some of the original ethnic groups have thus managed to maintain their identity throughout the Inca and Spanish conquest (Shuar and Saraguros), whilst others have completely disappeared or have been absorbed into the mestizo entity (Palta) (Taylor 1991). We do not know who inhabited the coastal areas and what became their fate.

Saraguros

The Saraguros, brought to southern Ecuador by the Incas (as *mitimae*), have been little influenced by Spanish culture. During Spanish rule, their main responsibility was the maintenance of a *tambo* (resting-place for travellers) near San Lucas on the *camino real (*the Inca road from Cuzco to Quito), rather than working in the gold mines (Jaramillo 1991). Throughout the Spanish time and after Ecuadorian independence (1830), they maintained their separate identity, or created their identity as we know it today from various influences. Their identity is visually expressed in their distinctive traditional black and white clothes (with the men wearing distinctive knee-length trousers). The Saraguros belong to the Quichua linguistic group.

Shuar

The Shuar are part of the linguistic and cultural group of Jívaro people, which comprises the Shuar, Achuar, Huambisa, Aguaruna and Mayna in south-east Ecuador and northern Peru (Harner 1984; Steel 1991). The name Jívaro was given to them by the Spanish, but is now abandoned because of its pejorative connotation (savage). They call themselves Shuar or *untsuri suara*. Despite attempts by both Incas and Spanish to rule them, they avoided contact, moved further south, or rebelled violently against any potential ruler. The unfavourable tropical climate and geography helped them in this. Even missionaries were unsuccessful in trying to infiltrate their territory. Until the beginning of the 20th century, they were very little influenced by colonisers. Then, slowly contact with the outside world increased, mainly through trade (guns, machetes) and the influx of colonisers and missionaries. As a result, their lifestyle has changed dramatically over the last 40 years. Agriculture and cattle farming have gained importance to provide cash income. Roads connecting the *sierra* with the *oriente*, and national policies encouraging colonisation of so-called "virginal" lands, brought in ever more mestizo colonisers (*colonos)*. This caused serious territorial conflicts, with *colonos* claiming private ownership of land, whilst Shuar people have a communal concept of land utilisation and ownership. In 1964, the traditionally anarchistic Shuar created the *Federación de Centros Shuar* to protect their economic, political and cultural interests. The most urgent matter was to obtain territorial property rights (Steel 1999). Today the Shuar are fully part of Ecuadorian society, but maintain their own identity and language, albeit that most are bilingual.

1.5 Agriculture and economy

(CATER 1996; Pietry-Levy 1993)

Until the 1960s, southern Ecuador was relatively isolated from the rest of Ecuador due to lack of roads. Throughout the 19th and the first half of the 20th century, a serious increase in the number of commercial *haciendas* (farms) and their ever continuing accumulation of land, took place (especially in the Andean region), unlike what happened in the rest of Ecuador. In the south, the *haciendas* were the largest of the whole country. In 1954 for example, 0.3% of all farms occupied 50% of the land in Loja province. The workers on the *haciendas* were either *partidarios* (who have the use of a small piece of land in exchange for part of the harvest) or *arrimados* (who have the use of a piece of land in exchange for free labour, but have no hereditary rights over the land). The latter were mainly European ex-miners, who had come to work in the gold mines of Zaruma and Nambija. Apart from the *haciendas,* there were *minifundistas* who owned their own small farms, e.g. the Saraguros. From 1964, several land reforms intended to re-divide land by forcing landowners to sell part of their *haciendas* to the *partidarios* and *arrimados*. In reality, only the most infertile and driest areas were sold at exorbitant prices, and only at a very slow rate. The problematic land reforms and masses of land-less people eventually caused huge migrations towards both the coastal and Amazonian areas. Today, the division of land is still very irregular throughout southern Ecuador. In some areas, *haciendas* did get divided, whereas in other areas landowners maintained their large farms but with reduced areas. This means that the agricultural situation in southern Ecuador today is very mixed. In some areas traditional *minifundistas* managed to maintain their lands and status (e.g. the indigenous Saraguros). Some *ex-arrimados* became *minifundistas* (small farmers), whereas others became *finqueros* (middle-sized farmers). Emigration to new areas created the group of *colonos* (colonisers) that have claimed new lands. *Haciendas* that still exist today are now referred to as adapted *haciendas* and have paid employees. Others have turned into business *haciendas* (e.g. the sugar business in Catamayo) (Table 1-6).

Since the 1970s, the petroleum boom has brought an enormous investment in infrastructures to Ecuador. The road net has expanded rapidly. Electricity was brought to rural areas. The health situation has improved immensely. As a result, the economic situation in southern Ecuador has changed a lot. The urban population has increased. Commerce and industry have become more important and the public sector has expanded.

Agriculture is still the most important economic activity today in southern Ecuador, but has lost its monopoly. In Loja province, 50% of the active population works in agriculture. In El Oro and Zamora-Chinchipe these percentages are 28 and 50, respectively. They represent a total of 39,877; 15,767 and 6,045 farming units in the respective provinces (in 1995). This shows that in Loja province there is a high number of relatively small farms. In the coastal lowland areas, agriculture is mainly large-scale and export-oriented. Main cash crops are bananas, coffee, shrimps (in the coastal waters) and cattle. In the *sierra*, small-scale traditional agropastoral farmers practise mainly subsistence agriculture. Alongside subsistence crops, small amounts of cash crops such as sugarcane, maize, peanut and coffee are grown. In the *oriente*, the indigenous Shuar combine traditional agriculture, hunting, fishing and gathering, whereas immigrants (*colonos*) log timber and practise cattle farming and agriculture. The Shuar in the Upper Río Nangaritza have no cattle, although in other parts of Ecuador Shuar people do (Rudel et al. 2002).

During an agro-socio-economic survey in southern Ecuador between 1994 and 1996, realised by the Centro Andino de Tecnología Rural (CATER 1996), 18 different agro-regions were recognised in the area, based on their ecological conditions, agricultural history and present production systems (Table 1-6).

An important factor in the economy of southern Ecuador is the presence of the border with Peru. Trading with Peru and cross-border smuggling has always been an important activity. During fieldtrips we saw for example gas cylinders being transported across the Catamayo river on donkeys (gas was at the time highly subsidised in Ecuador, but not in Peru). Also drug trafficking (coca pasta) was economically very important during the 1980s and 1990s in the areas of Espíndola, Cariamanga and Macará (CATER 1996) and probably still is today.

Table 1-6. Homogenous agro-regions in southern Ecuador with their respective producers and products (CATER 1996)

Agro-region	Producers	Farming products
Pasaje-Machala	shrimp farms, agrobusinesses, colonisers, *finqueros**	shrimps, bananas, cacao, cattle
Arenillas	colonisers, small landowners, few agrobusinesses	cattle , maize, coffee, fruits
Puyango-Pindal	colonisers, *minifundistas ex-arrimados*	cattle , maize, coffee, sugarcane, pineapples
Cazaderos-Paletillas	colonisers	cattle , goats, maize, onions
Centro Loja-Playas	*finqueros**, *minifundistas ex-arrimados*, few adapted *haciendas*	maize, peanuts, cattle
Macará	*finqueros**, *minifundistas ex-arrimados*, few adapted *haciendas*	rice, peanuts, maize, cattle, sugarcane (alcohol)
Catamayo	sugar business, *finqueros**, *minifundistas ex-arrimados*	sugarcane, tomatoes
Zaruma	small landowners, *finqueros*	cattle , coffee, sugarcane, alcohol, mining
Cariamanga-Amaluza	few adapted *haciendas*, *finqueros**, *minifundistas ex-arrimados*	maize, manioc, coffee, cattle, wheat
Yangana-Malacatos	few adapted *haciendas*, *minifundistas ex-arrimados*, recreational farms	sugarcane, tomato, fruits, cattle
Chilla-Uzhcurrumi	colonisers	wheat, cattle, tomatoes
Loja	adapted *haciendas*, *minifundistas ex-arrimados*	cattle for milk, sweet maize
Saraguro	traditional *minifundistas*	cattle for cheese, sweet maize, potatoes, garlic, wheat, sheep
Yacuambi	saraguro colonisers, shuar communities	cattle for cheese, sugarcane
Zamora	colonisers	wood, cattle, sugarcane
Valladolid-Zumba	colonisers	wood, naranjillas, cattle, coffee
El Pangui-Nambija	colonisers, miners, shuar communities	wood, cattle, coffee, plantain, naranjillas
Nangaritza	shuar communities, colonisers	manioc, plantain, wood, wild plants, fishing, hunting

* resulting from land reforms

1.6 Plant use in southern Ecuador

To place the use of edible plants in context, we can give a short description of how wild plants are generally used in southern Ecuador, based on personal observations. A distinction needs to be made between plants use in rural mestizo areas and plant use in Shuar communities.

Mestizo people use wild plants for a variety of items. Houses are made form adobe blocks. Timber is used for roof structures, frames, windows, doors, etc. Furniture is made from local timber. Wood is also used for making tools. Few people rely on fuelwood for cooking nowadays, but use gas, except in areas far away from roads. Medicinal plants are widely used. Many are grown in people's homegardens or can be bought at local markets.

Shuar people in Zamora-Chinchipe use plants more widely. Houses are traditionally oval shaped and made from palm trees, palm leaves (thatch), wood and plant fibres. Houses in communities along the Nangaritza river are nowadays often made from timber rather than palm trees (and rectangular), and may have zinc roofs. Houses further in the forest are still made the traditional way. Trees are used for making canoes, furniture, tools, etc. Wild plants are important for medicine and for cultural and spiritual purposes. Hallucinogenic plants play an important role in healing and other ceremonies. For fishing, palm fibres are used for constructing fishing traps and fish poisons are made from plants. For hunting guns are used. Shuar people rely on fuelwood for cooking. Plants are also used for handicrafts, dyes, etc.

There have only been limited studies on edible plants in southern Ecuador. An ethnobotanical study amongst the Saraguros mentions 24 edible species (Elleman 1990). Some references to edible non-crop plants were found in international (National Research Council 1989) and national (Estrella 1990) literature. Popenoe (1924) mentions 16 promising fruit species for southern Ecuador. Espinosa (1997) describes 11 edible species in his inventory of the Loja herbarium collections. Twenty-one species of Ericaceae and Rosaceae are mentioned as part of an inventory of small fruit germplasm resources (Ballington et al. 1991). In a floristic study of Loja, Emperaire & Friedberg (1990) describe 4 edible non-crop species. Popular publications produced by Shuar communities provide ample information on common names, preparations, mythology and beliefs related to edible plants (Anon 1977; Bianchi 1978). Botanical information, however, is confusing. All these bibliographic data were used as background information for this research on edible non-crop plant species in southern Ecuador.

1.7 Wild or non-crop foods in southern Ecuador

Because the term "wild" is too limited to describe the plants studied, it was replaced by the term "non-crop" plants, including all plants that are not domesticated crops. It was often confusing to define the term 'wild plant' or 'non-crop plants' amongst mestizos. The Spanish term '*planta silvestre'* is not always clear to people. Plants that grow in non-cultivated areas like shrubland or forest, are clearly seen as wild plants. They are called *plantas del campo* (plants from the wilderness). There is no human interference with where these plants grow. Wild plants that grow within agricultural areas, especially in homegardens, are not necessarily seen as wild plants. There is a clear distinction between crops (*cultivos*) and non-crop plants. But non-crop plants in gardens are a mixture of native and introduced, wild and managed plants. Many are described as "plants that grow spontaneously" (*plantas que nacen no más*). But this group can include, apart from wild plants, exotics like orange trees, guayava trees or pawpaw trees that may regenerate spontaneously in gardens from fallen seeds. Some exotics like *Opuntia ficus-indica, Spondias mombin, Brassica napus, Portulaca oleracea* have escaped from gardens and are now well established outside agricultural areas. Moreover, people do not readily distinguish native species from introduced species. Often the latter have been introduced so long ago, that people do not remember they were introduced, and consider them as native plants. During interviews, all possible descriptions of wild plants were used, to best define the plants we were inventorying.

Shuar people do not have this confusion as to what exactly a wild plant is. They distinguish native plants perfectly from introduced ones, and strictly wild plants (growing in the forest) from plants that receive some form of management.

1.8 Institutional context

The idea for research on uses of edible non-crop plants in southern Ecuador was initiated by the Centro Andino de Tecnología Rural (CATER) of the Universidad Nacional de Loja. CATER sought co-operation with the Department of Tropical and Subtropical Agriculture and Ethnobotany of the University of Gent, which has extensive experience in ethnobotanical research. A joint project was set up, titled "*Conocimientos y prácticas culturales sobre los recursos fitogenéticos nativos en el austro Ecuatoriano*". For CATER, this project fitted into their mission of applied research and development in agriculture, aimed at the small-scale farmers (*campesinos*) of southern Ecuador. CATER works in the whole of southern Ecuador, i.e. the provinces of Loja, El Oro and Zamora-Chinchipe. This explains why the study area was based on these political divisions. The project also coincided with a agro-socio-economic survey that was carried out by CATER in southern Ecuador, between 1994 and 1996. Research on the uses of edible non-crop plants was done by the author with the assistance of Eduardo Cueva and Omar Cabrera. Each researcher used their data for their respective personal projects. The research on plant management and plant names was not part of the above-mentioned research project and was initiated and executed entirely by the author alone.

The researchers worked closely with the Herbario LOJA of the Universidad Nacional de Loja. All plant collections resulting from this project were deposited in this herbarium, as well as in the main national Ecuadorian herbaria (QCA and QCNE).

2 Objectives and research questions

…hay una yuquilla rastrera….
…tiene raíz como camote…
…no sabemos si es de comer o no…
(Romulo Lascano, Isla Bellavista)

Wild or non-crop plants often play an important role in local livelyhoods. In farming communities, people's daily subsistence may not depend on it, but wild plants do fulfill many needs. Edible plants in particular may provide important nutritional elements, may be used as seasonal foods and often provide income, especially for marginal communities in society like women, children and poorer families (Scoones et al. 1992). Wild plants have therefore been named the hidden harvest of agriculture.

Non-crop plants may be wild, but many occur within the agricultural system. Recent work in ethnobotany and anthropology has challenged conventional distinctions between cultivated and non-cultivated, domesticated and non-domesticated plants, and what we mean by "wild". It is now clear that many of the seemingly wild plants and natural ecosystems are actually managed and have been so for a long time (Balée 1989, Gómez-Pompa 1996, Posey 1985). Plants can be managed in their natural habitat or within agroecosystems. The management of plant resources has been studied widely amongst indigenous people in the humid tropics. Less attention has been paid to non-indigenous populations, such as mestizos.

Southern Ecuador has a high ecological, agricultural and cultural diversity. Natural plant resources may be limited in certain areas due to agricultural and economical pressures. At the same time, little ethnobotanical research into useful wild plants has been carried out in the region, especially amongst mestizo farming communities. Mestizo people are often dubbed "accultured", indicating that traditional knowledge is lost or threatened by loss. This may, however, make research into mestizo knowledge more urgent. On the other hand, non-indigenous knowledge may be different from knowledge of indigenous people, but therefore not less valuable.

The aim of this study was to study non-crop edible plants in farming communities in southern Ecuador, both in terms of their use and their integration within the agro-ecosystem.

Research was conducted in two stages. The first phase was a detailed inventory of non-crop edible plants used in southern Ecuador (provinces Loja, El Oro and

Zamora-Chinchipe). The fact that many edible plants are gathered from agricultural areas, where they are managed, led to a more detailed study of their management. This second part was limited to the Andean area above 1500 m altitude, a fairly homogeneous area in terms of agricultural practices and ethnicity. Traditional small-scale agropastoral farming has been practised here for centuries by mestizo subsistence farmers.

The specific research questions that are addressed in this study are:

- Which edible non-crop plants are used in southern Ecuador and how are they used?
- How significant is the use and knowledge of edible non-crop plants in the region?
- How does the use of edible plants vary according to the ecological, agricultural and cultural (ethnic) context in the region?

- Focusing on the agropastoral mestizo population in the Andean area, how significant is the management of edible plants?
- Which particular management systems, practices and techniques do farmers apply and which edible non-crop plant species are associated with each of them?
- Why are certain plant species managed, rather than domesticated or simply gathered, and what are the criteria for their selection?

Additionally, the large number of common plant names that was recorded throughout southern Ecuador, combined with information on where they were recorded and how often they were recorded, offered a unique opportunity to analyse how indigenous and non-indigenous people in the area name plants. Meanings, structures and variations in the names of plants were analysed.

3 Methodology

…también hay el apai…. esto solo lo comen los Shuar …
… lo comen crudo, como aguacate…
Tomás, El Padmi
(on *Grias peruviana*)

Data on plant use were collected in the whole of southern Ecuador (provinces El Oro, Loja and Zamora-Chinchipe). Data on plant management were only collected in the Andean part of southern Ecuador, above 1500 m altitude (Andean southern Ecuador). The reason to limit this area is because the wide variety of ecological areas, agricultural systems and ethnic groups implies a wide range of plant management practices. Andean southern Ecuador is a fairly homogeneous area, where traditional small-scale agropastoral farming is practised by mestizo farmers.

All fieldwork was carried out between June 1994 and December 1997. By living and working for three and a half years in the area, valuable additional information on plant use and management was collected during observations and talks with many local people during travels in the region.

3.1 Plant use data

Field research

The main factor for selecting fieldwork sites to collect data on edible non-crop plants used in southern Ecuador, was to include maximum plant diversity of the region. Field sites were therefore spread over all existing ecological areas and at various altitudes. This way we to aimed to reach a complete inventory of all edible non-crop plants in the region.

Although various ecological and vegetation classifications exist for southern Ecuador (as described in chapter 1), the only one for which regional maps existed at the time, was Holdridge's life zone system (Cañadas Cruz 1983). Although not necessarily a very accurate classification, it was considered to be good enough for selecting field sites.

For each life zone at least two different field sites were selected in each province. This was not possible for some little represented life zones (bePM, bhT, bmhT) and for life zones in areas with scarce population (bmhMB, bpM). Some field sites were representative for two life zones (as plants could be recorded from quite a large area around a village).

Forty-two field sites were thus studied (Table 3-1; Map 3-1). Some field sites represent a village, whilst others represent an area with various small villages within it. Along the Alto Río Nangaritza, fieldwork was done in the Shuar communities of Shayme, San Antonio, Yayu, Mariposa and the mestizo community Nuevo Paraíso. El Padmi has a mixed Shuar-mestizo population. All other villages are mestizo communities. Each site was visited at least twice at different times of the year, in order to collect a maximum amount of flowering and/or fruiting plant specimens.

Field research combined ethnobotanical, botanical and anthropological techniques. Ethnobotanical information on edible plants was collected through semi-structured interviews (Cotton 1996) with various male and female informants, including at least one expert informant in each field site, as well as through field observations. Expert informants with a profound knowledge of plants were chosen based on recommendations by villagers. Plant use data were thus gathered during interviews with 60 expert informants and 123 non-experts. Interviews were conducted in Spanish without the need for translators. All Shuar informants were bilingual (Shuar – Spanish). People were asked about the edible non-crop plants they know and use. Information collected included common plant names; plant uses and preparations for all used plants and plant parts; places where plants are found; frequency of use; production, harvesting, cultivation and management details; and economic information (marketing). Data on the sale and economic value of wild fruits were also collected during occasional visits to local markets. Besides interviews, edible plants use information was also collected simply by talking to any person met during field trips. Hundreds of people contributed information in this way.

Botanical samples of all plants mentioned by informants were collected in each area, with the help of the expert informants. This was typically done during daylong walking trips in the area surrounding each village. The informants always chose the places where plants could be found. The walks often triggered their recognition of additional edible plants. Expert informants were paid a day's salary for assisting with collecting plants. For each specimen, altitude, geographical position and ecological and vegetation information were noted. Five duplicates were collected for each plant. As fieldwork progressed, less new plant species had to be collected. Plants were pressed in the field and dried at the end of each trip in the LOJA herbarium. On longer trips in the Amazonian region, pressed plants were kept in plastic bags with alcohol, to prevent decay due to the high humidity, until they could be dried. All plants were identified and deposited in three Ecuadorian herbaria: LOJA (Herbario Reinaldo Espinosa of the Univerdidad Nacional de Loja), QCA (herbarium of the Pontífica Universidad Católica del Ecuador) and QCNE (herbarium of the Museo Nacional de Ciencias Naturales).

Plant identification was primarily done by the author and co-researchers, using the Flora of Ecuador, Flora of Peru, Flora Neotropica and various other monographs (Flora Neotropica 1967-2001; Geesink et al., 1981; Gentry 1993; Harling & Sparre 1968-1986; Harling & Andersson 1986-2000; Mabberley 1987; Macbride 1936-1960; Ulloa Ulloa & Jørgensen 1993), and by comparing the specimens with existing collections in various herbaria. The international herbaria visited for this purpose were QCA, QCNE, K (Kew Botanic Gardens herbarium in England), AAU (herbarium of the University of Aarhus, Denmark), NY (New York Botanical Garden herbarium) and MY (herbarium of Maracay University, Venezuela). Plants that could not be identified through this process were sent to international taxonomical specialists. The following taxonomists helped with plant identifications (names are followed by the herbarium acronym indicating where the scientist works and the plant family he or she specialises in): V.M. Badillo (MY, Caricaceae), H. Balslev (AAU, Arecaceae), C.C. Berg (GB, Moraceae, Cecropiaceae), F. Borchsenius (AAU, Arecaceae), E. Cotton (QCA, Melastomataceae), T. Croat (MO, Araceae), R.E. Gereau (MO, Sapindaceae), B. Hammel (MO, Clusiaceae), H. Iltis (WIS, Capparidaceae), P.M. Jørgensen (MO, Passifloraceae), L.R. Landrum (ASU, Myrtaceae), A.J.M. Leeuwenberg (WAU, Apocynaceae), G. Lewis (K, Fabaceae), J. Luteyn (NY, Ericaceae), P.J.M. Maas, L.W. Chatrou & C.P. Repetur (Utrecht, Annonaceae), J. Miller (MO, Boraginaceae), M. Nee (NY, Solanaceae), E. NicLughadha (K, Myrtaceae), C. Ott (QCNE, Menispermaceae), W. Palacios (QCNE, various families), H. B. Pedersen (AAU, Arecaceae), T.D. Pennington (K, *Inga* spp.), K. Romoleroux (QCA, Rosaceae), D.D. Soejarto (F, Actinidiaceae), B. Ståhl (AAU, Theophrastaceae), W. Till (WU, Bromeliaceae) and J.J. Wurdack (US, Melastomataceae).

Analyses

All ethnobotanical and botanical data were entered in an MS Access database, organised by plant. Data were statistically analysed using MS Excel, XLSTAT for MS Excel, the Numerical Taxonomy and Multivariate Analysis System NTSYS-pc2.1 (Rohlf 2000) and online statistical tools (Ball 2003; Pezullo 2004).

Regional variations in plant use were analysed using similarity coefficients and clustering analysis (Rohlf 2000). A data matrix was made containing all edible plant species as rows and field sites (villages) as columns (Annex 2). Presence / absence data indicate the use (presence) or the non-use (absence) of a particular plant species in a field site. These are qualitative data. Different villages (areas) were then compared to see whether plant use between them is similar or not.

The similarity between any pair of villages (or areas) in terms of edible plant species, was calculated using the Dice coefficient.:

$$\text{Dice coefficient DI} = \frac{2a}{2a+b+c}$$

whereby a = the plant species is used in both villages 1 and 2; b = the plant species is used in village 1 but not in village 2; c = the plant species is used in village 2 but not in village 1 (Ludwig & Reynolds 1988). This coefficient does not take double negatives (absence of a species in both villages) into account.

Calculating a similarity coefficient for each pair of villages (sites), resulted in a similarity matrix. Clustering analysis aims to group villages into homogeneous groups, based on the similarities (associations) in plant use between them (Ludwig & Reynolds 1988; Urban 2004). Various methods of clustering analysis were performed on the similarity matrix to obtain the best results: unweighted pair-group method analysis (UPGMA, links a new item to the arithmetic average of a group), single linking (links a new item to the most similar item in a group), complete linking (links a new item to the most dissimilar item in a group) and neighbour unweighted joining (links a new item to the nearest neighbour, the neighbour being the average of the group) (Rohlf 2000; Urban 2004).

In order to test the goodness of fit of clustering methods, the cophenetic value matrix was calculated for all resulting tree matrices, and compared to the original dissimilarity matrix. This comparison produces a cophenetic correlation coefficient (Rohlf 2000), varying between 0 and 1, the value 1 corresponding to a perfect fit.

3.2 Plant management data

Field research

The management of edible non-crop plants was studied in the Andean part of southern Ecuador, at altitudes above 1500 m. To complement the management data already collected during fieldwork on plant uses, additional research was carried out in thirteen villages (Table 3-1; Map 3-1). These were selected through the ecological areas (lifezones) and agro-regions (Table 1-6), seven of which are found in the Andean area above 1500 m.

Plant management data were collected through semi-structured interviews with informants and through field observations. Some informants were the same as those interviewed for obtaining plant uses data. In each field site, all managed edible plants were inventoried. For each managed species information was recorded on its use, economic use, where the plant was managed (grows); and how and why the plant was managed.

Analyses

Patterns in plant management were analysed through clustering and ordination analysis, using NTSYS-pc2.1 (Rohlf 2000) and XLSTAT for MS Excel. Plant management was analysed by species and by management event. The basic data matrix contains qualitative presence/absence data (1=presence/ 0=absence), with managed plant species or events as rows and their management characteristics as columns (Annex 3). The resulting matrix contain resp. 80 plant species as rows and 20 variables as columns, and 250 events as rows and 19 variables as columns.

Clustering analysis aims to group managed plant species into homogeneous groups, based on similarities between them in terms of their characteristics. Two major types of clustering exist: hierarchical clustering, which groups plants in hierarchical groups; and non-hierarchical clustering, which pools plants together in a fixed number of groups with similar characteristics (Urban 2004).

For hierarchical clustering, three similarity matrices were calculated (containing as elements the similarity coefficients between pairs of plant species), using the simple matching coefficient, the Dice coefficient and the Phi coefficient, respectively:

$$\text{Simple matching coefficient SM} = \frac{a+b}{a+b+c+d}$$

$$\text{Dice coefficient DI} = \frac{2a}{2a+b+c}$$

$$\text{Phi coefficient PHI} = \frac{(ad-bc)}{\sqrt{(a+b)(c+d)(a+c)}}$$

whereby a = value 1 for plant 1 and 2; b = value 1 for plant 1, value 0 for plant 2; c = value 0 for plant 1, value 1 for plant 2; d=value 0 for plant 1 and 2 (Ludwig & Reynolds 1988).

Five different clustering analyses were performed on each similarity matrix to obtain the best results: unweighted pair-group method analysis (UPGMA, links a new item to the arithmetic average of a group), single linking (links a new item to the most similar item in a group), complete linking (links a new item to the most dissimilar item in a group), flexible clustering (combination of single and complete linking) and neighbour unweighted joining (links a new item to the nearest neighbour, the neighbour being the average of the group) (Rohlf 2000; Urban 2004).

In order to test the goodness of fit of these hierarchical clustering methods, the cophenetic value matrix was calculated for all resulting tree matrices, and compared to the respective original dissimilarity matrix. This comparison produces a cophenetic correlation coefficient (Ludwig & Reynolds 1988; Rohlf 2000), varying between 0 and 1, the value 1 corresponding to a perfect fit.

K-means clustering was performed as a non-hierarchical clustering. In K-means clustering, plant species are grouped around randomly chosen centres (Urban 2004). A fixed number of centres are chosen and each plant is allocated to the nearest centre. The centres are continuously repositioned according to the elements already in the group. The contribution of each characteristic to the group is also given, whereby the main characteristic contributors identify the group. K-means clustering was done with 2, 3, 4, 6, 8, 10 and 15 fixed centres, to obtain the best results.

Ordination analysis separates those units that are most dissimilar from one another, thereby trying to determine underlying patterns in the data. It projects the multivariate patterns of managed plant species onto a limited number of axes, according to their similarities, maintaining maximum variation between plant species (Ludwig & Reynolds 1988; Urban 2004). It also aims to identify characteristics that cause dissimilarities between groups of plant species. Two types of ordination analysis were used.

A principal co-ordinates analysis was performed. A principal co-ordinates analysis in two directions (according to plant species and characteristics), projects the plant species in a two-dimensional space, maintaining maximum variation between species. The main characteristics contributing to variation can then be identified from the eigenvectors. For each analysis, a similarity matrix was calculated using the simple matching coefficient, Dice coefficient and Phi coefficient. The similarity matrix was then double-centred. An eigenanalysis (calculating eigenvalues and eigenvectors) was performed on the double-centred matrix, to identify the characteristics that account for the clustering of groups of plant species. The plant species were projected in the two-dimensional space of principal co-ordinate axes, to visualise the variation (and similarity) of managed plant species.

Multidimensional scaling aims to represent all managed plant species in a two-dimensional space, whereby the Euclidean distances between points in the plot represent the relation (similarity) between the plant species (Ludwig & Reynolds 1988; Urban 2004). Multidimensional scaling starts from a similarity matrix, calculated between pairs of characteristics, for each plant species. The similarity matrix was calculated using the simple matching coefficient. Multidimensional scaling was performed with eigenvectors (resulting from a principal co-ordinates analysis) as an initial configuration for the points. The multidimensional scaling simplification process causes a certain amount of stress, which should be as small as possible (preferably < 0.15) (Rohlf 2000; Urban 2004). In the graphic presentation resulting from multidimensional scaling, the distance between any two points (plant species) indicates the real similarity or dissimilarity between the two species.

Clustering and ordination analyses were also used to analyse the variation of homegardens in southern Ecuador studied by Braem (1997). A total of twenty-six variables of plant composition and plant use were measured for each garden (Table 3-2). These were the total number of species and individual plants in a garden, the respective percentages of plants and species for each cultural status (crop, cultivated, tolerated or wild plant) and the respective percentages of plants and species for eight use categories (food, fuel, timber, shade, medicinal, ornamental, fodder and hedging). In any one garden a plant can only have one cultural status, but can have several different uses. All uses mentioned for each plant were included. The cultural status values therefore add up to 100%, whereas use values may add up to more. The data matrix of homegardens consists of 17 rows (gardens) and 26 columns (variables) (Annex 5). All data in the matrix are quantitative data.

For clustering analysis, a dissimilarity matrix was calculated (between all pairs of homegardens), using the average taxonomical distance coefficient:

$$\text{Average taxonomic distance E} = \sqrt{\sum_k \frac{1}{n}\left(x_{ki} - x_{kj}\right)^2} \quad \text{(Rohlf 2000).}$$

Then, clustering analysis was performed based on the unweighted pair-group method (UPGMA). In order to test the goodness of fit of this clustering analysis, the cophenetic value matrix was calculated for the resulting tree matrix, and compared with the original dissimilarity matrix.

Ordination analysis consisted of a principal component analysis (for quantitative data) and multidimensional scaling. For the principal component analysis the basic data matrix was first standardised in order to reduce the effects of different scales (the variables 'number of species' and 'number of plants' were converted into percentages). Then a correlation matrix was calculated, measuring the correlation between each pair of variables, using Pearson's product-moment correlation coefficient. An eigenanalysis (calculating eigenvalues and eigenvectors) was performed on this matrix in order to identify the variables that account for the clustering of groups of gardens. For non-metric multidimensional scaling, the basic data matrix was standardised and the dissimilarity matrix (between gardens) calculated using the average taxonomic distance. As initial configuration for the points, the eigenvectors resulting from the principal component analysis were used.

Table 3-1. Field sites selected for plant use (bold) and plant management (italic) research, with various characteristics and expert informant(s). Province: O=El Oro, L=Loja, Z=Zamora-Chinchipe

Selected field sites	Life zone	Province	Altitude (m)	Ethnic group
El Sauce	beT	L	600-700	mestizo, *colonos*
Mangaurco	beT	L	400	mestizo, *colonos*
Zapotillo	beT	L	250-400	mestizo
La Rusia	bePM	L	600-700	mestizo, *colonos*
Sabanilla	bmsT	L	700-800	mestizo
Tambo Negro	bmsT	L	600-1000	mestizo
Puyango	bsT	L	300-400	mestizo, *colonos*
Valle de Casanga (Playas)	bsT, bsPM	L	1000-2000	mestizo
Cariamanga (El Tablón)	bsPM	L	1600	mestizo
El Limo	bsPM	L	1000-1200	mestizo, *colonos*
Sacapo	bsPM	L	1600	mestizo
Zambi	bsPM	L	1200-1700	mestizo
Catacocha	bsMB	L	1400-2000	mestizo
Celica (Sazanamá)	bsMB	L	2200-2500	mestizo
Chuquiribamba	bsMB	L	2000-2700	mestizo
Nambacola	bsMB	L	1800	mestizo
Amaluza	bsMB, bhMB	L	1900-2500	mestizo
Orianga	bhPM	L	1200-1600	mestizo
Sozoranga	bhPM	L	1400-2200	mestizo
Huachanamá	bhMB	L	2600-3000	mestizo
Lauro Guerrero	bhMB	L	2000-2400	mestizo
Uritusinga	bhMB	L	2400-2900	mestizo
Gualel	bhMB, bmhM	L	2500-3000	mestizo
Santiago	bhMB, bmhM	L	2400-2700	mestizo
San Lucas	bhM, bmhM	L	2300-2700	mestizo
Sevillán	bhM, bSA	L	2700-3500	mestizo
Chacras	beT	O	30	*colonos*
Isla Bellavista	beT	O	5	mestizo
Arenillas	bmsT	O	50-200	*colonos*
Piedras	bsT	O	150-200	*colonos*
Salatí	bsT	O	1200-1400	mestizo
Carabota	bhT	O	500-900	*colonos*
Casacay-Ducus	bhT	O	200-300	*colonos*
Zaruma-Piñas	bhPM	O	800-1200	mestizo
Chilla	bhPM, bpM, pSA	O	2500	mestizo, *colonos*
Cerro Azul	bmhT	O	400-1000	*colonos*
Paccha-Daucay	bmhPM	O	1200-2000	*colonos*
Sambotambo	bmhPM	O	1100-1300	*colonos*
Palanda	bhPM	Z	1100-1800	*colonos*
Timbara	bhPM	Z	800-1000	*colonos*
Zumba	bhPM	Z	700-1300	*colonos*
Sabanilla	bhMB	Z	1600-2000	*colonos*
Tutupali	bhMB	Z	1300-1600	*colonos*
Alto Río Nangaritza	bmhPM	Z	800-1000	Shuar
El Padmi	bmhPM	Z	850-1000	Shuar, *colonos*
Quebrada Honda	bmhMB, bmhM	Z	1700-2000	*colonos*

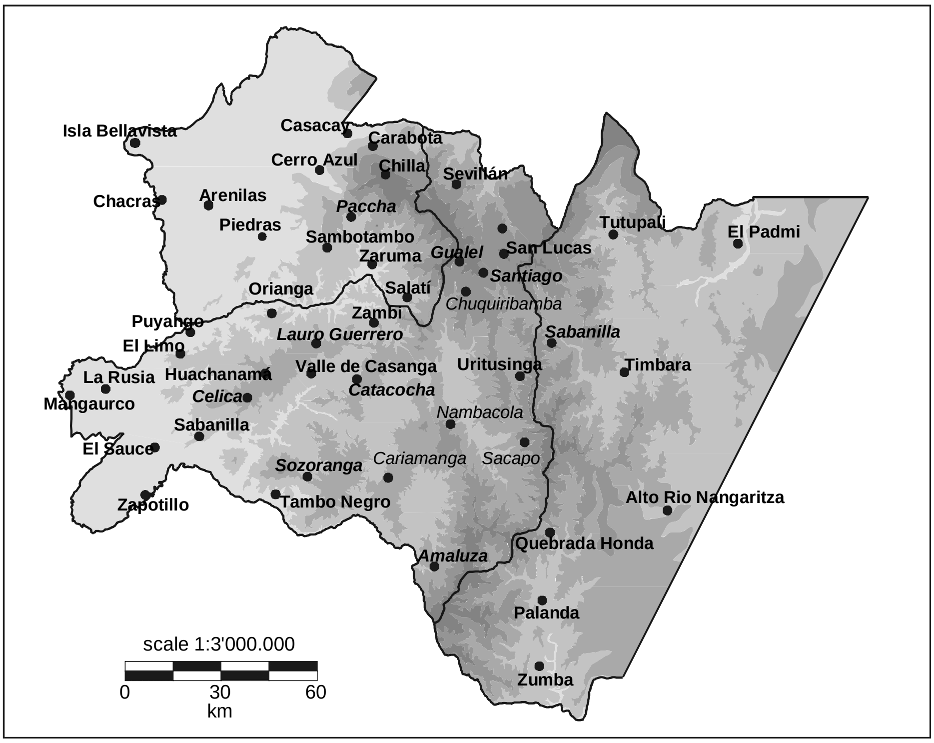
Table 3-1. Continued

Main economic activity	Expert informants
subsistence farming	Raul Barba
subsistence farming, cattle	Vidal Cordoba
subsistence farming, smuggling	Anon.
subsistence farming, cattle	Isolina Montoño
subsistence	Miguel Bera
subsistence farming, cattle	Luciano Vasquez
cattle	José Noriega
subsistence farming, cattle	Miguel Lalangui
subsistence farming, drug trafficking	Anon.
cattle, coffee	Benizario Sánchez
subsistence farming	Manuel Guamán
subsistence farming	Alfonso Maldonado
subsistence farming	Plutarco Guamán, Carmen Saritama, Umberto Jimenez, Orphelina Márquez
subsistence farming	Jarro Pascana
subsistence farming	Carmen Días, Leovina Bautista
subsistence farming	Anon.
subsistence farming, coffee, smuggling	Florecio Vaca, Juvenal Vicente
subsistence farming, cattle	Angel Idalgos
subsistence farming	Galo Hidalgo, Andrés Hidalgo, Raúl Tandaso
subsistence farming, cattle, coffee	Anon.
subsistence farming	José G, Izquierdo
subsistence farming, cattle	Anon.
subsistence farming, cattle	Nixon Tene
subsistence farming	Jova Gordillo
subsistence farming, cattle	Anon.
subsistence farming	Angel Polibio Armijos
cattle	Pedro Carillo
shrimp farming	Romulo Lascano
cattle	Pedro Carillo
cattle	Leonidas Montesinos
subsistence farming, cattle	Angel Aguilar
cattle	Juan Huanuchi
banana plantations	Anon.
gold mining	Angelita Sanchez
cattle	Luis Fajardo
cattle	Emilio Vasquez, Jacobo Pineda
cattle, coffee	Anon.
cattle	Anon.
timber logging, cattle	Sergio Jimenez, José Alberca
cattle, timber logging , gold mining	Oscar Castillo
timber logging, cattle, smuggling	Anon.
cattle	Angel Sauca
cattle	Justo Romero, Miguel Romero, José Maria Calle
subsistence farming, gathering	Antonio Tupikiá, Adam Ubigin, Lisardo Yuma, Angel Ubigin, Dominga Ubigin, Eduardo
subsistence farming, cattle, timber	Tomás, Jorge Medina, Tsukanka Joaquin
cattle	Lucho Rivera, Juan Rivera

Table 3-2. Variables used to analyse the variation in composition and use of homegardens in Loja province

Diversity variables	Cultural status variables		Plant use variables	
# species	% crop species	% crop plants	% food species	% food plants
# plants	% cultivated species	% cultivated plants	% fuel species	% fuel plants
	% tolerated species	% tolerated plants	% timber species	% timber plants
	% wild species	% wild plants	% shade species	% shade plants
			% medicinal species	% medicinal plants
			% ornamental species	% ornamental plants
			% fodder species	% fodder plants
			% hedge species	% hedge plants

Map 3-1. Map of southern Ecuador showing all field sites; villages where plant use data were collected are in bold, villages where plant management data were collected in italic (base map by CINFA)



4 Use of edible plants in southern Ecuador[2]

…la ovilla tamnbién se come ….
…es frutita roja que crece así en un baloncito espinudo…
…y de la cepa se hace un aquita…
…es buena para los asientos de las guaguas…
Eleodora Villafuertes, La Cruz Grande, Cangonamá
(on *Solanum sisymbriifolium*)

A total of 354 species of edible non-crop plants were recorded in southern Ecuador during the present ethnobotanical study. All plants are presented in Annex 1, arranged per family and in alphabetic order. This list is only based on our own fieldwork data. No data from literature were added. Listed information for each plant includes botanical and local names, edible parts, uses, preparations, economic aspects, geographical distribution and herbarium vouchers.

Non-crop plants are those plants that are not domesticated. Some are wild, others managed (see chapter 5). The same plant species is often found wild and managed in different places. Only native plants were included in the list. Some plants in the list may, however, have been introduced to Ecuador a long time ago, but were included because they have escaped and now grow as wild, adapted plants in the area (Annex 1). For some species, it is difficult to known with certainty whether they are native or not.

4.1 Knowledge of edible non-crop plants

Through field research we found that amongst mestizos, most people, adults as well as children, have a good knowledge of edible non-crop plants, albeit that this knowledge was not measured. All people we spoke to knew various edible plants.

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[2] The uses and ecology of 250 edible species are decribed in detail in the bilingual booklet "*Plantas silvestres comestibles del sur del Ecuador – Wild edible plants of southern Ecuador*" (Van den Eynden et al. 1999).

Part of the use data are published in the articles "*Wild foods from southern Ecuador*" (Van den Eynden et al. 2003) and "*Regional and ecological variations of wild edible plants in southern Ecuador*" (Van den Eynden n.d.).

New species *Carica palandensis* is published as "*Carica palandensis (Caricaceae), a New Species from Ecuador*" (Badillo, Van den Eynden & Van Damme 2000).

Most people also knew very well where to find them. Although generally people's knowledge of plant uses increases with age, that seems not to be the case for edible plants (Phillips & Gentry 1993). A study in mestizo communities in Peru showed that children already know very well which plants are edible, and that this knowledge only increases slightly with age. Which plants are edible and which ones are not seems to be learned early in life, often through trial and error.

In every village studied, however, we found some people that are locally known as 'plant' experts, with a more comprehensive knowledge about wild plants. Knowledge about plant uses in general and about edible plants in particular can vary highly amongst individual informants, irrespective of their age (Phillips & Gentry 1993). In our experience it was usually people who work the land or go hunting that had the best knowledge of wild plants. This may be men as well as women, although men tend to work the land more often. Women were found to have a better knowledge of garden plants and of plant preparations. Men gave more detailed information on technical plant uses (timber).

Lauwers (1997) measured Shuar plant knowledge during interviews that were part of this research project, and found that plant knowledge was closely linked with age. Older people had a more extended knowledge of edible plants and their uses than young people. On an individual basis, Shuar people also tend to know more edible non-crop plants than mestizo people do.

4.2 Botanical aspects

A total of 6186 plant species occur in southern Ecuador (Jørgensen & Léon-Yánez 1999). With 354 edible species recorded, this means that almost 6% of all plant species in southern Ecuador are edible. This corresponds well with a world-wide estimate of 5% of all plants (12,000 species) being edible (Lewington 1990). Ethnobotanical inventories in other regions (with diverse vegetation types) give similar percentages of edible species for the total flora: 6.6% for Tehuacán-Cuicatlán in Mexico (Casas et al. 2000); 6% for Ethiopia (Cotton 1996); 6% for the Namib desert (Van den Eynden et al. 1993) and 7.5% for the humid Mexican forests (Toledo et al. 1995).

The 354 recorded edible taxa belong to 65 families and 156 genera (Table 4-1; Fig. 4-1). Two hundred and forty four (244) species have been identified to species level, an additional 93 species to genus level and 17 species could only be identified to family level. Four species that could not be identified to family level have been omitted. The reason why species could not be fully identified, is either because no flowering or fruiting plant material could be collected (e.g. very high trees or not the right season), or through lack of literature and reference specimens for identification.

The most important plant families in terms of number of edible species in the area are Mimosaceae (10.5% of all recorded edible species), Arecaceae (8.2%), Solanaceae (7.9%), Ericaceae (6.5%), Myrtaceae (6.5%), Rosaceae (5.1%) and Passifloraceae (4.8%) (Fig. 4-1). Most of these families are known world-wide for their high percentages of food plants.

All recorded edible species of Mimosaceae, except for two, belong to the *Inga* genus. They are found almost everywhere in southern Ecuador, but an even higher number of species occurs in the coastal and Amazonian areas. Most species have an edible aril around the seeds, which is eaten as a snack. The trees are also important for their many other uses. They provide fuel, increase soil fertility by fixing nitrogen and provide good shade in traditional coffee groves, which is also confirmed in other studies (Pennington & Revelo 1997).

The recorded edible palms (Arecaceae) show a large variety of genera. The 29 species found belong to 11 genera. Three species - *Aiphanes grandis*, *A. verrucosa* and *Phytelephas aequatorialis* - are endemic to Ecuador (Jørgensen & Léon-Yánez 1999). The majority of edible palms are found in the Amazonian area, where their fruits and palm hearts form part of the diet of the Shuar people. Especially *Bactris gasipaes* (*chonta* in Spanish, *uwí* in Shuar language), which is often cultivated, is very important in Shuar culture. The fruits are an important staple food. Each year in April, the *uwí* celebration (*fiesta de la chonta*) takes place (Anon. 1977; Borgtoft et al. 1998), honouring nature's life cycle. *Chicha* made of *uwí* fruits is drunk during these celebrations. In Andean and coastal areas, palm hearts are quite popular as a food. Palms are known throughout the neotropics to be particularly useful species that provide a wide range of products (Balick 1984).

Most species of edible Solanaceae have small berries that are eaten as snacks, especially by children. *Solanum quitoense,* which has large juicy fruits, is cultivated in the Amazonian area, but wild populations grow in the Amazonian and coastal regions. Various other *Solanum* species are grown in Shuar homegardens. Some wild crop relatives also occur in the area. The wild tomato species *Lycopersicon peruvianum* and *L. pimpinellifolium* grow in the coastal lowlands. Two wild *ajís* (chilli pepper) - *Solanum* spp., a wild tree tomato - *Cyphomandra cajanumensis* (the real tree tomato *C. betacea* is an important local fruit crop), and the well-known Cape gooseberry - *Physalis peruviana,* are all native to southern Ecuador.

Ericaceae are mostly restricted to the Andean areas. The most important genera are *Cavendishia*, *Macleania* and *Vaccinium*. Their small but sweet fruits are sometimes sold on local markets. The different genera of the Myrtaceae family have their specific altitudinal distribution: *Psidium* and *Myrcia* generally grow in the lower coastal areas, *Eugenia* in the Amazonian region and *Myrcianthes* in the Andes.

Amongst the edible Rosaceae, *Rubus* is the most important genus: 14 different species grow in southern Ecuador. They all occur in the Andes, except for *R. urticifolius*, a lowland species. Other genera within this family, such as *Hesperomeles* and *Fragaria*, are all Andean.

Passifloraceae are represented with only 1 genus, but seventeen species. The Andean species *Passiflora cumbalensis*, *P. luzmarina*, *P. matthewsii*, *P. mixta* and *P. tripartita* have generally oblong fruits and trilobed leaves and are called *gullán*. The lowland species have roundish sweet fruits and are called *granadilla* or *munchi*. *P. ligularis* is widely cultivated but is often found wild or escaped.

Amongst the other plant families, some have a limited distribution in southern Ecuador, as far as their edible species are concerned. Cactaceae, Capparidaceae, Polygonaceae and Theophrastaceae are found in the dry coastal lowlands; Cecropiaceae, Lecythidaceae, Piperaceae and Zingiberaceae in the Amazonian region; Sapotaceae and Sterculiaceae in humid lowland regions; and Actinidiaceae and Theaceae in the Andes. Twenty-one families are only represented wuth one edible species (Fig. 4-1).

The plant families with the largest numbers of edible species, do not correspond with the families that are most abundant in Ecuador, which are Orchidaceae, Asteraceae, Melastomataceae, Rubiaceae and Poaceae (Table 4-2) (Jørgensen & Léon-Yánez 1999). For example, only one species of Orchidaceae, the most common family in Ecuador, was reported as edible: *Vanilla* sp., a wild vanilla species, whose pod is used as flavouring. *Taraxacum* sp., is the only edible Asteraceae species.

The families with a high number of different genera of edible plants in southern Ecuador are Arecaceae (15 genera), Ericaceae (11 genera), Solanaceae (9 genera), Cactaceae (6 genera) and Myrtaceae (6 genera) (Fig. 4-1). Some genera of edible plants show a remarkable representation in the area (Fig. 4-2). Thirty-five different species of *Inga*, 17 species of *Passiflora*, 15 species of *Solanum* and 14 species of *Rubus* were recorded. The three first genera are also highly represented in the whole of Ecuador, with respectively 75, 87 and 174 species (Jørgensen & Léon-Yánez 1999).

More than a quarter of all Ecuadorian plant species are endemic (Jørgensen & Léon-Yánez 1999). At least 14 of the recorded edible species are endemic to southern Ecuador (Table 4-2).

The majority of all edible species in the area are trees (51% or 182 species), 23% are shrubs (83 species), 14% are herbs (48 species), 2% are epiphytes (6 species) and 10% are vines (35 species). When comparing these data with the general life form ratios for Ecuador (Table 4-1), it is clear that trees are over-represented amongst the edible plants in southern Ecuador, and so are vines. Shrubs, herbs and epiphytes are under-represented.

Table 4-1. Comparison between edible plants in southern Ecuador and the entire flora of Ecuador

		Edible plants of southern Ecuador	**Flora of Ecuador** (Jørgensen & Léon-Yánez 1999)
	Number of families	65	273
	Number of genera	156	2110
	Number of species	354	16087
	Number of endemic species	14	4173
	Five main plant families	Mimosaceae Arecaceae Solanaceae Ericaceae Myrtaceae	Orchidaceae Asteraceae Melastomataceae Rubiaceae Poaceae
Life form (%)	Tree	51	23
	Shrub	23	26
	Herb	14	38
	Epiphyte	2	28
	Vine	10	6
Distribution (%)	*Costa*	39	29
	Sierra	38	64
	Oriente	38	32

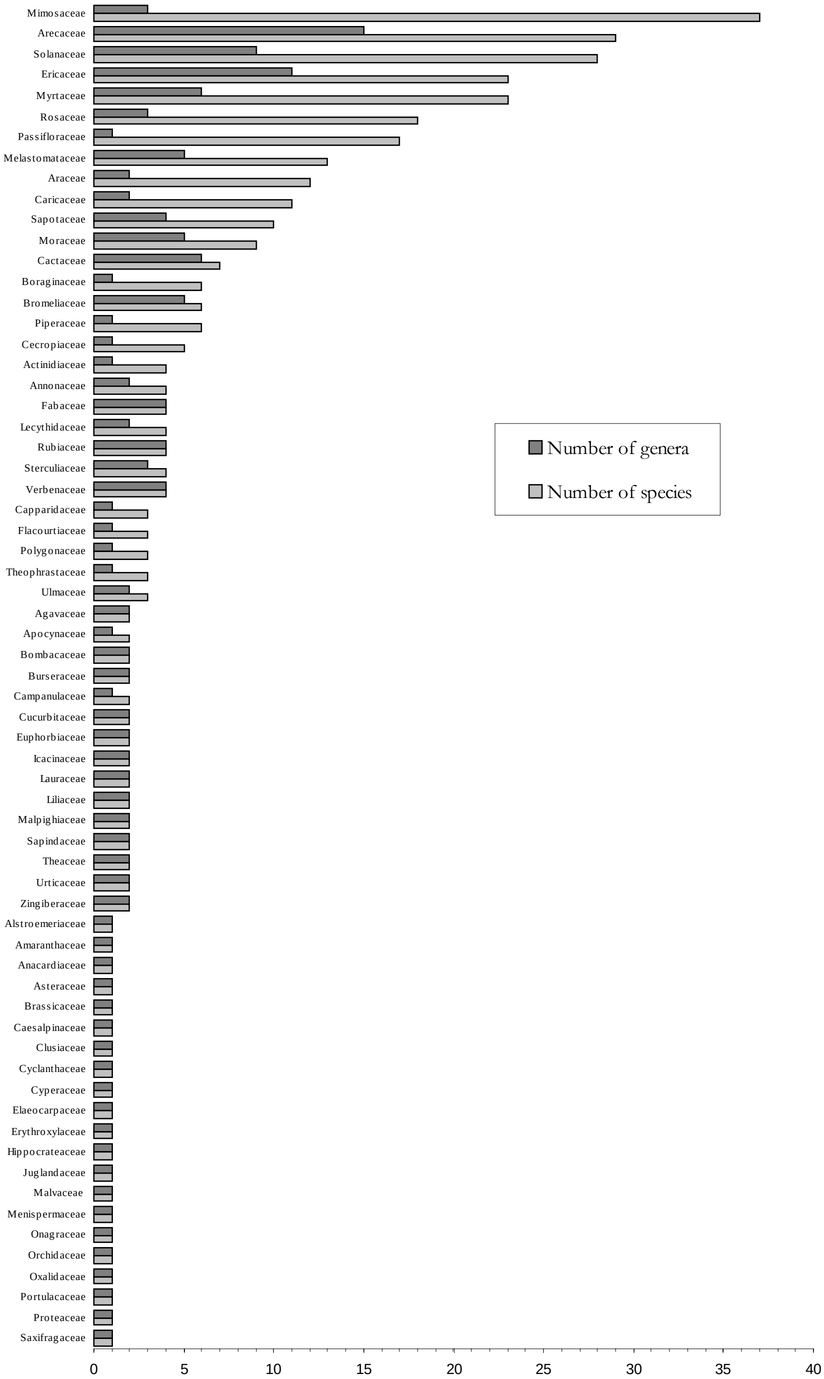


Figure 4-1. Families of edible non-crop plants in southern Ecuador, with their numbers of genera and species

Table 4-2. Edible plants endemic to southern Ecuador

Species	**Distribution area** (Van den Eynden et al. 1999)
Aiphanes grandis	humid coastal region, 1100-1700 m
Aiphanes verrucosa	humid eastern Andes, 1800-2800 m
Cavendishia nobilis var. *capitata*	humid eastern Andes, 1600-3000 m
Ceratostema sp. nov. ined.	humid western Andes, around 2800 m
Clavija pungens	dry coastal region, 50-150 m
Miconia ledifolia	humid eastern Andes, 3000-3500 m
Miconia lutescens	dry and humid Andes, 1800-2800 m
Oreanthes fragilis	dry western Andes, 1400-3300 m
Passiflora luzmarina	humid western Andes, around 2500 m
Passiflora pergrandis	humid Amazonian region, 850-950 m
Passiflora tripartita var. *azuayensis*	humid Andean region, around 2700 m
Phytelephas aequatorialis	humid coastal region, up to 1500 m
Rubus azuayensis	humid western Andes, around 2800 m
Vasconcellea palandensis	humid eastern Andes, around 1800 m

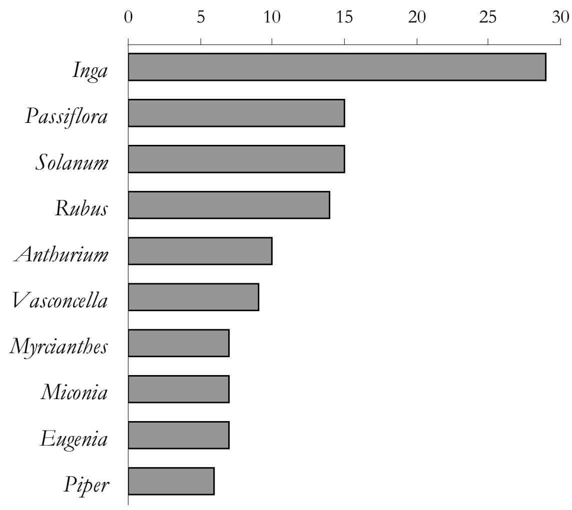


Figure 4-2. Ten main genera of edible non-crop plants in southern Ecuador, with their number of species

4.3 New species

In the course of this research, at least three plant species new to science were discovered. So far only two of them have been botanically described and the new name published. Each of them was found in a very limited area. Other edible species may be new species. Some species were recorded for the first time in Ecuador.

Vasconcellea palandensis (Badillo et al.) Badillo (Fig. 4-3 and 4-4)
(originally described as Carica palandensis Badillo, Van den Eynden & Van Damme)

TYPE: *Carica palandensis* Badillo, Van den Eynden & Van Damme. Ecuador. Prov. Zamora-Chinchipe: Palanda, barrio Agua Dulce, sector Los Cedros, 1850 m, 4º41'03"S, 79º10'16"W, 8 June 1997, *V. Van den Eynden, E. Cueva & O. Cabrera 998* (holotype QCA; isotypes QCNE, LOJA, MY).

Vasconcellea palandensis is a small dioecious tree, which grows on the eastern slopes of the Andes in Zamora-Chinchipe province, near the village Palanda, after which it was named. It is only known from this area. The plant grows at around 1800 m in remains of cloud forest, which are seriously threatened by timber logging. A female plant was first collected in December 1995. The area was revisited in June 1997, whereby more material was collected from male and female plants. The site of the December 1995 collection was by then completely cleared and the species was no longer found there. Fortunately it could still be found at 15 minutes walk further in the forest. The entire distribution area of this species is under threat of complete forest clearance.
Besides the female type collection (*V. Van den Eynden, E. Cueva & O. Cabrera 998*), a further four paratypes were collected, three of which are female (*V. Van den Eynden, E. Cueva & O. Cabrera 549; V. Van den Eynden, E. Cueva & O. Cabrera* 1000 and *V. Van den Eynden, E. Cueva & O. Cabrera* 1001) and one male (*V. Van den Eynden, E. Cueva & O. Cabrera* 999).
This species is readily distinguished from other *Vasconcellea* species by its always compound palm-shaped leaves, with 5 to 9 petiolulate leaflets. Furthermore, it is characterised by its seeds being arranged in 5 groups, with each group surrounded by pulp. When opening the large spherical orange fruit (7-8 cm diameter), the seeds fall apart in these 5 groups (cf. an orange). The sweet pulp surrounding the seeds (gelatinous arils) can be eaten. The mass of seeds and pulp is put in the mouth and sucked. The seeds are spat out. Seeds and pulp can also be mixed with water and sugar. After stirring and straining off the seeds, a juicy drink results. The plant is locally known as *papaillo* (small pawpaw) (Badillo, Van den Eynden & Van Damme 2000).

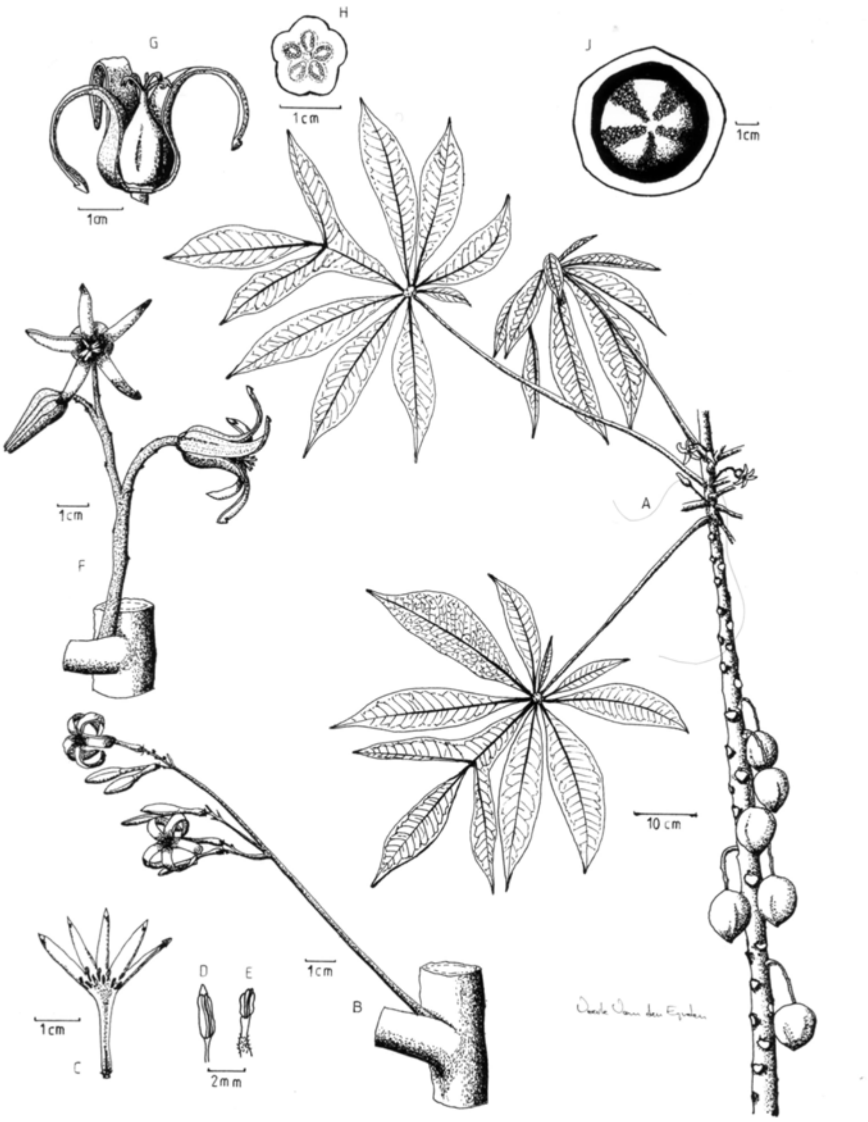


Figure 4-3. *Vasconcellea palandensis* (V. Badillo et al.) V. Badillo –A. Tree. –B. Male inflorescence. –C. Male flower, longitudinal view with perianth removed. –D. Lower stamen. –E. Upper stamen. –F. Female inflorescence. –G. Female flower, longitudinal view with perianth removed. –H. Ovary in cross-section. –J. Fruit in cross-section (from Badillo et al. 2000).

Originally this species was named *Carica palandensis* Badillo, Van den Eynden & Van Damme. The *Carica* genus was since revised by Victor Badillo and is now named *Vasconcellea* (Badillo 2000; Badillo 2001), except for *Carica papaya* L. This new species is therefore now called *Vasconcellea palandensis* (V. Badillo et al.) V. Badillo. Only 21 species of *Vasconcellea* have been described world wide so far (Badillo 2000; Badillo 2001).

Passiflora luzmarina Jørgensen (Fig. 4-5)

TYPE: *Passiflora luzmarina* P. Jørgensen. Ecuador. Prov. Loja: Cantón Loja, Uritusinga, camino a La Argentina, 200 m antes de La Argentina, cerco de potrero, 4º05'15"S, 79º15'00"W, 2450 m, 10 Nov. 1995, *E. Cueva 516* (holotype MO; isotype LOJA) (Jørgensen & MacDougal 1997).

Eduardo Cueva, who participated in the ethnobotanical inventory, first collected this species in October 1995 in the western Andean mountain range near Uritusinga village (near Loja), at an altitude of around 2500 m (*E. Cueva 510* and *516*). The plant specimen was sent to Peter Jørgensen for identification and recognised by him as a new species, which he himself had collected in 1994, but not yet described. Further collections with flowers and fruits were made in March and April 1997 in the same area (V. *Van den Eynden & E. Cueva 991*, *992*, *993* and *994*). The species was subsequently described in 1997 (Jørgensen & MacDougal 1997).
This passion fruit is a climber that grows in roadside hedges or in remnants of wild shrub vegetation. It has kidney-shaped stipules, deeply lobed trilobed toothed leaves up to 10 cm long, 2-4 glands on the top of the petiole, pink-lilac narrow tubular hanging flowers up to 8 cm long and red oblong fruits up to 7 cm long. The pulp (aril) surrounding the seeds can be eaten. The fruit is locally known as *gullán*, a name given to most *Passiflora* species with oblong fruits in southern Ecuador.

Ceratostema sp. nov. ined. (Fig. 4-6)

This species was identified by James Luteyn, a taxonomical specialist in Ericaceae, as a new species of *Ceratostema,* but still awaits description. It was collected in Chilla (3º28'18"S, 79º34'30"W) in El Oro province in February 1996 (*V. Van den Eynden & E. Cueva 630*). This area is part of the westernmost mountain range of southern Ecuador. The species grows in secondary humid montane shrubland at 2800 m altitude. It is a shrub of about 2 m tall with heart-shaped leathery hairy leaves and whitish spherical fruits of about 2 cm diameter. Flowers were not found. It is locally known as *salapa blanca grande* and has sweet edible fruits.

Figure 4-4. *Vasconcellea palandensis* (V. Badillo et al.) V. Badillo – female tree and fruit

Figure 4-5. *Passiflora luzmarina* Jørgensen

Figure 4-6. *Ceratostema* sp. nov. ined.

Figure 4-7. *Celtis* sp.

Figure 4-8. *Arthrostema ciliatum* (L.) Druce

Figure 4-9. *Vasconcellea candicans* (A.Gray) DC.

Other species that were recorded in the course of this research may well be new species, but it is sometimes difficult to confirm that. For some plant families, no taxonomical specialists could be found to identify unnamed species. Sometimes even specialists are not entirely sure whether a species is new or else lack time for a thorough review.

***Celtis* sp.** (*Van den Eynden & Cueva 273*) (Fig. 4-7), collected on the banks of the Río Casanga in Playas (4º02’00”S, 79º42’00”W), could possibly be a new species. This tree is found in the dry lowland areas of southern Ecuador and northern Peru at around 1000 m (Van den Eynden et al. 1999). It has oval, toothed leaves, curved spines on the branches and small spherical fruits of 1 cm diameter. The seeds can be eaten raw or roasted and its wood provides good timber and fuel. It is locally known as *palo blanco*.

Also ***Saurauia* sp.** (*Van den Eynden & Cueva 592 and Van den Eynden & Cueva* 990), collected in a meadow in Lauro Guerrero (3º57’50”S, 79º45’30”W), may be a new species. Locally called *ataringue*, this tree of about 8 m high grows at around 2000 m altitude in humid areas in the western Andes. It has oboval, toothed leaves, long yellow-brownish hairs on twigs, leaves and inflorescences and white-greenish gelatinous berries of 1 cm diameter. The fruits are mashed and eaten. The wood is used for fuel.

New records

Arthrostema ciliatum Ruiz & Pavón (Melastomataceae) (Fig. 4-8), *Arcyctophyllum thymifolium* (Ruiz & Pavón) Standley (Rubiaceae), *Centropogon erianthus* (L.) Druce (Campanulaceae) and *Vasconcellea candicans* (A. Gray) DC. (Caricaceae) (Fig. 4-9), were newly recorded for Ecuador during this study. They were known to exist in other countries but were not known to occur in Ecuador (Jørgensen & Léon-Yánez 1999).

4.4 Used plant parts and their preparations

Most edible non-crop plants of the area (85%) have edible fruits or fruit parts (Table 4-3; Fig. 4-10; Annex 1). For 54% of all recorded plants, the entire fruits are eaten, raw (96%) or prepared (19%). For other fruits, only very specific parts are eaten, such as the mesocarp, exocarp (peel), seed, seed coat or aril. If only the mesocarp is eaten, the fruits are peeled before consumption. *Grias* and *Gustavia* species (Lecythidaceae) have large fruits whose savoury mesocarp is eaten raw. Three wild relatives of pineapple (*Aechmea magdalenae*, *Ananas* sp. and *Bromelia plumieri*) produce small, pineapple-like fruits whose juice is consumed.

Twenty-two species have edible seeds. Some are eaten like nuts, raw or roasted, as in the case of *Cayaponia capitata*, *Caryodendon orinocense*, *Centrolobium paraense* and *Juglans neotropica*. Oil is extracted from the seeds of certain palm trees (*Attalea colenda* and *Iriartea* sp.). Other palms' seeds can be eaten raw or cooked.
All *Inga* species (Mimosaceae) have an edible aril. This is a sweet white fleshy pulp that surrounds the large individual seeds in the fruit pod. The aril is always eaten raw. The size of the aril is variable from species to species (Pennington & Revelo 1997). *Inga edulis*, *I. spectabilis* and *I. striata* are cultivated specifically for their large edible aril. Many other plant species have edible arils or swollen seed coats. *Passiflora* species have fruits with a sweet juicy swollen seed coat. The seeds are not eaten, but it is impossible to separate them from the seed coat. So usually, the mass of seeds and pulp is eaten fresh (and the seeds spat out), or a fruit juice is made by stirring or pureeing the seeds and pulp in water and sieving the liquid to remove the seeds. *Passiflora pergrandis*, *P.* cf. *pergrandis* and *P. popenovii* have relatively large fruits with particularly sweet seed coats.

Not many flowers are eaten. The flower buds of *Agave americana, Fourcroya* sp. and *Yucca* sp. are pickled like capers (see food preparations). *Arthrostema ciliatum* (Melastomataceae) and *Orthaea secundiflora* (Ericaceae) flowers are eaten fresh as snacks.

Table 4-3. Number of species with specific edible plant parts

Plant part	Detailed plant part	Number of species
Inflorescence		8
	Flower	3
	Flower bud	3
	Entire inflorescence	2
Infructescence		303
	Entire fruit	196
	Fruit mesocarp	22
	fruit exocarp (peel)	2
	seed	22
	seed coat	21
	aril	45
Vegetative parts		61
	leaf	33
	leaf bud	2
	stem	2
	palm heart	24
	plant sap	1
Underground parts		5
	root	2
	tuber	3

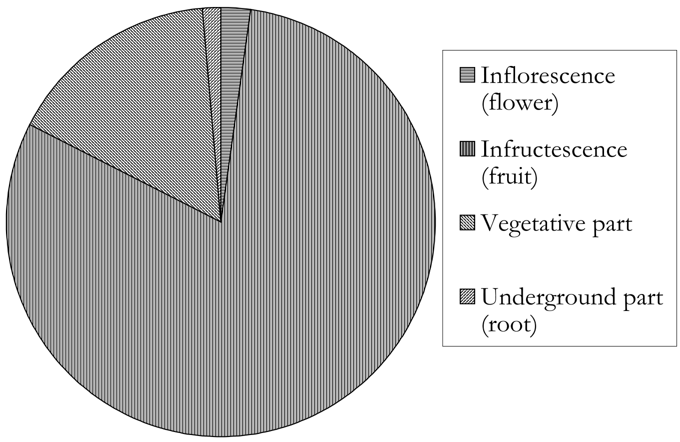


Figure 4-10. The consumed parts of edible non-crop plants in southern Ecuador

Sixty-one species have edible vegetative parts. Most species with edible leaves belong to the families Piperaceae (genus *Piper*) and Araceae (genera *Anthurium* and *Rhodospatha*). Leaves are generally cooked. The large leaves of some plants are used for wrapping food, when preparing *tamales* or *tonga* (see food preparations). The leaves of *guaviduca* (*Piper* sp.) and *ramoncillo* (Verbenaceae gen. indet.) are used as condiments. Twenty-four out of 29 palm trees found in the area have edible palm hearts. The palm heart is the group of immature leaf buds, which are found at the growth tip of the stem, surrounded by mature leaves. Palm heart can be consumed raw or cooked. The tree must be cut down to harvest its palm heart.

Only two edible roots and three edible tubers were recorded. *Oxalis latifolia*, *Bomarea* sp. and *Cyperus* sp. have relatively small roots or tubers, which are eaten raw. The large roots of *Vasconcellea parviflora* and *Anthurium* sp. (*pelma*) are only used as famine foods and need boiling.

The majority of plants are eaten raw (306 species or 86%), the others are prepared (Annex 1). Fruits may be preparaed as preserves (25), jellies (3), jams (16), juice (23), *colada* (4) and ice cream (2). Some plant's seeds, leaves, flowers or fruits are cooked (14), fried (3), roasted (9), pickled (5) or prepared in soups (11), stews (41) or *tonga* (12). Some fruits are poached (5) by simply pouring boiling water over them. A few plants are used for their aromatic properties as a condiment (6), in infusions (5) or are macerated in alcohol (6).

Local food preparations

Some specific regional food and drink preparations were recorded during this research and deserve further explanation. Local names of the described preparations are in Spanish or Shuar language. *Dulce* or *conserva* (preserve) is often made from fruits. Whole or sliced fruits are cooked in syrup made from water and *panela*. *Panela* is a brown crude cane sugar mass (usually made into rectangular blocks), that is obtained by boiling and subsequent cooling of sugarcane juice, pressed from fresh sugarcane stems. Sugar can be used in *dulce* instead of *panela*, but in southern Ecuador people generally use *panela*. At the end of the preparation the fruits can be pureed. The whole process of preparing *dulce* is referred to as '*pasar en dulce*'. *Jalea* (jelly) is prepared in a similar way, except that after boiling the fruits in water, the mixture is sieved or pureed. *Panela* is added to the liquid and further boiling thickens it into a jelly. *Nogada* is a nut preparation made from *Juglans neotropica* (nogal) nuts. *Panela*, sugar and water are boiled into a thick syrup. The syrup is removed from the fire and stirred until it thickens. Then chopped nuts are added and the mixture is poured onto a cold surface, left to cool, and cut into small squares. *Algarrobina* is a dark brown syrup made from the pods of *algarrobo* (*Prosopis juliflora*). The pods are cooked in water until soft and squeezed. The remaining liquid is boiled until it thickens into syrup. *Algarrobina* is spread on bread or drunk with milk.

As far as savoury preparations are concerned, various wild plants are used as vegetables in soups and stews. A typical preparation from the Shuar community is *tonga* (also called *yampaco* (Bianchi 1978)). A mixture of fish, meat, vegetables and/or condiments is wrapped in large leaves of *Canna edulis*, *Heliconia* spp. or *Renealmia alpinia*. The leaves are rolled up, tied together and then roasted on an open fire. Young leaves of various wild species of *Piper*, *Anthurium* and *Rhodospatha* are used in *tonga* fillings. Palm heart of any palm species are used in *fanesca*, a traditional Ecuadorian dish that is eaten on Good Friday. *Fanesca* is a stew made of various grains, beans, pulses, root vegetables, pumpkins and dried fish. The dish is garnished with shredded palm heart, hardboiled eggs, cheese, fish and *ají* (chilli pepper) (Anon., n.d.). Some flower buds, fruits or leaves are prepared as pickles (*encurtido*). They are mixed with lemon juice, onion and spices (pepper, salt, cumin) and left to stand. Flower buds of *Agave americana*, *Fourcroya* sp. and *Yucca* sp. are prepared in this way as a caper substitute (*alcaparras*). Once pickled they can be kept for months.

Various wild fruits are used to prepare drinks. *Fresco* or *jugo* (juice) is a cold drink made by mixing fruit with water and sugar. The mixture is pureed and sieved if necessary. *Colada* is a hot, thick beverage, prepared by cooking a starchy product (ground corn, barley, etc.) in water or milk, adding *panela*, spices and fruits (optional). The famous *colada morada*, which is drunk on All Souls' Day (2nd November) is made from purple or black corn, which is ground and cooked with water and *panela*. Added to this are an infusion of cinnamon, clove, sweet pepper, *hierba luisa* (*Cymbopogon citratus*) and *cedrón* (*Aloysia triphylla*). Finally the juice of *naranjilla* (*Solanum quitoense*), blackberry (*Rubus* spp.) and *mortiño* (*Vaccinium* spp.) are added, together with orange and *arrayán* (Myrtaceae species) leaves (Anon., n.d.). Fermenting a starchy product in water for several days makes *chicha*, an alcoholic drink. In the Andes it is common to use corn (purple corn for *chicha morada*), whilst in the Amazon *yuca* root (*Manihot esculenta*) or *chonta* fruits (*Bactris gasipaes*) are used. The basic ingredient is first boiled in water. Fermentation is initiated either by chewing the mash and spitting it back into the pot, or by adding *panela*.

Detailed information on preparations and uses of individual plant species can be found in Van den Eynden et al. (1999).

4.5 Importance of wild foods

Research concentrated mainly on people's knowledge of edible non-crop plants. People were asked whether they themselves use edible plants, but this was not verified through observations. No immediate distinction was made as to whether or not the person providing the knowledge really eats the plants or collects them, or just knows that they are edible.

The mestizo recorded information on edible plants does not reflect actual use. Plants are known to be edible, but many are only eaten occasionally, as snacks or are referred to as famine foods. They may be picked and eaten by children as they walk to and from school, or by adults who walk past them on their way to their fields or elsewhere. They are eaten, but people do not make special collection trips to pick them. Quantitatively, they do not contribute much to the daily diet. They may well contribute important vitamins on an ad hoc basis.

The Shuar's relation with wild foods is very different. Shuar people do use wild foods frequently as part of their diet, some of them even as staple foods (*Bactris gasipaes*, *Mauritia flexuosa*). They do make special collection trips to collected wild plant foods on a regular basis.

Most recorded plant species (214 species or 60% of all plants) are only used or known in one place. The number of plants used in more than one village decreases rapidly (Fig. 4-11). Only 140 species are known in at least 2 villages and 93 in at least 3 villages. Ten species are used in more than 10 villages throughout southern Ecuador and thus widely used throughout the region (Table 4-4). Most plants have therefore a very local importance. This is partly due to the narrow ecological range of many species and the highly varied ecology of southern Ecuador. Knowledge of edible plants that are only known in a very small area can rapidly disappear, as people in other areas may not know the species.

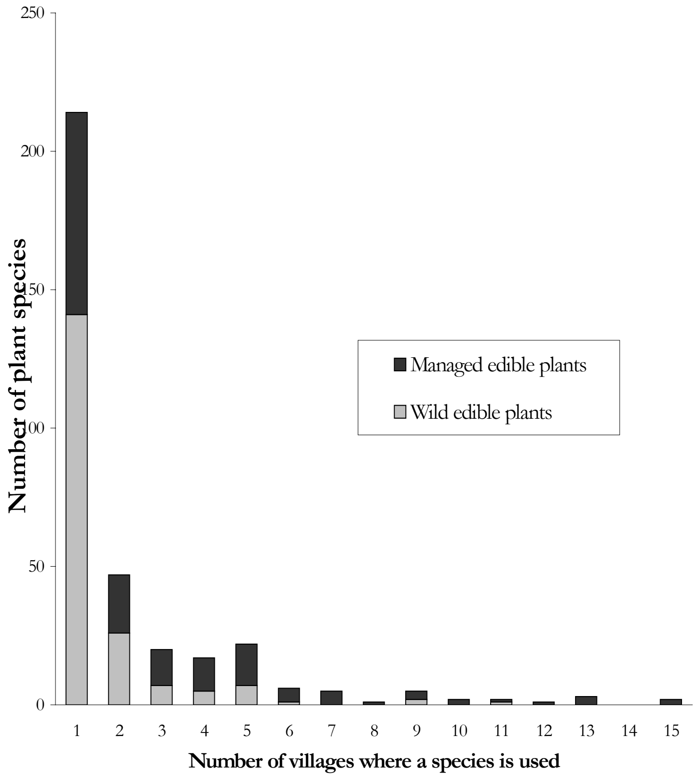


Figure 4-11. The number of times each edible plant species (of 354) was mentioned as being used over the 42 surveyed villages, with a distinction between wild and managed species

Table 4-4. Edible plant species used in at least 10 villages and thus widely used in southern Ecuador

Plant name	Number of villages
Acnistus arborescens	15
Vasconcellea x heilbornii	15
Inga oerstediana	13
Inga striata	13
Pouteria lucuma	13
Prestoea acuminata	12
Hylocereus polyrhizus	11
Myrcia fallax	11
Annona muricata	10
Rubus urticifolius	10

Often the frequency of use of a plant species depends on its abundance, wide distribution and adaptation to disturbed vegetation (Benz et al. 1994; Phillips & Gentry 1993). These factors mean that people are more likely to come in contact with the plant species and therefore to use it more. The most widely used plant species in southern Ecuador (Table 4-4), except for *Hylocereus polyrhizus,* are actually managed species (see more on this in chapter 5). When comparing the number of times a plant species is mentioned with whether the species is strictly wild or managed (Fig. 4-11), there is indeed a significant link between the two factors (χ^2=43.9; d.f.=13; p<=0.001; H_o rejected) (Annex 7). Managed edible plants are therefore more likely to be widely used throughout southern Ecuador, whilst the use of wild species is more restricted to specific areas.

Additional uses

Fourty percent of all plants (142 species) are also used for other purposes than as food plants (Annex 1; Fig. 4-12). This is especially the case for woody species. Ninety-eight species (28%) are used for fuelwood, 70 (20%) for timber and 23 (6%) as medicine. Twenty-two species (6%) are used for dyes, glues, thatch, soap, and for making crafts and artefacts. Shuar people often use palm leaves for thatching and for crafts, like *huashimas*. These are woven mats, made by tying palm leaf raches together, and are used as fishing traps. Fish stupefied by fish poison are caught downstream by vertically placed *huashimas*. Twenty species (6%) have environmental uses and are used in living hedges (14) or for shade (6). Shade trees are used in traditional coffee groves, or for cattle in pastures. Especially *Inga* species are often used for shade in coffee. Eleven species (3%) are used as animal feeds for various animals (cattle, chickens,…).

Trees like *Cordia lutea*, *Inga densiflora*, *I. oerstediana*, *I. striata*, *Prosopis juliflora*, *Pradosia montana*, *Acnistus arborescens* and *Guazuma ulmifolia* can be considered as local multipurpose trees, by virtue of having many different uses (in this case at least five). When considering all the uses for each plant (including the edibility), 212 species are only used as food plant, 74 species have one additional use, 45 two uses, 15 three uses, five four uses and three have five additional uses (Fig. 4-13).

4.6 Economic importance

Most edible non-crop plants are used for self-consumption. Very few are marketed in southern Ecuador, so the economic importance of edible non-crop plants is relatively low. Only 23 of the studied species were recorded as being sold at local or regional markets (Table 4-5). Prices of non-crop fruits are generally lower than those of cultivated fruits.

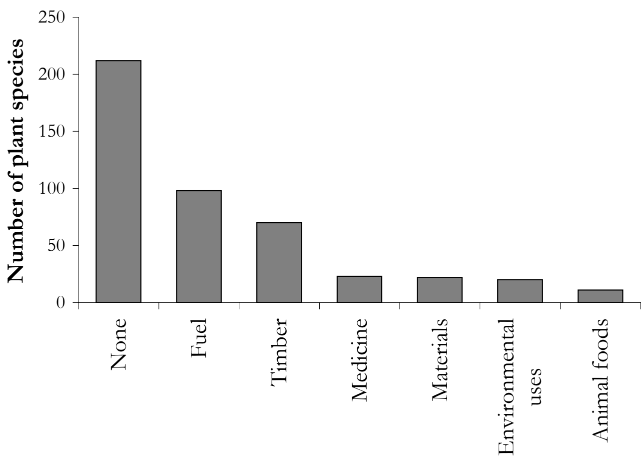


Figure 4-12. Additional uses of edible non-crop plants in southern Ecuador

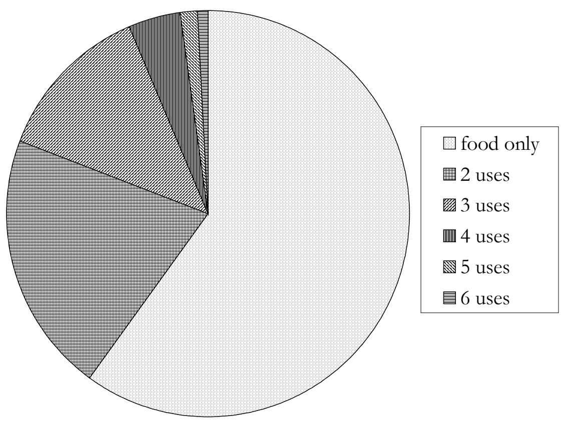


Figure 4-13. Number of edible non-crop plants with additional uses in southern Ecuador

People who collect the fruits usually sell them themselves at the market. Only fruits of *Annona cherimola* (chirimoya) are bought from farmers by middlemen. Chirimoya was bought at the time for about 4-5 US$/100 fruits, sold to retailers for 7.5 US$/100 fruits and to customers for 0.25 US$/fruit (Scheldeman, et al. 2001). Chirimoya is the only local species marketed to other Ecuadorian towns

(Verheyen pers. comm.[3]). It is cultivated in other regions of Ecuador and abroad (Scheldeman 2002).

Annona cherimola, *Annona muricata, Inga spectabilis*, *Juglans neotropica, Passiflora ligularis, Pouteria lucuma* and *Rubus floribundus* are fairly frequently sold at regional markets in cantonal capitals like Catacocha, Cariamanga, Celica, Loja and Zamora. These are all managed species, but are also frequently found as wild plants. Their fruits form their main product, except for *Juglans neotropica*, which is primarily valued for its good quality timber, and *Inga spectabilis*, which is used as a shade tree in coffee. The other species mentioned as being marketed in Table 4-5 are only sold at local village markets. None of the recorded fruits are exported.

Few edible plants are processed before being sold. *Prosopis juliflora* (*algarrobo*) pods are used to prepare *algarrobina* syrup. This syrup is sold in the dry coastal areas near Zapotilla, the area where *Prosopis* trees grow. *Juglans neotropica* (*nogal*) nuts are sold unprocessed or *nogada* made of the nuts is sold. *Rubus floribundus* (*mora*) berries are sold fresh or are sometimes used for making marmalades or ice creams, which are then sold. Flower buds of *Agave americana* (*penco, méjico*) are pickled and sold in jars. An entire *Agave americana* plant can be 'bought' for a season to extract its plant sap (*mishque*). The plant is sold by the landowner on whose land the plant grows. To harvest the sap, the growth tip is cut out of the plant just before the plant flowers, and a hole is made in the base. Plant sap collects in this hole and is harvested twice a day for about a month. The sap is drunk fresh, prepared as *colada*, fermented into an alcoholic drink, or fed to pigs to fatten them.

All other fruits and plants are sold fresh and unprocessed. The most frequently sold *guabas* are the large-podded (cultivated) species *Inga spectabilis* and *I. edulis,* but also the fruits of local managed and wild species like *I. striata, I. oerstediana* and *I. densiflora* are occasionally sold. Berries of wild *Rubus* species with compound inflorescences and large fruits like *R. loxensis, R. nubigenus* and *R. roseus* are sometimes sold, besides the commonly marketed berries of *R. floribundus*. *Opuntia ficus-indica* (*tuna*) is an introduced species that now grows wild in the drier areas. Its fruits are only rarely sold. In some areas cochineal (*cochinilla*), *Dactylopodius* insects, are grown on *Opuntia* plants for their red dye. The dried insects can be sold to local middlemen for 4.5-22 US$/kg (according to informants).

A particularly high number of marketed species (13) grows in the dry western Andes between 1500 and 2000 m elevation. Wild plant foods are commonly sold on markets in the Casanga valley, in Zambi, Catacocha, Amaluza, Celica and Lauro Guerrero. There possibly is a link between the economic importance of noncrop plants in this area and their management within the traditional agricultural systems (more on this in chapter 5).

[3] Personal comment by Imma Verheyen, Loja, October 1996.

Table 4-5. Wild foods sold at local markets in southern Ecuador, with market values for 1997 (based on interviews and market observation)

Plant	Market value (US$)
Agave americana	0.7-4.5/plant[a]
Allophylus mollis	0.4/kg
Annona cherimola	0.02-0.25/fruit
Annona muricata	0.2/fruit
Annona squamosa	-
Bactris gasipaes	-
Fragaria vesca	0.2/cup
Hesperomeles ferruginea	-
Inga densiflora	-
Inga edulis	0.01/fruit
Inga oerstediana	0.002-0.004/fruit
Inga spectabilis	0.02/fruit
Inga striata	0.002-0.004/fruit
Juglans neotropica	*nogada* 0.5/packet of 250g
Macleania rupestris	0.04-0.07/cup
Macleania salapa	0.04-0.07/cup
Opuntia ficus-indica	0.07/fruit
Passiflora ligularis	0.01-0.02/fruit
Pouteria lucuma	0.1-0.2/fruit
Prosopis juliflora	-
Rubus floribundus (and other *Rubus* spp.)	0.5-0.15/kg
Vasconcellea cundinamarcensis	0.04-0.1/fruit
Vasconcellea x *heilbornii*	0.04-0.1/fruit

[a] an *Agave americana* plant can be "bought" for a season to extract the plant sap

Hardly any non-crop fruits are sold at markets in the Amazonian part of southern Ecuador. In the Amazonian region of northern Ecuador, *Bactris gasipaes* fruits, palm heart of various palm species and fruits of *Rollinia mucosa* and *Pouteria caimito* are frequently sold (personal observation), but not so in southern Ecuador. Virtually no non-crop foods are marketed in the humid coastal region either, except in Sambotambo (El Oro province) where a private commercial and experimental *Passiflora popenovii* (granadilla de Quichos) plantation has been established and commercialisation was due to start in 1997.

Many of the here recorded economic non-crop species (and others) have been branded as 'promising' species in the past (even as early as 1924) or are already being cultivated abroad (Table 4-6). So far, however, no cultivation or commercialisation projects exist in southern Ecuador (Scheldeman 2002). Farmers often see native fruits as 'poor people's' food and therefore inferior to exotic fruits. Althoug many of the species have been managed for centuries by farmers for self-consumption, commercialisation is not considered important. Most people, when asked, say that few people would buy wild foods, because they are considered to have no value since they are available for free to everyone who wants to go and gather them. There is thus no local market demand. Exotic fruits grown locally fetch far higher prices at the markets than native fruits do. This has also been reported in other studies (Styger et al. 1999). Part of the problem is also the lack of interest of policy makers and other restraints (Van Damme & Scheldeman 1999).

Based on criteria such as farmer's interest, management, widepread use and local commercialisation (obtained from field research), plant species with potential for cultivation were identified for Loja province (Van den Eynden & Van Damme 1996).

Table 4-6. Promising and cultivated non-crop fruits of southern Ecuador

Promising Ecuadorian fruits (Popenoe 1924)	**Promising Ecuadorian fruits** (National Research Council 1989)	**Non-crop fruits of S Ecuador cultivated elsewhere** (Pennington & Revelo 1997; Scheldeman 2003; Smith et al. 1992; Vaughan & Geissler 1997)	**Promising non-crop fruits of Loja province** (Van den Eynden & Van Damme 1996)
Annona cherimola	*Annona cherimola*	*Annona cherimola*	*Annona cherimola*
Bunchosia armeniaca	*Inga* spp.	*Annona squamosa*	*Carica* x *heilbornii*
Disterigma alaternoides	*Juglans neotropica*	*Bactris gasipaes*	*Inga striata*
Fragaria vesca	*Passiflora* spp.	*Inga spectabilis*	*Allophylus mollis*
Hesperomeles obtusifolia	*Physalis peruviana*	*Inga edulis*	*Annona muricata*
Inga spp.	*Pouteria lucuma*	*Juglans neotropica*	*Myrcia fallax*
Juglans neotropica	*Rubus* spp.	*Passiflora ligularis*	*Inga oerstediana*
(Macleania popenoei)	*Solanum quitoense*	*Physalis peruviana*	*Pouteria lucuma*
Passiflora mixta	*Vaccinium floribundum*	*Vasconcellea cundinamarcensis*	
Passiflora ligularis	*Vasconcellea* spp.		
Physalis peruviana			
Prunus serotina			
Rubus floribundus			
Rubus roseus			
Vasconcellea cundinamarcensis			
Vasconcellea x *heilbornii*			

4.7 Ecological and regional variations in the use of edible plants throughout southern Ecuador[4]

Large variations in the number and species of edible plants that are used at any location throughout southern Ecuador exist. Various factors contribute to this and will be explored here. One obvious factor is the varying ecological conditions throughout the region. Different vegetation types (Map 1-3) have very different species compositions. This will be reflected in the species of edible plants used, possibly also the numbers. Factors such as ethnicity, agricultural practices and economic activities may also influence the intensity and variation of plant use, and their influence will be analysed. Non-crop plants eaten in any one area are generally the species that are found locally. Little trade or exchange of fruits occurs between different areas. The only fruits traded regionally throughout southern Ecuador are *Annona cherimola*, *Annona muricata, Inga spectabilis*, *Juglans neotropica, Passiflora ligularis, Pouteria lucuma* and *Rubus floribundus.*

Ecological variations

At the largest scale, the distribution of edible non-crop plants throughout the four major geographical regions is analysed: *costa* (coastal area between sea level and 1600 m), western *sierra* (Andes slopes between 1600 and 3800 m), eastern *sierra* (Andes slopes above 1600 m) and *oriente* (Amazonian area between 800 and 1600 m). One hundred and forty two (142) edible species or 40% of all recorded species are found in the *costa*, 115 species or 32% in the western *sierra*, 36 species or 10% in the eastern *sierra* and 131 species or 37% in the *oriente* (Fig. 4-14). The low number of species recorded for the eastern *sierra* is due to sparse population. No villages exist anywhere in the eastern *sierra* above 2000 m. There probably are many edible species here, but nobody knows or uses them.

Various species are found in more than one region (Fig. 4-14). This figure indicates how many plant species are shared between 2 or more of the four regions. For example, 23 edible species occur in both *costa* and western *sierra*; 16 edible species ocuur in both eastern and western *sierra*; 4 species occur in *costa*, western and eastern *sierra*. Only three species, *Erythrina edulis*, *Inga striata* and *Prestoea acuminata*, are panregional and thus found (and used) in all four regions.

The similarity of species found in each area can be analysed by calculating the Dice similarity coefficient. This coefficient indicates the similarity of two areas, based on the fact whether a plant species occurs in one or both areas, for every pair of areas. Non-presence of species in both areas is not taken into account in

[4] Data matrix of regional variations of recorded plant species in Annex 2.

calculating the Dice coefficient. The similarity in edible plant use between the four major regions is relatively low (Table 4-7). The western and eastern *sierra* have most similar edible species. The western *sierra* and the Amazonian area show some similarity with the coastal area in terms of edible plant use.

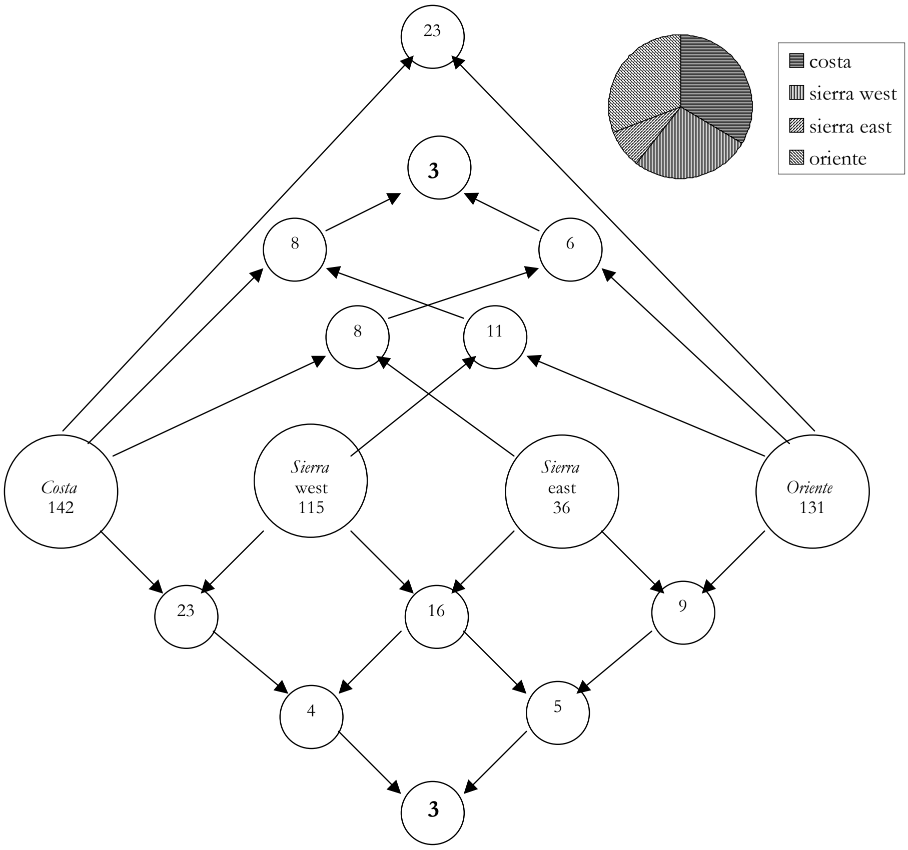


Figure 4-14. Number of edible species occurring in and shared between the four major natural regions in southern Ecuador (a circle where two arrows meet gives the number of species that the regions where the arrows start have in common)

Table 4-7. Similarity in the use of edible non-crop plants between the four major regions in southern Ecuador, indicated by Dice similarity coefficients (high values in bold)

Costa	1			
Sierra west	0.18	1		
Sierra east	0.09	**0.21**	1	
Oriente	0.17	0.09	0.11	1
	costa	*sierra west*	*sierra east*	*oriente*

To analyse the ecological variation of edible non-crop plants in more detail, the study area was divided into altitudinal zones of 500 m interval (from sealevel to above 3000 m), and in dry and humid areas. The split between dry and humid areas corresponds to a mean annual precipitation of less or more than 900-1000 mm. This gives 17 different ecological categories for southern Ecuador (Fig. 4-15). Dry areas only exist in the coastal area and in the western Andes up to about 2000 m altitude.

When considering the number of edible non-crop plant species recorded in each area, we find the highest number (104) in the Amazonian area below 1000 m. Not only is this a region where large parts of the original humid tropical forest vegetation are still intact, but also is this region inhabited by Shuar people, who use more plants compared to mestizos or *colonos*. The high number of edible plants in this area is thus a result of the large potential pool of edible plant resources, and the Shuar's extensive use and knowledge of wild plants. As the elevation increases in the Amazonian area, the number of recorded edible species decreases. This follows the general vegetation trend in Ecuador whereby species numbers decline with elevation (Jørgensen & Léon-Yánez 1999). At the same time, however, the higher areas in the Amazonian region are less populated, and no Shuar people live at higher altitudes. The decreasing use of edible plants with altitude in the Amazon results therefore from a combination of ethnic, botanical and population factors.

The area where the second highest number of edible species was recorded (66) is the dry coastal area between 1000 and 1500 m. An important difference with the previous area (lowland Amazon) is that here almost no original forest vegetation remains. This dry coastal area is intensely cultivated. This shows that the presence of high levels of natural vegetation is not necessary for wild plant use to be high in agricultural areas. In the dry areas, the number of recorded edible plants decreases both with decreasing and increasing altitudes from this elevation zone. In the humid coastal areas, the number of edible plants generally follows the same trend as in dry areas, but lower numbers were recorded. This can be due to various factors. Humid coastal areas have been colonised more recently, so people may be less familiar with wild plants in these areas. Agriculture in humid areas focuses strongly on commercial cattle husbandry and banana plantations. Such farmers may show little interest in wild plants. Also in southern Ecuador the overall humid coastal land area is smaller than the dry coastal land area.

The third highest number of edible plants (59) wss recorded in the western humid Andean area between 2500 and 3000 m. Here we again find fairly high levels of natural vegetation and the majority of edible plants used are wild.

Very low numbers of edible plants were recorded in the lower coastal wetlands (0-500 m). These areas have only recently been colonised and are largely under extensive banana plantations, so very few wild plants in general and edible ones in particular grow here. Another area with few recorded edible species is the higher eastern Andes. Here the factor explaining such low number of recorded plants, is that this region is largely uninhabited, as was discussed earlier.

When analysing the species of edible plants recorded in each elevation zone (through presence/absence data), and comparing how similar the species composition of different elevation zones is (by calculating Dice similarity coefficients for each pair of elevation zones), we find that edible plants recorded in any 500 m elevation zone show the highest similarity to the species in the elevation zone just below or above (Table 4-8). The Dice coefficient for any two adjacent zones ranges from 0.27 to 0.46. The similarity in recorded plant species of two elevation zones decreases rapidly as they are further apart in altitude. Eventually, when the elevation difference is more than 2000 m, zones have completely different edible species compositions (similarity coefficient near 0). This shows the large variability in edible non-crop plant species in southern Ecuador due to large differences in relief. Species that occur at low altitude are completely different from Andean species and vice versa.

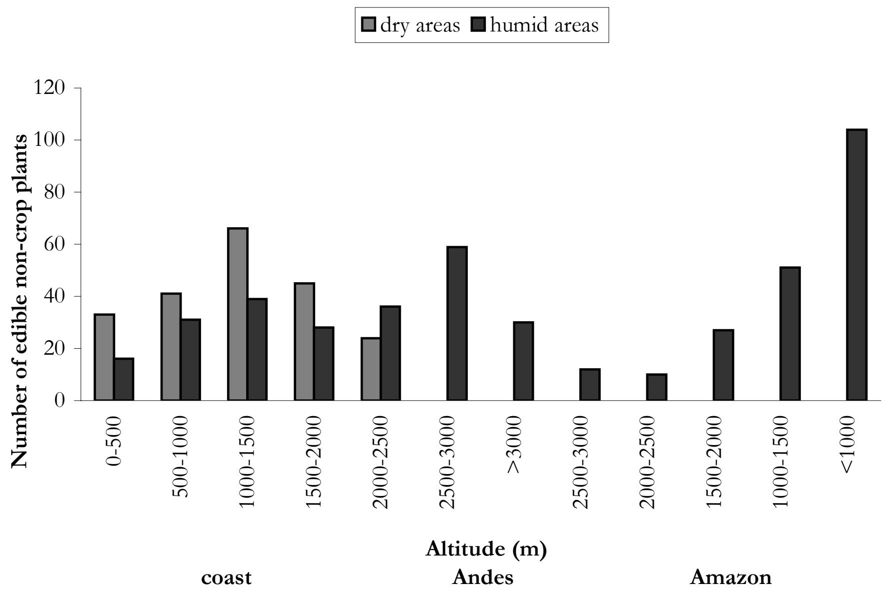
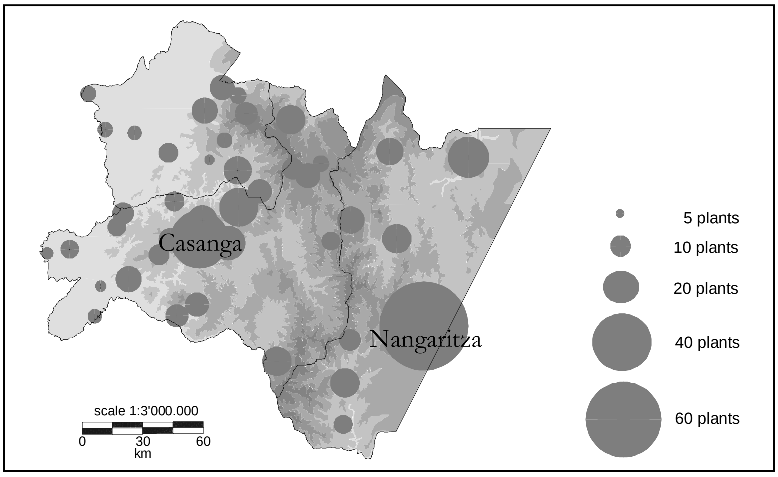


Figure 4-15. The number of edible non-crop plant species recorded in dry and humid 500 m interval elevation zones throughout southern Ecuador

Table 4-8. The similarity in edible non-crop plants recorded in 500 m elevation zones in southern Ecuador, indicated by Dice similarity coefficients (high values in bold)

0-500 m	1						
500-1000 m	**0.27**	1					
1000-1500 m	0.22	**0.42**	1				
1500-2000 m	0.15	0.23	**0.37**	1			
2000-2500 m	0.02	0.08	0.16	**0.44**	1		
2500-3000 m	0	0.03	0.05	0.20	**0.46**	1	
>3000 m	0	0.01	0.03	0.06	0.15	**0.43**	1
	0-500 m	*500-1000 m*	*1000-1500 m*	*1500-2000 m*	*2000-2500 m*	*2500-3000 m*	*>3000 m*



Map 4-1. The number of edible non-crop plants used in each surveyed field site (base map by CINFA)

Regional differences and similarities in edible plants can be studied in most detail by analysing the similarity in edible non-crop plants recorded (and used) in different villages. The 354 species of edible plants were recorded in 42 field sites (villages) (Map 3-1). The numbers of plant species recorded per village range from 5 to 82 (Map 4-1; Table 4-9), with an average of 19 ± 13 plants per village. The number of plants used per village is therefore highly variable. The highest number of plant species was recorded in the Alto Río Nangaritza area. Shuar people here use 82 different species of edible non-crop plants. The second highest number (48 species) was recorded in the Casanga valley, in the dry premontane areas of Loja province. Few edible non-crop plants were generally recorded (and used) in villages in the arid coastal areas (average of 12 ± 4 per village for villages below 1000 m). More plants are used in villages in the humid coastal area (average of 15 ± 5 per village for villages below 1000 m). This seems contradictory to the finding from the elevation zone analysis, i.e. that the total number of edible plant species recorded in humid coastal areas is lower than in dry areas (Fig. 4-16). At a village level less edible plant species were recorded in dry areas, but the coastal dry area is more extensive than the humid area (also reflected by 11 vs. 3 field sites). This makes the total number of recorded edible species for dry lowland areas higher than for humid areas.

The recorded plant species vary enormously from one village to another. The similarities and differences in edible plants between villages were analysed by calculating Dice similarity coefficient for each pair of villages, comparing presence or absence of species (double absences are not taken into account). After calculating the similarity coefficients for all pairs of villages, clustering analysis was performed on the similarity matrix, in order to find villages where similar edible non-crop plant species are used.

The unweighted pair-group method arithmetic average (UPGMA) clustering method gives a cophenetic correlation coefficient of 0.81, which means that the resulting tree plot (Fig. 4-16) is a good fit of the reality. The single link and complete link clustering methods gave a smaller cophenetic correlation (0.54 and 0.71 respectively) and thus a lesser fit of the reality. They are therefore not shown here. Fig. 4-17 shows the result tree obtained with the neighbour-joining clustering method. When comparing both tree plots (Fig. 4-16 and 4-17), clusters of villages with similar edible plant species can be identified in southern Ecuador.

Eight groups of villages where similar edible plant species are used can be distinguished (Map 4-2; Table 4-9). The villages that show the highest similarities in edible plant species are these in the arid coastal lowlands region below 1000 m. This is the westernmost strip of El Oro province and the south-western part of Loja province (group 1). Isla Bellavista, Chacras, Zapotillo, El Sauce, Mangaurco, Puyango, Sabanilla, La Rusia and Tambo Negro have all very similar edible plants. The Dice similarity coefficient between any two of these villages ranges from 0.25 to 0.67. The highest similarity occurs between villages situated at similar altitudes. The larger the difference in altitude between two sites, the less similar the edible plants are. The vegetation in the nine villages is deciduous and semi-deciduous forest or dry shrubland vegetation (Map 1-3). The edible plant species that are used in all nine villages of group 1 (and that are therefore characteristic for this group) are the cacti *Hylocereus polyrhizus* and *Monvillea diffusa*.

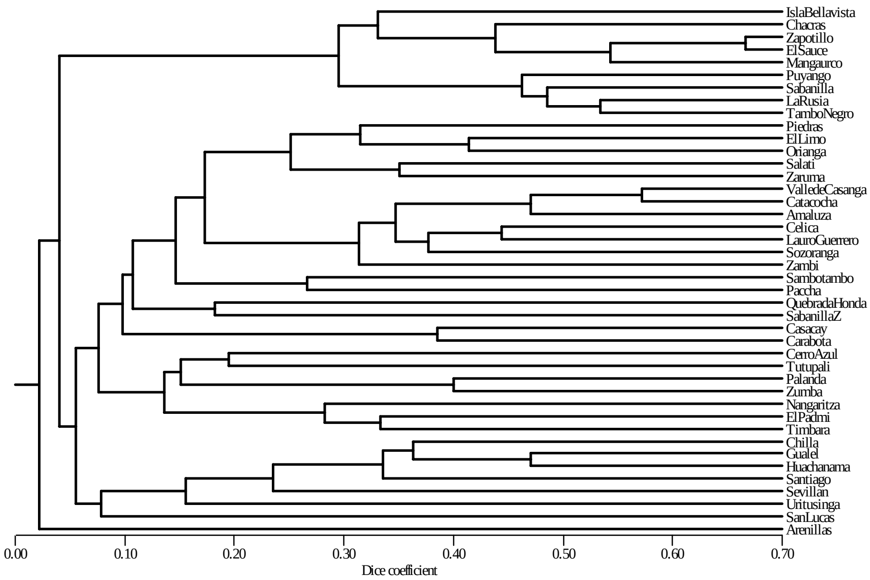


Figure 4-16. Tree plot indicating similarities between villages in terms of edible species used, based on Dice similarity coefficients and UPGMA clustering method

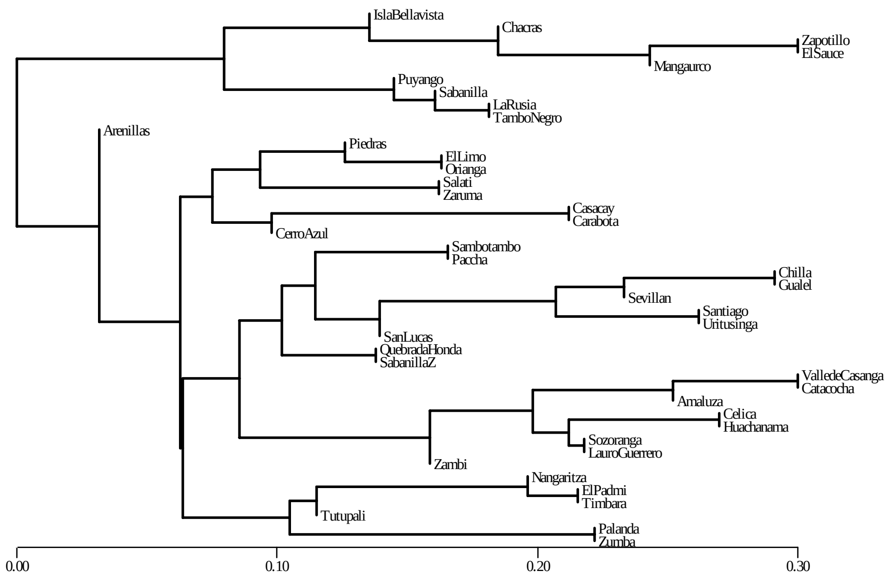
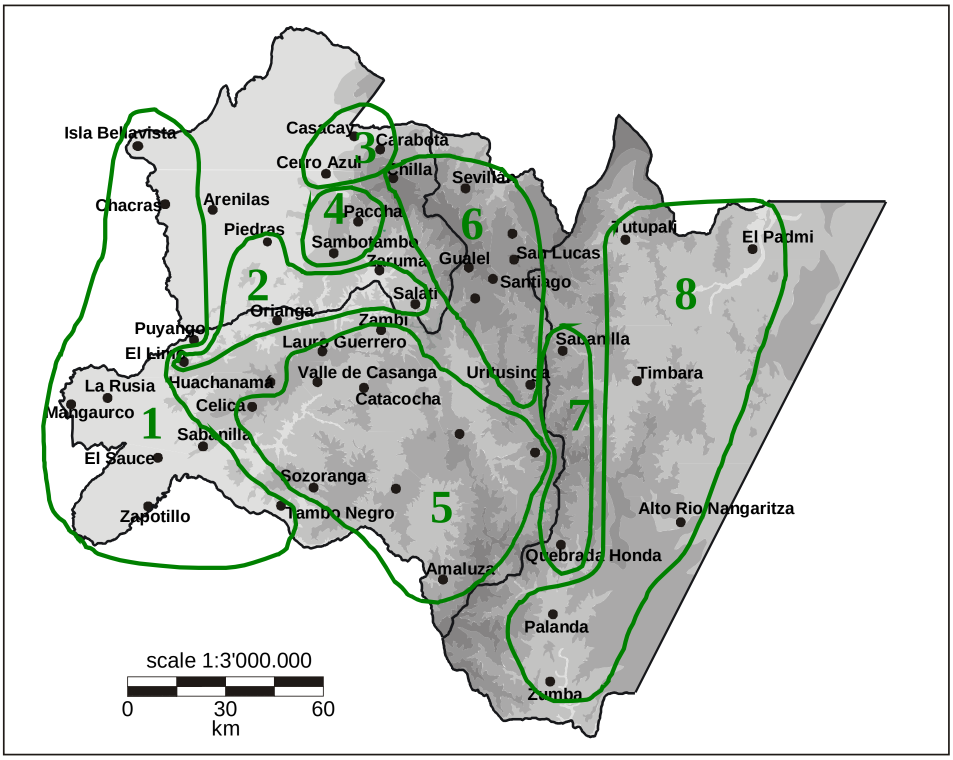


Figure 4-17. Tree plot indicating similarities between villages in terms of edible species used, based on Dice similarity coefficients and neighbour-joining clustering method



Map 4-2. Eight areas with similar edible non-crop plant species in southern Ecuador, based on Dice similarity coefficients, and UPGMA and neighbour-joining clustering analysis (base map by CINFA)

Table 4-9. Areas with similar edible non-crop plants in southern Ecuador, with their characteristic edible species

Group	Characteristic edible species
1	*Hylocereus polyrhizus, Monvillea diffusa*
2	*Acnistus arborescens*., *Bactris macana, Inga oerstediana*
3	*Vasconcellea microcarpa, Centropogon cornutus, Wettinia kalbreyeri*
4	*Vasconcellea* x *heilbornii, Prestoea acuminata*
5	*Annona cherimola*, *Allophylus mollis*, *Vasconcellea* x *heilbornii*, *Inga striata*, *Myrcia fallax*, *Pouteria lucuma*
6	*Vasconcellea* x *heilbornii*, *Hesperomeles ferruginea*, *Macleania rupestris, Passiflora matthewsii*, *Rubus floribundus, Solanum caripense.*
7	*Inga extra-nodis*, *Saurauia peruviana*
8	*Bactris gasipaes, Inga edulis, Passiflora pergrandis*, *Pouteria caimito, Rubus urticifolius.*

Of all field sites selected in the dry coastal lowlands, only Arenillas and Piedras do not belong to this first group. Arenillas has very few edible plant species similar to those of other villages in the dry areas. Its species are most similar to those of the humid area around Casacay (Dice coefficient 16%). The climate and vegetation in Arenillas seem therefore more humid than was thought. It shares even few species with Casacay. The edible plants in Arenillas are overall very different from the edible plant species used in any other location in southern Ecuador, probably explained by its particular microclimate.

A second group of villages (group 2) that share similar edible plant species, are Piedras, El Limo, Orianga, Salatí and Zaruma, situated between 1200 and 1400 m altitude (except for Piedras), in the central coastal area around the Puyango river. The climate is more humid compared to group 1 villages; the vegetation is semi-deciduous forest (Map 1-3). Plant species in Piedras are most similar to those of more humid areas like Orianga and El Limo, but are also similar to species in the lower dry areas Puyango and Tambo Negro. Characteristic edible species for group 2 are *Acnistus arborescens.*, *Bactris macana* and *Inga oerstediana.*

A third group is situated in the humid coastal lowlands below 1000 m (evergreen premontane forest vegetation; Map 1-3), in the northernmost part of El Oro province. The similarity between plant species of Casacay, Carabota and Cerro Azul is 0.17 to 0.38 (Dice coefficient), which is fairly low. Characteristic edible species are *Vasconcellea microcarpa, Centropogon cornutus* and *Wettinia kalbreyeri.*

At a slightly higher elevation (1200-1400 m), in the very humid coastal area of El Oro province and south of the previous group, lies a fourth cluster of villages with similar edible plants (group 4). This area has evergreen premontane and lower montane forest vegetation (Map 1-3). Sambotambo and Paccha have a species similarity coefficient of 0.27. Characteristic edible species for this group are *Vasconcellea* x *heilbornii* and *Prestoea acuminata.*

In the central part of Loja province, a fifth group is situated in the dry to humid western Andes between 1200 and 2500 m elevation. The Casanga valley, Catacocha and Amaluza are fairly dry areas and have the most similar edible plant species (Dice coefficient 0.46 to 0.57). Celica, Lauro Guerrero, Sozoranga and Zambi (Dice coefficient 0.25 to 0.44) have a more humid climate. Vegetation in this area includes dry shrubland, deciduous premontane forest, semi-deciduous lower montane forest and evergreen lower montane forest (Map 1-3). Characteristic edible species for this group are *Annona cherimola*, *Allophylus mollis*, *Vasconcellea* x *heilbornii*, *Inga striata*, *Myrcia fallax* and *Pouteria lucuma.* Most of these are economic species.

A sixth cluster of villages with similar plants is situated in the higher Andes, at altitudes above 2500 m (group 6). Chilla, Gualel, Huachanamá, Santiago, Sevillán, Uritusinga and San Lucas all have a cold and humid climate. The area has evergreen (lower) montane forest and montane cloud forest vegetation (Map 1-3). Plant species in Huachanamá, situated in the westernmost Andes range and separated from the remaining high areas of southern Ecuador by large interandean valleys, show high similarity with species in this cluster and with species at lower altitude sites within the western mountain range (Celica and Lauro Guerrero). Characteristic edible species for group 6 are *Vasconcellea* x *heilbornii*, *Hesperomeles ferruginea*, *Macleania rupestris, Passiflora matthewsii*, *Rubus floribundus* and *Solanum caripense*.

A seventh group of villages with similar edible plants is found in the higher parts of Zamora-Chinchipe province in the Amazonian area, between 1600 and 2000 m (montane cloud forest and montane evergreen forest vegetation; Map 1-3)). Quebrada Honda and Sabanilla have a Dice similarity coefficient of only 0.18 though. Characteristic edible species are *Inga extra-nodis* and *Saurauia peruviana*.

A last group of villages with similar edible plants is situated in the lower Amazonian region, below 1600 m (group 8). One subgroup is the southern part of Zamora-Chinchipe province. Palanda and Zumba have a 0.40 species similarity coefficient. They have evergreen lower montane forest vegetation (1-4). Timbara, El Padmi and the Río Nangaritza area form an eastern Amazonian lowland subgroup, with evergreen premontane and lower montane vegetation (Map 1-3). Plant similarities between the latter three villages ranges form 0.25 to 0.33. Both subgroups have low similarity between them, probably because they are separated by the easternmost Andean *cordillera*. Edible plant species in Tutupali are not very similar to those of any of the other Amazonian sites. Plants have a similarity of 0.22 with plants in El Padmi and Zumba and 0.20 with plants in Cerro Azul in the coastal wetlands. Characteristic edible species for group 8 are *Bactris gasipaes, Inga edulis, Passiflora pergrandis*, *Pouteria caimito* and *Rubus urticifolius*.

Summarising all analyses of regional variations, we see that edible non-crop plant species in southern Ecuador show a large variation throughout the region. This variation is largely determined by altitude and climate (dry or humid) of an area. When comparing the clusters of villages where similar edible plant species are found (Map 4-2) with the vegetation map for southern Ecuador (Map 1-3), we see that zones with similar edible plant species do not strictly follow single vegetation types, but do follow altitudinal and ecological gradients. Each of the eight zones with similar edible plant species has a dry or humid climate, is situated on one side of the Andean *cordillera* (east or west) and has a limited altitudinal range. Transitional groups 2 (around the Río Puyango watershed) and 5 (central Loja) have climates ranging from dry to humid. Major changes in species composition (as far as edible species are concerned) occur at 1000 and 1600 m in the coastal area, at 1600 m in the Amazonian area, and at 2500 m in the Andes.

The characteristic species for the central part of Loja province (group 5; Table 4-9) are mainly economic species. This area, which has a high number of edible plant species (Map 4-1; Fig. 4-15), has been cultivated for centuries by small-scale farmers. The management of native edible plants within the agricultural system may well be the key to the high number of edible species and economic species found here (see more on this in the next chapter).

The edible plant composition of some sites is more dissimilar from neighbouring sites than expected. Arenillas, Huachanamá and Tutupali do not fit into any one group of the classification. The edible plants recorded here are different from what we would expect from their ecological conditions.

Socio-economic variations

Agricultural and economic activities may well influence the use of edible non-crop plants in an area. Agricultural practices vary throughout the region (Table 1-6). In some areas, particular non-agricultural economic activities exist (Table 4-10). Gold mining is an important economic activity around Zaruma and in some Amazonian areas (Nambija). For border villages like Zapotillo, Amaluza and Zumba, cross-border smuggling was an important economic activity at the time of the study. The influence of economic activity on edible non-crop plant use can be analysed by separating villages where small-scale subsistence agriculture predominates from villages where money-oriented agriculture (monoculture, cattle farming) or other economic activities predominate (Table 4-10). On average more edible non-crop plants are used in villages where subsistence agriculture predominates (23 plants) than in villages where other economic activities are important (16 plants). When testing statistically whether this difference is significant (one-way ANOVA test or student t-test) we see that this difference is not significant ($p=0.099 > 0.05$; Annex 7). There is therefore no significant link between the number of edible non-crop plants used in a place and the main economic activities in that place.

Variation in numbers of edible plants used may also be influenced by the colonisation history. Many areas have been inhabited for centuries by mestizo people, whereas others have only been colonised during the last 50 years (indicated as *colonos* in Table 4-10). When distinguishing areas of old and recent colonisation, we can test whether in recently colonised areas plant use and knowledge is lower. In villages inhabited by *colonos*, an average of 14 edible non-crop plants is used per village, as opposed to an average of 20 plants per village in mestizo villages. A one-way ANOVA test shows that the difference between the averages of both groups is significant ($p=0.022 < 0.05$; Annex 7). There are therefore significantly more edible non-crop plants used in mestizo villages than in recently colonised villages.

Indigenous Shuar people use significantly more edible non-crop plants than mestizos (or *colonos).* In the upper Río Nangaritza area, 82 edible non-crop plants were recorded as being used. This is much more than in any mestizo village (5 to 48 species). In the El Padmi area, inhabited by Shuar and *colonos*, 32 species are used (Table 4-10). Although it can not be statistically tested whether Shuar people use more edible non-crop food plants than mestizo people, because sample sizes are too different (2 Shuar vs. 40 mestizo field sites), the figures are a strong indication that they do.

A higher use of edible non-crop plants does not exist amongst indigenous Saraguros, compared to mestizos. Elleman (1990) reported 22 edible species from her research on wild plant use amongst Saraguros. This relatively low use of wild plants may be due to the fact that Saraguros are cattle farming people, whereas Shuar are farmer-gatherers. Also, the two ethnic groups inhabitat a completely different envrionment. Saraguros live in the high Andes at an altitude of around 2500 m. Their environent is largely an agricultural landscape with very few forest remains. Shuar people on the other hand inhabit the Amazonian lowland rain forest. The number and types of available edible species in both environments are entirely different.

4.8 Shuar edible plant use

The elaborate use of edible plants by the Shuar people merits a special emphasis. Eighty-five species of edible non-crop plants were recorded to be used by the Shuar people of Zamora-Chinchipe province (Annex 8). These are combined data for plants used by various small Shuar communities along the Alto Río Nangaritza (Shayme, San Antonio, Yayu, Mariposa) and in El Padmi.

Edible plants used by the Shuar belong to 25 plant families. The majority (71%) of plants have edible fruits or fruit parts (mesocarp, aril, seed). A large proportion of them have edible leaves (18%) or palm hearts (15%). No edible roots were recorded and very few edible flowers (2%). When comparing these percentages with the percentages for mestizo people (Table 4-11), we see that Shuar use remarkably more edible leaves and palm hearts (vegetative parts) and therefore relatively less fruits, than mestizo people do.

Table 4-11. Comparison between edible plant parts used by Shuar and mestizo people in southern Ecuador (%)

Edible part	Mestizo people	Shuar people	Total populations
Fruit	90	71	85
Vegetative part	12	33	17
Flower	2	2	2
Root	2	0	1

Table 4-10. Socio-economic factors that may influence edible non-crop plant use in southern Ecuador (code 0 = primarily subsistence economy; 1 = primarily monetary economy)

Village	Main economic and agricultural activities	Code	Ethnicity and colonisation	Number of plants used
Sambotambo	cattle	1	mestizo	5
El Sauce	subsistence	0	mestizo	6
Mangaurco	subsistence, cattle	0	mestizo	7
Arenillas	cattle	1	mestizo	9
Zapotillo	smuggling, subsistence	1	mestizo	9
Carabota	cattle	1	mestizo	10
Isla Bellavista	shrimp farming	1	mestizo	10
Paccha-Daucay	cattle, coffee	1	mestizo	10
Chacras	cattle, mango	1	mestizo	11
San Lucas	subsistence, cattle	0	mestizo	12
Uritusinga	subsistence, cattle	0	mestizo	12
Celica-Sazanamá	subsistence	0	mestizo	13
La Rusia	subsistence, cattle	0	mestizo	13
Zumba	timber, cattle, smuggling	1	mestizo	13
El Limo	cattle, coffee	1	mestizo	14
Piedras	cattle	1	mestizo	14
Quebrada Honda	cattle	1	mestizo	14
Orianga	cattle, subsistence	1	mestizo	15
Puyango	cattle	1	mestizo	15
Casacay-Ducus	banana plantations	1	mestizo	16
Chilla	cattle	1	mestizo	16
Sozoranga	subsistence	0	mestizo	16
Gualel	subsistence, cattle	0	mestizo	17
Huachanamá	coffee, cattle, subsistence	0	mestizo	17
Tambo Negro	subsistence, cattle	0	mestizo	17
Cerro Azul	cattle	1	mestizo	19
Sabanilla (Zam)	cattle	1	mestizo	19
Salatí	cattle, subsistence	1	mestizo	19
Santiago	subsistence	0	mestizo	19
Sabanilla	susbsistence	0	mestizo	20
Zaruma-Piñas	gold mining	1	mestizo	21
Timbara	cattle, timber, (gold)	1	mestizo	22
Tutupali	cattle	1	mestizo	22
Amaluza	smuggling, subsistence, coffee	1	mestizo	23
Lauro Guerrero	subsistence	0	mestizo	23
Sevillán	subsistence	0	mestizo	25
Palanda	timber, cattle	1	mestizo	27
Catacocha	subsistence	0	mestizo	29
El Padmi	cattle, timber	1	Shuar, mestizo (*colonos*)	32
Zambi	subsistence	0	mestizo	32
Valle de Casanga	subsistence, cattle	0	mestizo	48
Alto Río Nangaritza	subsistence, gathering	0	Shuar	82

During two similar ethnobotanical studies with Shuar communities in Morona-Santiago province, approximately 250 km northeast of the Nangaritza area, 111 non-cultivated food plants were recorded as being used by various Shuar communities (Bennett et al. 2002) and 41 wild food plants as being used by the Shuar of Makuma and Mutints (Borgtoft et al. 1998). Eleven edible plant species were the same in all three studies (Annex 8). Thirty-five of our species were also recorded by Bennett et al. (2002), 15 by Borgtoft et al. (1998). Equally, 46 edible species recorded in Zamora-Chinchipe were not recorded in Morona-Santiago and almost 100 species recorded in Morona-Santiago were not recorded in Zamora-Chinchipe. This shows that Shuar communities living in different areas, use and know large numbers of edible wild plant resources, but the species used can be very distinct due to differing vegetation compositions.

The absolute number of wild foods used by indigenous populations is highly variable. Cotton (1996) gives as examples numbers ranging from 33 to 90 wild food species for various traditional groups. The highest number of species was recorded amongst the Waimiri Atroari in Brazil, whose subsistence system is similar to that of the Shuar (swidden agriculture with manioc as staple crop on a tropical forest environment) (Milliken et al. 1992). In Amazonian Ecuador alone, 44 species are known to be used by the Waorani (Davis & Yost 1983) and 69 by the Cofanes (Cerón 1992). The 85 species recorded by us to be used by Shuar people in southern Ecuador is therefore a relatively high number.

Non-crop food plants play an important role in the diet of Shuar people. Although crop plants cultivated in *chacras* (gardens, fields) provide the majority of food, plant gathering, fishing and hunting also provide significant contributions to the diet. Palm trees are the most important sources of wild fruits and palm heart, and are the mostly used plant family. This is the case throughout the lowland neotropics (Balick 1984). Many of the available fruit trees have other important uses, such as for construction materials, crafts and fuel. Edible plants are not marketed by Shuar people.

4.9 Where people collect edible plants

The habitats where botanical specimens were collected indicate where people generally collect edible non-crop plants. The collection sites of specimens were always chosen by the informants. Despite the fact that most field sites had been chosen in close proximity to areas of natural vegetation, only 20% of all specimens were avtually collected in natural habitats (forests, primary forests and *paramo*) and 30% in disturbed habitats. Fourty-four percent of specimens were collected within the agricultural area (homegardens, fields, hedges or pastures) and 6% were collected along roads or paths (ruderals). People's preference for collecting edible plants in manmade and disturbed habitats and near the homes, was also documented in other studies (Styher et al. 1999). This shows that many edible non-crop plants form part of the agricultural system.

The situation is, however, different in the three provinces (Table 4-12). In the Amazonian area, where forest cover is high, more than one third of all specimens were collected in natural vegetation. In the coastal and Andean areas, with scarce forest cover, one quarter of plants were collected in homegardens and half of all plants within the agricultural area. In the coastal region (El Oro) the lowest numbers of plants were collected in natural habitats

Table 4-12. Habitats where edible non-crop plants are collected

Habitat	El Oro	Loja	Zamora-Chinchipe	Southern Ecuador
Natural vegetation	12%	15%	36%	20%
Disturbed vegetation	23%	33%	25%	30%
Agricultural area	51%	46%	37%	44%
Homegarden	*28%*	*25%*	*20%*	*24%*
Pasture	*18%*	*12%*	*15%*	*14%*
Field	*2%*	*4%*	*2%*	*3%*
Hedge	*3%*	*6%*	-	*3%*
Ruderal	13%	5%	2%	6%

4.10 Conclusions

This in-depth ethnobotanical study of the use of edible non-crop plants in southern Ecuador shows that 6% of all existing plant species in the area are edible. This is comparable to percentages recorded in other countries and areas and to global figures. This therefore indicates that the inventory can be considered as representative for the existing flora and fairly complete. Research in 42 communities with 183 informants is considered to be representative for southern Ecuador, since field sites were carefully chosen to include maximum ecological, geographical, altitudinal and ethnic diversity in the region.

From a taxonomic point of view, the families Mimosaceae, Arecaceae (palm family) and Solanaceae (potato family) have most edible species. The occurrence of a high number of edible *Inga* species explains the high representation of the Mimosaceae family. The palm family is known throughout the neotropics to be a very widely used plant family (Balick 1984). The potato family is globally an important family of edible and medicinal plants. Passionfruits (*Passiflora*), *Solanum* and blackberries (*Rubus*) are abundant genera in the area. From a taxonomic point of view, the profile of edible non-crop plants of southern Ecuador follows patterns seen throughout the world.

Cotton (1996) compared the numbers, plant parts and major families of edible plants used in different traditional societies with their specific subsistence strategies. She concluded that it is very difficult to compare use of wild plant foods in a quantitative way. It seems, however, that regardless of the subsistence mode of a society (hunting-gathering or farming) and the vegetation of an area, traditional people throughout the world use large numbers of edible plants. The number and families of plants used are independent of the vegetation or the dominant subsistence strategy. Other ethnobotanists have, however, concluded that horticultural societies know (and use) more useful plants than hunter-gatherers do (Brown 1985) and that the most frequently used plant families do correspond with the floristically most abundant plant families in an area (Benz et al. 1994). My feeling is that both sides are partly right. To a certain degree it is predictable which plant families are important families of edible species in an area (as they often are throughout the world). Other families will be more regionally specific. In certain areas, the most frequent families of edible plants may correspond to the floristically most abundant families, whereas in other areas that may not be the case.

In southern Ecuador we do see a significant difference between edible plant use by mestizo peoples and use amongst native Shuar communities in the Amazonian area. Shuar people seem to have a superior knowledge of edible plants and use them more frequently, when comparing the (at least) 85 edible species used by Shuar people with the average of 17 species recorded per mestizo village (with a range of 5 to 48 species).

Two factors can explain this significant difference. First of all, Shuar people have more access to wild plants because they live in a forest environment surrounded by large numbers of wild plants. Most mestizo people live in a largely agricultural environment, where forests are scarce. This alone, however, can not explain the difference. *Colonos* living in the same area as the Shuar have a more limited plant knowledge (maximum 30 known plant species per village) than Shuar people. Also, plants are more often collected form anthropogenic habitats than from natural vegetation. So people do not necessarily rely only on wild plant species.

The main reason for the Shuar's superior use and knowledge of edible non-crop plants must therefore be culturally determined. Their subsistence activities incorporate the use of wild plants. Edible non-crop plants are actively collected by the Shuar, often on a daily basis. Gathering, hunting and fishing supplement the diet significantly, besides their main horticultural activities. Their knowledge and use of 85 different edible plant species is a relatively high number compared to the number of edible non-crop plants used by other traditional societies. The Shuar do not market edible plants, but only use them for self-consumption.

Mestizo people on the other hand generally know which plants are edible, and which ones are not, but they do not tend to use edible non-crop plants that frequently. Few mestizo people actually make special trips to collect non-crop foods. Still, they contrinbute important vitamins to people's diets, especially for children, who often eat more wild foods than adults do (Alavarez-Buylla et al. 1989; Scoones et al. 1992; Styger et al. 1999). Acculturation probably plays a role in the lower plant knowledge of mestizo people. Although no significant link exists between the level of plant knowledge and use and the dominant economic activity in a village (farming or other), there is a significant link between the level of edible plant use and the colonisation history of a village. Significantly more edible plants are known (used) in villages that have been inhabited for centuries, whereas in recently colonised areas less edible plants are known. The migration of mestizo people throughout the area therefore seems to cause a decline in traditional plant knowledge.

It is remarkable that only very few species with edible leaves or roots, compared to edible fruits, are used in southern Ecuador. The majority of plants have edible fruits and are eaten raw. Again, we find significant differences between mestizo and Shuar people. Shuar people use significantly more vegetative plant parts (leaves and palm hearts). Mestizo people use mainly edible fruits. This raises the question whether this may also be due to a relative loss of traditional plant knowledge amongst mestizo people. It is relatively easy to assess whether fruits are edible or not (through trial and error, especially when eating them raw), even if traditional knowledge regarding their use may be diminishing. Fruits are also relatively easy to collect. Knowledge and collection of edible leaves and roots, as well as plants that require preparation, could be considered more specialised. Edible roots were often mentioned as famine foods, which is indeed an important function of wild foods (Scoones et al. 1992).

The subsistence system of a society seems to have an influence on the parts of edible plants used. Hunter-gatherers use a higher proportion of seeds and roots (storage parts which provide energy), whilst agriculturalists use a higher proportion of fruits and leaves (which provide vitamins and minerals) (Cotton 1996). Shuar people, who combine hunting and gathering with agriculture, eat no wild roots, but do cultivate many native root crops in their gardens. They consume eight wild seed species, which is not a particularly high proportion of the total wild foods they use (<10%). The main edible seeds they use are *Cayaponia capitata, Caryodendron orinocense, Trophis racemosa* and *Theobroma bicolor*. However, many of the wild palm fruits and fruits of *Grias peruviana* and *Gustavia macarenensis* consumed by Shuar people are very nutritious energy-providers. Such fruits are not consumed by mestizo people.

Mestizo people not only use and know less plants than Shuar people do, but the type of plants they use seems different too: more fruits and more plant products that require no preparations.

Although no distinction was made in this study between the knowledge and actual use of edible non-crop plants, there often is a significant difference. Ladio & Lozada (2000) showed that in a Mapuche community in Patagonia, significantly less plants are gathered and consumed than are known. Only 69% of known edible species were actually consumed. The main reason for this discrepancy seems to be the travelling distance to collect edible plants. All known edible species found in anthropogenic areas near houses were consumed, but only about half of all known edible forest and steppe species (growing further away) were actually consumed. Besides the place where a plant grows, Styger et al. (1999) also found that the collection intensity of edible fruits was influenced by their taste. Good tasting fruits are collected more systematically than less tasty fruits. Melnyk (1995) also observed use and knowledge of edible plants to be differing. Although indigenous Huottuja people in Venezuela know 131 edible non-crop plant species, during a yearlong observation of daily activities only 36 species were seen to be effectively collected.

This may well be an important issue in southern Ecuador. There is no doubt the use of edible plants is much lower than people's knowledge of them, especially amongst mestizo people. The majority of edible plants recorded in southern Ecuador were found to grow in anthropogenic areas (agricultural and disturbed habitats). There may be a shift occurring, whereby knowledge of forest species has diminished significantly (together with their use), as the forests themselves disappear. Farming communities live largely in a man-made environment, use plants from within that environment and may well lose knowledge of forests and their plants altogether. Unless if forest plants are maintained within that man-made environment.

Overall, most edible non-crop plants in southern Ecuador only have a local importance. Few species are marketed or traded. The majority of plants are only known in a specific area, many were only recorded in one village. Since we believe that the inventory is sufficiently complete, this can not be due to a lack of data. It is a consequence of the high species diversity and high proportion of restricted-range species that exists in the area (Borchsenius 1997). Many species have a narrow ecological range and are therefore known in only a small area. Even these species are often used in traditional food preparations. This shows that they do form part of the local culture, even if collective cultural plant use knowledge may be declining.

Large regional variations exist in the number and species of edible plants used throughout southern Ecuador. These variations were analysed at macrolevel (coastal, Andean and Amazonian area), within altitudinal and climatic zones and at village level.

In terms of species composition, eight areas where similar edible species occur (and are used) could be identified. These do not necessarily represent areas with distinct vegetation types, but do follow general ecological gradients. Each area has a restricted geographical, altitudinal and climatological range. Certain exceptional areas were identified, like Huachanamá, Arenillas and Tutupali. The edible species growing in these localities are dissimilar from the species in any of the eight homogeneous zones. This may suggest that these areas have exceptional vegetation compositions. A more in-depth study of edible plants and the overall vegetation in these places would be recommended.

Certain areas like the Amazonian lowlands below 1000 m, the dry central part of Loja province (between 1000 and 1500 m) and the high western Andes between 2500 and 3000 m, seem hotspots with a particularly high occurrence and use of edible plants. In the Amazonian lowlands, the availability of plant resources (forest vegetation) and the habitation by Shuar people can explain the abundance of edible plant use. For the other two areas, these explanations are not valid. Little natural vegetation is found in the dry central part of Loja province and the high western Andes. The native Saraguros who do live in the Andes above 2500 m do not make more use of edible non-crop plants than mestizos do. One possible factor may be the ancient colonisation of these areas. Also, relatively many economic species are found in these two areas. Other factors must explain the particular high number of edible species found in the dry central part of Loja province and the high western Andes. This will be explored in the next chapter.

5 Plant management in Andean southern Ecuador[5]

…pechiche hay en el campo, pero más en los huertos…
…este árbol es sembrado…
…da buena madera para muebles y casas ….
…también leña… y para carbón
…se prepara los frutos en conserva….pasarlos con panela o mile…
Pedro Carillo, Chacras
(on *Vitex gigantea*)

5.1 Plant management explained

Throughout history, useful plants have been subjected to various manipulations by humans. Some have been cultivated and domesticated for centuries and become common crops. On the other end of the scale there exist wild plants that are gathered. Between these two extremes, various other plant manipulations and different levels of care or interaction exist. Useful plants can be protected, tolerated in fields, transplanted from the wild into gardens, encouraged to grow in hedges, etc., without ever becoming crops. But it sets them apart from unmanipulated, wild plants. This variety of existing plant manipulations is called plant management. It is now clear that many of the seemingly wild plants and natural landscapes are actually managed by people and have often been so for a long time (Balée 1989, Gómez-Pompa 1996, Posey 1985, Etkin 1998). Some signs of plant management date back more than 30,000 years (Etkin 1998). Everywhere where humans live, they have influenced their environment and the plants within it. In Mexico for example, an estimated 5000 to 7000 "wild" useful plant species are actually managed by local people (Caballero 1994).

People often combine various systems of plant management in their subsistence activities. Most societies are not either gatherers or agriculturalists, but combine cultivating certain plant species, with managing or gathering other plants, either within the natural environment or within the farming environment. These two environments - natural and farming - are often difficult to separate. Agriculture can be seen as one form of plant management. Many other management strategies and systems have developed alongside it (Casas el al. 1996). Different systems often co-exist alongside each other. The same plant species may be collected in the wild, and grown in gardens (Casas et al. 1996). Management is variable and depends on many factors, like the plant's utility, the intensity of its use, its growing

[5] Partly published in the article "*Traditional management of wild fruit trees by farmers in southern Ecuador*" (Van den Eynden n.d., in press).

place, its abundance and quality, and the cultural and individual interest for the plant (Walter 1996). It is different from individual to individual and also changes continuously in time (Padoch & de Jong 1987).

People have tried to classify plants according to their management status, also called a plant's cultural status. De Wet & Harlan (1975) distinguish three categories of plants, based on their ecological response to different environments: i.e. wild plants, weeds and domesticated plants. A wild plant is a plant that grows naturally outside habitats disturbed by humans. Weeds are defined as plants that grow in habitats disturbed by humans but that do not depend on humans for their reproduction and survival. This may include ruderals (plants that grow along roadsides). Domesticated plants grow in human-made habitats, depend strongly on humans for their reproduction and survival and their geno- and phenotype are usually highly altered in favour of desirable characteristics.

Bye (1993) classifies plants into six cultural categories, based on the their management level: i.e. cultivated plants, weeds, protected plants, tolerated plants, ruderals and wild plants. Cultivated plants are managed and cared for by people during their entire life cycle. Most domesticated plants are cultivated but not all cultivated plants are necessarily domesticated. Weeds are plants that grow spontaneously in man-made habitats. Protected plants are in some ways cared for by people (e.g. by eliminating competition), which increases their chance of survival. Tolerated plants develop spontaneously (without any human intervention) and are not eliminated from human habitats during weeding or land clearing. Ruderal plants grow along roadsides and paths. Wild plants grow in natural habitats without any human manipulation. Some species may belong to several of these categories simultaneously. A certain species can for example grow wild in a natural habitat and can have been transplanted to a garden occur there as a cultivated plant.

Semi-domestication is a confusing term that is used by some authors to indicate certain processes of plant management like tolerating, protecting or cultivating (Caballero 1994, Posey 1985). It is confusing, because it implies that a process of domestication is happening, which is not always the case (Alcorn 1981). It is not because a plant is managed, that it will eventually be domesticated. Even cultivation is not synonymous with the process of domestication. Domestication implies that the plant becomes dependent on human interference for its survival. There is no such path that leads from wild plants, over management practices and cultivation to domestication. But at any moment in time and in any place, different completely independent plant management processes may be happening. Agriculture is only one form of plant management and domestication is only one plant manipulation process.

Two levels of plant management can be distinguished: manipulation of individual plants and manipulation of the entire vegetation (Alcorn 1982). They obviously often occur simultaneously and produce cumulative patterns that change spontaneous vegetation into an anthropogenic one.

Casas et al. (1996) give a good classification of how individual plants may be managed, distinguishing in-situ and ex-situ management. Plants can be gathered, tolerated, enhanced or protected. These are all in-situ management practices, which can be applied to weeds or wild plants in the place where they originally grow. Gathering simply implies the picking or collecting of the desired plant or plant part. Tolerating means that a plant is allowed to stay where it grows, whilst other plants are being removed (e.g. weeding) or whilst the entire environment is altered (e.g. clearing new fields). Enhancing implies some management measures that encourage the increase of a population (e.g. through irrigation, fertilisation). Protecting means that competing plants or pests are removed. Ex-situ management happens when a plant is moved from its original place of occurrence and the management takes place in a man-made environment. This can be through sowing, planting (of shoots or cuttings) or transplanting.

At vegetation level, plant management is often strongly influenced by the existing land use or farming practices. The clearing of new fields (e.g. through slash and burn), the weeding of fields, the maintaining of certain boundaries around fields, etc. may all have an influence on how wild plants are managed. Land use systems throughout the world are widely variable, but certain universal systems can be identified that specifically favour the management of wild plants: homegardens, fields (*milpa*, *chacra*) and managed forests (Alcorn 1990).

Homegardens (also called dooryard gardens, *huertas familiares*, urban gardens or kitchen gardens) are the classic example of an agricultural system that incorporates many managed non-crop plants. They form a particularly important part of the agricultural system in most tropical areas where subsistence farming systems predominate. Fernandes & Nair (1986) define a homegarden as the "*land-use practice involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and livestock, within the compounds of an individual house, …and being intensily managed by family labour*".

Although plant composition, layout and management of gardens are enormously varied, certain aspects of tropical homegardens are surprisingly universal. Diversity indices are often comparable to those for the natural ecosystem (Gajaseni & Gajaseni 1999). They have therefore often been described as artificial forests, mimicking the natural environment. They are usually multi-storied collections of herbs, shrubs and trees, consisting generally of 3-5 vertical layers: tall emerging trees, a canopy layer, under-story layer, shrub layer and ground cover (herbaceous plants) (Fernandes & Nair 1986; Gajaseni & Gajaseni 1999).

Homegardens generally contain a mixture of minor garden crops, fruits, ornamentals, medicinal plants and other useful plants and livestock (Alcorn 1990).

Species composition is determined by species utility, environmental conditions, dietary habits and local market demands (Alcorn 1990; Fernandes & Nair 1986; Gajaseni & Gajaseni 1999). Homegardens provide for a wide variety of needs, the main ones being food and income (Alcorn 1990; Fernandes & Nair 1986; Gajaseni & Gajaseni 1999; Millat-e-Mustafa et al. 2000). Income is often provided by cash crops like coffee, but even wild plants can provide a significant amount of income (High & Shackleton 2000). Apart from their direct use, garden plants may also be managed for indirect uses like attracting wildlife, erosion control, microclimate modification and fertility (Mergen 1987). Trees typically provide fruits, timber and fuelwood (Fernandes & Nair 1986). Herbaceous plants are often carbohydrate-providing crops (cereals, tubers).

Homegardens often look chaotic and unplanned, with plants seemingly put together in no order, without any set spacing rules and with no spatial separation between trees and crops. This chaos is, however, deceptive (Skutch 1995). Because of their location near the houses, the gardens and the plants within them are usually intensily managed. A combination of cultivated, domesticated, managed and wild plants are found in gardens. Plants may be planted or sown, transplanted from the wild (or from other areas), or else they have germinated spontaneously in the garden. Even domesticated and introduced plants may regenerate spontaneously in gardens (Alvarez-Buylla Roces et al. 1989). Very few native plants are actively sown or planted (Campbell et al. 1991). Planting material for homegardens may be sourced from the gardens itself, from friends and relatives, markets, government nurseries or from the wild (Millat-e-Mustafa et al. 2000). Useless plants and weeds may be removed. Trees may be pruned or selectively thinned to open up the canopy structure and allow light to the lower layers. The garden may be fertilised and pests controled (Alavarez-Buylla Roces et al. 1989; Fernandes et al. 1984.).

Plant management is not necessarily limited to the agricultural or anthropogenic area. Posey (1984) was the first researcher to document in detail forest management by the Kayapó in the Brazilian Amazon. The Kayapó practise so-called slash and burn agriculture, but also intensively manage both primary and secondary forest in many ways. They create forest fields by transplanting useful plants to certain forest areas in the forest, plant useful species along trails and in natural forest openings. Old fields are not simply abandoned and fallowed, but continue to be managed and used (albeit not actively cultivated). Non-crop plants are introduced to old fields Managed fallows remain important sources of medicinal plants and are used as hunting grounds (as fruiting plants attract game).

The management of non-crop plant resources has been studied widely amongst indigenous people in the humid tropics. Less attention has been paid to non-indigenous populations, such as mestizos or immigrants. One study amongst non-indigenous communities in Amazonian Peru shows that they manage a large variety of wild plants within their homegardens and that many of their management practices are similar to indigenous practices in the area. This shows that common beliefs that acculturation may lead to loss of traditional plant knowledge and interest is often unfounded (Padoch et al. 1985, Padoch & de Jong 1991).

Both woody and non-woody plants can be subject to plant management. Certain life forms are more favoured in certain systems. Farmers may leave (tolerate) trees and certain shrubs in fields but usually not herbs (Campbell et al. 1991; Fujisaka et al. 2000; Lykke 2000). Only low frequencies of useful trees are found in fields, in comparison with their frequencies in natural forests (Fujisaka et al. 1999). Often development policies in the past encouraged farmers to remove trees and non-crop plants from arable land (Campbell et al. 1991), whereas now many agencies try to re-introduce agroforestry practices. The management of trees is often more visable in the landscape, especially in the case of trees that are tolerated in pastures, fields or living hedges (they stick out from the crops). Traditional management of trees can be seen as a form of indigenous agroforestry. Native and exotic trees are typically managed in orchards and native species plantations like coffee, cacao and rubber groves (Alcorn 1990).

Two main tree management strategies were observed by Campbell et al. (1991) in Zimbabwe. Exotic trees (often fruit trees) are planted around homes and in gardens, whilst indigenous trees are conserved (tolerated) in fields and grazing areas. In Vanuatu, tree management varying from gathering of useful products to planting was observed (Walter 1996). The way a particular tree species is managed depends on its utility, place where it grows, intensity of its use, fruit quality and abundance, and cultural and individual interests regarding the tree. The most minimal form of management is protecting the tree. If a tree is considered to grow in the right place, it is protected. Additionally, weeds can be cleared from around the tree. Staple food trees are often transplanted and regrouped near villages. Also fast-growing trees are preferred for transplanting. Trees are selected for their quality when transplanting. Trees whose fruits are only occasionally used, are usually left in their natural environment (Walter 1996).

Herbaceous plants are also often managed. A relatively high proportion of native medicinal plants are weeds that are collected in fields and disturbed areas, rather than in areas of primary vegetation (Stepp & Moerman 2001). Easy accessibility of weeds is one possible explanation of their extensive medical use, but also active management of the plants concerned may play a role. Weeds in fields are often used for food (Scoones et al. 1992). In Mexico, weeds are allowed to grow in maize fields once the maize is large enough to outcompete the weeds and are commonly used for food (quelites), medicine, ornamentals and forage (Vieyra-Odilon & Vibrans 2001).

Casas et al. (1996) observed that woody and perennial plants in Mexico are managed differently from annual plants. Annual edible plants are usually gathered without a preference for specific individual plants. When gathering fruits of perennial plants, the best individuals are selected. Woody wild plants are also often actively sown or planted in homegardens, whereas wild annual plants are not.

The reasons why wild plants are managed are variable. In fields, indigenous trees are mainly managed for their fruits (Lykke 2000) and for shade. They may also be managed because of their social value (e.g. meeting place), medicinal or spiritual value, their use as fodder, their beneficial influence on soil fertility (e.g. N_2-fixation) or because it is difficult to remove them. Shrubs can be managed (tolerated) in fields for firewood, for fruit or to provide ashes after burning fallow vegetation (Campbell et al. 1991). In pastures, trees may be managed for timber, fuel, shade, fruit, fodder or for increasing soil fertility. They typically provide less than 10% vegetation cover in pastures (Alcorn 1990; Campbell et al. 1991; Harvey & Haber 1999). Wild plants may be managed in homegardens for a variety of reasons, as described before.

Management techniques or cultural operations applied to wild plants within the agricultural area, are weeding, thinning (e.g. for fuel), pruning and fertilisation (Millat-e-Mustafa et al. 2000).

5.2 Plant management of edible species in Andean southern Ecuador

A good first indication of the importance that the agricultural area in Andean southern Ecuador has for providing edible non-crop plants, can be deducted from the collection sites of the 846 collected specimens (Table 4-12). When analysing the collection sites, we notice that nearly one quarter of all plant specimens was collected in homegardens and a total of 44% in agricultural areas, i.e. pastures, fields, hedges and gardens. Another 36% of specimens was collected in disturbed vegetation such as secondary forest, small forest remnants within the agro-ecosystem (often in valleys along streams), shrubland areas and along roads, paths and tracks. Only 20% of all plant specimens was collected in natural habitats like forests, riverine forests or paramo vegetation (Fig. 5-1). When limiting these data to the 377 plant specimens that were collected in the Andean area, then 46% were collected in agricultural areas, mainly in pastures and homegardens. Fourty percent were collected in secondary forest or shrubland and only 14% in natural habtitats (Fig 5-1).

People therefore show a preference for collecting the edible plants they use near their villages, either within the agricultural area or in disturbed forests. People rely only very little on natural habitats (forests) to collect wild plants. Similar results were obtained by other researchers. Styger et al. (1999) reported that in

Madagascar native fruit trees are more intensely collected nearer the homes, in gardens, fields, fallows and secondary vegetation. In the humid tropics in Mexico (inhabited by 23 different ethnic groups), 21% of 1330 recorded useful plants are found in the agricultural areas (this includes domesticated crops), 22% in primary forest, 45% in secondary forest and 12% in both forest types (Toledo et al. 1995). This contradicts the widely held belief that pristine forests are important repositories of plants useful to humanity. Primary forests were shown to be the main source of wood for construction and fuel, whereas secondary forests are the main source for medicinal plants. Both primary and secondary forests are equally important sources of food plants (Toledo et al. 1995).

During the present study of plant management in Andean southern Ecuador, the focus was on the management of individual plants within the agricultural area, not the management of the entire vegetation. Management categories used were those recognised by Casas et al. (1996): toleration, enhancement, protection, sowing, planting and transplanting.

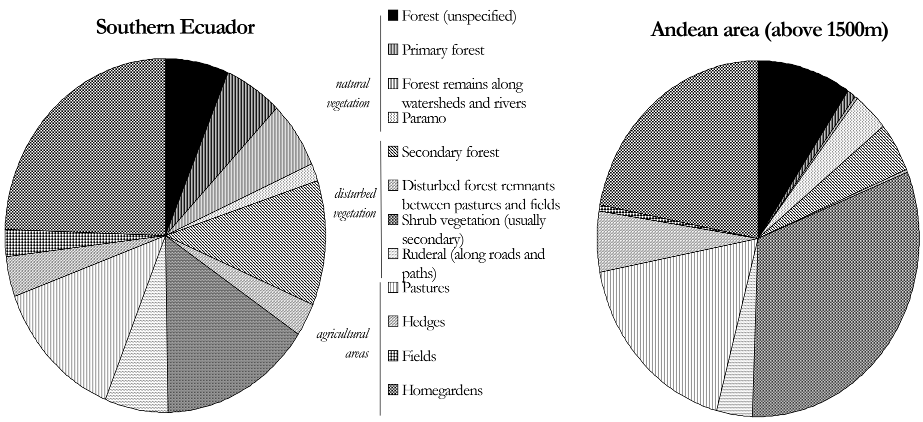


Figure 5-1. Vegetation of the sites where edible plant specimens were collected in southern Ecuador and in the Andean area above 1500 m (vegetation categories based on field observations)

Of the 354 species of edible non-crop plants recorded in southern Ecuador, 156 were found above 1500 m. Of these, 80 species (or 51%) receive some form of management (Annex 3). Where, how and why these 80 edible non-crop species are managed will be discussed hereafter. It is important to remember that all these 80 plants yield edible fruits (or other plant parts), but that may not be the main reason why they are managed. It may be that a plant is primarily managed for providing shade or for fuelwood, and that edible fruits are only a secondary use.

Also, the information considered here is the collective information provided by numerous informants. It needs to be stressed that where, why and how plants are managed are often very individual decisions. The information provided here intends to show general patterns for Andean southern Ecuador, not for individual farmers.

5.3 Characterisation of managed edible plants in the area[6]

Of the 156 edible non-crop plant species that were recorded in Andean southern Ecuador, 62 are trees, 52 shrubs, 15 herbs, 25 vines and 2 are epiphytes (Fig. 5-2; Table 5-1). The majority of managed plants are trees: 46 of the 80 species. This means that three quarter (75%) of the tree species with edible fruits that grow in the Andean area are managed (compared to 60% of edible herb species, 48% of edible vine and climber species and 25% of shrubs species) (Table 5-1). Trees therefore seem to be favoured by farmers in terms of management. The questions is whether this preference for trees is significant, i.e. whether trees are significantly more managed than other life forms. When testing for independence between the life form of the edible plants and whether a plant is managed or not, a χ^2-test (Table 5-1) shows that the two criteria are associated. There is thus a significant preference for managing trees, compared to other life forms. Alcorn (1982) documented for a similar study in Mexico that 36% of useful plants were managed and that half of all managed plants were trees, shrubs or woody vines.

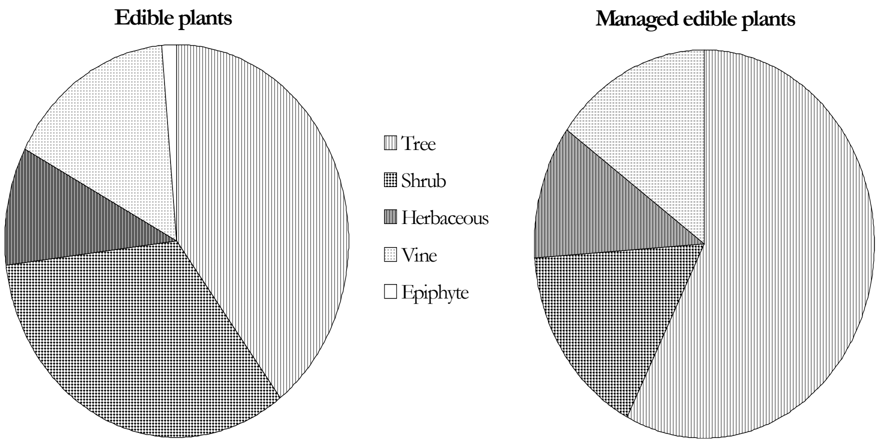


Figure 5-2. The life form of edible and managed edible plants in Andean southern Ecuador

[6] Detailed list of all managed species in Annex 3.

Table 5-1. $\chi 2$-test on the relation between life form and management of edible plants in Andean southern Ecuador

Life form	Number of non-managed edible plants	Number of managed edible plants	Total number of edible plants
Tree	16	46	62
Shrub	39	13	52
Herbaceous	6	9	15
Vine	13	12	25
Epiphyte	2	0	2
Total	76	80	156
$\chi 2$=30.07; d.f.=4; P<=0.001; H_o rejected			

Most managed plant species have edible fruits or fruit parts (73 of 80 species), 2 have edible flowers and 5 have edible vegetative parts. This follows from the fact that most managed edible plant species are trees, who all have edible fruits (rather than other edible parts).

The most important families of edible non-crop plants in Andean southern Ecuador are Ericaceae (22 species), Myrtaceae (20 spp.), Rosaceae (20 spp.), Solanaceae (16 spp.), Mimosaceae (10 spp.) and Passifloraceae (9 spp.) (Fig. 5-3). When considering only managed plants, then Myrtaceae (14 species), Solanaceae (11 spp.), Rosaceae (9 spp.), Mimosaceae (7 spp.) and Caricaceae (5 spp.) are the best represented families. On average 51% of all edible species are managed. A χ^2-test of the number of managed and non-managed species for the eight most important families shows that there is a significant link between plant management and plant family (χ^2=26.5, d.f.=7, p<=0.001, H_o is rejected). The families Ericaceae, Melastomataceae and Passifloraceae are relatively under-represented amongst the managed species. Significantly less than 51% of their edible species are managed. Species belonging to these families are therefore usually not managed. Although many of their species have edible fruits, they will usually only be collected from wild plants. The families Caricaceae, Mimosaceae, Myrtaceae and Solanaceae are especially favoured in terms of plant management. Significantly more than 51% of their edible species are managed.

All edible non-crop plants that are marketed (Table 4-5 and 5-2) are managed within the agricultural area. Twenty edible plant species in Andean southern Ecuador are marketed on local or regional markets. All but one of them is managed for their edible fruits. They may also be managed for additional other reasons, like for fuel, timber, etc. The marketed species grow mainly in pastures (16 species), homegardens (12 species) and hedges (10 species). Economic potential therefore seems to be an important criterion for plant management.

Table 5-2. Marketed edible non-crop plants in Andean southern Ecuador and why and where they are managed (management reasons: Fe=soil fertility, Fr=fruit, Fu=fuel, H=hedging, S=shade, T=timber; management places: C=coffee grove, F=field, G=garden, H=hedge, P=pasture)

Botanical name	Common name	Why managed	Where managed
Agave americana	Méjico	H	P H
Allophylus mollis	Shiringo	Fr Fu T	G H
Annona cherimola	Chirimoya	Fr S	G P F H C
Fragaria vesca	Fresa	Fr	P
Hesperomeles ferruginea	Quique	Fr	H
Inga oerstediana	Guaba musga	Fr Fu Fe S	G P F C
Inga spectabilis	Guaba machetona	Fr Fe S	G C
Inga striata	Guaba verde	Fr Fu Fe S	G P F H C
Juglans neotropica	Nogal	Fr T	G P
Macleania rupestris	Joyapa	Fr	P
Macleania salapa	Salapa	Fr	P
Opuntia ficus-indica	Tuna	Fr H	G P H
Passiflora ligularis	Granadilla	Fr	G P H
Pouteria lucuma	Luma	Fr Fu T S	G P H
Rubus floribundus	Mora	Fr	G P H
Rubus loxensis	Mora	Fr	P
Rubus nubigenus	Mora	Fr	P
Rubus roseus	Mora	Fr	P
Vasconcellea cundinamarcensis	Toronche	Fr	G P H
Vasconcellea x *heilbornii*	Toronche	Fr	G P F C

5.4 Management systems

Managed edible non-crop plants are found in different parts of the agricultural system. In tropical regions, the agricultural system often has no clearly delimited boundaries or demarcated plots. It may be difficult to see where a field starts, where the grazing area ends and shrub vegetation starts or where the boundary between a garden and the forest lies. The agro-ecosystem is a fluid continuum of fields, gardens, plantations, open areas, pastures and forests, where a variety of (often intermixed) crops are found alongside wild and managed plants. It is sometimes difficult to distinguish natural vegetation from anthropogenic vegetation. In Andean southern Ecuador we can distinguish the following components within the landscape and the agro-ecosystem (Table 1-4; CATER 1996; Espinosa 1997; personal observations; Fig. 5-4 to 5-9).

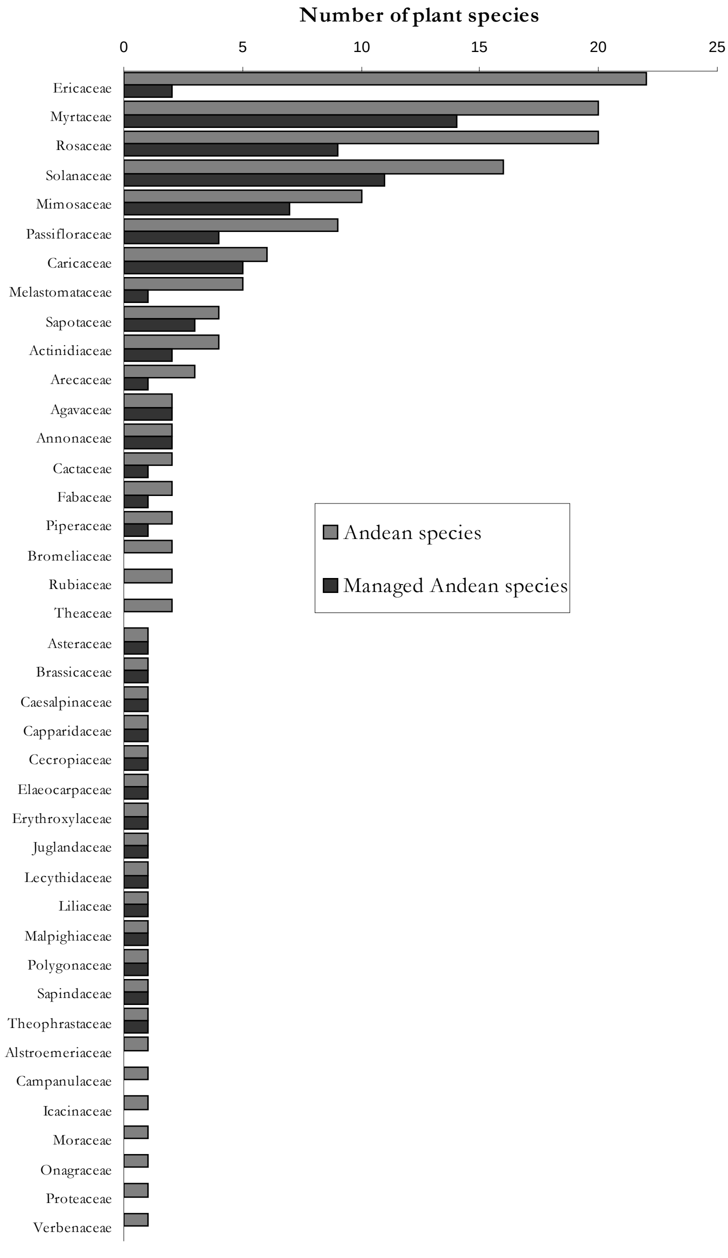


Figure 5-3. Families of edible non-crop plants in Andean southern Ecuador and their respective number of species and managed species

Fields are locally known as *terrenos* or *parcelas*. A maize field in particular is usually called *chacra*. Fields are planted with annual crops. The main annual crops in Andean southern Ecuador area are maize (often intercropped with beans), wheat, peas, beans, cassave and vegetables. Perennial sugarcane is also planted in fields.

Different types of **grazing areas** and pastures can be distinguished. C*ampo abierto* is the name given to communal grazing areas. The *campo abierto* is usually on the higher parts of the mountains, where no crops are cultivated. It has a natural grass, herb, shrub and tree vegetation, which is secondary in origin. *Campo abierto* is not found near all villages and not all farmers have access to communal grazing areas. It is not actively managed by farmers, since it is not privately owned. But its use for grazing does influence the vegetation.

Privately owned pastures are called *potreros*, *pastos*, *praderas, invernos* or *pastizales*. Most pastures have a natural (but managed) vegetation, consisting of native grasses, herbs, shrubs and trees. In the dry areas of Andean southern Ecuador (western cordillera) only natural pastures occur. In more humid areas (eastern cordillera), and especially in the Amazonian region, artificial pastures consisting of introduced grass species are more common. Even artificial pastures still contain many native trees for shade and fodder. Animal husbandry in the area mainly focuses on cattle, which is kept for meat production. In some areas pigs, goats and sheep are kept and near major towns cattle for milk production is more common.

Hedges, called *cercas, cercas vivas* or *cercos*, are found as boundaries between fields or pastures, around gardens, or along paths and roads. They may consist of trees, shrubs or tall spiny plants like *Agave americana* and *Opuntia ficus-indica*. The latter are useful for keeping animals within a pasture. Other forms of fencing (wires) are not used in the area.

Gardens or **homegardens** are called *huertas* or *huertos*. They are usually situated near the houses or along streams (*quebradas*). They harbour a mixture of trees, native and exotic fruit trees, vegetables, medicinal plants, herbs and ornamentals, and show a large variety in size and plant composition. A special type of garden is the **coffee grove** or *cafetal*. They are only found in the more humid parts of Andean southern Ecuador, at altitudes between 1000 and 2000 m. Coffee cultivation is concentrated in the southern part of Loja and Zamora-Chinchipe province and along the Río Puyango and Río Alamor. Southern Ecuador is, together with Manabí province, the main coffee growing area of Ecuador. An in-depth analysis of homegardens is presented hereafter (5.5).

Roadsides or *taludes* are not really a part of the agro-ecosystem, but their herb or shrub vegetation is clearly altered by human influence.

Figure 5-4. Maize fields, natural pastures, introduced pine trees and *Agave americana* hedges in Chuquiribamba

Figure 5-5. *Campo abierto* in Elari

Figure 5-6. *Campo abierto* and remains of *matorral* in Zambi

Figure 5-7. A homegarden, maize fields and secondary forest in Lauro Guerrero

Figure 5-8. Artificial and natural pastures in Paccha

Figure 5-9. Pastures separated by living hedges in Andean southern Ecuador

In terms of natural habitats, *matorral*, *bosque*, *selva* and *páramo* can be distinguished. *Matorral* is usually a secondary shrub vegetation at lower altitudes, but can also be primary shrub vegetation occuring at higher altitude (above the tree limit). *Bosque* (forest) can consist of primary or secondary vegetation and is dominated by trees. Primary forest is usually called *selva*. *Páramo* is the natural area of grass, herb and small shrub vegetation found above 2800 m altitude. *Páramo* may also be called *pajones* or *pajonales*.

5.5 Homegardens of southern Ecuador in focus

Since homegardens often harbour a high number of managed native plant species and food plants, this part of the agro-ecosystem deserves a more detailed presentation. An inventory of homegardens in Loja province was done by Braem (1997). Seventeen homegardens ranging in size from 120 to 20,000 m² were studied in 5 villages in different ecological areas: four in Macará - dry coastal region at 600 m; two in Orianga - humid coastal area at 1200 m, four in Zambi - dry western Andean region at 1500 m, three in Jimbilla - Andean cloud forest area at 1900 m and four in San Lucas - cloud forest area at 2500 m. All plants encountered in the gardens were catalogued, and their management and uses noted. Plants were categorised according to four states of management: crops (domesticated plants), cultivated plants (sown or planted but not domesticated), tolerated plants (develop spontaneously and are tolerated) and unmanaged wild plants (weeds) (Bye 1993; De Wet & Harlan 1975). The data on homegardens presented here were taken from the thesis by Braem (1997) (Annex 4). The described analyses were all performed by the author.

On average 33 different plant species and 280 plant individuals (including herbaceous plants) occur in a garden. Each garden is quite unique in terms of plant composition, even within the same village. This uniqueness is evidenced by the large range in number of plant individuals and number of species that exists between the gardens, and by the diverse species composition of each garden. The number of plants per garden ranges from 9 to 72 species and from 67 to 890 individual plants. Throughout the 17 gardens 263 different plant species were recorded. This high variability of homegardens is typical for homegardens. Fernandes & Nair (1986) compared ten different tropical homegarden systems on five continents, and found that total species numbers ranged from 14 to 191. In other Latin-American countries, 324 plant species were recorded in 20 gardens in Nicaragua (Mendez et al. 2001), 338 in 8 gardens in Mexico (Alvarez-Buylla et al. 1989); 233 in 30 gardens in Mexico (Blanckaert et al. n.d.) and 168 in 21 gardens in Peru (Padoch & De Jong 1991). A range of 18 to 74 species per garden was found in the Peruvian gardens (Padoch & De Jong 1991). In comparison Loja province gardens thus have relatively high species diversity.

The majority of plants in the Loja homegardens are crops. On average 45% of all species and 60% of all plants are crops. Thirty-seven percent of all species and 26% of all plants are cultivated, 14% of all species and 11% of all plants are tolerated and 3% of all species and 5% of all plants are wild (unmanaged) (Fig. 5-10 and 5-11). Most garden plants are thus crops or cultivated plants. Very few wild non-managed plants (usually weeds) occur in gardens.

The majority of species and plants in the gardens are used for food (on average 63% and 50% respectively) and medicines (24%). Providing food (and income) is usually the main function of homegardens (Fernandes & Nair 1986; Gajaseni & Gajaseni 1999; Millat-e-Mustafa et al. 2000). Sometimes a regional emphasis on other uses exists. Gardens in Jimbilla are very rich in medicinal plants. Gardens in Zambi and Orianga contain many coffee shrubs and associated trees that provide shade and fuel (Fig. 5-12 and 5-13).

Homegardens in Macará have high numbers of food plants. The most abundant plants are banana (30% of all plants in two gardens), cacao (up to 16% of plant individuals) and mango (up to 16% of plant individuals). Peanut, sugarcane, coffee and fruit trees are also common garden plants here. Garden size varies highly (0.4-2 ha).

The two gardens in Orianga are very different. One focuses very much on coffee cultivation (68% of plants are coffee plants), with banana, mango and *Inga* trees for shade. The other garden has very high numbers of medicinal plants.

Gardens in Zambi are very large (0.8-2 ha) and have high numbers of crop and food plants, as well as many shade species. Coffee shrubs are the most abundant plants (33-70% of all plants), often mixed with banana plants (0-54% of plants). Shade is usually provided by *Inga* trees and by native and introduced fruit trees like chirimoya (*Annona cherimola*), avocado (*Persea maericana*) and citrus fruits (*Citrus* spp.). The vegetation of Zambi homegardens is therefore largely dominated by trees, many of which are native species.

Jimbilla homegardens are fairly small (0.18-0.6 ha), contain very few trees and have lower than average numbers of crops and food plants. Thirty percent of plants are tolerated plants. Medicinal plants (9-52%), vegetables, herbs and ornamental plants (7-30%) dominate the gardens. Native fruits like tomate de árbol *(Cyphomandra betacea*), babaco (*Vasconcellea* x *heilbornii*) and granadilla (*Passiflora ligularis*) are also common.

The most common plants in gardens in San Lucas are native and introduced fruit trees, vegetables, medicinal plants (up to 42% of plants) and *Eucalyptus* trees. Gardens are fairly small (< 0.5 ha) and contain relatively few trees.

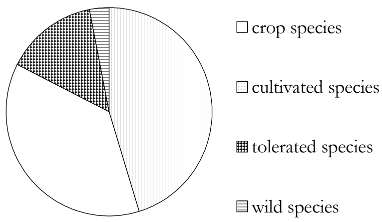


Figure 5-10. The cultural status of plant species found in 17 homegardens in Loja province

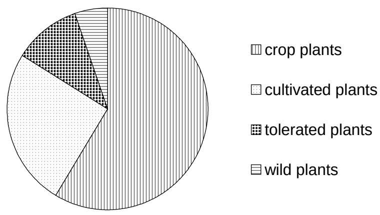


Figure 5.11. The cultural status of individual plants found in 17 homegardens in Loja province

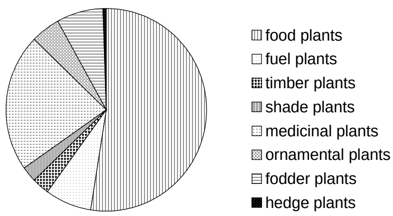


Figure 5-12. The use of plant species in 17 homegardens in Loja province

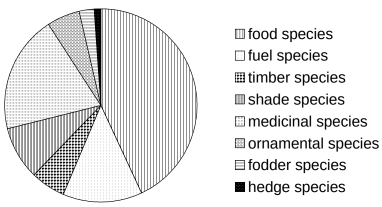


Figure 5-13. The use of individual plants in 17 homegardens in Loja province

In order to see whether variations between homegardens are continuous (random), determined by geography, or whether certain types of gardens with common characteristics in terms of plant diversity and plant use exist, clustering and ordination analysis were performed on the 17 homegardens. Because gardens were sampled in five different villages, each belonging to a very different ecological area, the plant diversity in terms of exact species composition was not considered. The species composition would be as much determined by the ecology of the area, as by personal choice of the farmers. Instead, garden composition was presented as the total number of plant species and plant individuals in the garden (indicating the diversity of the garden) and the cultural status of the different plants (crop, cultivated plant, tolerated plant or wild plant). The 26 variables measured for each garden (Table 3-2) describe the plant diversity of the garden, the needs that the garden plants fulfil for the family (plant uses) and the management of garden plants (crops, cultivated, tolerated or wild plants).

Clustering analysis, using average taxonomical distance coefficients and UPGMA clustering, groups the 17 homegardens into three clusters (Fig. 5-14). The cophentic correlation of the clustering (comparing the resulting tree matrix with the original dissimilarity matrix) is 0.85. This means that the presented clustering is a good representation of the real similarity of the gardens.

The principal component analysis (ordination analysis) identifies the characteristics (variables) that contribute mostly to the existing dissimilarities between groups of homegardens (Table 5-3). Principal component 1 is characterised by low percentages of food plants, fuel species, timber species and shade plants, and accounts for 33% of variation. Principal component 2 is characterised by high percentages of crops and ornamental species and low percentages of wild species and cultivated plants, and accounts for 14% of variation. Principal component 3 is characterised by high percentages of timber plants and tolerated plants and low percentages of cultivated species, and accounts for 13% of variation. The three components together, however, account for only 60% of the total variation amongst homegardens.

By projecting the 17 homegradens in a two-dimensional space, formed by the first two principal component axes, the dissimilarities between the homegardens are visualised (Fig. 5-15). This two-dimensional projection represents only 47% of existing variation amongst homegardens, which is fairly low. A similar projection, projecting the 26 variables alongside the 17 homegardens (Fig. 5-16) shows which variables are important for each garden. Each garden is dominated by the characteristics (variables) that are nearest in the graph. This also shows the correlation between variables: the smaller the angle between two vectors of variables, the closer related the variables are.

The graphic presentation resulting from multidimensional scaling (Fig. 5-16) shows again the similarity of the homegardens. Here the distance between any two points (homegardens) in the plot indicates the realistic similarity or dissimilarity of the gardens. The projection has a stress of 0.09, which is low. This is therefore a better visual representation of similarities between the 17 homegardens, than the principal component analysis graph is (Fig. 5-14).

When evaluating the accuracy of the clustering and ordination analyses in representing the similarities or dissimilarities between homegardens, the clustering analysis and multidimenional scaling represent the reality best. They both proof to be a good fit of reality (r=0.85 and stress=0.09 resp.). The results of both also coincide. The same three groups of homegardens are separated. We can thus recognise three types of homegardens in Loja province (Fig. 5-14; 5-15; 5-17; 5-18; Annex 4). Each type has its distinct plant composition and plant use focus. The variables causing the separation of the three types are known from the principal component anaylsis.

Table 5-3. The first three principal components (eigenvectors), resulting from an eigenanalysis of 17 homegardens in Loja province; the contribution of each of 26 variables to the principal components shows which variables contribute most to variation amongst homegardens (high contributing values in bold)

Variables	**PC1**	**PC2**	**PC3**
# species	**0.66**	0.47	0.38
# plants	0.40	0.46	0.03
% crop species	-0.08	**0.91**	-0.09
% crop plants	**-0.66**	0.52	-0.28
% cultivated species	0.48	-0.43	**-0.55**
% cultivated plants	0.50	**-0.61**	0.08
% tolerated species	-0.61	-0.13	**0.59**
% tolerated plants	0.43	0.13	**0.65**
% wild species	0.63	**-0.54**	0.11
% wild plants	0.40	-0.06	0.01
% food species	-0.52	0.09	-0.37
% food plants	**-0.85**	0.11	-0.19
% fuel species	**-0.89**	-0.15	0.33
% fuel plants	-0.13	-0.29	0.33
% timber species	**-0.85**	-0.01	0.13
% timber plants	-0.62	-0.07	**0.66**
% shade species	**-0.80**	0.02	-0.19
% shade plants	**-0.84**	-0.09	0.19
% medicinal species	0.60	-0.06	0.38
% medicinal plants	**0.66**	-0.33	0.26
% ornamental species	0.49	**0.67**	0.24
% ornamentalplant	0.47	0.53	0.38
% fodder species	-0.26	-0.03	0.35
% fodder plants	0.34	0.47	-0.06
% hedge species	-0.40	-0.04	0.50
% hedge plants	-0.19	-0.08	0.51
% variation explained	33	14	13

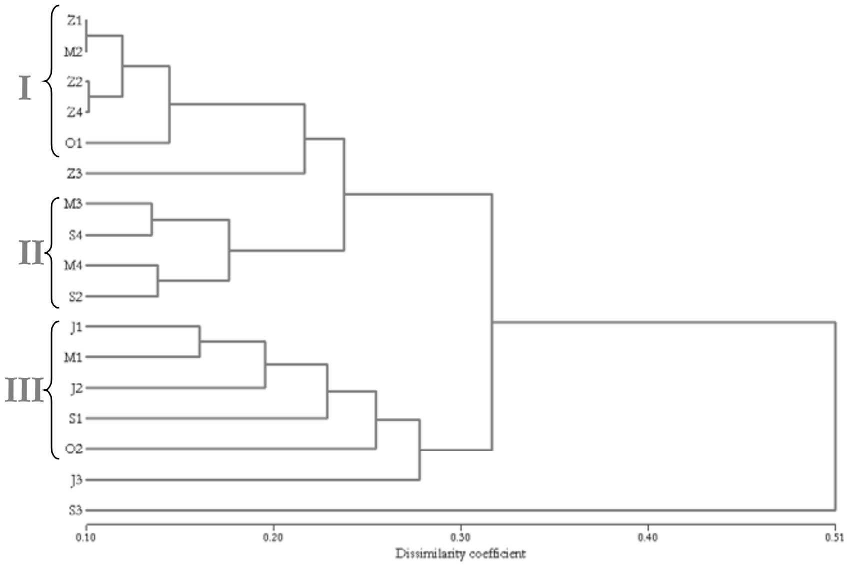


Figure 5-14. Dendrogram indicating the similarity of 17 homegardens in Loja province, according to number, cultural status and plant uses, resulting from an UPGMA clustering analysis (M=Macará; O=Orianga; Z=Zambi; J=Jimbilla; S=San Lucas) (cophenetic correlation r=0.85)

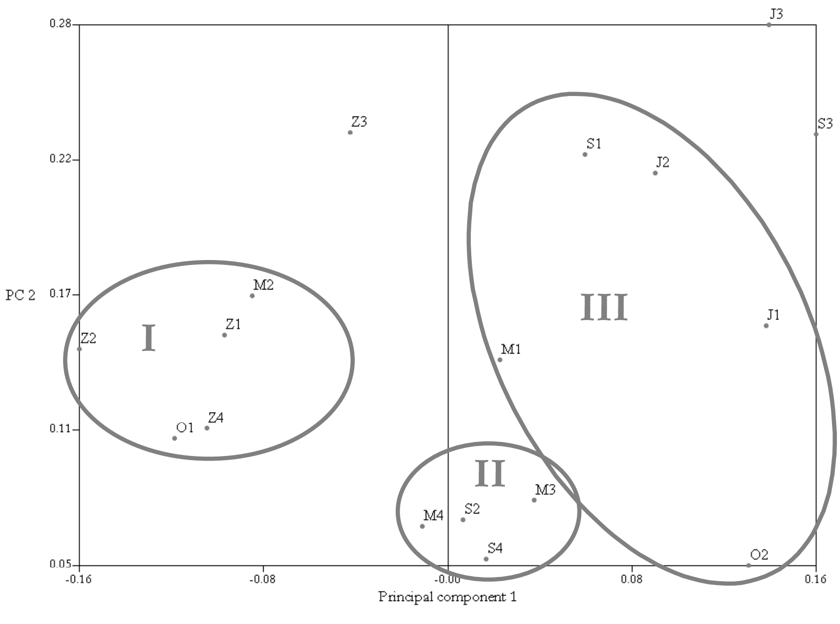


Figure 5-15. Representation of the principal component analysis, showing dissimilarities between 17 homegardens in Loja province according to number, cultural status and plant uses (M=Macará; O=Orianga; Z=Zambi; J=Jimbilla; S=San Lucas) (graph represents 47% of existing variation)

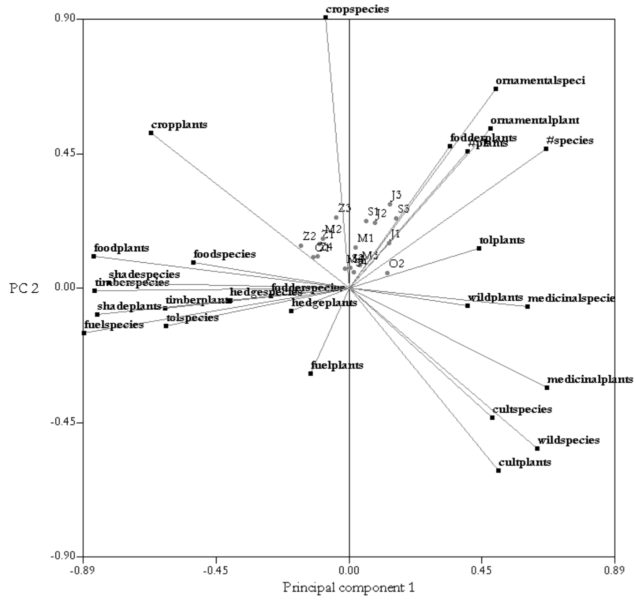


Figure 5-16. Projection of the 17 homegardens (●) and 26 variables (■) onto the two first principal component axes, resulting from a principal component analysis

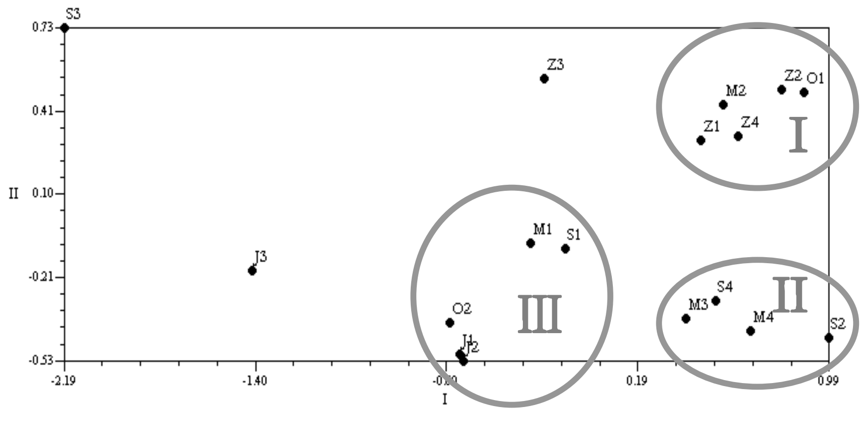


Figure 5-17. Projection of the non-metric multidimensional scaling analysis, indicating similarities between 17 homegardens in Loja province (stress = 0.09)

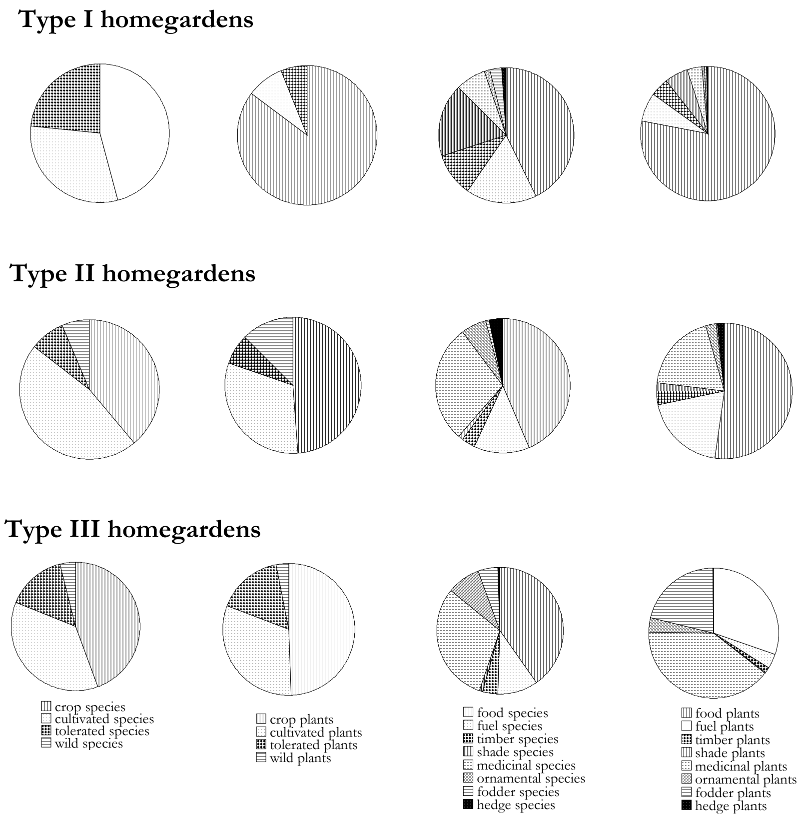


Figure 5-18. Characteristics of three types of homegardens identified in Loja province, showing number, cultural status and uses of individual plants and species

Type I homegardens are characterised by a high number of food plants, crops, fuel, timber and shade plants. The relative high number of fuel, timber and shade plants means that the gardens contain many trees. Three sampled gardens in Zambi belong to this group (Z1, Z2 and Z4), as well as one garden from Orianga (O1) and one from Macará (M2). These gardens are typically coffee groves, where coffee is grown under trees for shade. Shade is provided by *Inga* species, banana, mango, citrus and other fruit trees. The gardens have a high percentage of crop plants (coffee) and trees, contain many tolerated species but no wild plants. They are all fairly large gardens (7980 m² average) with relatively few plant species (17 on average). The gardens are mainly found in the western part of Loja province, at altitudes of 1100 to 1600 m (the optimum altitude for coffee cultivation in Ecuador is 1000 to 2000 m altitude (CATER 1996)).

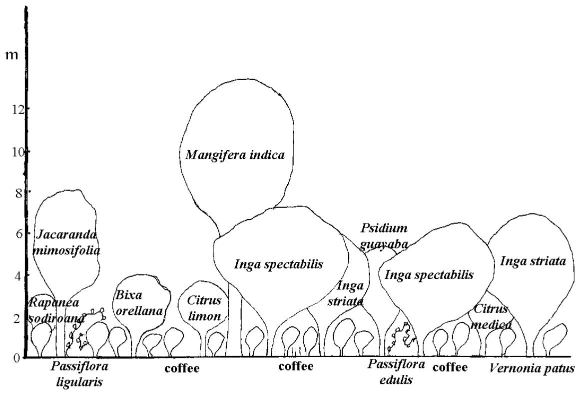


Figure 5-19. Schematic representation of a type I homegarden or coffee grove (Zambi, 1500 m)

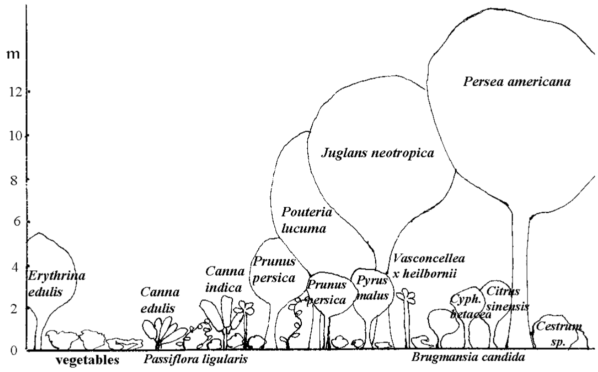


Figure 5-20. Schematic representation of a type II homegarden, dominated by fruit trees (San Lucas, 2400 m)

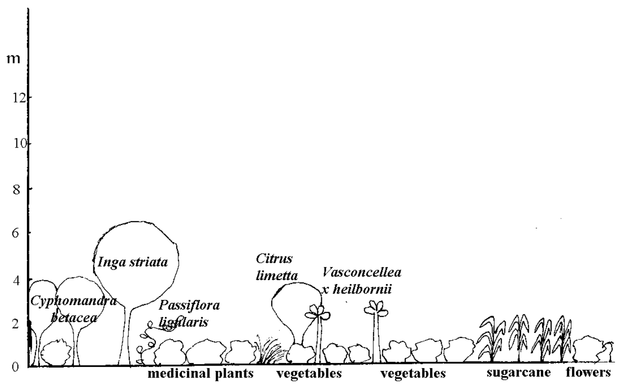


Figure 5-21. Schematic representation of a type III homegarden, dominated by vegetables, medicinal plants and fruit trees (Jimbilla, 1900 m)

One garden in Macará falls within this group. Here no coffee is grown, but cacao is the main shaded crop. Other coffee gardens (Z3, O2) fall outside this group because here coffee is not grown under shade trees.

Type II homegardens have low percentages of crops and tolerated plants and relatively high numbers of cultivated and wild plants. Althoug the main function of the gardens is still food provision, the percentage of plants used for this purpose is relatively low. Relatively many plants are used for fuel and medicine. The gardens are characterised by a low total number of plants (88 on average), despite being fairly large gardens (5300 m² average). The main focus in the gardens is on native and exotic fruit trees. The gardens are situated at various altitudes (M3, M4 in Macará and S2, S4 in San Lucas).

Type III homegardens have low percentages of food plants, and only few fuel, timber and shade plants (therefore few trees), but relatively many ornamental plants. Despite their small size (236 m² on average), plant numbers are very high (26 species and 312 plants on average). The focus in these gardens is on medicinal plants, ornamental plants, vegetables and herbaceous plants. Very few trees grow in these gardens, except for some native fruit trees. The gardens are generally situated at higher altitudes (2000-2600 m) in Jimbilla (J1, J2) and San Lucas (S1), but also some lower altitude gardens (M1 in Macará and O2 in Orianga) belong to this group. A strong focus on medicinal plants in highland homegardens in the area is confirmed by a recent study of Saraguro homegardens (Finerman & Sackett 2003).

The average characteristics of each type of homegarden are shown in Fig. 5-18. Schematic representations of the three types of homegardens were drawn, based on the plant composition of one garden of each type (Fig. 5-19, 5-20 and 5-21).

This analysis of homegardens shows that, irrespective of the exact species composition of gardens and their geographical position in the area, and despite the high variability in plant composition and use, three main types of homegardens can be recognised in Loja province. Certain gardens have a clear focus on coffee production; others on fruit trees; others are small gardens with a focus on medicinal plants, ornamentals and vegetables. The main determining factors to classify gardens into one of these groups, are the total species number, whether or not they contain food plants, crops or cultivated plants, and whether or not they contain trees. High numbers of food plants, crops and trees suggest a type I garden; few trees and crops but high species number a type III garden; and few crops but many cultivated plants a type II gardens. When analysing the correlation between variables (Fig. 5-16), we see that fuel, timber, shade and hedge plants in homegardens are mainly tolerated (trees). Medicinal plants are mainly wild or cultivated. Food plants are either crops or tolerated plants.

The altitude of an area seems to have an important influence on what type of gardens prevail in that area. At altitudes suitable for coffee cultivation (1000-1600 m), this cash crop determines the composition of the garden. Since coffee needs shade, many trees are tolerated or introduced in the garden, turning the garden into a pseudo-forest. At higher or lower altitudes, coffee cultivation becomes impossible. Trees are less necessary for shade. The emphasis at these locations shifts towards growing vegetables and medicinal plants. If trees are still present, they are usually fruit trees. This shows that the function of homegardens is mainly to provide cash, food and medicine.

The three types of homegardens do not fully represent all homegardens in Loja province, as some surveyed gardens do not belong to any of the three groups. Also, this analysis of homegardens was only done in Loja province, and should not be seen as being representative for the whole of southern Ecuador. When, however, excluding the homegardens situated below 1500 m (in Macará and Orianga), the same three types of homegardens can be distinguished for the Andean part of Loja province: coffee groves, fruit tree gardens and high altitude vegetable and medicinal plant gardens.

5.6 Edible non-crop plants managed in the agro-ecosystem

The 80 recorded species of managed edible non-crop plants are found in all parts of the agro-ecosystem in southern Ecuador, i.e. in fields, pastures, homegardens, coffee groves, hedges and on road sides or along paths (Annex 3; Fig. 5-22). Somespecies are managed in various places. *Annona cherimola, Brassica napus, Coccoloba ruiziana, Erythrina edulis, Inga fendleriana, Inga striata, Inga oerstediana, Opuntia ficus-indica, Passiflora ligularis, Physalis peruviana, Pouteria lucuma, Rubus floribundus, Solanum americanum, Solanum caripense, Vasconcellea* x *heilbornii* and *Vasconcellea cundinamarcensis,* are managed in at least 3 different parts of the agricultural system.
Edible non-crop plants found outside the agricultural system, e.g. in *matorral* (shrub vegetation) or in forest vegetation are not included in this list of managed plants. Fifty-five of the managed species (69%) were also found in natural habitats. The other 25 species are either not found in the wild, or it is not known for certain from fieldwork or literature whether they occur in the wild or not.

Fields

Very few wild managed plants are found in fields, both in terms of number of species and number of plants within a field. Fields are usually just dedicated to crops. Ten species of trees and herbs (one cactus) were found in fields (Table 5-4).

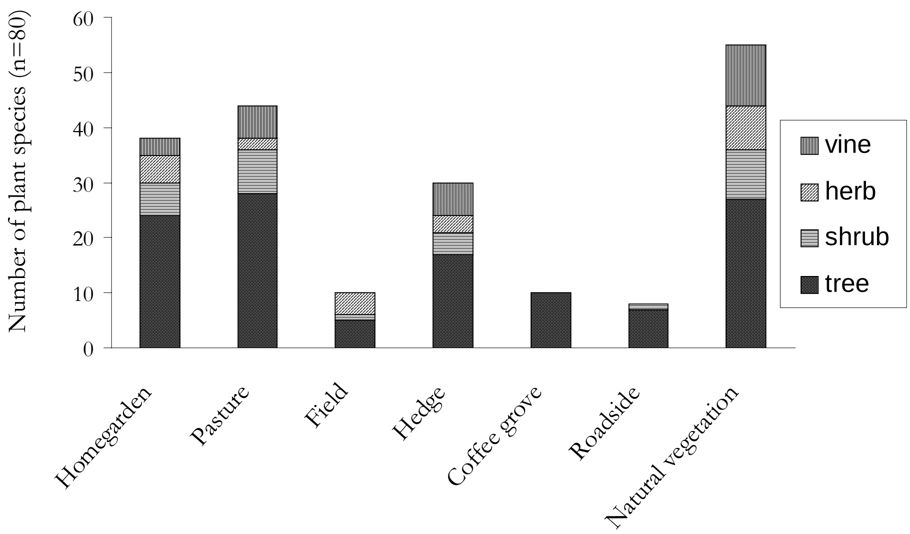


Figure 5-22. The number of managed edible non-crop plant species found in various parts of the agricultural system in Andean southern Ecuador, with a subdivision in life form

Trees are tolerated as solitary trees for their fruits, for shade, to increase fertility or to retain water in the soil. On one farm an inter-cropping system of *Annona cherimola* (chirimoya) and maize was seen (Fig. 5-23). Chirimoya trees were tolerated at low density (5 trees/ha) for shade and for their fruits. Sometimes *Inga* species are tolerated in fields for their ability to fix nitrogen and thus increase soil fertility. Herbaceous plants like *Solanum caripense*, *S. americanum*, *Physalis peruviana* and *Brassica napus* may be tolerated as weeds between crops because of their edible fruits and leaves, and because they occupy little space and are non-invasive. *Opuntia ficus-indica* and *Vasconcellea* x *heilbornii* are planted in fields for their fruits. In general managed plants in fields are there because they have grown spontaneously and are tolerated, rather than being actively introduced.

In various agricultural systems throughout Latin America native trees and shrubs may be spared and encouraged for soil fertility, firewood and to avoid soil erosion (Alcorn 1990). Certain fruit trees may even be planted in maize fields (Mexico). Often a sequential cycle of fields and fallows exists, whereby over time crops are more and more replaced by trees until the fallow stage starts. Fallows may still be managed, and are only cleared again when the next field cycle starts. Other studies confirm that generally few trees are managed in fiels (Fujisaka et al. 1999) and those that are, are managed for their fruits (Lykke 2000).

Table 5-4. Managed edible non-crop plants found in fields in Andean southern Ecuador

Botanical name	Common name*	Management
Annona cherimola	Chirimoya	tolerated for fruit and shade
Brassica napus	nabo silvestre	tolerated for edible leaves
Inga oerstediana	guaba musga	tolerated for shade and N_2-fixation
Inga striata	guaba verde	tolerated for shade and N_2-fixation
Myrcianthes sp3	yanamuro	tolerated for shade and water retention
Opuntia ficus-indica	tuna	planted for fruit
Physalis peruviana	uvilla	tolerated for fruit
Solanum americanum	mortiño	tolerated for medicine
Solanum caripense	simbailo	tolerated for fruit
Vasconcellea x *heilbornii*	toronche	planted for fruit

* name most commonly used throughout the area

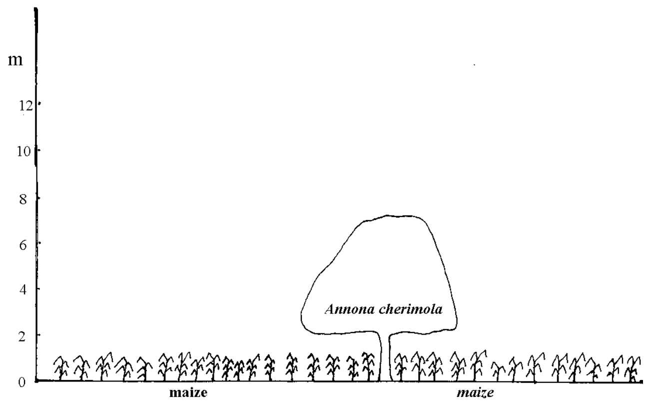


Figure 5-23 Schematic representation of a field in Nambacola (1600 m)

Pastures

The majority of managed edible non-crop plants (44 species) are found in pastures, where they are tolerated for different reasons (Table 5-5). The majority are trees, but also edible shrubs and vines are tolerated in pastures. Trees are mostly tolerated to provide shade for cattle and for fuelwood, timber and fodder. The only plants that are actively introduced to pastures are *Agave americana* and *Opuntia ficus-indica,* both used for fencing. Many species of the Myrtaceae family are found as tolerated trees in pastures, belonging mainly to the genera *Eugenia, Myrcia, Myrcianthes* and *Psidium*. They are managed to provide fuel, timber and shade for cattle, rather than for their fruits, which are usually small and have quite a strong, insipid flavour. An exception is *Psidium guineense*, a shrub sometimes tolerated for its fruits. *Myrcia fallax* is sometimes tolerated because its fruits provide fodder. Several *Inga* species are found in pastures as shade trees for cattle and to improve soil fertility (nitrogen fixation). *Rubus* and *Passiflora* plants are regularly found at the edges of pastures, where they are tolerated for their edible fruits. Farmers tend to eliminate *Rubus* shrubs from within the pastures as their thorns could hurt the cattle's udders. Economic fruit species like *Annona cherimola*, *Vasconcellea* spp., *Juglans neotropica, Opuntia ficus-indica* and *Pouteria lucuma* are sometimes tolerated for their fruits.

Throughout Latin America and the tropics, native timber trees, forage trees and palm trees are frequently found in pastures and provide a wide variety of benefits and uses (shade, forage, fuel, soil fertility, fruits) (Alcorn 1990; Campbell et al. 1991; Harvey & Haber 1999).

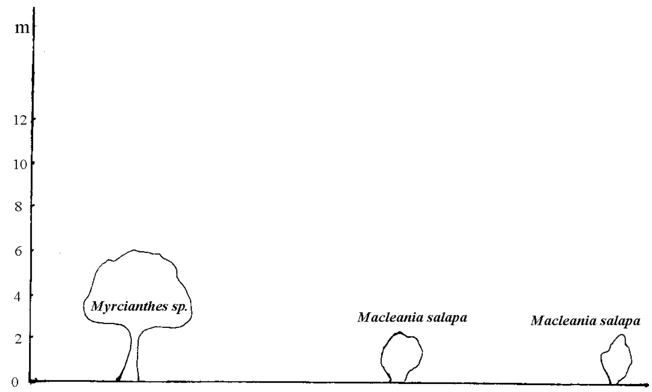


Figure 5-24. Schematic representation of a pasture in Gualel (2500 m)

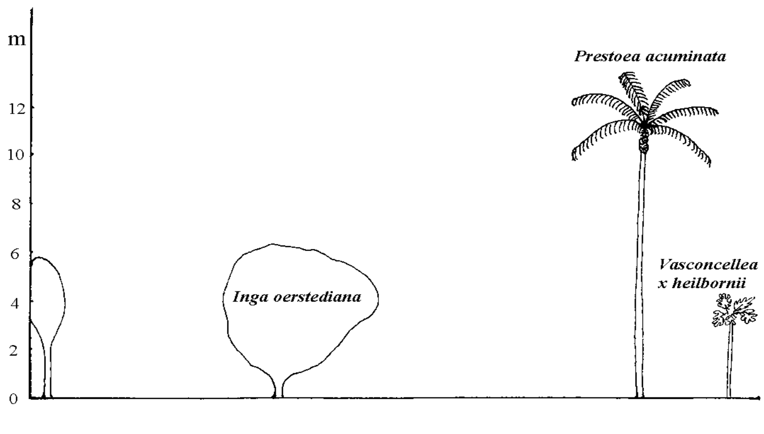


Figure 5-25. Schematic representation of a pasture in Paccha (1500 m)

Table 5-5. Managed edible non-crop plants found in pastures in Andean southern Ecuador

Botanical name	Common name*	Management
Agave americana	méjico	transplanted for hedging
Annona cherimola	chirimoya	tolerated for shade
Coccoloba ruiziana	añalque	tolerated
Eugenia sp1	arrayán	tolerated
Eugenia sp6	capulí	tolerated
Eugenia sp7	-	tolerated
Grias peruviana	apai	tolerated
Inga extra-nodis	guaba	tolerated for shade
Inga fendleriana	guaba	tolerated for shade and fertility
Inga insignis	guaba	tolerated
I. nobilis ssp. *quaternata*	guaba	tolerated
Inga oerstediana	guaba musga	tolerated
Inga striata	guaba verde	tolerated for shade and fertility
Jaltomata sp1	uvilla	tolerated
Jaltomata sp2	uvilla	tolerated
Juglans neotropica	nogal	tolerated for timber
Macleania rupestris	joyapa	tolerated
Macleania salapa	salapa	tolerated
Miconia lutescens	taruma	tolerated for fuelwood and fodder
Micropholis venulosa	capulí	tolerated
Myrcia fallax	saca	tolerated for fertility, fuel, fodder, timber
Myrcianthes fragrans	guaguel	tolerated
Myrcianthes sp3	yanamuro	tolerated for shade and water retention
Myrcianthes sp4	singulique	tolerated for shade
Myrcianthes sp5	saca	tolerated
Myrcianthes sp6	arrayán	tolerated
Opuntia ficus-indica	tuna	tolerated for cochineal and fencing
Passiflora ligularis	granadilla	tolerated
Passiflora matthewsii	gullán	tolerated
Physalis peruviana	uvilla	tolerated
Pourouma melinonii	uva	tolerated
Pouteria lucuma	luma	tolerated for shade, fruit, timber and fuel
Prestoea acuminata	tinguiso	tolerated
Psidium guineense	guayabilla	tolerated
Rollinia mucosa	anona	tolerated for shade
Rubus floribundus	mora	tolerated
Rubus loxensis	mora	tolerated
Rubus nubigenus	mora	tolerated
Rubus roseus	mora	tolerated
Saurauia bullosa	jicamillo	tolerated
Saurauia sp1	ataringue	tolerated for timber
Solanum caripense	simbailo	tolerated
Vasconcellea x *heilbornii*	toronche	Tolerated for fruit
V. cundinamarcensis	toronche	Tolerated for fruit

* name most commonly used throughout the area

Homegardens

A total of 38 different managed edible plants were found in homegardens (Table 5-6). Many of them are actively introduced into the garden (sown, planted or transplanted). Eighteen species are sown, ten planted from cuttings and seven transplanted from wild seedlings. Most species may also germinate spontaneously and are then tolerated.

Several plants are managed in homegardens for a variety of reasons. They provide fruits (22 species), fuel (7 species), timber (5 species), shade (7 species) and fodder (2 species) or improve soil fertility (5 species). Economic species are frequently managed in homegardens. *Vasconcellea candicans*, *V. monoica*, *V. cundinamarcensis, V. stipulata* and *V.* x *heilbornii* are managed for their fruits, which are prepared in preserves and sometimes sold at local markets. They are tolerated, sown or planted as cuttings. *Annona cherimola,* the most important economic species of the area, is tolerated or sown in homegardens. The fruits of *Juglans neotropica* and *Pouteria lucuma* are also sold at markets, the trees provide good timber. The former is tolerated, whereas the latter may also be sown. Several *Inga* species are managed to improve soil fertility, for shade, fuel and edible fruits. They are sown, transplanted from the wild or tolerated. Herbaceous plants like *Brassica napus*, *Physalis peruviana* and *Solanum americanum* and fruit-bearing climbers like *Passiflora ligularis*, *Rubus floribundus* and *R. glaucus* are tolerated or planted for their edible fruits or leaves.

By comparing the managed plants recorded in homegardens, with the plant composition of the homegardens inventoried in Loja province, we can see which species are found in which type of homegarden (Table 5-6). Non-crop edible plants managed in coffee groves (type I) are all trees, managed for shade, soil fertility, fuel, timber and fruits. Edible plants managed in fruit gardens (type II) are trees, vines and herbs, managed for their fruits. In vegetable and medicine gardens (type III), we find managed trees, vines and herbs, managed for their edible fruits or as a medicinal plant. Schematic representations of homegardens from Andean southern Ecuador were shown in Fig. 5-19, 5-20 and 5-21.

These findings coincide with the many studies on plant management in homegardes that have been carried out throughout the tropics. Homegardens are usually intensily managed (Skutch 1995) and contain besides crops many managed species that provide for a wide variety of needs (Alcorn 1990; Blanckaert et al. n.d.; Fernandes & Nair 1986; Gajaseni & Gajaseni 1999; Millat-e-Mustafa et al. 2000).

Table 5-6. Managed edible non-crop plants found in homegardens in Andean southern Ecuador, with indication in which of homegardens they occur (I=coffee grove; II=fruit garden; III=vegetable and medicinal plant garden)

Botanical name	Common name*	I	II	III	Management
Acnistus arborescens	picopico			x	tolerated for fruit, fuel, fodder and hedging
Allophylus mollis	shiringo				sown, transplanted and sown for fruit, fuel and timber
Annona cherimola	chirimoya	x		x	tolerated and sown for fruit and shade
Brassica napus	nabo		x		tolerated
Bunchosia deflexa	ciruela				tolerated
Caesalpinia spinosa	tailin				tolerated for fuel
Capparis petiolaris	shora	x			tolerated, sown and transplanted for fruit, fertility and shade
Clavija euerganea	naranjilla del campo				tolerated
Coccoloba ruiziana	añalque				tolerated
Cyphomandra cajanumensis	pepino de campo				tollerated or planted
Erythrina edulis	guato	x	x	x	planted and sown for fuel, fruit, fodder and hedging
Erythroxylum sp.	indicoca				tolerated
Inga fendleriana	guaba	x			tolerated, sown and planted for shade, fertility and fruit
I. nobilis ssp. *quaternata*	guaba				tolerated
Inga oerstediana	guaba musga	x			tolerated, sown and planted for fertility, shade and fruit
Inga spectabilis	guaba machetona	x	x	x	sown for fruit, fuel, timber, fertility and shade
Inga striata	guaba verde	x		x	tolerated, sown and transplanted for shade, fertility and fruit
Juglans neotropica	nogal				tolerated and sown for fruit and timber
Muntingia calabura	cerezo				planted
Opuntia ficus-indica	tuna				planted for fruit
Passiflora ligularis	granadilla		x	x	tolerated, transplanted and sown for fruit
Physalis peruviana	uvilla		x	x	tolerated for fruit
Piper crassinervium	guaviduca				sown for aromatic leaves
Pouteria lucuma	luma	x	x	x	sown, planted, transplanted and tolerated for fruit, fuel, timber and shade
Pradosia montana	lusumbe				sown
Prunus serotina ssp. *capuli*	capulí				planted for fruit
Rollinia mucosa	anona				tolerated
Rubus floribundus	mora				tolerated for fruit
Rubus glaucus	mora				tolerated for fruit
Solanum americanum	mortiño				tolerated for medicine
Solanum sp14	ají				tolerated
Taraxacum sp.	muelo de león			x	tolerated for medicine
Vasconcellea candicans	chungay				sown, planted and tolerated for fruit

Botanical name	Common name*	I	II	III	Management
V. cundinamarcensis	toronche		x		sown, planted and tolerated for fruit
Vasconcellea x *heilbornii*	toronche	x	x	x	planted and tolerated for fruit
Vasconcellea monoica	chamburo				planted and tolerated for fruit
Vasconcellea stipulata	toronche				tolerated for fruit
Gen. indet. (Liliaceae)	pata blanca				Tolerated

* name most commonly used throughout the area

Coffee groves

Traditional shaded coffee cultivation relies on many tree species to provide shade for the coffee shrubs. These can be native or introduced trees. Edible non-crop plants frequently found in coffee groves in Andean southern Ecuador, and often the farmer's favourite shade trees, are various species of the genus *Inga*, i.e. *I. fendleriana, I. insignis, I. marginata, I. oerstediana, I. spectabilis* and *I. striata*. They are mainly planted or tolerated for shade. *Inga striata* is said to provide the best shade. *Inga* species also fix nitrogen, thus improving soil fertility. The pods have an edible aril around the seeds and the wood is a good source of fuel. *Inga* trees are used throughout Ecuador and other Andean countries as shade trees for tea, coffee, cacao and coca cultivation. They are valuable multipurpose trees, a good source of fuelwood due to their rapid growth and resistance to coppicing, easily grown from seeds and improve soil fertility through nitrogen fixing root nodules and high mycorrhizal activity. Their high species diversity (75 species in Ecuador) offers a large pool of species suitable for specific ecological conditions (Pennington & Revelo 1997).

Tall *Capparis petiolaris* trees are another preferred shade species for coffee cultivation. *Annona cherimola* is also often found in coffee groves, providing both shade and valuable fruits. *Vasconcellea* x *heilbornii* and *Erythrina edulis* do not provide much shade. *Vasconcellea* x *heilbornii* is managed for its fruits, *Erythrina edulis* as fodder (its pods) and for fuel. *Juglans neotropica* is usually removed from coffee groves. Some farmers say the falling leaves can damage the coffee fruits. All ten species of managed edible non-crop plants found in coffee groves are trees. They are either tolerated or are actively introduced to the site by sowing or (trans)planting.

Various non-edible native trees are used for shade alongside the edible species. Examples are *Mauria heterophylla* (colorado), *Triplaris guayaquilensis* (roble), *Ficus* sp. (higuerón), *Licaria* sp. (canelo) and *Jacaranda mimosifolia* (arabisco) (Braem 1997). Iintroduced exotic trees like *Eugenia jambos* (pomarosa), *Persea americana* (avocado), *Casuarina equisetifolia* and *Mangifera indica* (mango) also provide shade in coffee groves (Braem 1997). Coffee in southern Ecuador is often intercropped with banana, whereby the banana plants also provide shade.

Six coffee groves studied by Braem (1997) in Zambi and Orianga had on average 126 (+/- 16) coffee shrubs in a grove of 900 to 15,000 m². The number of banana plants varied from none to more than 200 per coffee grove. On average 25 trees, corresponding to 6 to 14 species grow in each coffee grove, giving a rate of 1 tree to 5 coffee shrubs. Half of the trees in each grove are managed native trees with edible fruits. Tree species numbers are low compared to similar studies of traditional shaded coffee systems in Mexico, where 13 to 58 tree species were recorded in various inventories of coffee groves (Moguel & Toledo 1999). Native multipurpose trees and introduced fruit trees are used throughout Latin America for shade in coffee *fincas* (Alcorn 1990), but variability in species choice and structure of shaded coffee systems are typically very high.

Table 5-7. Managed edible non-crop plants found in coffee groves in Andean southern Ecuador

Botanical name	Common name*	Management
Annona cherimola	chirimoya	sown and tolerated for fruit and shade
Capparis petiolaris	shora	sown, tolerated and transplanted for fruit, shade and soil fertility
Erythrina edulis	guato	planted and sown for fuel and fodder
Inga fendleriana	guaba	sown, tolerated and transplanted for fruit, shade and soil fertility
Inga insignis	guaba	tolerated for shade and soil fertility
Inga oerstediana	guaba musga	sown, tolerated and transplanted for fruit, shade and soil fertility
Inga spectabilis	guaba machetona	sown and transplanted for fruit, shade and soil fertility
Inga striata	guaba verde	sown, tolerated and transplanted for fruit, shade and soil fertility
Pouteria lucuma	luma	tolerated for fruit, shade and fuel
Vasconcellea x *heilbornii*	toronche	tolerated and planted for fruit

* name most commonly used throughout the area

Hedges

Many edible non-crop trees, shrubs and vines grow in hedgerows. A total of 30 managed species were recorded in Andean southern Ecuador. The majority are plants that grow spontaneously and are tolerated. Some species, like *Agave americana* and *Opuntia ficus-indica,* are planted for hedges around fields and pastures. Because of their thorns they keep animals within the boundaries. *Agave* spp. and cacti are also frequently used in Mexico (and elsewhere) for living fences (Alcorn 1990). *Erythrina edulis* is a popular native hedge tree, which is often planted. Around pastures, managed plants may provide fodder for cattle, as in the case of

Erythrina edulis and *Inga striata*. Hedgerow trees also provide fruits and fuel. *Acnistus arborescens*, *Myrcianthes* spp., *Psidium guineense* and *Saurauia bullosa* are trees frequently found in hedgerows. *Passiflora* (*P. ligularis* and *P. matthewsii*), *Rubus* and *Solanum* climbers and vines thrive well in shrubby hedgerows and are often tolerated for their edible fruits. Studies throughout Latin America shows that trees in living fences typically provide firewood, fodder and fruits (Alcorn 1990).

Roadsides

Edible non-crop plants that occur along roadsides and paths have probably been submitted to less active management than plants found in gardens, fields and pastures. But still, their presence along paths is influenced by humans. Eight edible species (one vine, the rest trees) were found tolerated along roads and paths, not in hedges, but as solitary plants.

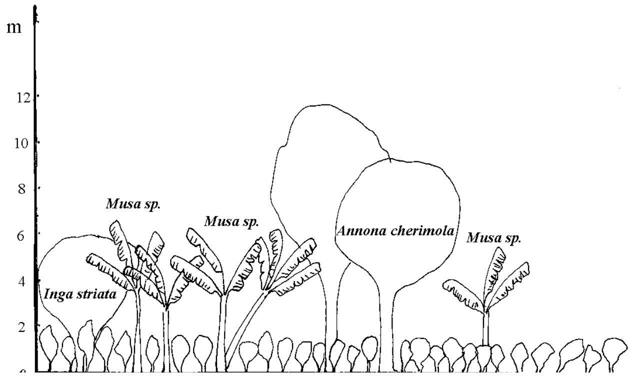


Figure 5-26. Schematic representation of a coffee grove in Lauro Guerrero (2000 m)

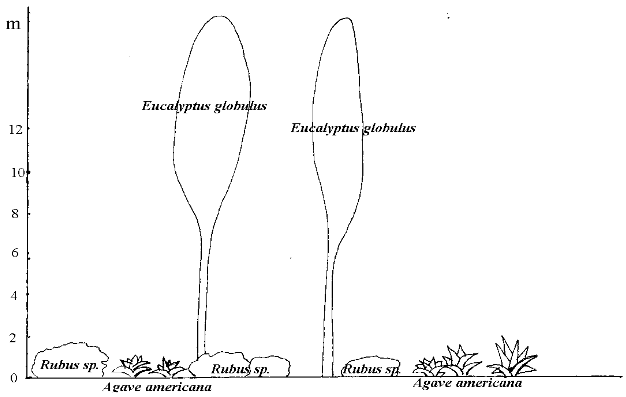


Figure 5-27. Schematic representation of a hedge in Chuquiribamba (2000 m)

Table 5-8. Managed edible non-crop plants found in hedges in Andean southern Ecuador

Botanical name	Common name*	Management
Acnistus arborescens	picopico	tolerated
Agave americana	méjico	plantyed and transplanted
Allophylus mollis	shiringo	tolerated
Annona cherimola	chirimoya	tolerated
Caesalpinia spinosa	tailin	tolerated
Calyptranthes sp.	arrayán	tolerated
Coccoloba ruiziana	indindo	tolerated
Erythrina edulis	guato	planted for fruit
Hesperomeles ferruginea	quique	tolerated
Inga striata	guaba verde	sown for shade
Myrcianthes fragrans	guaguel	tolerated
Myrcianthes orthostemon	singulique, saca	tolerated
Myrcianthes rhopaloides	guaguel	tolerated
Myrcianthes sp3	yanamuro	tolerated for shade
Myrcianthes sp5	saca	tolerated
Opuntia ficus-indica	tuna	tolerated and planted for fruit
Passiflora ligularis	granadilla	tolerated for fruit
Passiflora matthewsii	gullán	tolerated
Physalis peruviana	uvilla	tolerated
Pouteria lucuma	luma	tolerated for fruit, fuel and timber
Psidium guineense	guayabilla	tolerated for fruit
Rubus floribundus	mora	tolerated and protected for fruit
Rubus glaucus	mora	tolerated
Salpichroa diffusa	chululay	tolerated
Saurauia bullosa	jicamillo	tolerated
Solanum americanum	mortiño	tolerated
Solanum brevifolium	uchuchi	tolerated
Solanum caripense	simbailo	tolerated
Vasconcellea candicans	chungay	tolerated and sown for fruit
Vasconcellea cundinamarcensis	toronche	tolerated and planted for fruit

* name most commonly used throughout the area

Table 5-9. Managed edible non-crop plants found along roadsides in Andean southern Ecuador

Botanical name	Common name*
Acnistus arborescens	picopico
Caesalpinia spinosa	tailin
Calyptranthes sp.	arrayán
Inga insignis	guaba
Inga nobilis ssp. *quaternata*	guaba
Inga oerstediana	guaba musga
Muntingia calabura	cerezo
Rubus floribundus	mora

* name most commonly used throughout the area

5.7 The reasons why edible non-crop plants are managed

Farmers were asked why they manage the edible plants within their agricultural system. Although all species are edible, less than half of them (43%) are actually managed for their edible fruits (or other edible parts) (Fig. 5-28; Table 5-10). Other important management criteria are shade (18%), fuel (10%) and timber (10%). The species that are managed for reasons other than their edibility, are always trees or shrubs. Herbaceous plants and vines are only managed for their use as a food source.

Certain species are managed for a multitude of reasons. These are again only tree and shrub species. *Inga oerstediana* and *Inga striata* are managed for their fruits and fuel, for shade and for soil fertility improvement (nitrogen fixation). *Pouteria lucuma* is managed for its fruits, for fuel, timber and shade. *Myrcia fallax* is managed for fuel, timber, shade and fodder (the fruits). *Opuntia ficus-indica* is managed for its fruits, for hedging and for cochineal (a red dye produced by insects that grow on *Opuntia* cacti; the insects are actively "sown" onto the cacti). *Acnistus arborescens* is managed for chicken fodder (berries), hedging and as a honey shrub. *Erythrina edulis* is managed for food, fuel, timber, hedging and fodder. Economic species are either managed for their fruits or for a variety of reasons.

It is important to remember that these "statements" about why certain plants are managed are the collective information provided by many informants in Andean southern Ecuador. Not each informant would mention all these reasons for a plant.

5.8 How edible non-crop plants are managed

The majority of plants (89% or 71 species) are tolerated (Fig. 5-29; Table 5-11). This means they germinate and grow spontaneously, and are not removed. This can be seen as a relatively passive type of management. Tolerated species belong to all growth forms. Twenty-three plant species (29%) are actively sown, eight are planted as cuttings and nine are transplanted from the wild as seedlings. It is mostly trees that are actively managed by sowing or (trans)planting. *Allophylus mollis*, *Annona cherimola, Capparis petiolaris*, *Erythrina edulis*, *Inga fendleriana*, *I. oerstediana*, *I striata*, *Juglans neotropica*, *Pouteria lucuma*, *Vasconcellea candicans* and *V. x heilbornii* are managed in a variety of ways, both tolerated and actively managed. These tree species are frequently found in coffee groves and homegardens. Economic species are subjected to all these management practices, without preference for one or another.

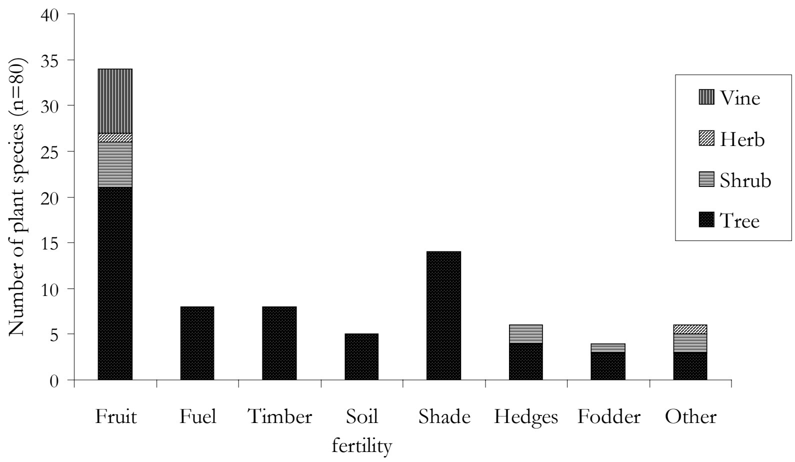


Figure 5-28. The reasons why edible non-crop plants in Andean southern Ecuador are managed

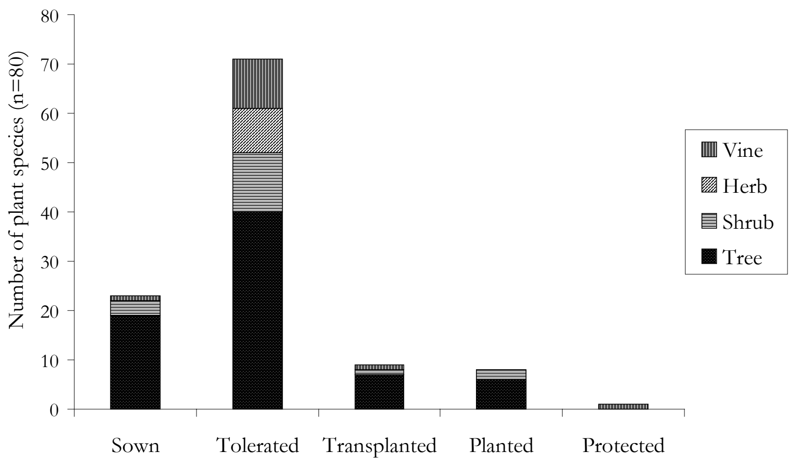


Figure 5-29. The ways in which edible non-crop plants in Andean southern Ecuador are managed

Alcorn (1982) noted similarly for Huastec plant management in Mexico that the largest group of managed plants are those that are tolerated. Usually these were trees that were spared for houseposts, firewood and shade for animals. Another Mexican study reported 68% of edible non-crop plants to be tolerated, 26% sown, 7% transplanted, 22% protected and 8% enhanced (Casas et al. 1996).

Table 5-10. Uses for which edible non-crop plant species of Andean southern Ecuador are managed

Fruit	Fuel	Timber	Soil fertility
Acnistus arborescens	*Allophylus mollis*	*Allophylus mollis*	*Capparis petiolaris*
Allophylus mollis	*Caesalpinia spinosa*	*Erythrina edulis*	*Inga fendleriana*
Annona cherimola	*Erythrina edulis*	*Eugenia* sp6	*Inga oerstediana*
Capparis petiolaris	*Inga oerstediana*	*Juglans neotropica*	*Inga spectabilis*
Erythrina edulis	*Inga striata*	*Myrcia fallax*	*Inga striata*
Hesperomeles ferruginea	*Miconia lutescens*	*Pouteria lucuma*	
Inga fendleriana	*Myrcia fallax*	*Pradosia montana*	
Inga oerstediana	*Pouteria lucuma*	*Saurauia* sp1	
Inga spectabilis			
Inga striata			
Juglans neotropica			
Macleania salapa			
Myrcianthes orthostemon			
Myrcianthes sp4			
Myrcianthes sp6			
Opuntia ficus-indica			
Passiflora ligularis			
Passiflora matthewsii			
Physalis peruviana			
Pouteria lucuma			
Pradosia montana			
Prunus serotina ssp. *capuli*			
Psidium guineense			
Rollinia mucosa			
Rubus floribundus			
Rubus glaucus			
Rubus loxensis			
Rubus nubigenus			
Rubus roseus			
Saurauia bullosa			
Vasconcellea candicans			
Vasconcellea cundinamarcensis			
Vasconcellea x *heilbornii*			
Vasconcellea stipulata			

Table 5-10. Continued

Shade	**Hedge**	**Fodder**	**Other**
Annona cherimola	*Acnistus arborescens*	*Acnistus arborescens*	*Acnistus arborescens*
Capparis petiolaris	*Agave americana*	*Erythrina edulis*	*Erythrina edulis*
Inga extra-nodis	*Caesalpinia spinosa*	*Inga striata*	*Myrcianthes* sp3
Inga fendleriana	*Erythrina edulis*	*Myrcia fallax*	*Opuntia ficus-indica*
Inga insignis	*Opuntia ficus-indica*		*Piper crassinervium*
Inga oerstediana	*Saurauia* sp1		*Solanum americanum*
Inga spectabilis			
Inga striata			
Myrcia fallax			
Myrcianthes orthostemon			
Myrcianthes sp3			
Myrcianthes sp4			
Pouteria lucuma			
Rollinia mucosa			

Table 5-11. How edible non-crop plant species of Andean southern Ecuador are managed within the agricultural system

Sown	Transplanted	Planted
Allophylus mollis	*Agave americana*	*Acnistus arborescens*
Annona cherimola	*Allophylus mollis*	*Annona cherimola*
Capparis petiolaris	*Capparis petiolaris*	*Erythrina edulis*
Cyphomandra cajanumensis	*Inga fendleriana*	*Juglans neotropica*
Erythrina edulis	*Inga oerstediana*	*Opuntia ficus-indica*
Fourcroya sp.	*Inga spectabilis*	*Pradosia montana*
Inga fendleriana	*Inga striata*	*Vasconcellea candicans*
Inga insignis	*Passiflora ligularis*	*Vasconcellea* x *heilbornii*
Inga oerstediana	*Pouteria lucuma*	
Inga spectabilis		
Inga striata		
Juglans neotropica		
Markea sp.		
Muntingia calabura		
Passiflora ligularis		
Piper crassinervium		
Pouteria lucuma		
Pradosia montana		
Prunus serotina ssp. *capuli*		
Vasconcellea candicans		
Vasconcellea cundinamarcensis		
Vasconcellea monoica		
Vasconcellea x *heilbornii*		

Table 5-11. Continued

Tolerated		**Protected**
Acnistus arborescens		*Rubus floribundus*
Allophylus mollis	*Myrcianthes rhopaloides*	
Annona cherimola	*Myrcianthes* sp3	
Brassica napus	*Myrcianthes* sp4	
Bunchosia deflexa	*Myrcianthes* sp5	
Caesalpinia spinosa	*Myrcianthes* sp6	
Calyptranthes sp.	*Opuntia ficus-indica*	
Capparis petiolaris	*Passiflora matthewsii*	
Clavija euerganea	*Passiflora mixta*	
Coccoloba ruiziana	*Passiflora* cf. *mixta*	
Cyphomandra cajanumensis	*Physalis peruviana*	
Erythrina edulis	*Pourouma melinonii*	
Erythroxylum sp.	*Pouteria lucuma*	
Eugenia sp1	*Prestoea acuminata*	
Eugenia sp6	*Psidium guineense*	
Eugenia sp7	*Rollinia mucosa*	
Fragaria vesca	*Rubus floribundus*	
Grias peruviana	*Rubus glaucus*	
Hesperomeles ferruginea	*Rubus loxensis*	
Inga extra-nodis	*Rubus megalococcus*	
Inga fendleriana	*Rubus nubigenus*	
Inga insignis	*Rubus roseus*	
Inga nobilis ssp. *quaternata*	*Salpichroa diffusa*	
Inga oerstediana	*Saurauia bullosa*	
Inga striata	*Saurauia* sp1	
Jaltomata sp1	*Solanum americanum*	
Jaltomata sp2	*Solanum brevifolium*	
Juglans neotropica	*Solanum caripense*	
Macleania rupestris	*Solanum* sp14	
Macleania salapa	*Taraxacum* sp.	
Miconia lutescens	*Vasconcellea candicans*	
Micropholis venulosa	*Vasconcellea cundinamarcensis*	
Myrcia fallax	*Vasconcellea* x *heilbornii*	
Myrcianthes cf. *rhopaloides*	*Vasconcellea monoica*	
Myrcianthes fragrans	*Vasconcellea stipulata*	
Myrcianthes orthostemon	Gen. indet. (Liliaceae)	

Generally no cultural operations like pruning, pest control or fertilisation are performed on edible non-crop plants in Andean southern Ecuador, not even on the economically important species like *Annona cherimola*, *Vasconcellea* x *heilbornii*, *Vasconcellea cundinamarcensis*, *Juglans neotropica* and *Pouteria lucuma* (Scheldeman, et al. 2001).

5.9 Plant management patterns in Andean southern Ecuador

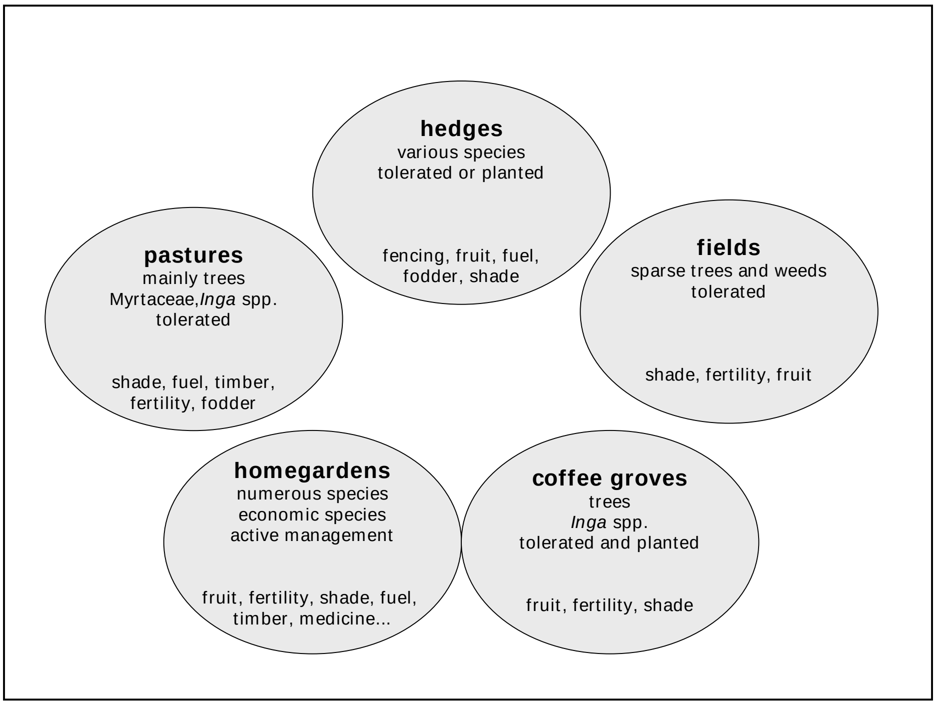


Figure 5-30. Schematic representation of the management of edible non-crop plants within the agricultural system in Andean southern Ecuador

Certain plant management patterns for Andean southern Ecuador emerge from the data (Fig. 5-30). In order to analyse these patterns statistically and to analyse whether certain management patterns exist for particular groups of plant species, all data on where, how and why edible plants are managed in Andean southern Ecuador, were summarised per species (Annex 3). Binary values (1/0) indicate in which agricultural or natural habitat each species was found (homegarden, pasture, field, hedge, coffee grove, roadside or natural vegetation), for which reason(s) a species is managed (fruit, fuel, timber, soil fertility, shade, hedging, fodder or other) and how it is managed (sown, tolerated, transplanted, planted or protected). The information for each species does not refer to one particular place, situation or informant, but reflects all management information obtained in Andean southern Ecuador for that particular species.

Clustering analysis

Various hierarchical clustering analyses were tested, using similarity matrices based on simple matching coefficients, Dice coefficients and Phi coefficients, and five different clustering analyses. The best result or best goodness of fit was obtained with the UPGMA clustering method and the simple matching coefficient. A cophenetic correlation r=84 indicates that the resulting dendrogram (Fig. 5-31) is a good representation (fit) of the real similarities of plant species (Rohlf 2000). Also the neighbour joining method combined with simple matching coefficient gave a good result (Fig 5-32).

In the dendrogram resulting from the UPGMA clustering analysis (Fig. 5-31), we can distinguish four main groups of managed plants. Group I are actively managed plants in hedges. Active management includes sowing, planting and transplanting. The large group II contains the majority of plant species, being primarily tolerated plants (more passive management). These plants can occur in all parts of the agricultural system (homegardens, pastures, hedges). Subgroups linked with certain agricultural areas can be identified within group II. Group III are actively managed plants in homegardens. Group IV are plant species actively managed in coffee groves (and homegardens).

In the dendrogram resulting from the neighbour joining clustering (Fig. 5-32), we can distinguish three main groups of managed plants. Group I are plants that are often actively managed (sown, planted, transplanted) in homegardens. Group II are plants primarily tolerated (sometimes actively managed) in homegardens. Group III are plants primarily tolerated in pastures or hedges. The desciptive characteristics for each group are the dominant characteristics. Many plant species have of course a multitude of management characteristics.

Better clustering results were obtained from the non-hierarchical K-means clustering. A 2-means clustering (around 2 centres) splits the 80 plants into a group of 18 actively managed plants (sown, planted or transplanted) and a group of 62 tolerated plants. Active or passive management seems therefore the main distinguishing characteristic for managed plants in the area.

Of all performed K-means clustering analyses, the best results were obtained with a 3-means and 4-means clustering. A 3-means clustering divides the plants into three groups: plants actively managed in homegardens; plants tolerated in homegardens; and plants tolerated in pastures (Table 5-12). A 4-means clustering divides the plants into: plants managed in coffee groves; plants tolerated in any part of the agricultural system; plants managed for fruit in homegardens; and plants tolerated in pastures (Table 5-13).

The two main separating characteristics for managed edible plant species therefore seem to be whether plants are tolerated or actively managed; and whether plants occur in homegardens (coffee groves) or not.

Ordination analysis

A principal co-ordinates analysis of the managed edible plant species matrix identifes the variables that contribute to the clustering of managed species. The best results were obtained by using the simple matching similarity coefficient for measuring similarities between plant species (Table 5-14). Principal co-ordinate 1 is characterised by tolerated plants, occurrence in natural vegetation and in pastures, and accounts for 40% of variation between species. Principal co-ordinate 2 is characterised by presence in homegardens, sown plants and absence in pastures, and accounts for 12% of variation between species. Principal co-ordinate 3 is characterised by presence in hedges and absence in pastures and accounts for 9% of variation between species. The principle co-ordinates analyses performed using the Dice and Phi coefficients, only yielded a variation of 33% and 31%, respectively, for the first principal co-ordinate, and were therefore not used.

Projection of the 80 plant species and 20 variables onto the two first principal co-ordinates axes visualises the dissimilarity (variation) between plant species (Fig. 5-33). Variation shown in this two-dimensional projection, is only 52% of total existing variation, which is fairly low. Most plant species are positioned on the right hand side of the graph (positive side of PC1). Variables that contribute most to variation between plants species are therefore: tolerating plants and presence of plants in natural vegetation and pastures. Presence in homegardens and hedges, management for fruit and management by sowing also contribute in some way to the variation between managed species. The remaining 13 characteristics contribute very little to variation between managed species.

The first principal co-ordinate does not divide the plants into different groups. Besides a few exceptions, most managed plant species are tolerated, occur in natural vegetation (apart from being managed) and in pastures (apart from being found in other areas). PC2, however, divides the plants in a group of plants found mainly in homegardens and sown (I), and a group of plants mainly found in pastures (II) (Fig. 5-33). PC3 divides the plants into a group of plants managed in hedges and a group of plants managed in pastures. Combining PC2 and PC3 therefore separates the managed plants in four main groups: plants that are mainly tolerated in pastures (I), plants tolerated in pastures and hedges (II), plants actively managed (sown) in homegardens and pastures (III), and plants actively managed in homegardens and hedges (IV) (Fig. 5-34). All managed plants have in common that they are likely to be found tolerated in pastures, and are also usually found in natural habitats.

Multidimensional scaling using eigenvectors as initial configuration was done onto various dimensions, resulting in stress values of 0.35 for two dimensions, 0.27 for three dimensions and 0.22 for four dimensions. By using a four- and three-dimensional multidimensional scaling as initial configuration for a two-dimensional multidimensional scaling, the stress could be reduced to 0.2. This stress results from the reduction of the multidimensional space (represented by 20 variables) to a two-dimensional space. A stress of 0.2 is a fair goodness of fit (Rohlf 2000).

In the projection of this analysis (Fig. 5-35) the Euclidean distances between points in the plot represent the similarities or dissimilarities between the plant species. The closer two points are, the more similar the management of the two plant species is. This projection therefore more realistically represents the true relationship between plants than the principal co-ordinates analysis projection. The two axes, however, have no metric meaning.

On the left-hand side of the projection, we see a fairly tight cluster of tolerated plants. This group of plant species shows a very similar management pattern. They are typically found as tolerated plants in pastures, homegardens or hedges, and are usually not managed in any other way (not sown or planted). In the top half we find the plants more likely to occur in homegardens, in the bottom half the pasture plants are grouped. On the right-hand side of the projection we find the plant species that are actively managed (sown, planted, transplanted) in homegardens or coffee groves. Here, plants are spaced much further apart, which means that their management is more individual. At the top we find the plants managed for their fruit in homegardens, at the bottom those managed in coffee groves.

Figure 5-31. Dendrogram indicating the similarity of managed plant species in Andean southern Ecuador, resulting from UPGMA clustering analysis based on simple matching similarity coefficients

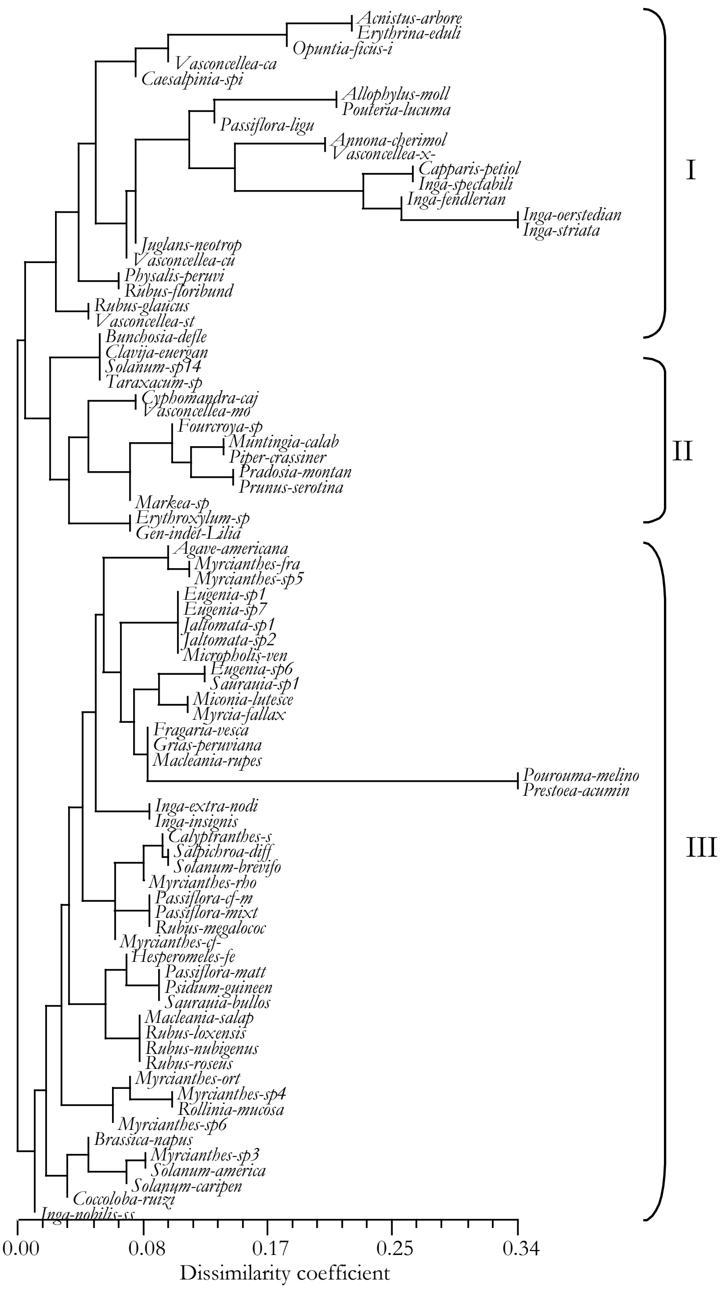


Figure 5-32. Dendrogram showing the similarity of managed edible plants in Andean southern Ecuador, resulting from neighbour joining unweighted clustering, using the simple matching similarity coefficient

Table 5-12. Three groups of managed edible plants in Andean southern Ecuador, obtained from 3-means clustering

Plants actively managed in homegardens	Plants tolerated in homegardens	Plants tolerated in pastures
Acnistus arborescens	*Bunchosia deflexa*	*Agave americana*
Allophylus mollis	*Caesalpinia spinosa*	*Brassica napus*
Annona cherimola	*Calyptranthes* sp.	*Coccoloba ruiziana*
Capparis petiolaris	*Clavija euerganea*	*Eugenia* sp1
Erythrina edulis	*Cyphomandra cajanumensis*	*Eugenia* sp6
Inga fendleriana	*Erythroxylum* sp.	*Eugenia* sp7
Inga oerstediana	*Fourcroya* sp.	*Fragaria vesca*
Inga spectabilis	*Hesperomeles ferruginea*	*Grias peruviana*
Inga striata	*Markea* sp.	*Inga extra nodis*
Juglans neotropica	*Muntingia calabura*	*Inga insignis*
Passiflora ligularis	*Myrcianthes* cf. *rhopaloides*	*Inga nobilis* ssp. *quaternata*
Pouteria lucuma	*Myrcianthes rhopaloides*	*Jaltomata* sp1
Pradosia montana	*Passiflora* cf. *mixta*	*Jaltomata* sp2
Vasconcellea candicans	*Passiflora mixta*	*Macleania rupestris*
V. cundinamarcensis	*Piper crassinervium*	*Macleania salapa*
Vasconcellea x *heilbornii*	*Prunus serotina* ssp. *capuli*	*Miconia lutescens*
	Rubus glaucus	*Micropholis venulosa*
	Rubus megalococcus	*Myrcia fallax*
	Salpichroa diffusa	*Myrcianthes fragrans*
	Solanum americanum	*Myrcianthes orthostemon*
	Solanum brevifolium	*Myrcianthes* sp3
	Solanum sp14	*Myrcianthes* sp4
	Taraxacum sp.	*Myrcianthes* sp5
	Vasconcellea monoica	*Myrcianthes* sp6
	Vasconcellea stipulata	*Opuntia ficus indica*
	Gen indet Liliaceae	*Passiflora matthewsii*
		Physalis peruviana
		Pourouma melinonii
		Prestoea acuminata
		Psidium guineense
		Rollinia mucosa
		Rubus floribundus
		Rubus loxensis
		Rubus nubigenus
		Rubus roseus
		Saurauia bullosa
		Saurauia sp1
		Solanum caripense

Table 5-13. Four groups of managed edible plants in Andean southern Ecuador, obtained from 4-means random clustering

Plants managed in coffee groves	Tolerated plants	Plants managed for fruit in homegardens	Plants tolerated in pastures
Capparis petiolaris	*Bunchosia deflexa*	*Acnistus arborescens*	*Agave americana*
Inga fendleriana	*Caesalpinia spinosa*	*Allophylus mollis*	*Brassica napus*
Inga oerstediana	*Calyptranthes* sp.	*Annona cherimola*	*Coccoloba ruiziana*
Inga spectabilis	*Clavija euerganea*	*Erythrina edulis*	*Eugenia* sp1
Inga striata	*Cyphomandra cajanumensis*	*Juglans neotropica*	*Eugenia* sp6
	Erythroxylum sp.	*Opuntia ficus indica*	*Eugenia* sp7
	Fourcroya sp.	*Passiflora ligularis*	*Fragaria vesca*
	Hesperomeles ferruginea	*Physalis peruviana*	*Grias peruviana*
	Markea sp.	*Pouteria lucuma*	*Inga extra nodis*
	Muntingia calabura	*Pradosia montana*	*Inga insignis*
	Myrcianthes cf. *rhopaloides*	*Prunus serotina* ssp. *capuli*	*Inga nobilis ssp quaternata*
	Myrcianthes rhopaloides	*Rubus floribundus*	*Jaltomata* sp1
	Passiflora cf. *mixta*	*Vasconcellea candicans*	*Jaltomata* sp2
	Passiflora mixta	*Vasconcellea cundinamarcensis*	*Macleania rupestris*
	Piper crassinervium	*Vasconcellea* x *heilbornii*	*Macleania salapa*
	Rubus glaucus		*Miconia lutescens*
	Rubus megalococcus		*Micropholis venulosa*
	Salpichroa diffusa		*Myrcia fallax*
	Solanum americanum		*Myrcianthes fragrans*
	Solanum brevifolium		*Myrcianthes orthostemon*
	Solanum sp14		*Myrcianthes* sp3
	Taraxacum sp.		*Myrcianthes* sp4
	Vasconcellea monoica		*Myrcianthes* sp5
	Vasconcellea stipulata		*Myrcianthes* sp6
	Gen indet Liliaceae		*Passiflora matthewsii*
			Pourouma melinonii
			Prestoea acuminata
			Psidium guineense
			Rollinia mucosa
			Rubus loxensis
			Rubus nubigenus
			Rubus roseus
			Saurauia bullosa
			Saurauia sp1
			Solanum caripense

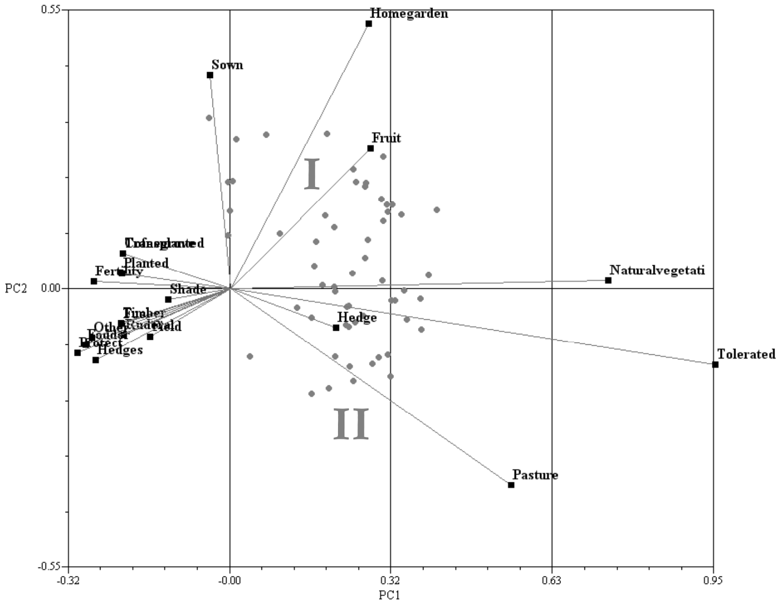


Figure 5-33. Projection of 80 managed plant species and 20 variables (bold) onto the two first principal co-ordinate axes (plant name labels not shown as it makes the plot visually unclear; coinciding dots show as one)

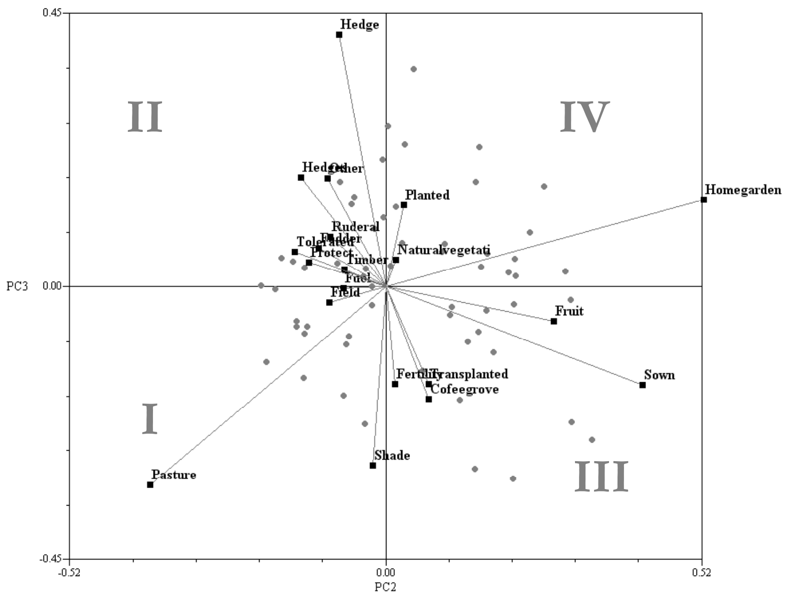


Figure 5-34. Projection of 80 managed species and 20 variables (bold) onto the second and third principal co-ordinate axes (plant name labels not shown as it makes the plot visually unclear; coinciding dots show as one)

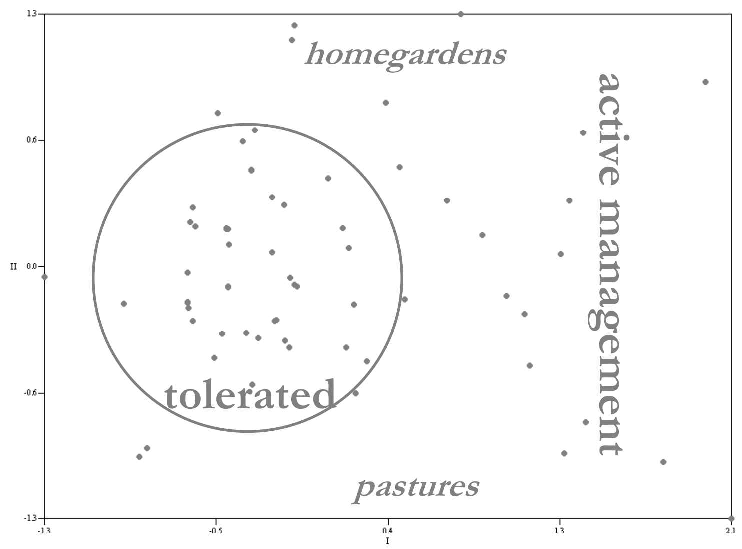


Figure 5-35. Projection of managed plants of Andean southern Ecuador in a reduced ordination space, resulting from non-metric multidimensional scaling (mds), using 4 and 3-dimensional nds as initial configuration for 2-dimensional mds; stress = 0.2 (plant name labels not shown as it makes the plot visually unclear; coinciding dots show as one)

Table 5-14. First three principal co-ordinates (eigenvectors) resulting from an eigenanalysis of 80 managed species in Andean southern Ecuador; contributions of each variable to the principal co-ordinates shows causes of variation amongst managed species (high values in bold)

Variables	PC1	PC2	PC3
Homegarden	0.27	**0.52**	0.14
Pasture	**0.55**	**-0.39**	**-0.33**
Field	-0.16	-0.09	-0.03
Hedge	0.21	-0.08	**0.42**
Cofeegrove	-0.21	0.07	-0.19
Ruderal	-0.21	-0.09	0.08
Naturalvegetati	**0.74**	0.02	0.04
Fruit	0.28	0.28	-0.06
Fuel	-0.21	-0.07	0.00
Timber	-0.22	-0.07	0.03
Fertility	-0.27	0.01	-0.16
Shade	-0.12	-0.02	-0.30
Hedges	-0.27	-0.14	0.18
Fodder	-0.29	-0.11	0.06
Other	-0.27	-0.10	0.18
Sown	-0.04	**0.42**	-0.16
Tolerated	**0.95**	-0.15	0.06
Transplanted	-0.21	0.07	-0.16
Planted	-0.21	0.03	0.13
Protect	-0.30	-0.13	0.04
% variation explained	40	12	9

Management patterns

Table 5-15 summarises the results of all performed multivariate analyses. We can conclude that there exist certain patterns within the group of managed edible plants in Andean southern Ecuador. The main distinction between plants is whether a plant is actively managed (sown, planted, transplanted), or whether it is passively managed (tolerated). A second distinguishing character is whether the plant is more likely to occur in homegardens or in pastures. Three main groups of managed plants exist in Andean southern Ecuador: plants actively managed in homegardens, plants tolerated in homegardens and hedges and plants tolerated in pastures and hedges (Table 5-16).

A high number of economic species, whose edible fruits are sold on markets *(Annona cherimola, Inga spectabilis, I. striata. I. oerstediana, Juglans neotropica, Opuntia ficus-indica, Passiflora ligularis, Pouteria lucuma, Vasconcellea cundinamarcensis, V.* x *heilbornii*) occurs amongst the plants actively managed in homegardens. Also trees used for shade in coffee groves (*Annona cherimola, Inga* spp.*, Capparis petiolaris, Erythrina edulis*) belong to this cathegory. Plants tolerated in pastures and hedges are often fuel and timber trees. Herbaceous plants belonging to this group are found in hedges, rather than in pastures.

Table 5-15. Summary of multivariate analyses on plant management in Andean southern Ecuador, showing management patterns

clustering		k-means clustering		principal co-ordinates analysis	multidimensional scaling
UPGMA	• coffee groves • hedges • active management in homegardens • tolerated	2 clusters	• active management • tolerated plants	dominant characters: pastures, tolerated, natural vegetation	tight cluster of tolerated plants (very similar)
neighbour joining	• active management in homegardens • tolerated in homegardens • tolerated in pastures and hedges	3 clusters	• active management in homegardens • tolerated in homegardens • tolerated in pastures	main dissimilarities between plants in homegardens and in pastures	loose cluster of actively managed plants (less similar)
		4 clusters	• coffee groves • tolerated in homegardens • managed for fruit in gardens • tolerated in pastures	dissimilarities between sown plants and tolerated plants; pasture and hedge plants	

Table 5-16. Main management patterns and corresponding species in Andean southern Ecuador

Plants actively managed in homegardens	Plants tolerated in homegardens and hedges	Plants tolerated in pastures and hedges
Allophylus mollis	*Acnistus arborescens*	*Agave americana*
Annona cherimola	*Brassica napus*	*Coccoloba ruiziana*
Capparis petiolaris	*Bunchosia deflexa*	*Eugenia* sp1
Erythrina edulis	*Caesalpinia spinosa*	*Eugenia* sp6
Inga fendleriana	*Calyptranthes* sp	*Eugenia* sp7
Inga oerstediana	*Clavija euerganea*	*Fragaria vesca*
Inga spectabilis	*Cyphomandra cajanumensis*	*Grias peruviana*
Inga striata	*Erythroxylum* sp	*Inga extra nodis*
Juglans neotropica	*Fourcroya sp*	*Inga insignis*
Muntingia calabura	Gen indet Liliaceae	*Inga nobilis* ssp *quaternata*
Opuntia ficus-indica	*Hesperomeles ferruginea*	*Jaltomata* sp1
Passiflora ligularis	*Physalis peruviana*	*Jaltomata* sp2
Piper crassinervium	*Rubus glaucus*	*Macleania rupestris*
Pouteria lucuma	*Rubus megalococcus*	*Macleania salapa*
Pradosia montana	*Salpichroa diffusa*	*Miconia lutescens*
Prunus serotina ssp *capuli*	*Solanum americanum*	*Micropholis venulosa*
Rollinia mucosa	*Solanum brevifolium*	*Myrcia fallax*
Vasconcellea candicans	*Solanum* sp14	*Myrcianthes* cf *rhopaloides*
Vasconcellea cundinamarcensis	*Taraxacum* sp	*Myrcianthes fragrans*
Vasconcellea x *heilbornii*	*Vasconcellea monoica*	*Myrcianthes orthostemon*
	Vasconcellea stipulata	*Myrcianthes rhopaloides*
		Myrcianthes sp3
		Myrcianthes sp4
		Myrcianthes sp5
		Myrcianthes sp6
		Passiflora cf *mixta*
		Passiflora matthewsii
		Passiflora mixta
		Pourouma melinonii
		Prestoea acuminata
		Psidium guineense
		Rubus floribundus
		Rubus loxensis
		Rubus nubigenus
		Rubus roseus
		Saurauia bullosa
		Saurauia sp1
		Solanum caripense

5.10 Patterns based on individual management events

The same clustering and ordination analyses were performed on a matrix containing all recorded management events. Every time information on the management of one particular plant species was recorded from one informant or in one place, it formed a separate entry in the matrix. Various events therefore exist for each plant species. The variables are the same as in the previous matrix, except that the occurrence of plants in natural vegetation was omitted. This results in a matrix with 250 plant management events and 19 variables, containing presence/absence data.

Neighbour joining clustering forms five main clusters of management events: plants tolerated in pastures and hedges; ruderal plants (along roasides); plants managed for fruit in homegardens; plants sown for fruit in homegardens; and plants sown in homegardens for other reasons. UPGMA clustering analysis distinguishes five different groups of management events: plants managed in pastures; plants managed in hedges and fields; plants sown in homegardens; plants tolerated or planted in homegardens and plants managed in various ways. The cophenetic correlation of this clustering is only 0.76, which is a poor fit of the reality (Rohlf 2000). The dendrograms are not shown as they are not visually comprehensive with 250 management events.

Non-hierarchical 2-means clustering (around 2 centres) splits the 250 plant management events into a group of plants tolerated in pastures and a group of plants managed in homegardens (sown and tolerated). The main distinguishing management characteristic, when considering individual management events, is therefore the place (homegarden or pasture) where a plant is managed. Three-means clustering divides the plants into three groups: plants sown for fruit in homegardens; plants tolerated in homegardens and plants tolerated in pastures. Four-means clustering divides the plants into: plants managed in homegardens; plants managed in hedges;plants managed for fruit in homegardens (sown or tolerated); and plants tolerated in pastures (Table 5-17).

Principal co-ordinates analysis, projected into a two-dimensional space, accounts for only 48% of existing variation amongst management events (Fig. 5-36). Principal co-ordinate 1 is characterised by tolerated plants and occurrence in homegardens, and accounts for 27% of variation (Table 5-18). Principal co-ordinate 2 is characterised by presence in homegardens, absence in pastures and plants that are not tolerated, and accounts for 21% of variation (Table 5-18). In the graph most plant species are positioned on the right hand side (positive side of PC1). The variables that contribute mostly to variation between management events are therefore: tolerating plants, presence of plants in homegardens and/or in pastures. Management for fruit and management by sowing also contribute in some way to the variation in plant management. The remaining characteristics (variables) contribute very little to variation. Management events are divided into three main groups. A first group of plants are mainly found in homegardens, where they are sown and managed for fruit (I). A second group of plants occur in homegardens and pastures and are mainly tolerated and managed for fruit (II). A third group of plants are absent from homegardens and pastures, are not managed for fruit, but for other reasons (III).

The projection resulting from a multi-dimensional scaling analysis shows the 250 plant management events in a two-dimensional space (Fig. 5-37). Since coinciding dots cover each other, many dots in the figure correspond to more than one event. Euclidean distances between points in the plot represent the similarities or dissimilarities between the plant species. The closer two points are, the more similar the management of the two plant species is. Two relatively tight clusters can be identified: a group of plants tolerated or sown for fruit in homegardens (I) and a group of plants tolerated in pastures (and hedges) (II). Outliers outside these clusters are plants managed for reasons other than for fruit, plants managed in other areas (not gardens or pastures) and plants managed by (trans)planting. The stress resulting from the reduction of the multidimensional space (of 19 variables) to a 2-dimensional space is 0.4, which gives a poor goodness of fit.

The clustering and ordination analyses of the 250 management events all yield poor statistical results. There are therefore no clear management patterns to derive from these data. The vague patterns that can be extracted from individual management events are summarised in Table 5-19.

The main factors separating management events are management of a plant in homegardens or in pastures, and whether a plant is tolerated or sown. Three main groups of plants can be distinguished: i.e. plants tolerated or sown for fruit in homegardens; plants tolerated in pastures; and plants managed in hedges. Lists of these plants correspond to the plants listed in Tables 5-5, 5-6 and 5-8.

When comparing these results with the results of multivariate analyses of plant species (5.9), we can conclude that the place where plants are managed within the agricultural system influences why and how the plants are managed. Plants in homegardens are mainly managed for their fruits (or other edible parts), and can be tolerated or actively planted or sown. Plants in pastures are mainly tolerated for various reasons. They are often trees, belonging to the families Myrtaceae, Mimosacaea and Sapotaceae. Plants in hedges are mainly tolerated. They are trees, shrubs, vines and herbaceous plants.

Table 5-17. Four groups of managed plants, obtained from 4-means clustering of 250 management events

Plants managed in homegardens	**Plants managed in hedges**	**Plants tolerated in pastures**	**Plants tolerated or sown for fruit in homegardens**
Acnistus arborescens	*Acnistis arborescens*	*Agave americana*	*Annona cherimola*
Allophylus mollis	*Agave americana*	*Anthurium* sp9	*Capparis petiolaris*
Annona cherimola	*Allophylus mollis*	*Bomarea* sp2	*Inga fendleriana*
Brassica napus	*Annona cherimola*	*Brassica napus*	*Inga oerstediana*
Bunchosia deflexa	*Caesalpinia spinosa*	*Centropogon erianthus*	*Inga spectabilis*
Caesalpinia spinosa	*Calypthranthes* sp1	*Clidemia sericea*	*Inga striata*
Capparis petiolaris	*Disterigma pentandrum*	*Coccoloba ruiziana*	*Passiflora ligularis*
Ceroxylon vogelianum	*Erythrina edulis*	*Eugenia* sp1	*Pouteria lucuma*
Clavija euerganea	*Gaultheria erecta*	*Eugenis* sp6	*Vasconcellea candicans*
Coccoloba ruiziana	*Hesperomeles ferruginea*	*Eugenis* sp7	
Cyphomandra cajanumensis	*Inga insignis*	*Fragaria vesca*	
Erythrina edulis	*Inga marginata*	*Grias peruviana*	
Erythroxylum sp1	*Inga oerstediana*	*Inga extra-nodis*	
Eugenia sp3	*Inga spectabilis*	*Inga fendleriana*	
Inga fendleriana	*Inga striata*	*Inga insignis*	
Inga spectabilis	*Juglans neotropica*	*Inga marginata*	
Inga striata	*Muntingia calabura*	*Inga nobilis spp. quaternata*	
Juglans neotropica	*Myrcia fallax*	*Inga oerstediana*	
Markea sp1	*Myrcianthes* cf. *orthostemon*	*Inga striata*	
Muntingia calabura	*Myrcianthes rhopaloides*	*Jaltomata* sp1	
Opuntia ficus-indica	*Myrcianthes* sp5	*Jaltomata* sp2	
Passiflora cf. *mixta*	*Passiflora luzmarina*	*Juglans neotropica*	
Passiflora ligularis	*Passiflora matthewsii*	*Macleania salapa*	
Physalis peruviana	*Physalis peruviana*	*Miconia lutescens*	
Pouteria lucuma	*Pouteria lucuma*	*Micropholis venulosa*	
Prunus serotina ssp. *capuli*	*Psidium guineense*	*Myrcia fallax*	
Rubus floribundus	*Rubus bogotensis*	*Myrcianthes* cf. *rhopaloides*	
Rubus glaucus	*Rubus compactus*	*Myrcianthes fragrans*	
Solanum americanum	*Rubus floribundus*	*Myrcianthes* sp.	
Solanum sisymbriifolium	*Rubus peruvianus*	*Myrcianthes* sp3	
Solanum sp14	*Rubus urticifolius*	*Myrcianthes* sp4	
Taraxacum sp.	*Salpichroa diffusa*	*Myrcianthes* sp6	
Vasconcellea candicans	*Solanum americanum*	*Opuntia ficus-indica*	
V. cundinamarcensis	*Solanum brevifolium*	*Opuntia quitensis*	
Vasconcellea monoica	*Solanum caripense*	*Oreanthus* sp1	
Vasconcellea stipulata	*Solanum* sp1	*Otholobium* sp1	
Vasconcellea x *heilbornii*	*Sphyrospermum cordifolium*	*Passiflora ligularis*	
Gen. indet. Liliaceae	*Vaccinium crenatum*	*Passiflora matthewsii*	
Gen. indet. Verbenaceae		*Passiflora mixta*	
		Physalis peruviana	
		Pouteria lucuma	
		Prestoea americana	
		Psidium guineense	
		Psidium salutare	
		Rollinia mucosa	
		Rubus azuayensis	
		Rubus floribundus	
		Rubus loxensis	
		Rubus nubigenus	
		Rubus roseus	
		Saurauia bullosa	
		Saurauia sp1	
		Solanum caripense	
		Solanum sp10	
		Solanum sp9	
		Vasconcellea cundinamarcensis	
		Vasconcellea x *heilbornii*	
		Gen. indet. Theaceae	

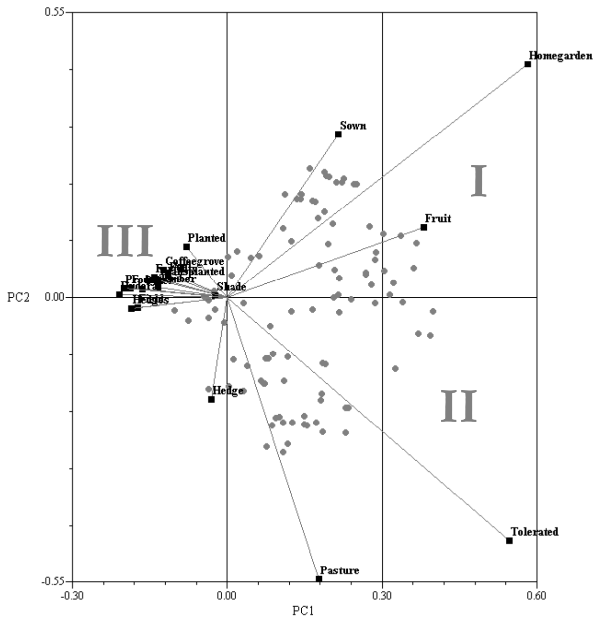


Figure 5-36. Projection of 250 plant managements events and vectors of variables into the two principal co-ordinates axes; explains only 48% of existing variation (plant name labels not shown as it makes the plot visually unclear; coinciding dots show as one)

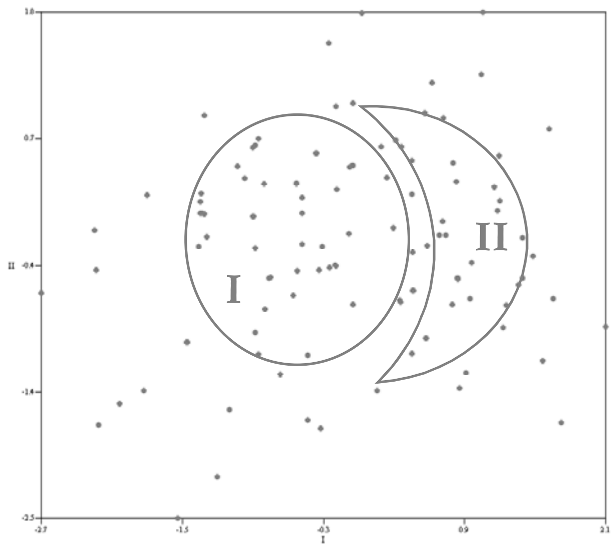


Figure 5-37. Projection of 250 plant management events in southern Ecuador in a reduced ordination space, as a result of non-metric multidimensional scaling onto 2 dimensions, stress = 0.4 (plant name labels are not shown as it makes the plot visually unclear; coinciding dots show as one)

Table 5-18. First three principal co-ordinates (eigenvectors), resulting from an eigenanalysis of 250 management events in Andean southern Ecuador (using the simple matching similarity coefficient); the contribition of each of the variables to the principal co-ordinates shows which variable contributes most to variation amongst management events (high contributing values are in bold)

Variables	PC1	PC2	PC3
Homegarden	**0.58**	**0.45**	0.08
Pasture	0.18	**-0.54**	**-0.40**
Field	-0.17	-0.02	0.03
Hedge	-0.03	-0.20	**0.39**
Cofeegrove	-0.12	0.05	-0.05
Ruderal	-0.21	0.01	0.01
Fruit	**0.38**	0.14	-0.09
Fuel	-0.12	0.04	-0.03
Timber	-0.13	0.02	-0.03
Fertility	-0.14	0.04	-0.04
Shade	-0.02	0.00	-0.09
Hedges	-0.19	-0.02	0.05
Fodder	-0.19	0.02	0.01
Other	-0.16	0.02	0.01
Sown	0.22	**0.32**	-0.20
Tolerated	**0.55**	**-0.47**	0.23
Transplanted	-0.14	0.03	-0.02
Planted	-0.08	0.10	0.14
Protect	-0.20	0.02	0.01
% variation explained	27	21	11

Table 5-19. Summary of multivariate analyses of plant management events in Andean southern Ecuador

Clustering (poor fit)		K-means clustering		Principal co-ordinates analysis (poor fit)	Multidimensional scaling (poor fit)
UPGMA	• Pastures • hedges and fields • sowing in homegardens • tolerating and planting in homegardens • various management methods	2 clusters	• pastures • homegardens	dominant characters: homegardens, tolerated, pastures	2 tight clusters: • plants managed for fruit in homegardens • plants tolerated in pastures
neighbour joining	• plants tolerated in pastures and hedges • ruderal plants • plants managed for fruit in homegardens • plants sown for fruit in homegardens • plants sown in homegardens	3 clusters	• sown for fruit in homegardens • tolerated in homegardens • tolerated in pastures	main dissimilarities between tolerated and sown plants	loose outliers: • plants managed for reasons other than for fruit • plants managed in other areas • plants planted or transplanted
		4 clusters	• homegardens • hedges • tolerated in pastures • tolerated and sown for fruit in homegardens	dissimilarities between plants solely managed in homegardens and plants managed in homegardens and/or pastures	

5.11 Plant management in different agro-regions of southern Ecuador

Because plant management is an integral part of agriculture, we can see how management varies according to the type of agricultural production system in an area. Seven main agro-regions with homogeneous characteristics of ecology, agricultural history and production system can be identified in Andean southern Ecuador (Table 1-6; Table 5-22). When considering all plant management data that were recorded within each agro-region, some interesting patterns emerge (Table 5-20).

In the agro-regions Centro Loja-Playas and Cariamanga-Amaluza, intensive and varied plant management takes place. Agriculture here is dominated by the growing of arable crops (mainly maize, also peanut, manioc, wheat and other crops) and traditional coffee. These Andean areas have been cultivated for centuries, have a dry climate and relatively few forest remnants. Many different species of edible plants are managed in all parts of the agriculural system. Active and passive management takes place. Many managed species are trees and have economic fruits.

In the humid agro-regions Chilla-Uzhcurrumi and Zamora, which have only been colonised over the last 70 years, managed plants are mainly tolerated in pastures. Relatively few managed species were recorded here. Agriculture is dominated by cattle farming, with some arable crops in the Chilla-Uzhcurrumi region.

In areas where cattle farming predominates, relatively few managed plant species are found within the agricultural system, many of them are herbaceous plants or vines, few are trees. Most managed plants are tolerated, rather than actively introduced.

These patterns are obviously influenced by the fact that the prevailing production sytems in an area determines the composition of the different parts of the agricultural system. In cattle farming areas, pastures are abundant and little attention is given to the production in homegardens. In coffee growing areas, coffee groves form an important part of the agricultural system, where many native plants are managed.

Table 5-20. Plant management characteristics in different homogeneous agro-regions of Andean southern Ecuador

Agro-region	Main agriculture characteristics	Field sites	Management characteristics
Centro Loja-Playas	arable crops maize coffee	Catacocha Lauro Guerrero Celica Huachanamá	in all parts of agricultural system tolerated, sown, (trans)planted plants managed for various reasons
Cariamanga-Amaluza	arable crops maize coffee	Cariamanga Sozoranga Amaluza	in all parts of agricultural system tolerated, sown plants managed for fruit, shade
Yangana-Malacatos	arable crops sugarcane	Sacapo Nambacola	in all parts of agricultural system tolerated, sown, (trans)planted plants managed for fruit
Chilla-Uzhcurrumi	recent colonisation arable crops cattle	Paccha Chilla	in pastures and homegardens tolerated, sown plants
Loja	cattle	Chuquiribamba Uritusinga	in pastures and hedges tolerated and sown plants
Saraguro	Cattle arable crops	Santiago Gualel San Lucas Sevillán	in pastures, hedges, fields, homegardens tolerated and sown plants managed for fruit, fuel
Zamora	recent colonisation cattle timber logging	Sabanilla Quebrada Honda	in pastures tolerated plants managed for shade

Table 5-20. Continued

Managed edible species
many tree species many economic species *Annona cherimolia*, *Inga* spp., *Vasconcellea* spp., *Pouteria lucuma*, *Opuntia ficus-indica*, *Capparis petiolaris*, *Juglans neoptropica*, Myrtaceae,…
many tree species *Annona cherimolia*, *Inga* spp., *Vasconcellea* spp., *Pouteria lucuma*, *Juglans neotropica*, *Agave americana, Opuntia ficus-indica,* …
mostly tree species few species *Annona cherimolia*, *Inga striata*, *Vasconcellea* spp., *Opuntia ficus-indica*
few species herbaceous species and trees *Passiflora* spp., *Juglans neotropica, Pouteria lucuma, Inga* spp., *Prestoea acuminata,* Myrtaceae
few trees some economic species *Rubus* spp., *Passiflora* spp., *Agave americana, Vasconcellea* spp., *Juglans neotropica, Pouteria lucuma, Annona cherimolia*
few trees herbaceous species and vines *Rubus* spp., *Passiflora* spp., Solanaceae
few species *Inga* spp.

5.12 Conclusions

Many edible non-crop plants used in southern Ecuador are collected from disturbed and agricultural habitats, rather than from natural habitats. This indicates that the agricultural area is an importante source of non-crop plants. Plant management is the term used to indicate a range of plant manipulations by people, that makes plants distinct from strictly wild plants and domesticates. Moreover, plant management does not necessarily imply the evolution of a plant to a state of domesticated plant. Various plant management practices were found in Andean southern Ecuador. Only management that takes place within the agricultural area and that focuses on individual plant species was studied. Tolerating a plant that has grown spontaneously in a certain place means that the plant is not removed from the habitat, when other plants are. Some non-crop plants are sown from seeds, planted from cuttings, or transplanted as a wild seedling, and thus actively introduced into the agricultural system. Although this implies some form of cultivation, it does not make the plant a crop. Crops are strictly those plants that have been domesticated.

The fact that plants are managed means that they somehow stand out from the large pool of wild plant resources in the area. They are resources that have a certain meaning or value(s) to the farmer and are therefore looked after more than wild plants are. Management decisions are very individual (Alcorn 1982) and dynamic in time, as are use decisions. A plant managed by one farmer is not necessarily managed by anyone else. Similarly, one particular plant species may be managed in different ways by different people, and its management may change in time. *Annona cherimola* for example can be found almost anywhere in the agricultural system in Andean southern Ecuador. In one place it was found tolerated in a hedge, in another place planted in a homegarden, in yet another place tolerated in a field, and it is often found just wild in remnants of secondary vegetation in *quebradas*. Similar examples can be given for many of the 80 plant species that were recorded as being managed in the area. Despite this individualistic character of plant management, certain patterns can be seen throughout the area, both in terms of where in the agricultural system the plants are managed, which edible species are managed and why.

Economic value is one reason for managing a plant. Although edible plants in southern Ecuador have little economic importance, those that are sold in markets are always managed. This also shows that economic value is not necessarily a reason for a plant to become a domesticated crop. Certain native species with economic importance have been domesticated, whereas others are managed. Again, these economic species may be found managed in a variety of ways in the area. *Annona cherimola* is the most important economic species in southern Ecuador. Despite the fact that this species is domesticated in many countries around the world, it is only found managed or wild in Andean southern Ecuador (Scheldeman et al. 2001).

Subsistence uses are other reasons for plants to be managed. The fact that we concentrated this study on edible plants means that the edibility of a species can be one important reason for a plant to be managed. But that is only the case for less than half of the 80 species studied. Especially in the case of trees, the use of a plant as shade, for fuel and for timber are important reasons for managing the tree. Other reasons for edible plants to be managed within the agricultural area are for improving soil fertility, for fencing and for fodder.

Plant management practices differ according to the place within an agricultural system. Each component has its characteristics of which species, how many species, how and why they are managed. Plant management is usually most intense nearer the houses. It is particularly common in homegardens. On average thirty seven percent of all plants in homegardens in Loja province are managed. They are often managed for food provision and/or for a range of uses (multipurpose plants). Various managed edible species found in homegardens in Andean southern Ecuador are actively sown, planted or transplanted there. Homegardens form the main part of the agricultural system where plants are activily introduced. In most other places they would be simply tolerated. High numbers of economic species and plants managed primarily for their fruits are found in homegardens. Plants managed for fuel, timber and shade are usually tolerated. This shows that the homegardens in Andean southern Ecuador have the characteristics found in homegardens throughout the tropics (Alcorn 1990; Fernandes & Nair 1986; Gajaseni & Gajaseni 1999). Coffee groves are one type of homegarden on the western Andes slopes below 2000 m where many native fruit trees, especially *Inga* species, are managed to provide shade for coffee shrubs. Half the shade trees in coffee groves are managed edible plants. Their fruits and beneficial influence on soil fertility are other reasons to manage trees in coffee groves.

Few edible plants are managed in fields, both in terms of number of species and number of plants per field. Those that are, are trees tolerated for shade or for improving soil fertility, as well as some edible or medicinal weeds.

Many different tree species are tolerated in pastures, but again the numbers are fairly low. They are not so much managed for their edible fruits, but rather to provide shade, soil fertility, fodder, fuel and timber.

Edible plants may be tolerated or sown and planted in hedges. Apart from their role as fencing, they may also provide fuel, fodder, shade and fruits.

All management patterns encountered are very similar to those observed throughout the tropics in areas where subsistence agriculture predominates (Fernandes & Nairn 1986, Campbell et al. 1991; Walter 1996).

A significant preference for managing trees, compared to other plant life forms, was noticed in the area. Moreover, it are mainly trees that are actively managed by sowing, planting are transplanting them in homegardens or coffee groves. Managed herbaceous plants, vines and shrubs are usually tolerated. Certain plant families are preferred too. Caricaceae, Mimosaceae, Myrtaceae and Solanaceae are favoured in terms of plant management. Many Caricaceae have economic species (wild pawpaws) and are usually managed in homegardens and fields. Mimosaceae are particularly favoured as shade trees for coffee, in gardens and in pastures. Myrtaceae are frequently found as tolerated trees in pastures for their good fuelwood and shade. Solanaceae are mainly managed for their edible fruits. Ericaceae, Melastomataceae and Passifloraceae are relatively under-represented amongst managed edible species.

When analysing whether specific management strategies exist for certain edible plant groups, major distinctions were found between plants that are actively managed and those that are tolerated; and between plants managed in pastures or in homegardens. Three main management strategies emerge for edible plants in Andean southern Ecuador. Certain plants are primarily actively managed in homegardens. These are frequently multipurpose trees with edible fruits that are managed in coffee groves or other types of homegardens, like *Annona cherimola*, *Capparis petiolaris*, *Inga* spp., *Juglans neotropica*, *Pouteria lucuma* and *Vasconcellea* spp. Many are economic species. Other plants are primarily tolerated in homegardens and hedges. These are non-economic species and are mostly herbaceous plants, vines and shrubs, with edible fruits, leaves or flowers. Examples of common species are *Acnistus arborescens*, *Clavija euerganea*, *Cyphomandra cajanumensis*, *Physalis peruviana* and *Solanum americanum*. A last group of plants are mainly tolerated in pastures and hedges. These are trees and shrubs tolerated for fuelwood and timber, like *Inga* species and Myrtaceae, or vines tolerated for their fruits in hedges along pastures, like *Rubus* and *Passiflora* species. Most have minor edible fruits, although some are marketed. No specific management patterns stand out for the three different types of homegardens that can be distinguished in the area: coffee groves, native fruit tree gardens and vegetable and medicine gardens.

Plant management is also stronlgy influenced by the agricultural production system in an area. The dry western Andean slopes, where arable cropping and coffee production predominate, are characterised by diverse plant management within all parts of the agricultural habitat. Active and passive management of many different plant species (many of them trees) can be seen here. Many of them have fruits that are sold at markets. *Annona cherimolia*, *Capparis petiolaris, Inga* species, *Juglans neotropica, Opuntia ficus-indica, Pouteria lucumaa* and *Vasconcellea* species are the species are are most commonly managed here.

Relatively few plant species are managed in recently colonised Andean areas, where cattle farming predominates. Trees like *Juglans neotropica*, *Pouteria lucuma*, *Prestoea acuminata, Inga* species and various Myrtaceae species; as wel as *Passiflora* species and other herbaceous plants may be tolerated in pastures and homegardens.

Generally, plant management is more widespread in areas where arable crops predominate than in cattle farming areas.

Similar comparative studies of management patterns throughout the agricultural system were not found to exist in Ecuador or other tropical regions.

This research shows clearly that non-indigenous mestizo farmers practice interesting and intrinsic forms of plant management within their traditional production systems, similar to results found in Peru (Padoch et al. 1985; Padoch & De Jong 1991). In Andean southern Ecuador, it was however not possible to make comparisons with indigenous plant management practices.

6 Local names of edible plants[7]

…hay muchas clases de mora aqui….
…la mora de los pajones es planta chiquita…
…la mora piña tiene fruto rojo, como frambuesa…
…la mora de pepa es pura pepa, no vale para comer…
…la mora grande la vendemos en Loja…ésta carga en Mayo…
…la mora pequña carga todo el año…
…la mejor de todas es la mora grande de jugo…
Jova Gordilla, Santiago
(on various *Rubus* species)

Local plant names can tell us a lot about how plants are viewed within a given culture. The purpose of plant names is for people to communicate about and make sense of the natural world around them and the relationships that exist within it. A plant's name may be based on its cultural or utilitarian meaning, on its morphological characteristics or on its ecology (Berlin 1992). It carries linguistic information and can reveal historical plant exchanges that may have occurred (e.g. plant introductions) or different linguistic influences in an area through human (im)migrations. A name can also indicate the plant's similarity to other plants.

Certain universal structures in the naming of plants can be found throughout all languages and societies (Berlin 1992). Two basic types of common plant names exist: primary and secondary names. Primary names are usually a simple expression (e.g. oak), but can occasionally be complex (e.g. meadowsweet). Secondary names are complex (binomial) and occur in sets of contrasting names, indicating the hierarchical relation of plant taxa (e.g. white clover and red clover). The contrasting descriptors refer often to a plant's characteristics, distribution or use and usually serve to distinguish a plant from related similar plants. Folk generic taxa usually have primary names, whereas subordinate folk specific taxa have secondary names. Some folk specific taxa, however, are referred to by primary names. This is usually when the plant is culturally important. Cultural importance means that the plant is cultivated or managed or has an important use or value within the culture.

One-to-one relationships between common names and scientific names do not always exist. Sometimes one common name refers to various botanical species (under-differentiated) and sometimes one species is referred to by various common names, showing further subdivision (over-differentiated) (Berlin 1992).
Whilst plant naming is a universal phenomenon with universal characteristics, it is at the same time very individual and culture-specific. Not only are regional

[7] Submitted to the Journal of Ethnobiology as the article "*Of climbing peanuts and dog's testicles, mestizo and Shuar plant nomenclature in Ecuador*", and accepeted for publication.

differences in plant names very common, but also individual people within a limited area or group may not always agree on the names given to a specific plant (Sillitoe 1980). Different common names may be given to one plant or names of related plants may be intermingled.

The large number of plant names (411 names for 354 species) that was recorded throughout southern Ecuador (Annex 1), combined with information on where they were recorded and how often they were recorded, provides a unique opportunity to analyse how indigenous and non-indigenous people in the area name plants. The linguistics, meanings, structure and variation of plant names are analysed here.

Various cultural and linguistic influences exist in the area, due to historical conquests and immigrations. The main linguistic influences that can be traced today are Spanish, Quichua and Shuar. Shuar language is spoken by the Shuar people. Saraguros are the only Quichua-speaking community in southern Ecuador. Spanish is the official language of Ecuador today and is the dominant language in our study area, spoken by all mestizo people. Pre-Inca languages like Cañari, Palta and Malacatos do not survive today and no written records of them exist (Harner 1984; Jaramillo 1991; Taylor 1991).

Two major groups of local plant names can be distinguished, Shuar plant names and mestizo plant names. Shuar plant names are almost exclusively used by Shuar people (in the easternmost part of southern Ecuador). All other plant names are grouped together as mestizo names, although various linguistic influences are found in these names.

6.1 Mestizo plant names

A total of 328 mestizo plant names of edible non-crop plants were recorded in southern Ecuador. They correspond to 305 botanical taxa. The names were recorded in 42 sites and in each site with various informants. The plant names therefore represent the collective knowledge of many individuals, living in a large area. All plant names mentioned were included in the list, regardless of how often they were mentioned.

Spanish dominates mestizo plant nomenclature. Forty-one percent of all plant names in the area are entirely or partly Spanish. Other linguistic influences easily identified are Shuar and Quichua. The linguistic origins or meaning of some plant names remain obscure.

Plant naming mechanisms

Historical and recent human population movements play an important role in the way plants in southern Ecuador are named. Spanish colonisers arriving in the area 500 years ago had to name plants that were unknown and unfamiliar to them, a process that still continues to this day as mestizo farmers colonise new areas in the humid coastal and Amazonian regions. Generally three mechanisms of naming plants exist among immigrants: transposition, borrowing and neology (Grenand 1995). Transposition is the naming of new plants using names of plants already known, that are similar in use or appearance. Plant names may also be borrowed from indigenous languages. Sometimes they are altered and adapted to fit the newcomers' own language and pronunciation. Neology is the coining of completely new names for plants. These neologisms are often very descriptive, referring to the appearance or use of a plant. All three naming mechanisms can be seen in the mestizo plant names recorded in southern Ecuador.

Transposition

Many names of edible non-crop plants in the study area refer to a known plant (Table 6-1) and are therefore formed through transposition. This is either because the native plant or its fruit looks similar to the known plant, or because its use is similar. The two plants need not be botanically related. For example, various purple and black berries are called *uva* (grape) or a derived name like *uva silvestre* 'wild grape', *uvilla* 'small grape' and *uva de montaña* 'mountain grape' or 'wild grape'. Various plants with edible seeds that are roasted and eaten like peanuts are called *maní* 'peanut'. Examples are *maní de árbol* 'tree peanut', *maní de bejuco* 'climbing peanut' and *maní del monte* 'wild peanut'. Almost all edible leaves are called *col de monte* 'wild cabbage', but the only thing they have in common with cabbages is the fact that their leaves are eaten and prepared like cabbages.

Often a descriptor is added to the name, indicating that the plant is a wild form. This can be *silvestre* (wild), *del monte* (from shrubland, wasteland or forest, as opposed to from cropland), *del campo* (from the countryside, as opposed to from an agricultural area) or the Quichua word ***sacha*** (see below). A diminutive form (*cafecillo*, *uvilla*) or augmentative form (*papayón*) may be used, thus comparing the native plant's size to that of the known plant. Adjectives or descriptors describing the plant's appearance are also sometimes added, for example in *maní de bejuco* 'climbing peanut' and *manzana rastrera* 'creeping apple'. Forty-four recorded mestizo plant names (of 328) are formed through transposition (Table 6-1). Not all plant names that refer to another plant are formed by transposition' however. When both plants belong to the same genus, names are not considered to be cases of transposition. The name *granadilla de monte* 'wild passionfruit' given to *Clavija pungens*, is an example of transposition. The same name, however, given to

Table 6-1. Mestizo names of edible plants in southern Ecuador, formed through transposition

Spanish name	Meaning	Scientific name
almendro, *almendra*[1]	almond	*Geoffroea spinosa*
		Pentagonia sp.
berenjena	eggplant	*Vasconcellea monoica?*
cacao de monte	wild cocoa	*Pachira aquatica*
cafecillo	small coffee	*Tabernaemontana columbiensis*
caña agria	bitter cane	*Costus scaber*
cerezo, *cereza*[1]	cherry	*Malpighia emarginata*
		Muntingia calabura
choclito	small corn cob	*Lantana* sp.
ciruela	plum	*Bunchosia deflexa*
ciruela de fraile	monk's plum	*Malpighia emarginata*
ciruela de monte	wild plum	*Spondias mombin*
col de monte	wild cabbage	*Anthurium* spp.
		Vasconcellea microcarpa
coquillo, *coquito*	small coconut	*Cyperus* sp.
granadilla de monte	wild granadilla[2]	*Clavija pungens*
higo	fig	*Jacaratia spinosa*
higuerón	large fig	*Ficus* aff. *andicola*
maní de árbol	tree peanut	*Caryodendron orinocense*
maní de bejuco	climbing peanut	*Cayaponia capitata*
maní del monte	wild peanut	*Caryodendron orinocense*
manzana	apple	*Pernettya prostrata*
		Vaccinium floribundum
manzana rastrera	creeping apple	*Vaccinium crenatum*
manzana silvestre	wild apple	*Malpighia emarginata*
manzanilla	small apple	*Vaccinium floribundum*
membrillo silvestre	wild quince	*Eugenia stipitata* ssp. *sororia*
mora	blackberry	*Clidemia hirta* var. *hirta*
		Clidemia sp.
naranjilla del campo, *naranjilla silvestre*	wild naranjilla[3]	*Clavija euerganea*
papayón	large pawpaw	*Grias peruviana*
pepinillo	small pepino[4]	*Cyphomandra cajanumensis*
pepino de campo	wild pepino[4]	*Cyphomandra cajanumensis*
pepino de monte	wild pepino[4]	*Physalis peruviana*
romero	rosemary	*Cordia polyantha?*
sacha manzana	wild apple	*Bellucia pentamera*
uva	grape	*Chondrodendron tomentosum*
		Cordia hebeclada
		Cordia lutea
		Pourouma bicolor
		Pourouma cecropiifolia
		Pourouma melinonii
uva de montaña	wild grape	*Pourouma cecropiifolia*
uva pequeña	small grape	*Clidemia sericea*
uvilla, ovilla, juvilla	small grape	*Jaltomata* sp.

Spanish name	Meaning	Scientific name
		Physalis peruviana
		Physalis sp.
yuca del campo	wild cassave	*Vasconcellea parviflora*
yuquilla, *yuquita*	small cassave	*Oxalis latifolia*
zanahoria del campo	wild carrot	Oxalis latifolia
zapote de campo	wild zapote[5]	*Capparis scabrida*
zapote de monte	wild zapote[5]	*Quararibea* sp.
zapotillo	small zapote[5]	*Casearia* sp.

[1]the male form (ending in –o) refers to the tree, the female form (-a) to the fruit
[2]*granadilla* is the common name of various *Passiflora* species
[3]*naranjilla* is the common name of *Solanum quitoense*; this name is in itself transposed from *naranja* - orange
[4]*pepino* is the common name of *Solanum muricatum*
[5]*zapote* is the common name of various species of Sapotaceae

Passiflora punctata,, is not a case of transposition, as most *Passiflora* species are named *granadilla*. Here *granadilla de monte* just specifies that particular species of passionfruit.

Borrowing

Colonisers in the Amazonian part of southern Ecuador living amongst or near the Shuar people have borrowed certain Shuar plant names and now commonly use them (Table 6-2). Nuevo Paraíso is a fairly new colonisers' village along the Upper Río Nangaritza, in the Shuar territory. Of the 29 plant names recorded here, ten are borrowed Shuar names. Five of them are used unchanged (*apai*, *yarasu*, *achu*, *iniak* and *shankuinia*) and another five show linguistic adaptations to Spanish (*pito*, *tinguiwí*, *kumbía*, *urutza* and *santa maría*) (Table 6-2). Only one plant name has a locally used mestizo synonym: *yarasu* is also called *caimito*. The other nine plant names are unique and no mestizo synonyms are used to refer to these plants. Mestizo colonisers in the area around El Padmi, living amongst Shuar families, use five plant names borrowed from Shuar (of a total of 29 names). Only one plant has a synonymous mestizo name: *munchi* is also called *granadilla*. In the other six Amazonian communities studied, the population consists entirely of mestizo people. Here fewer plant names borrowed from Shuar language are used: three were recorded in Timbara (*achu, iñaco* and *kumbía*) and Palanda (*munche, shimbe, yaraso*), two in Tutupali (*iñaco, yarasu*), and one in Zumba (*yarasu*, also called *caimito* here). The two villages where no plant names borrowed from Shuar were recorded (Quebrada Honda and Sabanilla) are both high up on the Andes slopes (above 1600 m), geographically far from the Shuar territory and do not have many plant species in common.

Table 6-2. Mestizo names of edible plants in southern Ecuador, borrowed from Shuar language

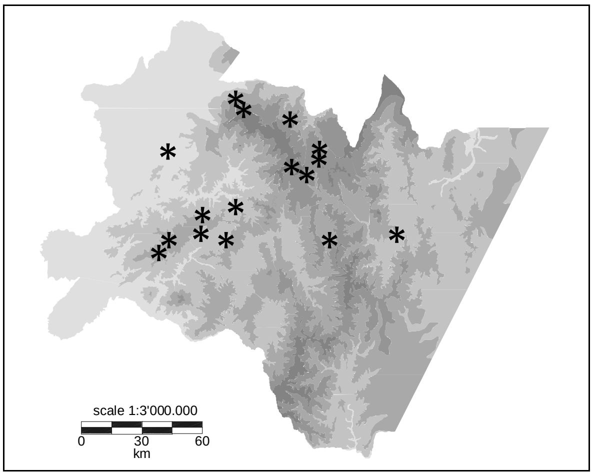
Plant name	Original Shuar name	Alternative mestizo synonym	Scientific name
Acho	***achu***		*Mauritia flexuosa*
Apai	***apai***		*Grias peruviana*
Iñaco	***iniák***		*Gustavia macarenensis*
Kumbía	***kumpía***		*Renealmia alpinia*
Munche, *munchi*	***(washi) munchi***	*granadilla*	*Passiflora pergrandis*
Pito	***pítiu***		*Trophis racemosa*
santa maría	***nátsamar***		*Piper* sp.
Shanguinia	***shankuinia***		*Pseudolmedia macrophylla*
Shimbe	*		*Euterpe precatoria*
Tinguiwí	***tinkimi***		*Prestoea schultzeana*
Urutza	***uruts***		*Protium* sp.
Yaraso, *yarasu*	***yaás***, ***yarasu***	*caimito*	*Pouteria caimito.*

* Shuar people use ***shimpi*** for *Oenocarpus mapora*, another palm tree

Table 6-3. Mestizo names of edible plants in southern Ecuador, borrowed from Quichua

Quichua borrowed name	Scientific name	Name with Quichua descriptor	Scientific name
aguarongo	*Puya* sp.	***sacha*** *capulí*	*Eugenia* sp.
chawar	*Agave americana*	***sacha*** *granadilla*	*Granadilla foetida*
chine (chini)	Urticaceae gen. indet.	***sacha*** *manzana*	*Bellucia pentamera*
chulala	*Solanum* sp.	***sacha*** *piña*	*Ananas commosus*
chulalay	*Salpichroa diffusa*	***sacha*** *sanguillo*	*Anthurium* sp.
chungay	*Vasconcellea candicans*		
Huicundo	Bromeliaceae gen. indet.		
mishiyuyu	*Centropogon cornutus*		
mishki	*Agave americana*		
mote* negro	*Gaultheria erecta*		
motepela*	*Centropogon cornutus*		
mote* pelado	*Gaultheria reticulata*		
Muyuyo	*Cordia lutea*		
taxo (taksu)	*Passiflora cumbalensis*		
uchuchi	*Solanum brevifolium*		
wile	*Freziera verrucosa*		
yanamuro (-u)	*Myrcianthes* sp.		

****mote*** is a type of cooked maize



Map 6-1. Areas where Quichua-borrowed plant names are used in southern Ecuador (base map by CINFA)

A total of twelve different plant names for edible plants, borrowed from Shuar language, were thus recorded amongst mestizo colonisers in the Amazonian region of southern Ecuador. They correspond to 12 separate botanical species (Table 6-2). Only two of the plant names have a synonymous mestizo name. Ten plant names borrowed from Shuar are therefore the only names used by mestizo people to name these particular plant species. No plant names borrowed from Shuar language were recorded outside the Amazonian area (Zamora-Chinchipe province).

Some Quichua linguistic influence in local plant names is found, mainly in the western Andes region of southern Ecuador. A total of 22 recorded mestizo plant names (of 328) are borrowed from Quichua or have a descriptor that is borrowed from Quichua (Table 6-3). ***Sacha*** is regularly used as a descriptor to indicate that a plant is wild. ***Sacha*** is originally a general Quichua term meaning plant, forest, and shrubland, but its meaning has changed to include 'wild' (Jacobs 2001). The descriptor ***sacha*** preceding a mestizo plant name indicates that a plant is wild or a wild relative of a crop. Mapping the occurrence of borrowed Quichua plant names and the use of ***sacha*** as a prefix in southern Ecuador, shows the highest influence of Quichua in plant names in the area around Saraguro (Map 6-1). This is the only area in southern Ecuador where today Quichua is still spoken (by the Saraguro people). The Quichua influence in plant names extends towards the Loja area, along the river Catamayo basin and also into the higher parts of the Amazonian region. Names borrowed from Quichua were recorded in 14 communities (of the 42 studied). In each community, only one to four plant names borrowed from Quichua are used, of a total of ten to sixty recorded plant names per village. In

Gualel, four of nineteen plant names are borrowed from Quichua. This is the highest occurrence of borrowed Quichua names encountered. Each name borrowed from Quichua is the only name used in that particular community to name a particular plant. No synonymous mestizo names are used in these villages for the same plants.

We can presume that other plant names would have been borrowed in the past from pre-Inca languages like Palta. Since these languages, or any written records about them, do not survive today, we cannot say anything more about this possible linguistic influence.

Neology

Twenty-two mestizo plant names that were recorded in this study can be considered as newly invented names (Table 6-4). The names refer to particular characteristics, uses or origins of the plants. Sometimes the reference is to the edible part of the plant, on other occasions it is to an obvious characteristic. Eleven plant names describe the shape or colour of the edible fruit (*cucharilla*, *gañil*, *huevo de gallo*, *huevo de pava*, *huevo de perro*, *lagaña*, *negrito*, *nigua*, *niguito*, *perlilla* and *vainilla*). Two names refer to the fruit consistency (*babosa* and *moco*). One name refers to the colour of the flower (*amarillo*). Six names refer to another plant characteristic (*palo blanco*, *pata blanca*, *sierra*, *sierilla*, *uña de gato* and *uña de pava*). The latter two names refer to the shape of the plant's thorns. One name refers to the use of the plant (*flor de novia*) and one to the plant's geographical origin (*méjico*). In seven names reference is made to an animal. English translations of the names are given in Table 6-4.

Most of these new plant names are used very locally and were recorded only once. They are generally used for edible fruits that are not very significant: the fruits are small and not tasty. The only exceptions are *huevo de perro, amarillo, uña de gato* and *palo blanco*. These names are used throughout southern Ecuador and even beyond. *Huevo de perro* is the name most commonly used for wild plants of *Solanum quitoense* Lam., a plant with large edible fruits that may be sold in markets. The cultivated form of this species is known as *naranjilla*. *Amarillo* and *palo blanco* are important timber trees, their edible fruits are only considered as snack foods. The common use of these names throughout the area may be attributed to their economic importance.

Almost one third of all mestizo plant names (102 of 328) are formed through one of these three mechanisms. Our study provides the opportunity to test the assumption that colonisers need to name unknown plants, by analysing mestizo plant names created through transposition, borrowing and neology in recently colonised areas, compared with those of older communities. In certain recently

Table 6-4. Mestizo names of edible plants in southern Ecuador, formed through neology

Spanish name	Meaning	Scientific name
amarillo	yellow	*Centrolobium ochroxylum*
babosa	slimy[1]	*Saurauia bullosa*
cucharilla	small spoon[2]	*Oreocallis grandiflora*
flor de novia	bride's flower	*Yucca* sp.
gañil	gill[2]	*Oreocallis grandiflora*
huevo de gallo	cock's testicle[2]	*Oreanthes fragilis* *Gaultheria tomentosa*
huevo de pava	turkey's testicle[2]	*Celtis iguanaea*
huevo de perro	dog's testicle[2]	*Solanum quitoense*
lagaña	dirt[2]	*Cordia polyantha?*
méjico	Mexico	*Agave americana*
moco	slime[1]	*Saurauia* cf. *peruviana*
negrito	little black thing[2]	*Coccoloba ruiziana*
nigua	type of fly[2]	*Disterigma alaternoides*
niguito	small fly[2]	*Muntingia calabura*
palo blanco	white trunk	*Celtis* sp.
pata blanca	white leg[3]	Liliaceae gen. indet.
perlilla	small pearl[2]	*Arcyctophyllum thymifolium*
sierra	saw[4]	*Miconia* spp.
sierilla	little saw[4]	*Gaultheria tomentosa*
uña de gato	cat's nail[5]	*Celtis iguanaea*
uña de pava	turkey's nail[5]	*Celtis iguanaea.*
vainilla	small pod[2]	*Caesalpinia spinosa* *Vanilla* sp.

[1] refers to the consistency of the fruit [2] refers to the shape or colour of the fruit
[3] refers to the white stem of the plant [4] refers to the serrated leaf margin
[5] refers to the plant's thorns

colonised coastal areas like Isla Bellavista, Cerro Azul and Arenillas, more than one third of all recorded plant names are formed through transposition and neology. There are no borrowed names here because there is no native population. In areas such as Sozoranga, Celica, Amaluza and Catacocha, which have been inhabited since pre-Inca times, fewer than 10% of all plant names are formed through these mechanisms. In the Amazonian region (Zamora-Chinchipe), where colonisation by mestizo people is fairly recent, and where there is a native population of Shuar people, more than one quarter of all mestizo names of edible plants are formed through transposition and neology or are borrowed from Shuar language. Especially in El Padmi and Nuevo Paraíso, where mestizo people live within the Shuar territory, more than half of the plant names are formed through the three mechanisms.

The percentage of plant names used in a village that are formed through transposition, borrowing and neology were compared for all mestizo communities (Table 6-5), distinguishing old and recent colonisation (less than 50 years). No significant difference exists between recently colonised areas and areas with old colonisation (one-way ANOVA test, p=0.25). When, however, considering the newly colonised coastal areas and newly colonised Amazonian areas separately (therefore distinguishing three categories of colonisation - old, recent in coastal areas and recent in Amazonian areas), then a significant difference is found between the newly colonised Amazonian areas and areas with old colonisation (one-way ANOVA test, p=0.0015). No significant difference, however, exists between newly colonised coastal areas and areas with old colonisation, in terms of mechanisms of plant naming.

Other naming patterns

Many binomial mestizo plant names that do not follow any of the three naming mechanisms do have a salient descriptive Spanish (or occasionally Quichua) adjective or descriptor, alongside a seemingly meaningless (opaque) name. The descriptor usually refers to a particular plant characteristic *(cardo rastrero* 'creeping cardo') or indicates that the plant is wild (*papaya del campo* 'wild pawpaw'), which allows similar plants to be distinguished. Many examples can be seen among *Inga* species (generally named *guaba*), where descriptors specify the appearance of the pods of different species (Table 6-6). The incidence of such binomial plant names, formed by a Spanish adjective and opaque primary name, is high amongst mestizo plant names. A total of 121 of our recorded mestizo plant names (or 37%) have such Spanish or Quichua salient adjective or descriptor. Spanish descriptors always follow the main name, whereas the Quichua descriptor **sacha** precedes the plant name. Some plant names even have two descriptors indicating further specification or subdivision (*salapa blanca grande*).

It is especially common for farming communities to use "wild" as a descriptor to name plants, in order to distinguish them from domesticated plants (comment of Ellen in Brown 1985:56). In our records, a total of 41 binomial mestizo plant names (13%) have a form of "wild" as a descriptor.

Meaning

Since many of the edible plants recorded in this study are managed, we would like to test Berlin's theory that semantic transparency of plant names is often inversely related to the cultural importance of the plant (Berlin 1992). Plant management indicates a certain level of cultural importance. Managed and cultivated species or

Table 6-5. Relation between percentage of mestizo plant names formed through neology, transposition and borrowing, and the colonisation history of a village

Village	Number of plant names	Naming[1]	Colonization history[2]		Colonization history[3]	
Sozoranga	16	6	0	mean 23.7; st.dev. 12.9	0	mean 23.7; st.dev. 12.9
Celica	13	7	0		0	
Paccha-Daucay	10	8	0		0	
Amaluza	23	8	0		0	
Catacocha	29	11	0		0	
Orianga	15	13	0		0	
LauroGuerrero	23	16	0		0	
Uritusinga	12	17	0		0	
Zambi	32	17	0		0	
Chilla	16	18	0		0	
Huachanamá	17	20	0		0	
Santiago	19	20	0		0	
Casanga	48	20	0		0	
Gualel	17	21	0		0	
Salatí	19	21	0		0	
Tambo Negro	17	30	0		0	
El Sauce	6	33	0		0	
San Lucas	12	33	0		0	
Mangaurco	7	38	0		0	
Sabanilla	20	38	0		0	
La Rusia	13	40	0		0	
Sevillán	25	41	0		0	
Zaruma	21	42	0		0	
Zapotillo	9	50	0		0	
Sambotambo	5	0	1	mean 29.2, st.dev. 17.9	1	mean 18.8; st.dev. 4.4
El Limo	14	0	1		1	
Casacay	16	4	1		1	
Piedras	14	14	1		1	
Carabota	10	20	1		1	
Chacras	11	23	1		1	
Puyango	15	24	1		1	
Arenillas	9	33	1		1	
Cerro Azul	19	34	1		1	
Isla Bellavista	10	36	1		1	
Palanda	27	26	1		2	mean 42.1;st.dev.4.9
Zumba	13	29	1		2	
Timbara	22	41	1		2	
Tutupali	22	36	1		2	
Nuevo Paraiso[4]	29	65	1		2	
Quebrada Honda	14	36	1		2	
El Padmi	32	60	1		2	
Sabanilla Zamora	19	44	1		2	
ANOVA test			p=0.25; > 0.05 not significant		p=0.0015; < 0.05 significant	

[1] percentage of plant names formed through transposition, borrowing and neology; [2] 0=old colonization; 1=recent colonisation (< 50 yrs); [3] 0=old colonisation; 1=recent coastal colonisation (< 50 yrs); 2=recent Amazonian colonisation; [4] mestizo community in Rio Nangaritza area

Table 6-6. Spanish descriptors, used in mestizo plant names in southern Ecuador, to specify different *Inga* species

Common name	Descriptor's meaning	Scientific name
guaba cajetilla	square	*I. sapindoides*
guaba de bejuco	liana-like	*I. edulis*
guaba de cajón	square	*I. feuillii*
guaba de mono	monkey[1]	*I. striata*
guaba de monte	wild	*I. silanchensis*
guaba de oso	bear[1]	*I. fendleriana*
guaba de perico	sloth[1]	*I. oerstediana*
guaba de zorro	fox[2]	*I. fendleriana*
		I. insignis
		I. oerstediana
guaba lanuda	hairy, woolly	*I. fendleriana*.
		I. insignis
guaba machetona	machete-shaped	*I. spectabilis*
guaba musga	hairy, mossy	*I. fendleriana*
		I. oerstediana
		I. striata
guaba natural	natural	*I. striata*
guaba negra	black hairy	*I. nobilis* ssp. *quaternata*
guaba poroto	bean-like	*I. silanchensis*
guaba rabo de mono	monkey-tail	*I. oerstediana*
guaba vainilla	small bean-like	*I. laurina*
guaba verde	green[3]	*I. striata*

[1] referring to brown hairs on pod
[2] referring to red hairs on pod
[3] referring to the smooth, hairless pod

species that are important within the local culture would according to this theory have a more opaque (non-descriptive) name than non-managed plants. The latter would have more semantically transparent or descriptive names, whose meaning is easy to understand and refers to its characteristics or use. Berlin argues that this is because everyone knows a culturally important plant, even when the common name gives no clues about its appearance, characteristics or use. On the other hand, culturally less important plants need a more descriptive, more transparent name for people to be able to remember the plant.

In our study, Spanish plant names like *maní de árbol* 'tree peanut' are the most transparent, non-Spanish plant names like *vichayo* are the most opaque. Plant names with some degree of Spanish influence, for example a Spanish descriptor, like *guaba de mono* 'monkey' *guaba*), are in between the two extremes and considered as semi-transparent. When organising all plant species according to their degree of management (distinguishing the categories wild, tolerated and cultivated) and the transparency of their common name (distinguishing the categories transparent, semitransparent and opaque) and testing for independence of the variables (Table 6-7), we can show statistically that there is no relation between the semantic transparency of a mestizo plant name and the cultural status of the plant in southern Ecuador (χ^2=5.17, d.f.=4, p=0.05).

Table 6-7. Relation between management of edible plants and semantic transparency of their names

Plant management	Opaque plant names	Semitransparent plant names	Transparent plant names
Wild plant	78	37	49
Tolerated plant	46	20	20
Cultivated plant[1]	21	19	14
χ^2=5.17; d.f.=4; p=0.05; H_o accepted			

[1] sown, planted or transplanted plants

Nomenclature structures

Mestizo plant names can be classified as primary and secondary. Primary names are either simple expressions (*shora*) or complex, binomial expressions (*guanábana silvestre*). Secondary names are always complex and occur in sets of contrasting names, whereby the contrast is shown by a descriptor (*granadilla amarilla* and *granadilla negra*). However, these contrasting sets are often only used in a single community. They depend on which plant resources grow locally. Since the mestizo plant names were collected in a large geographical area and represent the plant knowledge of many individuals in many communities, it is not possible to clearly distinguish primary complex names from secondary names.

The majority of mestizo plant names have a one-to-one correspondence with one botanical species. Forty-seven plant names, however, are under-differentiated and correspond with 2 to 14 botanical species. *Guaba* is used for 14 different species of *Inga* and *mora* is used for 13 different botanical species, belonging to various botanical genera. There are, however, strong regional differences here. In some communities various *Inga* species have their own binomial names, whereas in other areas the primary name *guaba* is used for all *Inga* species. This depends strongly on the number of different species that grow in any one area (see further). Also some informants are more inclined to use generalised (under-differentiated) names, whereas others use distinct names.

Some common names are over-differentiated and refer to varietal subdivisions within a botanical species. Two different varieties of *Macleania rupestris* are recognised in Sevillán: *joyapa blanca* and *joyapa chaucha*. In the area of Zambi, *M. salapa* is subdivided into *joyapa blanca* and *joyapa morada*. Two varieties of *Myrcia* *fallax*, *saca blanca* and *saca colorada*, are distinguished in Sozoranga. In Santiago, *Rubus floribundus* is divided into *mora pequeña*, *mora grande* and *mora grande de jugo*. *Vasconcellea* x *heilbornii* is an important economic species with an enormous range of fruit types and shapes, developed over centuries of active management and cultivation. Often they are all called *toronche*, but in some areas local varieties like *chamburo*, *siglo* and *babaco* are recognised.

6.2 Variations in mestizo plant names

The area where mestizo plant names were collected is so large and diverse that it is important to analyse regional variations in plant names. Because the vegetation in different areas is often distinctive, the botanical species of edible plants may be very different. It is therefore not always straightforward to compare plant naming variations between communities.

Ninety-nine edible plant species were, however, recorded in at least two communities. Two-thirds of these (65 plants) have only one common name throughout southern Ecuador; for some plants the same name was recorded in up to 10 different communities (Table 6-8). These plant names can be considered as names that are unique throughout southern Ecuador. Sometimes slight variations of the same name are used. These can be phonological (spoken) or lexical (written) variations, or binomial names derived from one and the same primary name. *Pouteria lucuma* is usually called *luma* (the fruit) or *lumo* (the tree), but can also be called *lucumo*. *Cyperus* sp. is called *coquillo* or *coquito*, both meaning 'small coconut', describing the edible roots. *Hylocereus polyrhizus* is generally called *pitaya*, but some people say *pitahaya*. *Clavija euerganea* is called *naranjilla del campo* or *naranjilla silvestre*, according to the area, both names indicate the "wildness" of the plant. *Lycopersicon pimpinellifolium* can be called *tomatillo*, *tomate del campo*, *tomatillo de gallinaso* or *tomate wishco*, according to the area. And various species of *Inga* are called *guaba*, or may have a binomial name derived from *guaba* (Table 6-6).

A second group of 10 plants are known with one common name throughout southern Ecuador, but one or two different names are used in particular areas or by some informants. *Acnistus arborescens* is generally called *pico pico* (in 14 communities of 42), only in two places is it called *sabaluco*. *Erythrina edulis* is called *guato* in the western part of southern Ecuador, but is called *pashul* or *cañari* in some areas in the east. *Prestoea acuminata* is generally known as *palmito*, in some areas distinct names like *tinguiso* and *caño* are used. Only in Amaluza is *Allophylus mollis* known as *clambo*, in all other areas it is called *shiringo*. *Inga marginata* is always called *guabilla*, except in Zambi, where it is called *porotillo*. *Cordia lutea* is called *uva* or *overal* and *Passiflora foetida* is *(sacha) granadilla* throughout southern Ecuador, except on Isla Bellavista where these are known as *muyuyo* and *bedoca* respectively. *Physalis* *peruviana* is named *uvilla*, *ovilla* or *juvilla*, but is known in Cerro Azul as *pepino de monte*. *Inga spectabilis* is generally called *guaba machetona*, but in some areas *panaco*. Likewise, *Inga oerstediana* generally has a binomial name derived from *guaba* (Table 6-7), but is sometimes called *laricaro*.

A third group are plants that are known throughout southern Ecuador by completely different names. Only 25 plants that were recorded in at least two villages belong to this group. *Celtis iguanaea* is called *cacumba*, *uña de gato*, *uña de pava*, *huevo de pava*, *mogroño*, *uva* or *uva de pava* in different communities. *Agave americana* can be called *méjico* (after its region of origin), *mishki* (the Quichua name of its juice), *penco* (the name of its leaves) or *chawar*. *Coccoloba ruiziana* is known as *añalque*, *añalque pampero*, *añalque chiquito*, *indindo* or *negrito*.

Table 6-8. Unique mestizo names of edible plants used throughout southern Ecuador and the number of communities where the name was recorded (minimum 5 of a total of 42 communities)

Common name	Number of communities	Scientific name
algarrobo	5	*Prosopis juliflora*
caimito	5	*Pouteria caimito*
chirimoya	9	*Annona cherimola*
chivila	5	*Attalea colenda*
chonta	5	*Bactris gasipaes*
chonta	7	*Bactris macana*
guanábana	10	*Annona muricata*
guásimo	6	*Guazuma ulmifolia*
guayabilla	5	*Psidium guineense*
lusumbe	7	*Pradosia montana*
mortiño	8	*Solanum americanum*
pechiche	5	*Vitex gigantea*
pitaya	11	*Hylocereus polyrrhizus*
quique	7	*Hesperomeles ferruginea*
sota	5	*Maclura tinctoria* ssp. *tinctoria*
verdolago	9	*Portulaca oleracea*

Why do certain plants have a single name throughout southern Ecuador, whilst others have various names? Often culturally important plants have fewer name variants than culturally less important plants (Berlin 1992). We can test this proposition for all name variants in southern Ecuador: phonological and lexical variants, binomial name variants and regional variants. Plant management is one way to measure cultural importance. By organising all recorded plant species according to their degree of management (distinguishing the categories wild, tolerated and cultivated plants) and the presence or absence of name variation (distinguishing plants with unique names, name variants and various names)

(Table 6-9), we can test for independence between both factors using a χ^2-test. There is a significant link between the cultural importance of a plant and the variation in its name(s) in southern Ecuador ($\chi^2=20.0$, d.f.=4; $p<0.001$). It is, however, opposite to the relation found by Berlin (1992): wild plants in southern Ecuador show less name variants than managed plants.

Most non-crop plants, however, were only recorded in one field site, with one name. This may give a false picture of name variation structures, as local names would count as unique names, without necessarily being it. When limiting ourselves to the 99 species of edible plants that were recorded in at least two different field sites, we can test the same. Although tolerated and cultivated plants seem to have more unique names than wild plants (Table 6-9), a χ^2-test shows that there is no significant link between the management of a plant and its name variations ($\chi^2=6.5$; d.f.=4; $p=0.05$).

Plants with a unique name or with one general name and local synonyms also seem to have a high percentage of economic fruits and of trees (Table 6-9). These are two other good indicators of cultural importance. Marketed fruits can be considered as culturally more important than fruits that are gathered occasionally as snack foods. Trees have often multiple uses (timber, fuel) and may be more visible in the landscape, giving them more cultural importance than herbs and shrubs. When testing for independence between name variation and whether or not a plant is marketed (Table 10), no significant relation between the two criteria was found ($\chi^2=0.26$; d.f.=2; $p=0.05$). When testing for independence between name variation and the life form of a plant (tree, shrub, herb), again no significant relation was found ($\chi^2=6.8$; d.f.=4; $p=0.05$).

Finally, we noticed that plant names that are unique throughout southern Ecuador are more likely to be opaque names and plants whose names vary throughout the study area are more likely to have salient, descriptive names, like names formed by transposition, neology, or the adding of a Spanish descriptor. When testing this hypothesis statistically using a χ^2-test (Table 10), a significant relation was found with 99 % probability ($\chi^2=10.1$; d.f.=2; $p<0.01$). Opaque plant names are therefore less likely to vary throughout southern Ecuador.

An important factor in the naming of plants within any one community, is the number of similar plants (for example plants belonging to the same botanical genus or family) occurring in the area. This determines the need to distinguish them. If only one type of palm tree is found in a village, it is likely to be simply called *palma*. If only one species of *Inga* is found in an area it will most likely be called *guaba*. If more species of the same genus or family occur in the area, usually distinctive names are given to each one of them. All *Rubus* species in southern Ecuador are called *mora*. Only in Santiago, where five *Rubus* species occur together, are they given distinct secondary names like *mora grande*, *mora pequeña*,

Table 6-9. Relation between management of edible plants and variation of their names

Plant management	Unique name	Name variants[1]	Various regional names
Wild plant	133	6	23
Tolerated plant	65	6	15
Cultivated plant[2]	29	10	14
χ^2=20.0; d.f.=4; $p<0.001$; H_o rejected			

[1] lexical or phonological name variants, or various binomial names derived from the same primary name
[2] sown, planted or transplanted plants

Table 6-10. Relation between name variation of edible plants (mentioned in at least two villages) and various factors expressing their cultural importance

Plant management	Unique name	Name variants	Various regional names
Wild plant	15	1	10
Tolerated plant	33	4	8
Cultivated plant[1]	17	5	6
χ^2=6.5; d.f.=4; $p<0.2$; H_o accepted			
Economic fruit	14	2	4
Non-economic fruit	51	8	20
χ^2=0.26; d.f.=2; $p<0.2$; H_o accepted			
Tree	40	6	8
Shrub	12	2	10
Herb	13	2	6
χ^2=6.8; d.f.=4; $p<1$; H_o accepted			
Salient name	10	1.7*	11.3*
Opaque name	55	8.3*	12.7*
χ^2=10.1; d.f.=2; $p<0.01$; H_o rejected			

[1] sown, planted or transplanted plants
* decimal values because all common names for each species are given a total value of 1

mora grande de jugo (three different types of R. *floribundus)*, *mora de pepa* (R. *bogotensis*), *mora de los pajones* (R. *loxensis*), *mora de piña grande* (R. *nubigenus*) and *mora piña* (R. *roseus*). The names given can be very local because they are used to distinguish between local species. *Inga striata* for example is called *guaba verde* in most places because its pods are typically hairless and green whereas most other *Inga* species have brownish hairy pods. In Sabanilla and Palanda, however, it is called *guabilla*, because it is the *Inga* with the smallest pods (compared to *I. extra-nodis* and *I. densiflora*).

6.3 Shuar plant names

Shuar people use exclusively Shuar names to name the plants they know and use, although they often know the equivalent mestizo or Spanish names. A total of 83 Shuar names of edible non-crop plants was recorded in the Shuar communities along the Upper Río Nangaritza and in El Padmi (Annex 5). They correspond to 72 botanical species. We are not familiar enough with the Shuar language to be able to analyse the meaning and origin of these names.

Nomenclature structures

The Shuar plant names were collected in a relatively small area with uniform vegetation. The structure of the names can therefore be studied in detail. Of the 83 recorded Shuar plant names, 65 (78%) are simple primary names and 16 (19%) are secondary (binomial) names. We have been unable to analyse the structure of two names. Table 6-11 shows examples of groups of primary and sets of contrasting secondary names, derived from each primary name. Shuar descriptors are always placed before the primary names. These primary names correspond to folk generic taxa, with further division into folk specific taxa by their secondary names. A folk generic taxon can correspond to a botanical genus, but does not necessarily comprise the entire genus (Berlin 1992). In the case of ***sámpi***, for example, five *Inga* species have a secondary name derived from the primary name ***sámpi***, but three other *Inga* species have different primary names (***wámpa***, ***napúrak***, ***wampukish***). The name ***sámpi*** is also used to name one particular species, *Inga acreana* Harms. In a similar way ***munchi*** both indicates a general group of passionfruits and one particular species, *Passiflora pergrandis*, which is the most common and largest edible passionfruit in the area. The fact that a primary name is used for one particular botanical species may indicate the cultural importance of that species. It is particularly interesting that all 12 different edible palm species used by the Shuar have their own primary name, which probably reflects their cultural importance. This is in stark contrast to the generalised naming of palms by mestizo people (Table 6-12), which will be discussed in more detail later.

The relationship between common name and botanical name is in most cases one-to-one. ***Shiniumas***, ***najaraip***, ***chimi*** and ***kushikiam*** are each used for two different species of the same botanical genus. These names are therefore under-differentiated (Berlin 1992). Some secondary names in the ***shuinia*** and ***sámpi*** group are used for different botanical species by some informants. ***Mutuch' shuinia*** is the common name for *Pourouma bicolor*, *P. guianensis* and *P. melinonii*, but some informants use ***nakantar shuinia*** for *P. bicolor* and ***washi shuinia*** for *P. guianensis* and also for *P. cecropiifolia*. ***Imik sámpi*** is the local name for three *Inga* species, *I. microcoma*, *I. nobilis* and *I. punctata*. But *I. nobilis* is by some informants called ***kunkuin sámpi***. This may either indicate that the different plant species are not considered as separate taxa, or that there exists variability in plant naming between informants.

Table 6-11. Primary and derived secondary Shuar names of edible non-crop plants

Primary Shuar names with corresponding scientific names	Secondary Shuar names with corresponding scientific names
chimi – *Pseudolmedia laevigata*	***kawachimi*** – *Cordia nodosa*
éep – *Anthurium* generic	***katshiniak éep*** – *A. breviscapum* ***natsa éep*** – *Anthurium* sp. ***wee éep*** – *A.* sect. *Xialophyllium*
but: ***shiniumas*** – *A. rubrinervium* ***wánkat*** – *A. triphyllum*	
iniák – *Gustavia macarenensis*	***tsantsaniak*** – *Gustavia* sp.
kukúch' – *Solanum* generic	***shuankukúck'*** – *Solanum* sp. ***ya kukúch'*** – *S. stramoniifolium?*
munchi – *Passiflora* generic *P. pergrandis*	***patúkmai munchi*** – *P. foetida* ***tsere munchi*** – *Passiflora* sp. ***washi munchi*** – *P. pergrandis*
sámpi – *Inga* generic *I. acreana*	***imik sámpi*** – *I. microcoma ?*, *I. nobilis* ssp. *quaternata*, *I. punctata* ***kunkuin sámpi*** – *I. nobilis* ssp. *quaternata* ***main sámpi*** – *I. leiocalycina* ***yakum sámpi*** – *I. capitata*
but: ***wámpa*** – *I. edulis* ***napúrak*** – *I. thibaudiana* ***wampukish*** – *I. nobilis* ssp. *nobilis*	
shuinia – *Pourouma* generic	***mutuch' shuinia*** – *P. bicolor*, *P. guianensis*, *P. melinonii* ***nakantar shuinia*** – *P. bicolor* ***pau shuinia*** – *P.* aff. *cecropiifolia* ***washi shuinia*** – *P. cecropiifolia*, *P. guianensis*

6.4 Variations in Shuar plant names

Few naming variations of Shuar plant names exist amongst informants and between communities in our area, even though the communities of El Padmi and Nangaritza are more than 100 km apart. Only four cases of lexical variations were recorded: ***tinkimi – tinkibi***; ***kúnakip – kúnapi***; ***nátsamar – nátsatsam; yáas - yarasu***. Some informants are inclined to use more detailed secondary names, whereas others use the general corresponding primary names (***kathsiniap éep – éep***; ***washi munchi – munchi***). For only two botanical species were two completely different Shuar names recorded from different informants: ***wankat*** and ***éep*** for *Anthurium triphyllum*; ***imik sámpi, kunkuin sámpi*** and ***wampukish*** for *Inga nobilis* ssp. *quaternata*.

In order to analyse possible regional variations of Shuar plant names even further, we compared the names we recorded with Shuar plant names elicited during two ethnobotanical studies carried out in Morona-Santiago province, approximately 250 km northeast of the Nangaritza area (Bennett et al. 2002; Borgtoft et al. 1998). The names of our 72 botanical species of edible plants were compared with names recorded during these two studies. Thirty-four botanical species were recorded in all three studies. Seven plant names were the same in all three studies ***(achu, apai, kumpia, kunchai, kunkuk', uwi*** and ***yaas***). Another 15 names were the same in our study and in one of the other two studies. For two of them a different name was recorded in the third study, for the remaining 13 no name had been recorded. Five names had a different descriptor, but the same generic name and five names showed lexical variations. For only two botanical species were the names recorded in the three studies completely unrelated. Thus, Shuar plant names used by different Shuar communities show little variation.

6.5 Comparing mestizo and shuar plant nomenclature

It is difficult to make an in-depth comparison between the naming of plants by non-indigenous mestizo and indigenous Shuar people in southern Ecuador, because the setting is too different. Mestizo plant names were recorded in a large area with a high diversity of vegetation types, plant species and communities. Various ethnic and linguistic factors have influenced the creation and evolution of mestizo plant names. Shuar plant names on the other hand, were recorded in a relatively small area with a relatively uniform vegetation and population. There are, however, some interesting points of comparison.

With regard to name structure, mestizo people tend to use a high percentage of binomial plant names. Thirty-six percent of mestizo plant names are binomial, compared to 25% of Shuar plant names. Mestizo plant names are more under-differentiated (14% compared to 5% for Shuar names). Shuar plant names show little geographical variation, compared to mestizo plant names.

Mestizo and Shuar plant names of two culturally important groups of plants (palm trees and *Inga* species) can be compared and different patterns emerge.

Shuar people use 12 species of edible palm trees that belong to ten botanical genera; they refer to each of them with a different primary name (Table 6-12). Mestizo people use 23 different species of palm trees, belonging to 13 genera, for which 18 common names exist. Thirteen of them are primary names (72%) and five are binomial names (28%). All palm trees with spiny trunks (five species) are called *chonta* or the derived name *chontilla*. Eleven species are called *palma* or a derived binomial name such as *palma de ramas*, *palma real*, *palmita* and *palma paja cambana*. Mestizo people often simply call a palm tree a palm (*palma*), whereas Shuar people give each palm tree a distinctive and unique name, which probably indicates the cultural importance of palm trees for the Shuar people. We need to keep in mind though that mestizo names are recorded over a large area. For any one mestizo community, there are usually only one or two palm species, each of which typically has its own name. Mestizo plant names given to palm trees are indeed very generalised, but then there is probably no need to give separate names if the variety of palm trees in the area is low.

Another interesting group of plants is the genus *Inga*, represented by 33 species in southern Ecuador. These multipurpose trees are often used as shade trees in traditional coffee groves, they provide good fuelwood and the fruits have an edible aril. Shuar people use nine species, for which four primary and 5 secondary names are used (Table 6-11). Mestizo people use 23 *Inga* species, which are generally called *guaba* or a derived binomial name (Table 6-6). Primary names *laricaro* and *panaco* are sometimes used as synonyms. Twenty-three binomial mestizo names for *Inga* species were recorded, 22 of which are derived from *guaba* and one from *laricaro*. This again illustrates the more generalised way of naming plants by mestizo people. Any species belonging to the genus *Inga* is most likely called *guaba*, or a name derived from *guaba*. In this case, however, often various *Inga* species grow in an area. Still, informants refer to all of them with the name *guaba*. Some informants use unique binomial names for each species, whereas others call them all *guaba*.

Table 6-12. Comparing Shuar and mestizo names given to palm trees

Scientific name	Shuar name	Mestizo name
Aiphanes grandis	-	*chonta*
Aiphanes verrucosa	-	*chonta*
Astrocaryum urostachys	**awant'**	-
Attalea colenda	-	*chivila*
Bactris gasipaes	**uwí**	*chonta*
Bactris macana	-	*chonta*
Bactris setulosa	-	*chontilla*, *chonta*
Ceroxylon amazonicum?*	**paik'**	*palma de ramas*
Ceroxylon echinulatum	-	*palma*
Ceroxylon vogelianum	-	*coco*
Ceroxylon sp.	-	*palma*
Dictyocaryum lamarckianum	-	*palma*
Euterpe precatoria.	-	*shimbe*, *palma*
Euterpe precatoria var. *longevaginata*	-	*palmo real* [1]
Euterpe ?	**yayu**	-
Iriartea deltoidea	**ampakaí**	*pambil*, *palmito*
Iriartea sp.	-	*palma*, *palmita*
Mauritia flexuosa	**achu**	*acho*
Oenocarpus bataua	**kunkuk'**	*palma real*
Oenocarpus mapora	**shímpi**	-
Pholidostachys synanthera	-	*palma paja cambana*
Phytelephas aequatorialis	-	*tagua*, *trapa*, *tapra*, *cade*
Prestoea acuminata	**saké**	*palma*, *palmito*[1], *caño*, *tinguiso*
Prestoea ensiformis	-	*caño*
Prestoea schultzeana	**tinkibi**, **tinkimi**	-
Socratea exorrhiza	**kúpat**	-
Wettinia kalbreyeri	-	*bambil*, *pambil*
Wettinia maynensis	**terén**	-
Wettinia cf. *maynensis*	-	*palma*

[1] the male variant *palmo* or *palmito* refers to the tree being tall, stout or single-stemmed

6.6 Conclusions

Folk taxonomists have analysed and compared plant naming in various indigenous languages (Berlin 1992; Brown 1985; Grenand 1995; Lewis et al. 1988; Villagrán 1998). No research into the origins, meaning and structures of mestizo plant names is known to exist anywhere in Latin America. This is thus original research on how mestizo people name plants.

The 411 plant names that were recorded throughout southern Ecuador for 354 edible species, combined with information on where they were recorded and how often they were recorded, provide a unique opportunity to analyse how indigenous and non-indigenous people in the area name plants. Mestizo plant names and Shuar plant names were analysed separately and then compared.

Transposition, neology and borrowing from native languages (Shuar and Quichua) are mechanisms through which almost one-third of all mestizo plant names in southern Ecuador are formed. These mechanisms are typical for the naming of plants by immigrants, who need to name unfamiliar plants. In the case of southern Ecuador, the immigrants creating new names were the Spanish colonisers more than 500 years ago, but also more recently Spanish-speaking mestizo farmers colonising new coastal and Amazonian areas. There is a significant link between the time of colonisation of an area and the percentage of plant names formed through these mechanisms in the Amazonian region. This is, however, not the case for the recently colonised coastal areas. Another third of mestizo plant names are binomial, one part of which is a Spanish adjective or descriptor. Descriptors are used to differentiate between similar plants or to describe a plant in more detail. They often refer to the plant being wild or they highlight some other characteristic.

Forty-one percent of all mestizo names are (partly) Spanish. The indigenous languages Shuar and Quichua, although still spoken today by ethnic minorities in southern Ecuador, have not had an important influence on the naming of plants by mestizo people, though they may have a local influence in the area where they are spoken. Names borrowed from Shuar are rarely used by mestizo people, even when they live in the Shuar territory, which shows how limited cultural exchanges between Shuar and non-Shuar people are.

Besides the names whose meaning or origin can be analysed, by recognising the mechanism that created the name, many mestizo plant names can not be analysed in any way. In many binomial names the meaning of the Spanish or Quechua descriptor can be understood, but the rest of the name has no apparent meaning. Some names may go back to local pre-Inca languages. Many plant names are, however, simply names and their origins or linguistic influences can not be traced.
Such undescriptive, opaque names are, however, the names that show the least variation and that are used to name the same plant species throughout southern Ecuador. Transparent, descriptive names, on the other hand, created through transposition or neology, or binomial names with Spanish descriptors, are most likely to vary from one area to another. Two-third of all edible plant species that grow throughout southern Ecuador and were recorded in at least two distinct field sites, have the same unique name in the whole region. For some plants local names exist besides a general name used in most areas. A small number of plants are known by a series of different common names throughout the region. Most recorded plants are, however, growing in a narrow geographical area and are

known there by one name. Their name variation can therefore not be analysed. No apparent reason could be identified to explain name variations of mestizo names. Economic or cultural importance of a plant has no influence on the uniqueness or variability of its name throughout southern Ecuador.

The naming of plants is influenced by the presence or absence of a plant species in an area. The number of related plant taxa determines the need for more of less explicit plant naming. There exists, however, no constancy in distinguishing plants through their names. In some areas detailed plant names are given to distinguish between related plants, whereas in other areas many similar plants are given very general names. Also, individual people in any one area may name plants in quite different ways, with more or less detail.

Shuar plant names show little regional and linguistic variation or variation amongst informants In southern Ecuador mestizo people tend to use more binomial plant names than Shuar people do. Mestizo names are more under-differentiated, meaning that the same name is given to various botanical species. Comparisons of names used for groups of culturally important plants like palms and *Inga* species, show that mestizo people use relatively more binomial names and often use the same primary name for several botanical species. Mestizo names also vary more from one area to another. Shuar people usually use one distinctive name for each botanical species, irrespective of whether they are primary or secondary names. The naming of plants by mestizo people therefore tends to be more variable, irregular and generalised. It is important to remember though, that the mestizo plant names presented here cover a large geographical area and are used by a large population group. Shuar names are used by a relatively small community in a limited and ecologically uniform area.

Could the differences in plant naming partly be explained by the different lifestyles of mestizo and Shuar people? According to Brown (1985), farming people use significantly more secondary plant names (binomials) than hunter-gatherers do, probably because of their more extensive plant knowledge (name more plants). Possible explanations for this are the fact that agriculture creates a diversity of ecosystems which contain more plants, and the fact that farmers, who usually live at higher population densities, need to know more wild plants in case their crops fail. Could this in part explain a difference in use of binomial names between Shuar and mestizo people? Mestizo people are primarily farmers, whereas Shuar people incorporate more hunting and gathering practices in their subsistence.

Another potential explanation is suggested by Lewis et al. (1988). They report a high occurrence of primary plant names used by Jívaro people in Peru and attribute this to an "economy of words" in an oral culture: using primary names (one word only) means communication can be more rapid. This, however, seems implausible. Why would mestizo people not want to economise on words? It is not because they have a written language (Spanish) that they would write plant names down in order to remember them. More detailed studies would be needed to get a full understanding of the differences in how indigenous and non-indigenous people in southern Ecuador name plants.

Many of the edible non-crop plants in the area are managed, indicating a certain level of cultural importance. There is however no significant relation between the management status of a plant and the transparency or linguistic variation of its name. This is a typical phenomenon in the naming of plants in various languages throughout the world (Berlin 1992). The fact that this does not apply to our recorded plant names is probably due to the ethnically mixed situation in southern Ecuador.

This analysis of names of edible plants can be considered representative for the naming of useful plants in southern Ecuador. It should not be seen as representative for the naming of all plants, because different nomenclature rules often apply to culturally significant plants (Berlin 1992). The plant names were recorded in various communities spread over a large and highly varied geographical area. They therefore represent the collective knowledge of many individuals, living in various communities and using often different plant species. Too many generalisations and analyses are somewhat dangerous, since it is difficult to distinguish individual perceptions of plants (which are reflected in their name) from a generalised view of plants that would represent the entire population of southern Ecuador. More detailed linguistic studies would be necessary to fully understand the logic behind the naming of plants in southern Ecuador by indigenous and non-indigenous people.

7 Discussion

…para hacer chicha,
se cocina la corteza de la piña silvestre con maíz tostado…
…se lo pone molido, albahaca, canela, clave de olor y panela…
…y después levadura… dejala fermentar una noche y ya … lista!
…también hay aquí la piñuela…
…la hoja es como la de la piña, pero moradita…
…se chupa la fruta, es dulce-amarga…
Angelita Sanchez, Malvas
(on *Ananas comosus* and *Aechmea magdalenae*)

The Spanish quotes at the beginning of each chapter immediately show the various aspects of plant-people interactions. These quotes were taken literally from my field notes, stories told by many people, scribbled down during interviews. They contain information on how Ecuadorian people use edible plants, but also tell us about doubts or lack of knowledge people may have about potentially edible plants. They tell how people see plants, name them and what the name may mean. They tell where plants grow and where people know they can find plants when they need them. They also contain much cultural information, such as the *apai* quote (chapter 3) that tells us that mestizo people do not eat this fruit, only Shuar people do. A cultural difference and possibly negative connotation to do with eating wild fruits.

These quotes really tell us what ethnobotany is about. It is about plants and people, but there are so many facets to the interaction between the two. My notebooks were filled with hundreds of such quotes and stories of what people know about plants. Although it is sometimes difficult to incorporate such information in databases and statistical analyses, this document should reflect most aspects of the knowledge people in southern Ecuador have about edible plants.

Strengths

This is the first regional ethnobotanical study carried out in southern Ecuador, an area rich in biodiversity. More than 6000 plant species occur in an area the size of Belgium, and that is just the species that are known today. New species are continuously discovered in Ecuador. One strength of the present research is therefore that it was carried out in a relatively understudied geographical area with a vast pool of plant resources. This is for example shown by the discovery of three edible plant species new to science, *Passiflora luzmarina*, *Vasconcellea palandensis* and *Ceratostema* sp. nov. ined.; and the recording of four species for the first time in Ecuador. Ethnobotanical plant inventories thus remain important. Moreover, these species were not found in isolated, uninhabited places, but within anthropogenic habitats. Edible plants in particular and useful plants in general, are often more studied than non-useful plants are. The new recordings thus indicate that much taxonomic and ethnobotanical research remains to be done in southern Ecuador in order to obtain complete knowledge of available plant resources and their importance to local people. Since our own research finished, however, several graduate students and Ecuadorian researchers initiated ethnobotanical research projects in the area.

Another strength is the fact that plant-people relationships amongst non-indigenous mestizo and farming communities were studied, an aspect that has long been neglected in ethnobotany (Prance 1995). Many ethnobotanists focus their research on indigenous communities, as these are perceived to have a more elaborate plant knowledge compared to non-indigenous people, through their way of living. At the same time, however, indigenous people form a small minority in terms of population numbers and the land surface they inhabit. Mestizo communities may have less elaborate relationships with their environment, but they often inhabit areas with more land pressure and therefore larger threats to loss of biodiversity. Also their cultural knowledge is often more under threat of loss. This emphasises the need to study plant-people relations amongst mestizo communities, a fact that is now widely recognised (Benz et al 1994; Padoch & de Jong 1987; Padoch & de Jong 1991).

Furthermore, the original research on how mestizo people name edible plants in particular, and useful plants in general, is a first analysis of mestizo plant nomenclature known to be made.

Answering questions

Returning to the original research questions, we can see which overall answers this research offers. Elaborate conclusions have already been presented at the end of each chapter.

- Which edible non-crop plants are used in southern Ecuador and how are they used?
- How significant is the use of edible non-crop plants in the region?
- How does the use of edible plants vary according to the ecological, agricultural and cultural (ethnic) context in the region?

Detailed information was gathered on 354 edible non-crop plant taxa that people in southern Ecuador know and use (Annex 1), showing that most plants have edible fruits and are eaten raw. Some plants are, however, prepared in various savoury and sweet dishes.

The knowledge of non-crop edible plants is widespread throughout the region. Every person and interviewee we spoke to knew various edible plants. Although non-crop edible plants have little economic importance compared to other economic activities, for some people selling fruits at local and regional markets does provide some income. The main significance of edible plants lies in their varying contribution to people's diets. Shuar people use plants on a regular basis, but do not market them. Edible plant use thus plays a significant role in Shuar subsistence. Amongst mestizo people, the actual use of edible plants is probably less than the knowledge they have on edible plants. This may well indicate a threatening decline in traditional mestizo plant knowledge. The threat is even more serious, knowing that the majority of plant species are only known in relatively small areas because of the narrow ecological range of many plant species. The entire mestizo population in southern Ecuador only shares the knowledge of a limited number of edible plants. A decline in plant knowledge can already be seen as a result of migrations, when mestizo people colonise new areas. As migration increases in the area due to economic pressures, plant knowledge will continue to decrease.

Plant use is very diverse throughout the area, both in terms of the number of plants used in any place and the species used. Species variation is caused by ecological variations within the region. Differences in altitude, climate and vegetation mean that very different plant species grow and are used in particular areas. Similarities between different sites indicate which edible species are representative for certain ecological areas. Dissimilarities highlight sites with potentially interesting plant compositions.

The number of edible plants known and used varies due to ethnic, socio-economic and agricultural factors. Shuar people use significantly more plants than mestizo people (or colonisers) do. Indigenous Saraguros on the other hand do not. Levels of plant use are sometimes influenced by the colonisation history of an area, whereby less plants are know in recently colonised areas in the Amazonian region. Economic activities in an area do not seem to have an influence on higher or lower plant use. Importantly, plant use is in certain areas strongly influenced by plant management and agricultural practices, which is discussed further on.

The ethnic groups mestizo and Shuar show not only differences in the number of plants they use and the role plants play in their subsistence, but also in the type of edible plants they use and where they collect them. Shuar people tend to use more edible leaves and palm hearts, whereas mestizo people mostly use edible fruits that are eaten raw. This may indicate a decline of plant knowledge amongst mestizo people. Shuar people rely more on forests to find edible plants, whereas mestizo people gather more from agricultural habitats, a reflection of the different worlds they inhabit and their different subsistence practices.

- Focusing on the agropastoral mestizo population in the Andean area, how significant is the management of edible plants?
- Which particular management systems, practices and techniques do farmers apply and which edible non-crop plant species are associated with each of them?
- Why are certain plant species managed, rather than domesticated or simply gathered, and what are the criteria for their selection?

About half of all non-crop edible plants that are used in the Andean area are managed. Most species are managed in pastures and homegardens. Fewer are managed in hedges, fields, coffee groves and along roadsides. Management practices used in the area are tolerating, sowing, planting and transplanting. The majority of managed species are tolerated *in situ*, a smaller number are actively sown or (trans)planted and thus managed *ex situ*. Farmers do not apply cultural operation and techniques like pruning, pest control or fertilisation to managed plants. Species lists for all management systems and practices are presented in chapter 5. Some species like *Annona cherimola, Erythrina edulis, Inga fendleriana, Inga oerstediana, Inga striata, Pouteria lucuma* and *Vasconcellea* x *heilbornii* may be subjected to various management practices and occur in various systems.

Plant management is influenced by the utility of a species. Wild, non-managed edible species typically have no additional uses (besides being used as a food) and are usually herbaceous plants or shrubs. Managed species have fruits that are deemed interesting (large, tasty, nutritious), have multiple uses or a definite economic value. Many managed plants are trees (with multiple uses) and all economic species are managed. Only half of all edible managed species are managed for their edible fruits. Trees are often managed for shade, fuelwood and timber. Plants may also be managed as living hedges, for fodder and to benefit soil fertility in fields, gardens and pastures. Many plants are managed for a variety of reasons.

The reasons why a plant is managed are strongly linked with the place where a plant is managed and how it is managed. Certain management patterns thus exist in Andean southern Ecuador. Three principal patterns found are: plant species that are actively managed in homegardens; plant species that are tolerated in homegardens and hedges; and plant species that are tolerated in pastures (Fig. 7-1). *Annona cherimola*, *Capparis petiolaris*, *Inga* spp., *Juglans neotropica*, *Pouteria lucuma* and *Vasconcellea* spp. are multipurpose trees that are often actively managed for their marketable fruits in homegardens. *Acnistus arborescens*, *Clavija euerganea*, *Cyphomandra cajanumensis*, *Physalis peruviana* and *Solanum americanum* are often tolerated in homegardens and hedges. These are non-economic species with edible fruits, leaves or flowers. *Inga* species, Myrtaceae, *Rubus* and *Passiflora* species are mainly tolerated in pastures and hedges for fuel, timber or edible fruits.

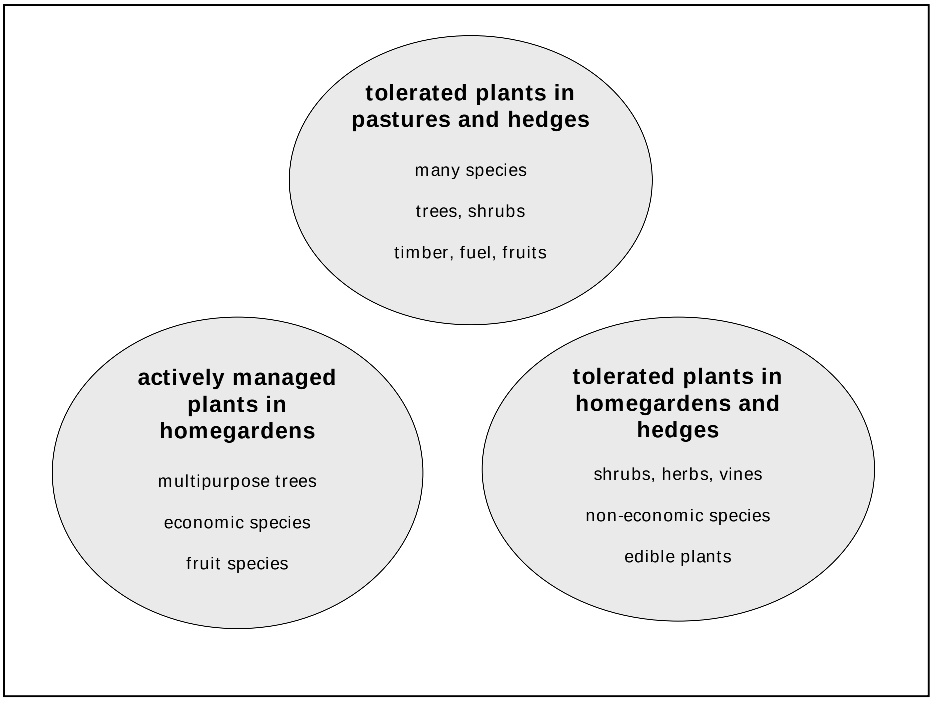


Figure 7-1. Principal management patterns for edible non-crop plants in *mestizo* farming communities in Andean southern Ecuador

Link between plant use and management

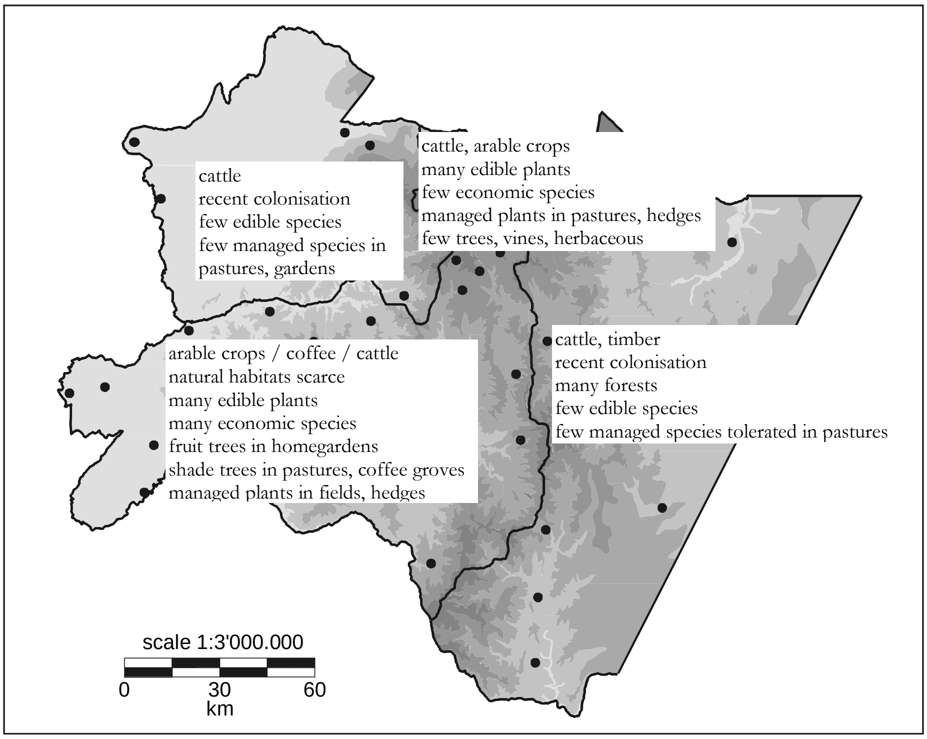
All these management aspects (how, where and why edible plants are managed) are also linked with the ecology and agricultural practices of an area. This in turn influences the use of edible plants in an area. When comparing the areas with similar edible plant species identified in the present research (Map 4-2) with the agro-regions and their characteristics of plant management (Table 5-20), we see some interesting results (Map 7-1). This comparison can only be made for mestizo communities in the Andean area, since detailed management research was only done here.

On the dry western Andes slopes of Loja province situated between 1200 and 2500 m (edible species group 5; agro-region Centro Loja - Playas and Cariamanga-Amaluza), agricultural production focuses on arable crops and coffee production, combined with some cattle farming. In this agricultural landscape, remnants of natural vegetation or forests are scarce. Despite this, a large number of edible non-crop plants was recorded here, 13 of which are marketed species, which are all managed. In this area, many edible plant species are managed in all parts of the agricultural system: homegardens, fields, coffee groves, pastures and hedges. Managed species are primarily trees and economic species. Many of them have been actively introduced by sowing or planting. A clear link exists here between edible plant use and management. The fact that many species are managed as part of an existing production system explains the high number of edible species present. The tradition of managing non-crop plants in an area that has been farmed for centuries, means that many of them survive in a farmed habitat. Examples of edible plants managed and used here are *Annona cherimola*, *Inga striata* together with other *Inga* spp., *Vasconcellea* x *heilbornii*, *Pouteria lucuma*, *Opuntia ficus-indica*, *Capparis petiolaris*, *Juglans neotropica*, *Agave americana* and various Myrtaceae trees (e.g. *Myrcia fallax*). These species are either fruit trees growing in homegardens, or shade trees in coffee groves and pastures, or growing in hedges. They were typically recorded in many villages throughout the area. Other plant species are also used and/or managed in the area, but these are the most common ones.

Higher up in the cold humid Andes above 2500 m (edible species group 6; agro-region Loja and Saraguro), cattle farming and growing arable crops are the principal farming activities. This is again an area where high numbers of edible species were recorded. Many of them are tolerated or sown in all parts of the agricultural system. However, most are found in pastures and hedges. More managed species are herbaceous plants and vines, less are trees and some are economic species. *Rubus* spp., *Passiflora* spp., *Agave americana, Vasconcellea* x *heilbornii, Juglans neotropica, Pouteria lucuma, Annona cherimola* and various Solanaceae (e.g. *Solanum caripense*) are managed

On the recently colonised humid, western Andean slopes between 1500 and 2500 m (edible species group 4; agro-region Chilla-Uzhcurrumi), cattle farming is the prime agricultural activity. Relatively few edible species and few managed species were recorded in this region. Plants like *Passiflora* spp., *Juglans neotropica, Pouteria lucuma, Inga* spp.*, Prestoea acuminata,* Myrtaceae and palm trees may be tolerated in pastures, or tolerated and sown in homegardens.

Similarly, few edible and managed species are found in another recently colonised area where cattle farming and timber logging are dominant, i.e. the high Amazonian slopes of the Eastern Andes (edible species group 7; agro-region Zamora). Despite the fact that relatively large areas of forest remain here, few edible forest species are used or known. Managed plants like *Inga* species and *Saurauia peruviana* are tolerated in pastures.



Map 7-2. Link between agricultural system, plant use and management in Andean southern Ecuador (base map by CINFA)

The main conclusion to be drawn by linking ecology, agricultural practices and plant use is that agricultural practices and ecology have a significant influence on plant use. The ecology of an area determines which edible species grow there, but also which agricultural system exists there. Certain parts of the agricultural system encourage specific forms of plant management, which in turn determines the types and numbers of edible plants used (Fig. 7-2). The production of arable crops and the presence of coffee groves and homegardens are aspects that encourage a diversity of active plant management, resulting in large numbers of edible non-crop plants. Cattle farming is linked with tree toleration in pastures and hedges, and relatively fewer edible species. Also the colonisation history of an area has an influence. In areas where agriculture has been practised for a long time, farmers manage useful plants. This means that relatively many non-crop species are used. In recently colonised areas, less plants are used.

The areas where the highest numbers of edible species were recorded are thus either areas where plant management is important (dry western Andes slopes and high Andes above 2500 m) or areas inhabited by indigenous Shuar people (Amazonian lowlands).

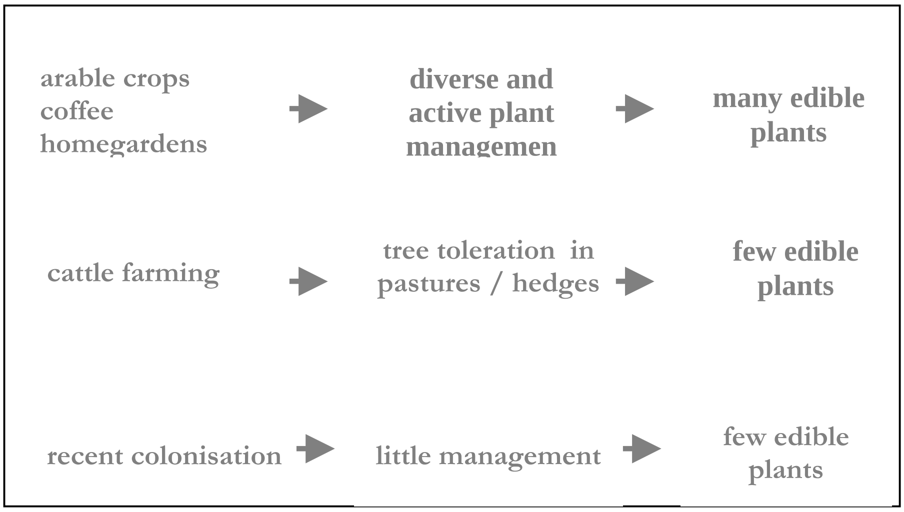


Figure 7-2. The influence of agriculture on plant management and use in Andean southern Ecuador

A result of the management of edible non-crop plants is that in mestizo communities many such plants are collected from agricultural rather than from natural habitats, even when people live adjacent to biodiversity-rich forest stands. A reliance of agricultural communities on agricultural habitats for wild foods and useful plants in general, has been found by other researchers, who have given various explanations for this. A preference to collect plants nearby the houses is one explanation (Ladio & Lozada 2000; Stepp & Moerman 2001; Styger et al. 1999). Why travel far to collect a plant if you can find the same plant nearby? Important to remember is, however, that the place where a plant grows is not necessarily arbitrarily chosen. As this study shows, many useful plants are encouraged to grow near houses through management. When other plants are removed, useful plants will be spared or even introduced into the agricultural area. This has led to a relative increase of non-crop edible plants within the agricultural area.

It is interesting to see that managed species do not necessarily become domesticated. Managed plants co-exist alongside domesticated crops. *Annona cherimola* for example, a fruit tree native to southern Ecuador and northern Peru, is grown commercially in many subtropical countries (Spain, California, Chile, New Zealand) (Scheldeman 2002). Although it is the most important economic non-crop fruit in southern Ecuador, it is not domesticated there. Alongside wild specimens we find tolerated and even cultivated specimens, whose fruits may be harvested to be sold. Similarly, *Vasconcellea* x *heilbornii* and *V. cundinamarcensis* are important local managed fruits, but are not domesticated, as they are in other regions of Latin America.

- Additionally, the large number of common plant names that was recorded throughout southern Ecuador, combined with information on where they were recorded and how often they were recorded, offered a unique opportunity to analyse how indigenous and non-indigenous people in the area name plants. Meanings, structures and variations in the names of plants were analysed.

Plant names form an important part of traditional knowledge. Many of the common plant names recorded in southern Ecuador show similarities with plant names used throughout Latin America. However, no research has been done into how Latin American plant names may have formed, which linguistic influences play a role and what the names may mean. Overall, only very few studies have been done into plant nomenclatures of non-indigenous societies. The analyses presented as part of this research are therefore a first attempt to analyse how mestizo people name plants. Transposition, borrowing from indigenous languages and neology, naming mechanisms typically used by immigrants, are shown to be important ways in which plant names have been formed in the region. Furthermore, these mechanisms still create new plant names today, as can be seen from the fact that in *colonos* villages in the Amazonian area, many plants are given newly coined names or names borrowed from Shuar language. Plant naming by mestizo people is variable throughout the region, irregular, and influenced by the plant composition of an area. Shuar people on the other hand use specific and unique plant names with little regional and linguistic variation.

Implications of traditional plant management for conservation of biodiversity

One last topic I would like to explore is the implications of traditional plant use and management for the conservation of the species and ecosystems involved, or maybe more importantly for the ones not involved. We see that about half of all known edible plant species in southern Ecuador are managed, whereas the other half are not. This must influence their survival in an agricultural landscape. As Gómez-Pompa (1996) said "*the biodiversity we have today is in great part the product of the actions of thousands of generations of humans on earth*".

The species that are managed have in common that they are often trees, have some economic value, and are considered particularly useful (multiple uses, nutritious fruits). Edible species that are not managed are often shrubs and herbaceous plants, have no economic importance and have usually no additional uses (Annex 6). They are usually not widely known (used and known in one or few places) or occur in areas with low population densities (e.g. Andes above 3000 m, higher Amazonian slopes, humid coastal region). The sample of edible plants presented here is only a part of the total number of useful plants and species that may be managed by local farmers.

Agricultural systems are recognised as important repositories of biological diversity, not just for crop diversity, but also for non-crop plants and wildlife. The conservation of biological diversity has become an issue of global importance over the last decades. Despite all interest and efforts, however, global biodiversity continues to decline (IUCN 2003), mainly through habitat loss, land degradation, agricultural and extractive activities and human development.

Conservationists have moved away from the romantic idea to preserve wild, untouched areas by excluding people (Cronon 1996). No area is really untouched by humans. Even seemingly pristine forests are often managed by people (Posey 1985). Nature preservation may preserve biological resources, but excludes the cultural diversity and positive influence of people on the environment (Haverkort & Millar 1994). Also local people often resent conservation programs imposed by outsiders without taking their needs into account (Etkin 1998), making it difficult to implement them.

Nearly a fifth of the world's protected area is used by local people for agriculture (McNeely & Scherr 2001). Nature and humans are intrinsically linked and conservation must focus on the responsible use of nature around us, rather than on preserving pristine areas. Recently, the potential of traditional agricultural practices has been seen as important for the conservation of wild plant resources (Aumeeruddy 1995; Haverkort & Millar 1994; McNeely & Scherr 2001), although it is often underestimated and understudied (Vandermeer & Perfecto 1997). Examples from across the tropics tell the story of how biodiversity is often an integral part of traditional agriculture.

In the Maya area of Mexico for example, high population densities in the past have not resulted in biodiversity depletion. On the contrary, this area is one of the world's prime centres of biodiversity. Forests have been enriched with useful trees through centuries of human management (Gomez-Pompa 1996). Today's indigenous communities make optimum use of the locally available biodiversity and space to optimise agricultural outputs by mimicking nature itself (Barrera et al. 1977).

Also in Mexico, traditional farming systems (fallows, *milpas* and homegardens) managed by indigenous people form islands of high biodiversity in a largely agricultural area, consisting of fields and pastures (Totonacapan region) (Toledo et al. 1994). The biodiversity islands contain a large proportion of the original plant diversity of the area. During different stages of changing land use over the last

centuries, forest cover has declined (sometimes dramatically). But today these managed patches successfully combine the conservation of biodiversity with production of cash products through multiple use of natural space and resources.
A comparison of different coffee production systems in Mexico, showed that traditional shaded coffee systems, whereby coffee is grown as understory vegetation in native forest, or alongside other useful indigenous and introduced plants in artificial agroforests, are important refuges for plant and animal biodiversity (Moguel & Toledo 1999). They harbour for example more bird species than many natural forest types in the area.

In a recently colonised area in Amazonian Peru, a comparison of plant communities in forests and agricultural areas showed that overall species numbers drop through land use. Many plant species in fields and fallows are, however, absent from forests, showing that land use also increases biodiversity, albeit it with a changed composition (Fujisaka et al. 2000). Trees in pastures in Costa Rica combine benefits for local people (shade, timber, fuelwood, fence posts) and wildlife (food for birds and bats) (Harvey & Haber 1999).

Many other researchers have shown that traditional knowledge, land use and plant use by both indigenous and non-indigenous people often enhance or increase the biodiversity of an area (Etkin 1998; Fujisaka et al. 2000; Haverkort & Millar 1994; Jain 2000; LaRochelle & Berkes 2003).

This importance of traditional knowledge and agriculture for the conservation of biodiversity is recognised globally by the international Convention on Biological Diversity (CBD 2004) and Agenda 21, the programme for sustainable development (Quarrie 1992). Farmers' fields and gardens are recognised as important repositories of biodiversity. One of the targets set in the Global Strategy for Plant Conservation (CBD 2004), is to manage at least 30% of production lands consistent with plant diversity conservation by 2010. Enhancing wildlife habitat on farms, mimicking natural habitats by integrating productive perennial plants and introducing trees in pastures are some strategies identified to combine increased agricultural production with biodiversity conservation (McNeely & Scherr 2001) and to complement conservation in protected areas.

Plant management is one farming method that enhances biodiversity. Certain parts of the agricultural system, like coffee groves and homegardens, especially favour plant management. This can be seen in our study, where 43% of all species in homegardens in Loja are managed species, many managed species are particularly found in gardens, and half of all trees in coffee groves are managed edible species. Many other researchers have emphasised the significance of plant management in homegardens and coffee groves, and therefore their high conservation value (Alcorn 1981: Gajaseni & Gajaseni 1999; Gómez-Pompa 1996; Guijt et al. 1995; Salinas et al. 2000; Steinberg 1998). Plant management also has an indirect ecological importance for conservation. Wild species maintained in an agricultural area form an important seed source for forest regeneration and provide habitats and food for wildlife (Styger et al. 1999).

In Ecuador, the Andes region has the highest number of plant species and the highest level of endemism. Agriculture and human impact are usually blamed for the destruction of the original forest cover, resulting in a general decline of total biological diversity (plants, birds, animals, etc.). Centuries of human interactions have shaped southern Ecuador's environment and biodiversity as it is today. The landscape may be dominated by agriculture. This does not, however, mean that biodiversity is only dominated by domesticated plants. Many wild plant resources are integrated within the agricultural system or survive alongside it, either because plants find a new niche within this anthropogenic landscape (like weeds), or because humans actively influence the presence of species through management.

For areas like the Andes in southern Ecuador, where forests have been reduced to isolated remnants as islands in an agricultural landscape, the best strategy to reduce deforestation and conserve biodiversity is through a combination of direct and indirect conservation policies (Rudel & Horowitz 1993). Direct approaches are the creation of protected areas, stimulating social forestry (giving local communities right of use and responsibility to protect forests) and agroforestry policies (encouraging tree crops to be planted in the production system). Indirect measures would focus on reducing deforestation through economic incentives, agricultural intensification and integrated rural development.

The land area protected in national parks or reserves has increased rapidly over the last few years. In southern Ecuador alone, local non-governmental organisations, communities and private landowners have created 32 nature reserves and protected forests, many of them established in the last 10 years (pers. comm. Naturaleza & Cultura Internacional[8]; Map 1-5). Protection does not exclude human use, but management plans drawn up after communication with local communities regulate it.

The biodiversity conserving potential of agriculture is recognised in Ecuador by ecological organisations. Recent projects promoting "*café de conservación*" and "*cacao de conservación*" (Suarez 2003) encourage coffee and cacao producers to practice a sustainable production system that not only includes organic farming practices, but also pays attention to the conservation of biodiversity at ecosystem level, in the entire coffee growing area. All coffee producers in an area must co-operate in a sustainable farming system, not just individual farmers. One such project has been introduced by the Ecuadorian coffee co-operative CORECAF in Alamor (Suarez 2003). Producing *"café de conservación*" encourages farmers to use native legume, fruit and timber trees for shade, like *guabo* (*Inga* spp.) and *algarrobo* (*Prosopis*

[8] Naturaleza & Cultura Internacional, Loja. Ecuador, August 2003.

juliflora) (SNIA n.d). Other land practices that are encouraged are the use of natural fertilisers, soil conservation, biological pest and disease control and crop diversification on coffee farms.

Environmental organisations in Ecuador clearly understand the need to encourage farmers to maintain biodiversity richness and to conserve nature within the agricultural area. What seems to be lagging behind tough, are government policies. Ecuador signed and ratified the Convention on Biological Diversity and produced a national biodiversity report. A national biodiversity strategy and action plan are being finalised at the moment, through a broad consultative process (CBD 2004). A biodiversity law was approved in 1998, giving the state sovereign right over all biological diversity, but granting indigenous people the collective intellectual property rights over their knowledge on biological resources (CBD 2004). No government policies exist so far on the conservation of biodiversity through agriculture. As this study shows there exists an enormous potential there. Even traditional agriculture is driven by economics, however, so conservation priorities need to be combined with economic strategies and farmers' needs and endorsed by appropriate policies.

Local people's views on conservation and biological resources are important. The few existing studies in this field indicate that people's views on conservation are mixed, depending on circumstances. Nazarea et al. (1998) found usefulness to be more important than commercialisation in people's perceptions on natural resources. Also beauty, appreciation of indigenous knowledge and plant diversity were seen as important values. Some researchers found local people to be in favour of conservation, as long as this linked in with local needs and acknowledged their knowledge (Osemeobo 2001; Marcus 2001; Muller-Boker & Kollmair 2000; Walpole & Goodwin 2001). Sometimes local people see conservation as a luxury they can not afford (Marcus 2001). Sometimes their positive attitude depends on whether they feel they benefit from conservation in an economic way (Sekhar 2003) or practices favouring conservation are threatened by market forces (LaRochelle & Berkes 2003). Some studies indicate that there is no link between people's view on conservation and financial benefits (Walpole & Goodwin 2001). Views are thus mixed and very case specific.

The key to successful conservation is that there exists no 'fit-all' policies or strategies to conserve or enhance biological diversity. The advantage traditional agriculture offers is the fact that it is adapted to local diversity and the local environment and grounded in local knowledge and acceptance. Successful strategies must develop locally, be applied locally and be flexible (Haverkort & Millar 1994).

Future research

Studies of local attitudes towards conservation and plant diversity are important. This is something that was not addressed in this study. It would be an important follow-up to confront the findings of this study with the needs of local farmers and their views on biodiversity, plant management and conservation. This study identifies areas with interesting edible species compositions, areas with significant levels of plant management and high species diversity. These areas may deserve more detailed research or could be chosen for integrated development and biodiversity projects. Results show that homegardens, coffee groves and hedges harbour many useful resources. Everywhere in the agricultural habitat biodiversity is maintained. This must be valued as an important aspect of existing production systems and must get as much attention as crop production in agricultural development projects.

Further recommendations would be to study other farming systems in the area, where plant management may be very different. Especially in the coastal area, where large banana plantations, shrimp farms and cattle farming have resulted in a very different landscape and production system. Biodiversity loss may well be much larger here than in the Andean region. It would be important to compare the effects of intensive agriculture with those of traditional Andean subsistence agriculture on the biodiversity in the respective areas. Lessons could be learnt form plant management practices used in the Andes to benefit the biodiversity in more intensive production systems.

In the Amazonian area, the situation is again very different. Shuar plant use is well documented in this study. Plant management is practised by Shuar communities, but has not been analysed in this study. It would be interesting to analyse plant management by Shuar communities. A recent comparative study of Shuar and mestizo agricultural practises in Morona-Santiago showed that even though Shuar may nowadays exploit forests much as colonisers do (cattle farming, forest clearance) as they participate in the market economy, they still maintain biologically more diverse landscapes by focusing more on garden crops and fallows than cattle farming (Rudel et al. 2002).

The other side of the picture is the fact that many species are not maintained or managed within the agricultural habitat (Annex 6). What happens to these species? Will they eventually disappear from a largely agricultural landscape? They may well be more threatened with extinction than managed species are. Do they deserve to be protected, even if local people consider them as less valuable resources?

Much remains to be studied in the field of traditional knowledge in the region. The knowledge of mestizo people may differ from indigenous people's knowledge, but is therefore not less important to study. The analysis of plant names alone shows the rich heritage that lies hidden in just one aspect of plant-people interactions, i.e. the way in which people name plants. No analysis of mestizo plant names in Latin America seems to exist, yet many of the naming patterns are very similar in other countries. This is an enormous field of knowledge with scope for more in-depth studies.

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Annexes

Annex 1. List of non-crop edible plants of southern Ecuador – ethnobotanical and botanical data

In print and on inserted CD

Annex 2. Regional distribution of edible non-crop plants throughout southern Ecuador

On inserted CD

Annex 3. Edible non-crop plants managed in Andean southern Ecuador

On inserted CD

Annex 4. Characteristics of 17 homegardens surveyed in Loja province: size, plant composition and plant use of gardens

On inserted CD

Annex 5. Shuar plant names of edible non-crop plants recorded in southern Ecuador

On inserted CD

Annex 6. Edible non-crop plants of Andean southern Ecuador that are not managed by local farmers and therefore less likely to be conservaed in agricultural areas

On inserted CD

Annex 7. Statistical analyses

On inserted CD

Annex 8. Edible non-crop plants used by Shuar people in southern Ecuador

On inserted CD

Curriculum vitae of author

Annex 1. List of non-crop edible plants of southern Ecuador – ethnobotanical and botanical data

Local names: (S) are Shuar names, all other are Spanish names; Market: plant product sold at local or regional market; Herbarium vouchers: all botanical specimens were collected by V. Van den Eynden, E. Cueva & O. Cabrera, except: EC = E. Cueva; OC&IL = O. Cabrera & I. Lauwers; VVDE&GE = V. Van den Eynden & G. Eras
* species likely to have been introduced

Plant family	Botanical name	Local names	Edible plant part
Actinidiaceae	*Saurauia bullosa* Wawra	Jicamillo	Fruit
	Saurauia peruviana Busc.	Jicamillo	Fruit
	Saurauia cf. *peruviana* Busc.	Moco	Fruit
	Saurauia sp.	Ataringue	Fruit
Agavaceae	*Agave americana* L.*	Méjico, mishque	Flower bud Plant sap
	Fourcroya sp.*	Cabuya	Flower bud
Alstroemeriaceae	*Bomarea* sp.	Coquito	Tuber
Amaranthaceae	*Amaranthus hybridus* L.	Bledo	Leaves
Anacardiaceae	*Spondias mombin* L.*	Ciruela de monte	Fruit
Annonaceae	*Annona cherimola* Mill.	Chirimoya	Fruit
	Annona muricata L.*	Guanábana	Fruit
	Annona squamosa L.*	Chirimoya	Fruit
	Rollinia mucosa (Jacq.) Baillon*	Anona, chirimoya silvestre, guanábana silvestre	Fruit
Apocynaceae	*Tabernaemontana columbiensis* (Allorge) Leeuwenberg	Cafecillo	Aril
	Tabernaemontana sananho Ruiz & Pavón	Kúnakip (S)	Aril
Araceae	*Anthurium breviscapum* Kunth	Katshiniak eép (S), eép (S), col de monte	Young leaves
	Anthurium rubrinervium (Link) G. Don	Shiniumas (S)	Young leaves
	Anthurium triphyllum Brogn. ex Schott	Wánkat (S), eép (S)	Young leaves
	Anthurium sect. *Xialophyllium*	Wee eép (S)	Young leaves
	Anthurium sp10	Col de monte	Young leaves
	Anthurium sp7	Eép (S)	Young leaves
	Anthurium sp11	Natsa eép (S)	Young leaves
	Anthurium sp3	Pelma	Young leaves Tuber
	Anthurium sp12	Sacha sanguillo	Young leaves
	Anthurium sp6	Shiniumas (S)	Young leaves
	Rhodospatha latifolia Poeppig	Katírpas (S)	Young leaves
	Rhodospatha moritziana Schott	Mukunanch' (S)	Young leaves
Arecaceae	*Aiphanes grandis* Borchs. & Balsev	Chonta	Palm heart Seed

Preparation	Market	Additional uses	Herbarium vouchers
Raw		Fuelwood	719, EC790
Raw		Fuelwood	718
Raw			775
Raw		Fuelwood	592, 990
Pickles	x	Pig fodder (plant sap)	180, 1003
Drink, *colada*	x		
Soup, pickles		Soap, fibres, dye mordant (leaves)	-
Raw			613
Raw, salad, pickles, stew			190
Raw		Timber	954
Raw, juice, preserve	x	Shade	137, 262
Raw, juice, preserve	x	Fuelwood	84, 128, 177, VVDE& GE239, 456, 459
Raw		Fuelwood	934
Raw, juice			723, 735, 780
Raw			893
Raw			703, 912
Soup, stew, *tonga*			662, 907, 920
Tonga			925
Tonga			668, 846
Stew			702
Stew			901
Tonga			837
Tonga			924
Stew			656
Cooked, stew			
Stew			319
Stew, soup			658
Tonga			OC&IL860, 923
Tonga, soup			917
Raw, stew			877
Preserve			

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Aiphanes verrucosa Borchs. & Balslev	Chonta	Fruit mesocarp
	Astrocaryum urostachys Burret	Awant' (S)	Palm heart Seed
	Attalea colenda (O.F. Cook) Balslev & Andr. Hend.	Chivila	Seed
	Bactris gasipaes H.B.K.*	Uwí (S), chonta	Fruit mesocarp Palm heart
	Bactris macana (Mart.) Pittier	Chonta	Palm heart Fruit mesocarp
	Bactris setulosa H. Karst.	Chontilla, chonta	Palm heart Fruit mesocarp
	Ceroxylon amazonicum? Galeano	Paik' (S), palma de ramas	Palm heart
	Ceroxylon echinulatum Galeano	Palma	Fruit mesocarp
	Ceroxylon vogelianum (Engel) H.Wendl.	Coco	Fruit mesocarp
	Ceroxylon sp.	Palma	Fruit mesocarp
	Dictyocaryum lamarckianum (Mart.) H. Wendl.	Palma	Immature inflorescence
	Euterpe precatoria Mart.	Shimbe	Palm heart
	Euterpe precatoria var. *longe-vaginata* (Mart.) Andr. Hend.	Palmo real	Palm heart
	Euterpe ?	Yayu (S)	Palm heart
	Iriartea deltoidea Ruiz & Pavón	Ampakaí (S), pambil	Palm heart Immature seed
	Iriartea sp.	Palma, palmita	Palm heart Seed
	Mauritia flexuosa L.f.	Acho, achu (S)	Fruit mesocarp Palm heart
	Oenocarpus bataua Mart.	Kunkuk' (S), palma real	Palm heart Fruit mesocarp
	Oenocarpus mapora H. Karst.	Shímpi (S)	Palm heart Fruit mesocarp
	Pholidostachys synanthera (Mart.) H.Moore	Palma paja cambana	Palm heart
	Phytelephas aequatorialis Spruce	Tagua, trapa, cade	Immature seed Palm heart
	Prestoea acuminata Willd.	Palma, palmito, caño, tinguiso, saké (S)	Palm heart
	Prestoea ensiformis (Ruiz & Pavón) H.Moore	Caño	Palm heart
	Prestoea schultzeana (Burret) H.Moore	Tinkimi (S)	Palm heart
	Socratea exorrhiza (Mart.) H.Wendl.	Kúpat (S)	Palm heart
	Wettinia kalbreyeri (Burret) R. Bernal	Bambil, pambil	Palm heart
	Wettinia maynensis Burret	Terén (S)	Palm heart
	Wettinia cf. *maynensis* Burret	Palma	Palm heart
Asteraceae	*Taraxacum* sp.	Chicoria, muelo de león	Young leaves

Preparation	Market	Additional uses	Herbarium vouchers
Raw, stew		Thatch	726
Raw, stew			715
Raw			
Oil extraction		Thatch, pig fodder (fruit)	443
Soup, stew, roasted, juice (+milk), preserve, *chicha*		Timber	VVDE&GE206
Raw, stew			
Raw, in sausages, *fanesca*		Timber	175, 448, 648
Raw, cooked	x		
Raw, stew		Timber	584, 884
Cooked			
Raw, stew			-
Roasted, cooked			172
Raw		Thatch	597
Raw			621
Raw			583
Raw, stew			538
Raw, stew			880
Raw, stew			-
Raw, stew		Timber	711, 885
Raw			
Raw, stew			-
Oil extraction			
Poached			VVDE&GE208
Raw, cooked			
Raw, stew		Arrows, fishing mats (*huashima*)	689
Poached			
Raw, stew		Timber, thatch, fishing mats (*huashima*)	856
Poached			
Raw			581
Raw		Handicrafts (seed), brooms, thatch	-
Raw			
Raw, stew			174, 450, 598, 646, 690, 730, 772, 878, 972, 982
Stew, *fanesca*			645
Raw, stew		Thatch	682
Raw, stew		Fuelwood, timber	704
Stew, *fanesca*		Timber	644
Raw, stew		Fuelwood, thatch	683
Raw, stew			733
Raw, salad			-

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
Bombacaceae	*Pachira aquatica* Aubl.*	Cacao de monte, capira, mococha	Seed
	Quararibea sp.	Zapote de monte	Fruit mesocarp
Boraginaceae	*Cordia hebeclada* I.M. Johnston	Lataringue, uva	Fruit
	Cordia lutea Lam.	Overal, uva, muyuyo	Fruit
	Cordia nodosa Lam.	Kawachimí (S)	Fruit
	Cordia polyantha Benth.	Lera lera	Fruit
	Cordia polyantha? Benth.	Lagaña	Fruit
	Cordia polyantha? Benth.	Romero	Fruit
Brassicaceae	*Brassica napus* L.*	Nabo silvestre	Leaves
Bromeliaceae	*Aechmea magdalenae* (André) André ex Baker	Piñuela, piña	Fruit
	Ananas comosus (L.) Merril	Sacha piña, piña silvestre, piña del monte	Fruit
	Ananas sp.	Piñuela	Fruit
	Bromelia plumieri (E. Morren) L.B. Smith	Piñuela	Fruit
	Puya sp. *(Puya hamata ?)*	Aguarongo	Palm heart
	Gen. indet.	Huicundo	Leaves
Burseraceae	*Dacryodes peruviana* (Loes.) J.F. Macbr.	Kunchái (S), copal	Fruit mesocarp
	Protium sp.	Uruts (S)	Fruit mesocarp
Cactaceae	*Armatocereus cartwrightianus* (Britton & Rose) Backeb.	Cardo, soroca, cardo grande	Fruit
	Hylocereus polyrhizus (Weber) Britton & Rose	Pitaya	Fruit
	Monvillea diffusa Britton & Rose	Cardo, cardo rastrero, tuna	Fruit
	Opuntia ficus-indica (L.) Mill.*	Tuna, tuna blanca, tuna amarilla	Fruit
	Opuntia quitensis F.A.C. Weber	Penco, tunilla	Fruit
	Rhipsalis micrantha (Kunth.) DC.	Congona	Fruit
	Selenicereus megalanthus?	Tuna silvestre	Fruit
Caesalpinaceae	*Caesalpinia spinosa* (Molina) O. Kuntze	Tailin, tallo, vainilla	Seed coat
Campanulaceae	*Centropogon cornutus* (L.) Druce	Mishiyuyu, forastero	Leaves
	Centropogon erianthus (Benth.) Benth. & Hook. F.	Motepela	Fruit
Capparidaceae	*Capparis avicennifolia* H.B.K.	Vichayo	Fruit
	Capparis petiolaris H.B.K.	Achora, shora	Fruit
	Capparis scabrida H.B.K.	Sapote de campo	Fruit
Caricaceae	*Jacaratia digitata* (Poepp. & Endl.) Solms	Chamburo, toronche, numbi (S)	Fruit
	Jacaratia spinosa (Aubl.) A.DC.	Higo	Fruit
	*Vasconcellea candicans (*A. Gray) A.DC.	Chungay, toronche chicope	Fruit
	Vasconcellea cundinamarcensis Badillo	Toronche, toronche redondo	Fruit
	Vasconcellea x *heilbornii (*Badillo) Badillo	Toronche, babaco, babaco redondo, chamburo, siglo	Fruit
			Fruit excocarp

Preparation	Market	Additional uses	Herbarium vouchers
Roasted, hot drinks		Hedges	VVDE&GE198
Raw		Timber	888
Raw		Fuelwood, glue (fruit)	VVDE&GE247, 623
Raw		Fuelwood, timber, glue, hedges	98, 189, 941
Raw			918
Raw		Fuelwood	609
Raw			940
Raw			100
Stew			633
Juice			171, VVDE&GE242
Raw, juice, jam, *chicha*			220, VVDE&GE230, 318, 574, 977
Juice			958
Juice			978
Stew			328
Food wrap			502b
Poached		Fuelwood, timber	679
Poached		Fuelwood, timber	687
Raw			274, 473, 947
Raw, juice			467, 938
Raw			466, 617, 939
Raw, juice	x	Fodder (plant), cochineal	267, 284, 311
Raw			92, 944
Raw			590
Raw			916
Raw			170, 475
Stew			649
Raw			EC791
Raw			946
Raw			168, 187, 285
Raw		Fuelwood	615
Raw, *colada*			391, 653
Raw, jam			530, 779, 806
Raw, jam, preserve			282, 507, 508, EC987
Raw, jelly, juice, preserve	x		505, EC782
Raw, jelly, preserve	x		77, 169, 259, 290, 313, 425, 426, 427, 478, 485, 489, 504,
Juice, *colada*			552, EC783, EC784, 894,985

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	*Vasconcellea microcarpa (*Jacq.) A.DC.	Tsambúnumi (S), col de monte	Young leaves
	*Vasconcellea monoica (*Desf.) A. DC.	Chamburo, yumbo papaya, toronche	Fruit
	Vasconcellea monoica ? *(*Desf.) A.DC.	Berenjena	Fruit
	*Vasconcellea palandensis (*Badillo et al.) Badillo	Papaillo	Seed coat
	Vasconcellea parviflora A.DC.	Papayillo, yuca del campo, papaya del monte	Fruit Root Fruit exocarp
	*Vasconcellea stipulata (*Badillo) Badillo	Toronche	Fruit
Cecropiaceae	*Pourouma bicolor* Mart.	Nakantar shuinia (S), uva	Fruit
	Pourouma cecropiifolia Mart.	Washi shuinia (S), uva negra, uva	Fruit
	Pourouma aff. *cecropiifolia* Mart.	Pau shuinia (S)	Fruit
	Pourouma guianensis Aublet ssp. *guianensis*	Mutuch' shuinia (S), washi shuinia (S), uva verde	Fruit
	Pourouma melinonii Benoist ssp. *melinonii*	Uva, mutuch' shuinia (S)	Fruit
Clusiaceae	*Garcinia macrophylla* Mart.	Chora	Aril
Cucurbitaceae	*Cayaponia capitata* Cogn. ex Harms	Wuak (S), maní de bejuco	Seed
	Cucurbita ficifolia? Bouché	Zambumba	Fruit
Cyclanthaceae	*Carludovica palmata* Ruiz & Pavón	Pumpuná (S)	Leaf bud
Cyperaceae	*Cyperus* sp.	Coquillo, coquito	Tuber
Elaeocarpaceae	*Muntingia calabura* L.	Cerezo, niguito	Fruit
Ericaceae	*Cavendishia bracteata* (R. & P. ex J. St. Hilaire) Hoerold	Salapa	Fruit
	Cavendishia nobilis Lindley var. *capitata* (Benth.) Luteyn	Joyapa	Fruit
	Ceratostema loranthiflorum Benth.	Joyapa	Fruit
	Ceratostema oellgaardii Luteyn	Joyapa	Fruit
	Ceratostema sp. nov. ined.	Salapa blanca grande	Fruit
	Ceratostema sp.	Salapa	Fruit
	Disterigma alaternoides (Kunth in H.B.K.) Niedenzu	Nigua, salapa chica	Fruit
	Gaultheria erecta Vent.	Mote negro, sapallo	Fruit
	Gaultheria reticulata H.B.K.	Mote pelado	Fruit
	Gaultheria tomentosa H.B.K.	Sierilla	Fruit
	Gaultheria vaccinoides A.C. Smith		Fruit
	Macleania hirtiflora (Benth.) A.C. Smith	Joyapa chica	Fruit
	Macleania rupestris (H.B.K.) A.C. Smith	Joyapa, joyapa blanca, joyapa chaucha, salapa verde	Fruit
	Macleania salapa (Benth.) Hook. F. ex Hoerold	Joyapa, Joyapa blanca, joyapa morada, salapa, salapa blanca	Fruit
	Oreanthes fragilis (A.C. Smith) Luteyn	Huevo de gallo	Fruit
	Oreanthes ?	Salapa	Fruit

Preparation	Market	Additional uses	Herbarium vouchers
Stew			576, 647, 883, 900, 915
Stew, preserve			289, EC518, 577
Preserve			1002
Raw, juice			549, 998, 999, 1000, 1001
Raw, preserve		Pig fodder (root)	315, 441, 591
Cooked			
Colada			
Preserve			148, 479
Raw		Fuelwood	681
Raw			685, 732, 845
Raw			913
Raw		Fuelwood	684, 825, 847
Raw, macerated in alcohol		Fuelwood	571, 911
Raw		Fuelwood, timber	VVDE&GE231, 317, 981
Raw, roasted			414, 738, 928
Preserve			464
Raw, stew		Fishing mats (*huashima*)	667
Raw			943
Raw		Fuelwood, timber	145, 442
Raw, jam			344, 357, 429, 498, 524
Raw			716
Raw			480
Raw			355
Raw			630
Raw			564
Raw			439, 499
Raw			336, 356, 497
Raw			321
Raw			322
Raw			332
Raw, jam			326
Raw, jam	x		324, 325, 334, 335, 431, 496, 639, 872
Raw	x	Cork	185, 287, 288, 296, 297, 596, 638
Raw			298
Raw			774

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Orthaea secundiflora ? (Poepp. & Endl.) Klotzsch		Flower
	Orthaea ?	Joyapa	Fruit
	Pernettya prostrata (Cav.) Sleumer	Manzana	Fruit
	Psammisia cf. *aberrans* A.C. Smith	Joyapa	Fruit
	Sphyrospermum cordifolium Benth.	Salapa	Fruit
	Vaccinium crenatum (Don) Sleumer	Manzana rastrera	Fruit
	Vaccinium floribundum H.B.K.	Manzana, tira	Fruit
Erythroxylaceae	*Erythroxylum* sp.	Indicoca, indina	Fruit Leaves
Euphorbiaceae	*Caryodendron orinocense* Karsten	Naámpi (S), maní de árbol, maní del monte	Seed
	Hyeronima sp.	Sanón	Fruit
Fabaceae	*Centrolobium ochroxylum* Tul.	Amarillo	Seed
	Erythrina edulis Triana ex M. Micheli*	Guato, pashul	Seed
	Geoffroea spinosa Jacq.	Almendro	Fruit mesocarp
	Otholobium sp.	Guallua	Leaves
Flacourtiaceae	*Casearia* sp2	Najaraip (S)	Aril Seed
	Casearia sp3	Najaraip (S)	Aril
	Casearia sp1	Zapotillo	Aril
Hippocrateaceae	*Salacia cordata* ? (Miers) Mennega	Luma blanca	Fruit mesocarp
Icacinaceae	*Calatola* sp.		Seed
	Gen. indet2	Pepino	Aril
Juglandaceae	*Juglans neotropica* Diels	Nogal	Seed Leaves
Lauraceae	*Persea americana* Mill.*	Aguacate silvestre	Fruit mesocarp
	Gen. indet3	Wayákish (S)	Fruit
Lecythidaceae	*Grias peruviana* Miers	Apai (S), papayón	Fruit mesocarp
	Grias cf. *peruviana* Miers	Nátsa ápai (S)	Fruit mesocarp
	Gustavia macarenensis Philipson ssp. *macarenensis*	Iniák (S), iñaco	Fruit mesocarp
	Gustavia sp.	Tsantsaniak (S)	Fruit mesocarp
Liliaceae	*Yucca* sp.*	Flor de novia	Flower bud
	Gen. indet4	Pata blanca	Lower stem
Malpighiaceae	*Bunchosia deflexa* Triana & Planchon	Ciruela	Fruit
	Malpighia emarginata DC.*	Ciruela de fraile, cereza, manzana silvestre	Fruit
Malvaceae	Gen. indet.	Manzana de campo	Fruit
Melastomataceae	*Arthrostema ciliatum* Ruiz & Pavón	Chúrunch' (S)	Flower
	Bellucia pentamera Naud.	Túnkia (S), sacha manzana	Fruit
	Clidemia hirta (L.) D. Don var. *hirta*	Mora	Fruit
	Clidemia pilosa D. Don	Dumarín	Fruit
	Clidemia sericea D. Don	Uva pequeña, mora	Fruit
	Miconia calvescens DC.	Sierra	Fruit
	Miconia ledifolia (DC.) Naud.	Sierra	Fruit

Preparation	Market	Additional uses	Herbarium vouchers
Raw			588
Raw			778
Raw (poisonous?)[9]			345, 435
Raw			895
Raw			451, 764
Raw			323, 346
Raw			333, 436
Raw		Fuelwood, timber	281
Infusion			
Raw, roasted		Fuelwood, timber	VVDE&GE195, 691
Raw		Fuelwood, timber	969
Raw, roasted, stew		Timber	VVDE&GE232, 611
Cooked, fried		Hedges, guinea pig fodder (leaves)	118, 173, 302, 539
Raw		Timber	472
Soup, salad (cooked)			EC786
Raw			848
Raw			
Raw		Fuelwood	706
Raw			974
Raw			VVDE&GE233
Raw			771
Raw, macerated in alcohol			973
Raw, preserve, *nogada*	x	Timber, dye (fruit, bark)	162, 561
Infusion			
Raw		Fuelwood, timber	452, 534, 579
Cooked			861
Raw, fried, cooked			VVDE&GE196, 586, 678
Raw		Fuelwood	677
Raw		Fuelwood, timber	VVDE&GE204, 568, 698, 731, 843
Raw		Timber	905
Soup, pickles			-
Stew			631
Raw		Fuelwood	781
Raw, juice, preserve		Fuelwood	471, 616, 937
Raw		Fuelwood	608
Raw			OC&IL862
Raw		Fuelwood	676, 744
Raw			VVDE&GE223
Raw			573
Raw			VVDE&GE224, 300
Raw			578
Raw			327

[9] according to Ulloa Ulloa & Jørgensen (1993) the fruits of *Pernettya prostrata* are poisonous

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Miconia lutescens (Bonpl.) DC.	Tarume, taruma	Fruit
	Miconia salicifolia (Bonpl.) Naudin	Sierra	Fruit
	Miconia cf. *theaeazans* (Bonpl.) Cogn.	Turumba	Fruit
	Miconia sp.	Mora	Fruit
	Miconia sp.	Moreida	Fruit
	Mouriri grandiflora A. DC.	Sharimiat (S)	Fruit
Menispermaceae	*Chondrodendron tomentosum* Ruiz & Pavón	Uva	Fruit
Mimosaceae	*Acacia macracantha* H. & B.	Faique	Unripe fruit (pod)
	Inga acreana Harms	Sámpi (S)	Aril
	Inga capitata Desvaux	Yakum sámpi (S)	Aril
	Inga densiflora Benth.	Guaba, guaba machetona silvestre	Aril
	Inga edulis Mart.	Wámpa (S), guaba, guaba de bejuco	Aril
	Inga extra-nodis T.D. Penn.	Guaba	Aril
	Inga fendleriana Benth.	Guaba, guaba musga, guaba lanuda, guaba de zorro, guaba de oso	Aril
	Inga fendleriana ? Benth.	Guaba de zorro	Aril
	Inga fendleriana or *I. vellosissima*	Guabilla	Aril
	Inga feuillei DC.	Guaba de cajón	Aril
	Inga insignis Kunth	Guaba, guaba de zorro, guaba musga pequeña, guaba musga, guaba lanuda	Aril
	Inga laurina (Sw.) Willd.	Guaba vainilla	Aril
	Inga leiocalycina Benth.	Main sámpi (S)	Aril
	Inga leiocalycina? Benth.	Guaba	Aril
	Inga manabiensis ? T.D. Penn.	Guaba	Aril
	Inga marginata Willd.	Tserempach' (S), guabilla	Aril
	Inga microcoma ? Harms.	Imik sámpi (S)	Aril
	Inga multicaulis Benth.	Guabilla	Aril
	Inga multinervis T.D. Penn.	Guabilla	Aril
	Inga nobilis Willd. ssp. *nobilis*	Wampukish (S)	Aril
	Inga nobilis Willd. ssp. *quaternata* (P.& E.) T.D. Penn.	Imik sámpi (S), kunkuin sámpi (S), wampukish (S), guaba negra, guabilla, guaba	Aril
	Inga oerstediana Benth.	Guaba, guabilla, guaba rabo de mono, guaba de zorro, guaba de perico, guaba musga, laricaro, laricaro de bejuco	Aril
	Inga cf. *oerstediana* Benth.	Guabilla	Aril
	Inga ornata Kunth	Guaba	Aril
	Inga punctata Willd.	Guabilla, imik sámpi (S)	Aril
	Inga sapindoides Willd.	Guaba cajetilla	Aril

Preparation	Market	Additional uses	Herbarium vouchers
Raw		Fuelwood	134, 184, 277
Raw			331
Raw			253
Raw			VVDE&GE225
Raw			890
Raw		Fuelwood	707, 828, 914
Raw			535
Salad (cooked)		Fuelwood, timber	64
Raw		Fuelwood	670
Raw		Fuelwood	910
Raw		Fuelwood, timber, shade, hedges	VVDE&GE216, 526, 547, 800, 811
Raw		Fuelwood	VVDE&GE200, 418, 695, 736
Raw		Fuelwood, timber	721, 776
Raw		Fuelwood, timber	481, 566, 599, 637, 984
Raw		Fuelwood	484
Raw		Fuelwood, timber, hedges	528
Raw			936
Raw		Fuelwood, timber, shade	105, 455, 488, EC521
Raw			963
Raw		Fuelwood	909
Raw		Fuelwood, timber	968
Raw		Fuelwood, timber, hedges	469
Raw		Fuelwood	142, 293, 519, 692, 717, 739, 831
Raw (induces vomiting)		Fuelwood	696
Raw			652
Raw		Fuelwood	887
Raw		Fuelwood	694, 835
Raw		Fuelwood	447, 520, 693, 697, 746, 777, 834
Raw	x	Fuelwood, timber, shade, hedges	164, 165, VVDE&GE226, VVDE&GE240, 304, 308, 449, 474, 527, 532, 559, 594, 802, 804, 879, 896, 962
Raw			514
Raw		Timber	490, 491, 570, 614, 810
Raw		Fuelwood, timber, hedges	536, 657, 801, 839
Raw		Fuelwood, timber, shade	959

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Inga silanchensis T.D. Penn.	Guaba de monte, guaba poroto	Aril
	Inga spectabilis (Vahl) Willd.	Guaba machetona, guaba, panaco	Aril
	Inga striata Benth.	Guaba, guaba verde, guaba musga, guaba de mono, guaba natural, guabilla	Aril
	Inga striolata T.D. Penn.	Guabilla	Aril
	Inga thibaudiana DC. ssp. *thibaudiana*	Napúrak (S)	Aril
	Inga sp. aff. *venusta* Standl.	Guaba	Aril
	Inga vera Willd.	Guabilla	Aril
	Inga vera Willd. ssp. *affinis* (DC.) T.D.Penn.	Guaba	Aril
	Inga sp.	Guabilla	Aril
	Inga sp.	Guabilla	Aril
	Prosopis juliflora (Sw.) DC.	Algarrobo	Fruit (pod)
Moraceae	*Ficus* aff. *andicola* Standley	Higuerón	Fruit
	Ficus sp.	Umbe	Fruit
	Maclura tinctoria (L.) Steudel ssp. *tinctoria*	Sota	Fruit
	Pseudolmedia laevigata Trécul	Chimi (S), capulí	Fruit
	Pseudolmedia macrophylla Trécul	Shanguinia (S)	Fruit
	Pseudolmedia sp.	Chimi (S), capulí	Fruit
	Trophis racemosa (L.) Urban	Pítiu (S), pito	Seed
	Trophis sp.	Pítiu (S)	Seed
	Gen. indet7	Mirikú (S)	Fruit
Myrtaceae	*Calyptranthes* sp.	Arrayán	Fruit
	Eugenia curvipilosa McVaugh	Saca negra	Fruit
	Eugenia florida DC.	Arrayán	Fruit
	Eugenia stipitata McVaugh ssp. *sororia* McVaugh	Membrillo silvestre	Fruit
	Eugenia sp1	Arrayán	Fruit Leaves
	Eugenia sp6	Capulí	Fruit
	Eugenia sp5	Pasaca	Fruit
	Eugenia sp2	Saca blanca	Fruit
	Myrcia fallax (Rich.) DC.	Saca, saca saca, saca blanca, saca colorada	Fruit
	Myrcia sp.		Fruit
	Myrcianthes fragrans (Sw.) McVaugh	Guaguel	Fruit
	Myrcianthes cf. *orthostemon* (O.Berg) Grifo	Saca botella, singulique	Fruit
	Myrcianthes rhopaloides (HBK) Mc Vaugh	Guaguel	Fruit
	Myrcianthes cf. *rhopaloides* (Kunth) McVaugh	Guaguel	Fruit
	Myrcianthes sp1	Arrayán	Fruit

Preparation	Market	Additional uses	Herbarium vouchers
Raw		Fuelwood	882
Raw	x		129, 130, 166, VVDE&GE201
Raw	x	Fuelwood, timber, shade	83, 102, 106, 149, 157, 159, 254, 257, 258, 265, 263, 266, 279, 301, 476, 543, 548, 600, 601, 619, 655, 722, 767, 971
Raw		Fuelwood	803
Raw		Fuelwood	669
Raw			582
Raw			745
Raw		Fuelwood	624, 935
Raw		Fuelwood, timber, hedges	537
Raw		Fuelwood	891
Algarrobina	x	Fuelwood, timber, fodder (pods), hedges	65, 465
Raw		Fuelwood	295
Raw			589
Raw		Fuelwood, timber, fodder (fruit)	268
Raw		Fuelwood, timber	833, 904
Raw		Fuelwood, timber	908
Raw		Fuelwood, timber	688, 844
Cooked		Fuelwood	686, 842
Cooked			404
Raw		Fuelwood	710
Raw		Fuelwood	454
Raw, preserve			807, 809
Raw		Timber, tool handles	540
Raw, juice			VVDE&GE197
Raw			642
Infusion			
Raw		Timber	727
Raw		Fuelwood	553
Raw, preserve			808
Raw, preserve, jam		Fuelwood, timber, fodder (fruit)	80, 104, 135, 256, 280, 486, 555, 556
Raw			542
Raw, macerated in alcohol			340
Raw		Fuelwood, timber, hedges	604
Raw		Fuelwood	430
Raw		Fuelwood, timber	640
Raw, macerated in alcohol		Timber	303

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Myrcianthes sp5	Saca	Fruit
	Myrcianthes sp4	Singulique	Fruit
	Myrcianthes sp3	Yanamuro, arrayán	Fruit
	Psidium acutangulum DC.	Guayaba del campo	Fruit
	Psidium guineense Sw.	Guayabilla	Fruit
	Psidium salutare (HBK) Berg	Arrayán pequeña	Fruit
	Psidium sartorianum (Berg) Nied.	Arrayán	Fruit
	Gen. indet.	Saca	Fruit
Onagraceae	*Fuchsia* sp.	Pena	Fruit
Orchidaceae	*Vanilla* sp.	Vainilla	Fruit (pod)
Oxalidaceae	*Oxalis latifolia* HBK	Yuquilla, yuquita, zanahoria del campo	Root
Passifloraceae	*Passiflora auriculata* H.B.K.	Granadilla	Seed coat
	Passiflora cumbalensis (Karst.) Harms	Gullán	Seed coat
	Passiflora foetida L.	Granadilla, bedoca, patúkmai munchi (S)	Seed coat
	Passiflora ligularis Juss.	Granadilla, granadilla de mate, granadilla del campo	Seed coat
	Passiflora luzmarina P.M. Jørgensen	Gullán	Seed coat
	Passiflora matthewsii (Mast.) Killip	Gullán, juliane	Seed coat
	Passiflora mixta (Benth.) Killip var. *eriantha* (Benth.) Killip	Gullán	Seed coat
	Passiflora cf. *mixta* (Benth.) Killip	Gullán	Seed coat
	Passiflora pergrandis Holm-Nielsen & Lawesson	Munchi (S), washi munchi (S), granadilla, granadilla de poto	Seed coat
	Passiflora cf. *pergrandis* Holm-Nielsen & Lawesson	Munchi (S)	Seed coat
	Passiflora popenovii Killip	Granadilla de Quijos	Seed coat
	Passiflora punctata L.	Granadilla, ñorbo, granadilla de monte	Seed coat
	Passiflora tripartita (Juss.) Poir. var. *azuayensis* Holm-Nielsen & Jørgensen	Gullán	Seed coat
	Passiflora sp2	Granadilla, tumbo de campo	Seed coat
	Passiflora sp4	Granadilla de monte	Seed coat
	Passiflora sp3	Tsere munchi (S)	Seed coat
	Passiflora sp7	Tumbo	Seed coat
Piperaceae	*Piper* sp2	Guaviduca	Leaves
	Piper sp3	Guaviduca	Leaves
	Piper sp4	Natsa unkuch' (S)	Young leaves
	Piper sp1	Nátsamar (S), natsatsam (S), santa maría	Young leaves Unripe inflorescence
	Piper sp4	Tunchinchi (S)	Young leaves

Preparation	Market	Additional uses	Herbarium vouchers
Raw			EC863
Raw		Fuelwood, timber	606
Raw		Fuelwood	421
Raw		Fuelwood, timber	955
Raw, jelly, preserve			88, 124, 178, 264
Raw			294
Raw, macerated in alcohol		Timber	192
Raw		Fuelwood, timber	966
Raw			EC789
Condiment, macerated in alcohol, infusion			546
Raw			GE2
Raw			970
Raw			EC353, EC515, 523, 550, EC865, EC866, EC867
Raw, juice			139, 140, 181, 942
Raw, juice	x		VVDE&GE237, 310, 482, 729
Raw			EC510, EC516, EC929, 991, 992, 994, 993
Raw			183, 437, 506, EC509, 641, 812
Raw			632
Raw			EC793
Raw			413, 420, 672, 734, 740
Raw			544
Raw, juice			218, 927
Raw			VVDE&GE238, 292
Raw			337
Raw, juice			580
Raw			892
Raw			708
Raw			620
Condiment			770
Condiment			979
Tonga			921
Stew			898
Cooked			
Stew			666

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Piper sp6	Unkuch' (S)	Young leaves
	Piper sp5	Untuntup' (S)	Young leaves
Polygonaceae	*Coccoloba ruiziana* Lindau	Añalque pampero, añalque chiquito, añalque, indindo, negrito	Fruit
	Coccoloba aff. *ruiziana* Lindau	Indindo	Fruit
	Coccoloba sp.	Añalqui	Fruit
Portulacaceae	*Portulaca oleracea* L.*	Verdolaga	Leaves
Proteaceae	*Oreocallis grandiflora* (Lam.) R. Br.	Cucharilla, gañil	Seed
Rosaceae	*Fragaria vesca* L.	Frutilla, mora	Fruit
	Hesperomeles ferruginea (Pers.) Benth.	Quique	Fruit
	Hesperomeles obtusifolia (Pers.) Lindl. var. *microphylla* (Wedd.) Romoleroux	Quique	Fruit
	Hesperomeles obtusifolia (Pers.) Lindl. var. *obtusifolia*	Quique	Fruit
	Rubus acanthophyllus Focke	Mora gateadora, mora	Fruit
	Rubus azuayensis Romoleroux	Mora	Fruit
	Rubus bogotensis H.B.K.	Mora, mora de pepa	Fruit
	Rubus compactus Benth.	Mora	Fruit
	Rubus coriaceus Poir.	Mora gateadora	Fruit
	Rubus floribundus Kunth in H.B.K.	Mora, mora grande, mora grande de jugo, mora pequeña	Fruit
	Rubus glaucus Benth.	Mora, mora grande	Fruit
	Rubus Laegaardii Rom.	Mora	Fruit
	Rubus loxensis Benth.	Mora de los pajones	Fruit
	Rubus megalococcus Focke	Mora	Fruit
	Rubus nubigenus Kunth in H.B.K.	Mora de piña grande	Fruit
	Rubus peruvianus Fritsch	Mora	Fruit
	Rubus roseus Poir.	Mora piña, mora	Fruit
	Rubus urticifolius Poir.	Mora, moras (S)	Fruit
Rubiaceae	*Arcytophyllum thymifolium* (R. & P.) Standley	Perlilla	Fruit
	Coussarea brevicaulis Krause	Supínim (S)	Fruit mesocarp
	Pentagonia sp.	Almendra	Seed Fruit mesocarp
	Rondeletia sp.	Jicamillo	Fruit
Sapindaceae	*Allophylus mollis* (Kunth) Radkl.	Shiringo, clambo	Fruit
	Sapindus saponaria L.	Checo, chereco, jurupe	Seed
Sapotaceae	*Chrysophyllum argenteum* Jacq. ssp. *panamense* (Pittier) T.D. Penn.	Caimito	Fruit
	Chrysophyllum lucentifolium Cronq.	Cauje	Fruit
	Micropholis venulosa (Mart. & Eichl.) Pierre	Capulí del monte, tillo	Fruit
	Pouteria brevipetiolata T.D. Penn.	Chiche	Fruit
	Pouteria caimito (R. & P.) Radlk.	Yaás (S), yarasu (S), yaraso (S), kaimitu (S), caimito	Fruit
	Pouteria aff. *glomerata* (Miq.) Radlk.	Caimito	Fruit

Preparation	Market	Additional uses	Herbarium vouchers
Stew, soup, *tonga*			660, 827, 922
Stew, soup			826
Raw, preserve		Fuelwood, timber	470, 558, 618, 945, EC988
Raw		Fuelwood	EC795
Raw, preserve, jam		Fuelwood, timber	468
Raw, juice, salad, soup	x		191, VVDE&GE217, 291
Raw		Dye (seed)	62, 95, 96
Raw	x		347, 432
Raw, preserve, jam, roasted	x	Fuelwood, timber	182, 434
Raw			440, 874
Raw, preserve, jam			350, 629
Raw, juice, jam, preserve			329, 876
Raw			870
Raw, jam			494, EC864
Raw			348, EC517
Raw, jam			330
Raw, jam, preserve, ice cream	x		188, 338, 438, 483, 492, 493, 495, 554, 557, 595, 603, 819
Raw			EC792
Raw			817
Raw			502, 820
Raw			512
Raw			501
Raw, jam			93, EC749, EC869
Raw			EC352, 500, EC748, 818
Raw, jam			VVDE&GE241, 307, 320, 444, 529, 569, 903
Raw			626
Raw		Fuelwood	680, 906
Raw		Fuelwood, timber	VVDE&GE203
Raw			
Raw			720
Raw, pureed	x	Fuelwood, timber	81, 151, 255, 487
Raw			932
Raw			650
Raw		Timber	956
Raw		Fuelwood, timber	VVDE&GE205, 572
Raw		Fuelwood, timber	881
Raw, juice		Fuelwood, timber	545, 673
Raw		Fuelwood, timber	953

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
	Pouteria lucuma (R. & P.) Kuntze	Luma	Fruit
	Pouteria sp6	Caimito	Fruit
	Pouteria sp4	Cauje	Fruit
	Pradosia montana T.D. Penn.	Lusumbe	Fruit
Saxifragaceae	*Escallonia* sp.	Maco maco	Fruit
Solanaceae	*Acnistus arborescens* (L.) Schlecht.	Pico pico, sabaluco	Fruit
	Cyphomandra cajanumensis (H.B.K.) Walpers	Pepino de campo, pepinillo	Fruit
	Jaltomata sp1	Uvilla	Fruit
	Jaltomata sp2	Uvilla	Fruit
	Lycopersicon esculentum Mill.*	Tomate de monte	Fruit
	Lycopersicon peruvianum (L.) Mill.	Tomatillo	Fruit
	Lycopersicon pimpinellifolium (Jusl.) Mill.	Tomatillo, tomate del campo	Fruit
	Markea sp.		Fruit
	Physalis peruviana L.	Yuránmis (S), uvilla, pepino de monte	Fruit
	Physalis sp.	Ovilla	Fruit
	Salpichroa diffusa Miers	Chulalay	Fruit
	Solanum americanum Mill.	Shímpiship (S), mortiño	Fruit
	Solanum brevifolium Dunal	Uchuchi (S)	Fruit
	Solanum caripense Dunal	Simbailo	Fruit
	Solanum quitoense Lam.	Naranjilla silvestre, naranjilla de campo, huevo de perro	Fruit
	Solanum sisymbriifolium Lam.	Uvilla, naranjilla, pisho	Fruit
	Solanum stramoniifolium ? Lam.	Ya kukúch' (S)	Fruit
	Solanum sp14	Ají	Fruit
	Solanum sp11	Ají clavo, ají gallinaso	Fruit
	Solanum sp1	Chulala	Fruit
	Solanum sp2	Jímia (S)	Fruit
	Solanum sp8	Kukúch' (S)	Fruit
	Solanum sp9	Pepino	Fruit
	Solanum sp10	Pepino	Fruit
	Solanum sp12	Sacha naranjilla	Fruit
	Solanum sp7	Shuankukúch' (S)	Fruit
	Gen. indet18	Juvilla	Fruit
	Gen. indet17	Tomate de árbol	Fruit
Sterculiaceae	*Guazuma ulmifolia* Lam.	Guásimo	Fruit
	Herrania mariae var. *putumayonis* R.E. Schultes	Kushíkiam (S)	Aril
	Herrania sp.	Kushíkiam (S), babaco silvestre	Aril
	Theobroma bicolor L.	Wakam (S), pataste, cacao blanco	Seed Aril
Theaceae	*Freziera verrucosa* (Hieron.) Kobuski	Wile	Fruit
	Gen. indet.	Higo	Fruit

Preparation	Market	Additional uses	Herbarium vouchers
Raw, ice cream	x	Timber	115, 117, 283, 773
Raw			976
Raw			587
Raw		Fuelwood, timber, fodder (fruit), hedges	74, 131, 270, 560
Raw			967
Raw		Fuelwood, timber, chicken feed (fruit), hedges	153, VVDE&GE227, VVDE&GE243, VVDE& GE244, 575
Raw			EC794, 798
Raw			342
Raw			728
Raw, pickles			737
Raw			461
Raw, fried			1, 138, 612, 933
Raw			724, 799
Raw			422, 705
Raw			742
Raw			423
Raw, *chicha morada*			155, 463, 701, 980
Curdle milk			433
Raw			286, 339, 424, 428, EC750
Raw, juice			VVDE&GE202, VVDE&GE207, VVDE&GE250, 305, 975
Raw			82, 116
Raw			824
Raw			602
Condiment			654
Raw			605
Condiment			700
Raw			663, 832
Raw			768
Raw			769
Juice			743
Raw			709
Raw			EC788
Juice			625
Raw		Fuelwood, timber, fodder (fruit), hedges	460, 607
Raw			829
Raw		Fuelwood	396, 675
Roasted		Fuelwood	651, 674
Raw			
Raw		Fuelwood, timber	636, 996
Raw			341

Annex 1. Continued

Plant family	Botanical name	Local names	Edible plant part
Theophrastaceae	*Clavija euerganea* Macbr.	Naranjilla del campo, naranjilla silvestre	Fruit
	Clavija pungens (Roem. & Schult.) Decne	Granadilla de monte	Fruit
	Clavija cf. *repanda* Ståhl	Naranjilla	Fruit
Ulmaceae	*Celtis iguanaea* (Jacq.) Sarg.	Tsachík (S), cacumba, uña de gato, uña de pava, huevo de pava, mogroño, uva	Fruit
	Celtis sp.	Palo blanco	Seed
	Trema micrantha (L.) Blume	Cerezo, niguito	Fruit
	Gen. indet11	Chine	Fruit
	Gen. indet10	Nara (S)	Young leaves Flower
Verbenaceae	*Lantana* sp.	Choclito	Fruit
	Vitex gigantea HBK	Pechiche	Fruit
	Gen. indet.	Choclito	Fruit
	Gen. indet12	Ramoncillo	Leaves
Zingiberaceae	*Costus scaber* Ruiz & Pavón	Caña agria	Stem
	Renealmia alpinia (Rottb.) Maas	Kumpía (S)	Seeds+seed coats Leaves

Preparation	Market	Additional uses	Herbarium vouchers
Raw, juice			113, 163, 593
Raw			957
Raw			179
Raw		Fuelwood, timber	71, 75, 275, 316, 458, 585, 712
Raw, roasted		Fuelwood, timber	273
Raw		Fuelwood	VVDE&GE248, 269, 446
Raw			272
Tonga			919
Tonga			
Raw			VVDE&GE222
Raw, preserve		Fuelwood, timber	622, 931
Raw			961
Condiment, infusion			260
Raw			899, 902
Tonga (in its own leaves), soup			661
Food wrap			

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Professional experience:

2003 – present	External lecturer Ethnobotany at Orkney College, University of the Highlands and Islands Millennium Institute, Scotland. Team member for validation procedure BA Cultural Studies.
2000 – present	PhD student Applied Biological Sciences at the University of Gent, Belgium (part-time) Project: Use and management of wild edible plants in southern Ecuador.
1998 – present	Self-employed ethnobotany researcher (consultancies for Flora Celtica - Royal Botanic Garden Edinburgh, Agros Associates, Falconer Museum, UHI Millennium Institute). Millennium Awards Fellowship for "Kids want to turn leaves too" project.
Feb.– March '98:	Consultant at the Institut Scientifique, Université Mohammed V, Rabat, Morocco. Design of project methodologies and strategies; training local researchers in ethnobotany for the project "Protection et gestion de la forêt de Mamora".
June '94–Dec '97:	Researcher (ethnobotanist) at the Centro Andino de Tecnología Rural (CATER), Universidad Nacional de Loja, Ecuador and the Department of Tropical and Subtropical Agriculture and Ethnobotany, University of Gent, Belgium. Project leader for the research and development VLIR project "Conocimientos y prácticas culturales sobre los recursos fitogenéticos nativos en el austro Ecuatoriano" and based in Ecuador for the entire period. Research consisted of studying edible wild plants in a range of different habitats in southern Ecuador and assessing their local use, management status and their potential for cultivation. Responsibilities included project management, training partner researchers, supervising undergraduate researchers, writing and editing publications and actual field research with local communities. A booklet for the general public was produced, based on the research results.

June '93–Nov. '93:	Researcher (ethnobotanist) at the Department of Tropical and Subtropical Agriculture and Ethnobotany, University of Gent, Belgium. Research into the use of medicinal trees used by traditional healers in the Kolda area of Senegal for the EU-funded project: "Inventaire et modelage de la gestion du couvert végétal pérenne dans une zone forestière du sud Sénégal".
Oct. '91-Dec. '92:	Researcher (ethnobotanist) at the Department of Tropical and Subtropical Agriculture and Ethnobotany, University of Gent, Belgium. Research of the plants used by the Topnaar people and co-management of the EU-funded project "Ethnobotanical survey of the Namib desert". Included lecturing assistance for the Tropical Plant Systematics course at the University of Gent, Belgium.
Aug. '90-Oct.'90:	M.Sc. project work at the Département de Socio-Economie, Faculté d'Agronomie, Bujumbura, Burundi. I studied the use of and needs for fuelwood and timber in the area of the Programme Spécial des Travaux Publics reforestation project in Ruyigi, Burundi.

Education:

2001-2004	Doctoral program University of Gent, Belgium
1986-1991:	M. Sc. Agricultural Sciences (Landbouwkundig Ingenieur), specialisation tropical and subtropical regions, University of Gent, Belgium
1980-1986:	Latin-mathematics at the College van het Eucharistisch Hart, Essen, Belgium

Additional training:

UK National Vegetation Classification, Kindrogan Field Centre, Scotland (1999).

Dendrología Tropical, Centro Científico Tropical, Costa Rica (1996).

Biodiversidad y manejo sostenible de bosques nativos, Ecuador (Feb. 1996)

Métodos Computerizados en Etnobiología y Sistemática, Ecuador (Oct. 1995).

Publications:

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Congresses & talks:

Talk "The people behind the shrunken head – the Shuar of Ecuador". Elgin Museum, 31 January 2004.

Talk "Cultural plant uses in Scotland today". Compendium of Symbolic and Ritual Plants in Europe book launch. Chelsea Physics Garden, London. 23 Oct. 2003.

II Congreso de la Conservación de la Biodiversidad en los Andes y la Amazonía. Loja, Ecuador, 25-29 augustus 2003. Paper "Regional and ecological variation of wild edible plants in southern Ecuador".

Innovative financing mechanisms for conservation and sustainable management of tropical forests. Tropenbos International Seminar, Den Haag, 20-21 March 2002.

Third International Congress of Ethnobotany, Etnobotanica Napoli, Naples, 22-30 Sept. 2001. Paper "Traditional management of wild fruit trees by farmers in southern Ecuador"

Conservación de la Biodiversidad en los Andes y la Amazonía. Cusco, Peru, 24-28 Sept. 2001. Poster "Frutos silvestres comestibles de la Provincia de Loja" (with Eduardo Cueva).

BBB2001 – Botanische biodiversiteit en de Belgische expertise, Brussels, 19-29 Oct. 2001. Poster " Wild edible plants in southern Ecuador … are they really wild?"

5th International Congress for Ethnobiology, Nairobi, 2-6 Sept. 1996. Talk "Wild edible fruits of southern Ecuador and their cultivation prospects".

Plants for Food and Medicine, London, 1-5 July 1996. Talk " Promising wild fruits of southern Ecuador".

II Simposio de Etnobotánica y Botánica Económica, Quito, Ecuador. 16-19 Oct.1995. Paper "Plantas comestibles en la provincia de Loja".

Biodiversity: Study, Exploration, Conservation, Dodonaea Symposium, Gent, 18 Nov. 1992. Paper "The ethnobotany of the Namib Desert"

Etnobotanica 92 – 20-26 Sept. 1992. Poster "Ethnobotany of the Topnaar, Namibia."

World Congress of Medicinal and Aromatic Plants, Maastricht, Netherlands, 19-25 July 1992. Paper "Medicinal and aromatic plants used by the Topnaar".

Radio talk for Namibian Broadcasting Cooperation on ethnobotanical research in the Namib Desert. 8 July 1992.

Research visits:

Kew Botanical Gardens, England – Aug. 1995, Aug. 1996
Aarhus Herbarium (AAU), Denmark - July 1996
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